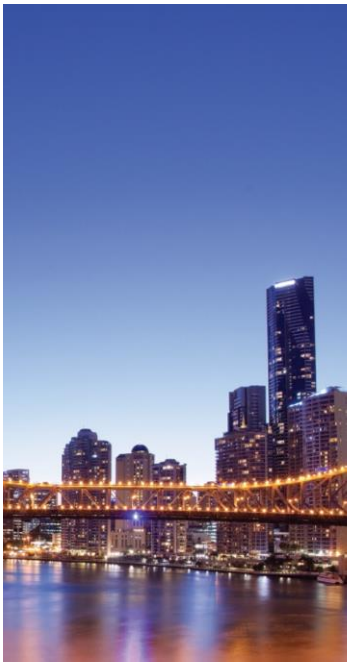
GHD Advisory



Remote Services with Smart Meters Semi Quantitative Risk Assessment (SQRA®)

Australian Energy Council

Executive Summary

The Australian Energy Council (AEC) is addressing regulatory safety requirements associated with remote services with smart meters and decided to conduct a risk assessment in a similar manner to GHD's previous smart meter assessments with CitiPower Powercor and AGL Energy, which used GHD's Semi Quantitative Risk Assessment (SQRA®) methodology. This study will be used as a risk based input into an industry code of practice for remote services with smart meters.

The AEC SQRA® has been completed by focusing on the operation of 'generic, technology-agnostic' smart meters when they perform remote re-energisation and remote de-energisation. The SQRA® identified risks to public safety, assessed their causes and measured the scale of relative risks. The assessment then reviewed current controls, and the development of potential risk reduction measures, in order to judge their relative value in terms of risk reduction.

The SQRA® comprised a workshop attended by a team of representatives with subject-matter knowledge (smart meter design, operation and transaction processes). In the SQRA® process, this workshop-based approach draws on the collective knowledge and expertise of the team members to analyse and review the identified hazards and individual risk scenarios.

The SQRA® workshop was conducted in October 2017 at AGL's and Origin's offices in Melbourne, and was attended by industry staff, meter equipment suppliers and retail personnel. The group comprised a comprehensive selection of people knowledgeable about meter design, configuration and operation, and experienced with operational, customer and retailer transactions and business processes.

Summary of Results

This SQRA® indicates that remote services with smart meters is a very low risk to public safety, and this finding is consistent with previous assessments and also the experience over the last few years of smart meter operation by AEC members. It was also recognised that smart meters reduce truck trips to customer sites, which is an additional worker safety benefit.

The current risk level associated with smart meters remote de-energisation and re-energisation measured as Potential Loss of Life (PLL) in one year is 1.83×10^{-03} per year[1], which equates to a period of 546 years between fatalities. Two critical controls were identified – the service order process (including validation) and retailer scripts. The team judged the critical controls to have a high adequacy rating.

In order to compare the PLL to commonly understood risk criteria, the PLL can be converted to an individual risk level (chance of a fatality to one person in a year). This is determined by sharing the PLL over the entire population that could be exposed. It was conservatively estimated that 2.6 people per meter could be exposed. This equates to 2.6 million people for a notional cohort of a million meters.

Therefore the individual risk level for smart meter remote de-energisation and re-energisation was estimated to be 7.04×10^{-10} per year (which equates to a period of 1420 million years between fatalities). This is 1000 times safer than the individual public risk tolerability level suggested by regulatory bodies in Australia.[2]

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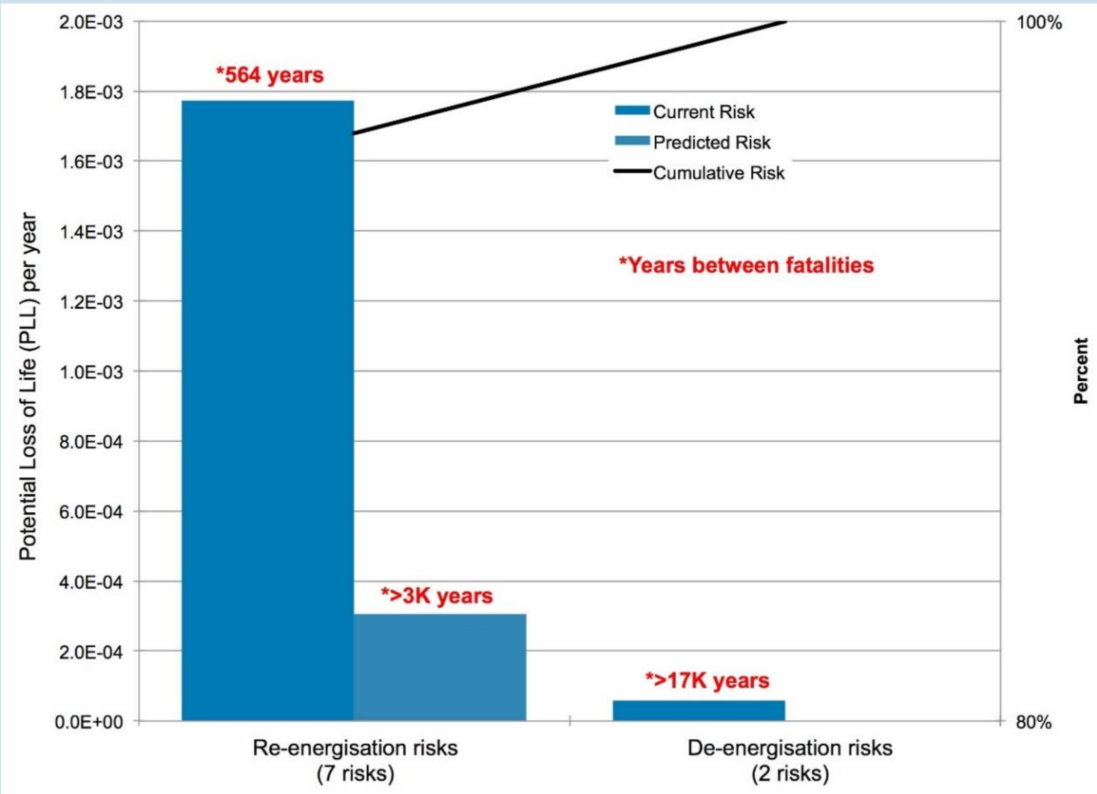
[1] 1×10^{-03} is equivalent to 1 E-03 and also 0.001.

[2] NSW Department of Planning Hazardous Industry Planning Advisory Paper No. 4, 2011, page 7. 'Individual fatality risk of 1 per million per year is the limit of risk acceptability for residential area exposure'. WorkSafe Victoria Guidance Note 16, page 15: 'Individual risk levels below 0.1 per million per year are broadly tolerable'.

Additional risk management considerations were identified which reduced the critical risk rating by 83% from 1.83 x 10^{-03} per year, which equates to a period of 546 years between fatalities to 3.06 x 10^{-04} per year, which equates to a period of 3265 years between fatalities.

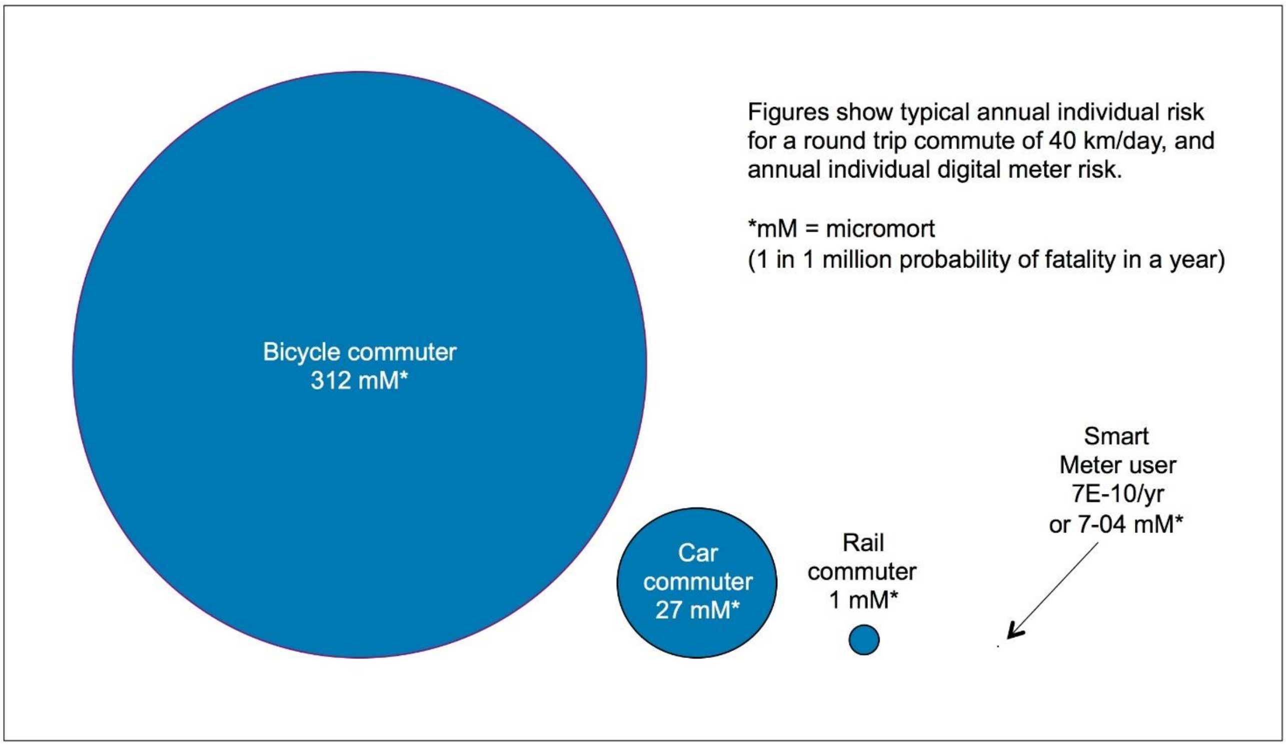
	SQRA® Results Summary for generic smart meters	
	Risk Scenarios Identified	9
	Current Critical Risk Score	1.83 x 10^{-03} fatalities per year (One fatality every 546 years)
	Top risk (contributing over 95% of the Critical Risk Score):	
	Risk ID 1-2: Customer harm while accessing the meter location (e.g. fall, hazard from wildlife, electrical hazards).	
	Critical Controls Identified	2
	Current Critical Controls with a High Adequacy Rating	2 (100%)
	Risk Management Considerations Identified	12
Predicted Risk	Predicted Reduction in Critical Risk Score if all considerations are implemented	83%
Predicted Risk	Predicted Critical Risk Score	3.06 x 10^{-04} fatalities per year (One fatality every 3265 years)
Predicted Risk	Predicted Critical Controls with High Adequacy Rating	2 (100%)

Critical Risk Score Profile



PLL versus Individual Risk

The current Potential Loss of Life (PLL) risk of 1.83 x 10^{-03} fatalities per year can be shared over the notional population to give an individual risk of 7.04 x 10^{-10} per person. This can be compared to other typical risks in a year to individuals, as shown by the relative comparison with commuter travel risks below, using the common risk metric of a micromort[3] (a one in one million probability of a fatality).



Recommendations

- Although risks are extremely small, opportunities were identified to further reduce risks, and if pursued, could potentially reduce risk by 83% from 1.83 x 10^{-03} per year, which equates to a period of 546 years between fatalities to 3.06 x 10^{-04} per year, which equates to a period of 3265 years between fatalities.
- The proposed risk management considerations can inform the development of the industry code of practice for smart meters.

[3] See https://en.wikipedia.org/wiki/Micromort (link accessed 9th October 2017)

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1. Introduction

1.1 Background

The Australian Energy Council (AEC) is addressing regulatory safety requirements associated with smart meter remote services and decided to conduct a risk assessment in a similar manner to GHD's previous smart meter assessments with CitiPower Powercor and AGL Energy, which used GHD's Semi Quantitative Risk Assessment (SQRA®) methodology.

1.2 SQRA® Scope

This SQRA® addressed the operation of smart meters when they perform remote re-energisation and remote de-energisation. Risks to public safety were examined, and the value of controls was considered in order to recommend potential improvements. The assessment examined 'generic, technology-agnostic' meters.

The SQRA® scope was defined by setting a base rate for the operational deployment of smart meters (one million meters as a notional cohort), and estimating annual transaction numbers and projecting failure scenarios and consequences that could impact public safety. The scope included the following limits and exclusions:

- Only public safety was examined (not asset damage, reputation or environmental harm).
- Smart meters were considered as a single cohort (not separate populations for different states or territories).
- Only re-energisation and de-energisation transactions were considered (not installation or abolishment of smart meters).
- The assessment excluded any potential long-term degenerative health issues, e.g. potential exposure to electro-magnetic fields.

The risk assessment was therefore targeted at analysing the public safety risks of smart meter transactions. This includes the identification and analysis of the individual risk scenarios that may lead to the uncontrolled exposure to these hazards.

1.3 Objectives

The objectives of the SQRA® process were to:

- Maximise the engagement of industry personnel in the analysis of public safety risks.
- Identify and analyse the individual risk scenarios that may lead to the uncontrolled exposure to the hazards, including understanding the potential causes and current control strategies.
- Determine the risk associated with the hazards and contributing risk scenarios (individually and cumulatively).
- Identify and assess the adequacy of critical controls.
- Identify potential risk management considerations targeted at largest risk contributors with the intention of achieving a risk that is As Low As Reasonably Practicable (ALARP).
- Restrict all assessment and findings to 'generic, technology-agnostic' meters, so that the results can inform the development of an industry code of practice for the provision of remote services.

1.4 Assumptions and Limitations

1.4.1 Assumptions

The hazard identification, bowtie analysis, control assessment and SQRA® calculations were reliant on the opinions of, and any data supplied by, AEC and industry representatives and / or risk assessment team.

Current meter numbers and transaction numbers were taken 'as supplied', and individual event frequency and probability judgements were the informed and considered consensus of the workshop participants.

1.4.2 Limitations

SQRA® is a risk assessment method that relies on team estimation of risks, and this necessarily includes consideration of causal likelihoods and consequences. Some of the smart meter risks were considered as hypothetical / postulated potential future events. It is impossible to identify and collate empirical data and evidence for events that have not occurred; therefore reasonable forecasting and estimation without empirical evidence was conducted.

1.4.3 Disclaimer

This report has been prepared by GHD for AEC and may only be used and relied on by AEC for the purpose agreed between GHD and AEC as set out in Section 1.2 and 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than AEC 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.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The services undertaken by GHD in connection with preparing this report did not include GHD verifying or accrediting the risk identification, risk judgements nor control adequacy assessments made by the risk assessment team.

2. Approach

2.1 Overall Approach

The SQRA® process involves seven core steps. The steps are built around a workshop process to maximise the level of engagement of stakeholders in the risk management process.

SQRA® has been used by clients worldwide in high hazard industries for over fifteen years. It is frequently used for regulatory submissions e.g. safety case, which demonstrates risk management to an acceptable level to operate such facilities. It is widely acknowledged and accepted by regulatory bodies.

The workshop process is attended by a team of representatives with subject-matter knowledge (smart meter design, operation and transaction processes) and draws on the collective knowledge and expertise of the team members to analyse and review the identified hazards and individual risk scenarios. The output is based on the informed and considered consensus of the workshop participants.

Each step is recorded into the SQRA® database (provided as an external file to this report). The process provides a systematic method for the identification and evaluation of risks and critical controls.

The process enables improvement initiatives, aimed at control improvement and risk reduction, to be identified and prioritised.

The seven steps in SQRA® process are:

1 Identify hazards

2 Describe hazard dynamics (bowtie diagrams)

3 Determine Current Risk profile

4 Identify critical controls

5 Assess the adequacy of critical controls

6 Select risk management considerations and estimate the Predicted Risk profile

7 Reporting and Improvement Planning

Risk measurement for this study was defined in terms of Potential Loss of Life in a one-year period (PLL). Hazards that potentially resulted in injury, not fatality, were scaled using a fatality-weighted injury scale, which is a standard that has been widely deployed.

The fatality-weighted injury scale used during this study is:

- Fatality = 1
- Major Injury e.g. LTI / disabling = 0.3
- Minor Injury e.g. medical treatment = 0.1
- Incident e.g. stress = 0.03

The SQRA® database contains the information for all hazards reviewed, and the detail behind relative judgements on control effectiveness and priorities. This will allow future studies to have access to all available data, so that the SQRA® can be updated if (for example) a significant change is made to meter design, configuration or operation.

All estimates of incident frequencies, probabilities and consequence scores were recorded in the SQRA® database.

2.2 Approach for Smart Meters

The purpose of smart meters is to provide for smarter electricity metering, allowing remote re-energisation and de-energisation, and encouraging flexibility in managing electricity supply and consumption. For example, a home (consumer) interface will allow consumers to monitor consumption, and to make decisions regarding when to use certain devices in their home or business.

The Distribution Business / consumer configuration is shown in Figure 1.

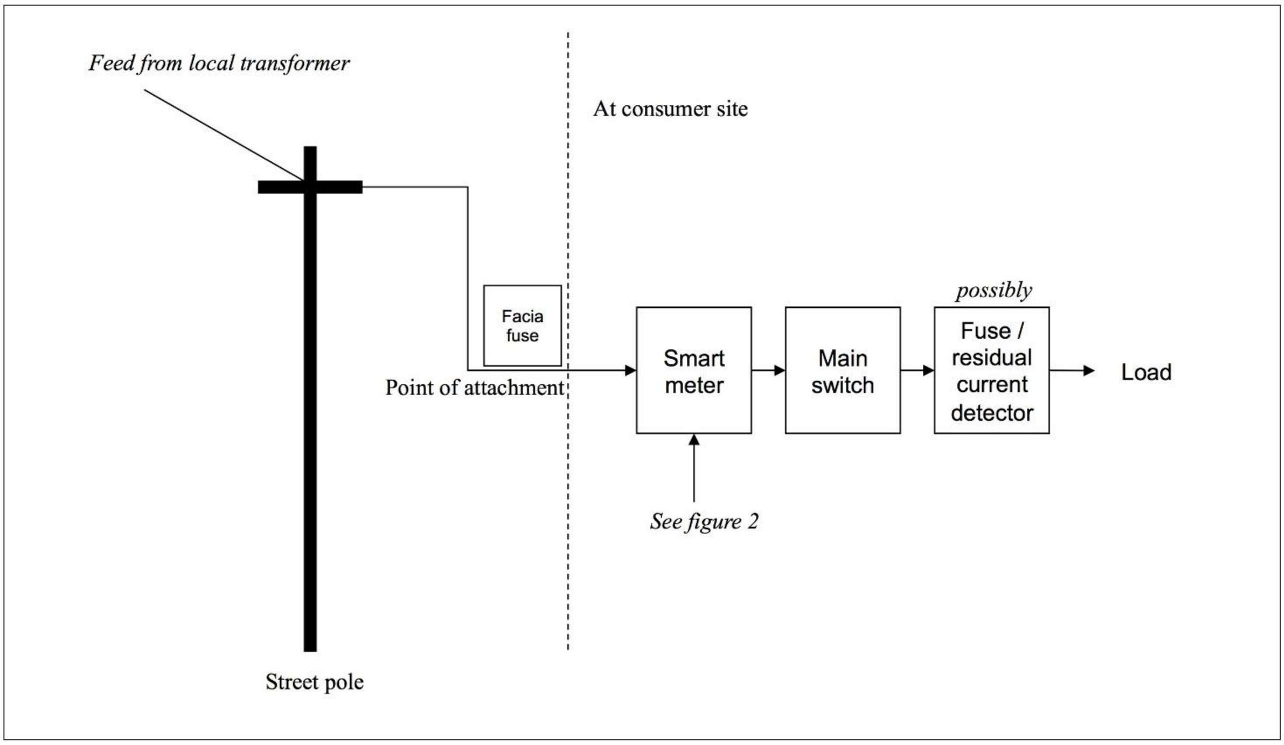

Figure 1 Connection Schematic

The system is retailer 'driven' from a customer's perspective, as the retailer will request a Meter Provider to conduct a transaction (such as re-energising power to a site, or de- energising power). These are business processes governed by 'retailer scripts', which also cater for retailer-customer communication.

The context of risk as it relates to smart meters is largely (but not exclusively) a matter of erroneous transactions (e.g. the wrong property being re-energised or de-energised, or the right property at the wrong time) and the safety consequences to people in or around the premises (e.g. occupants, builders, cleaners). Other scenarios considered include the following.

- Customers accessing the meter or main switch, which may be in a hazardous situation (basements, steps, snakes etc.)
- Equipment failure, such as meter malfunctions. An example may be the meter failing such that power is continually supplied, even when not required or intended.
- System failure, such as communications failure. An example may be the Network Management System sending an incomplete or corrupted control command to a meter.
- Retailer error. An example may be selecting the wrong meter from many meters in a block of flats.

- Consumer error. An example may be deliberate or inadvertent interference with a meter, or failing to isolate when moving out and leaving a box on a stovetop.
- Information integrity issues. This may be classed as a form of transaction error also, and includes examples such as sensitive load consumers not being correctly identified (such as consumers with load-dependent medical equipment on which they rely).

For this SQRA®, the focus was specifically on re-energisation and de-energisation risks to public safety (i.e. not asset damage, reputational damage or environmental harm). Public safety risks were considered to include electric shock, fire and denial of power to life-support equipment, loss of heating and air conditioning, lifts / stair lifts or security equipment.

Generally, a re-energisation occurs due to: consumers moving in; consumers paying an overdue bill; electrical work being completed; or other reasons for power being needed and authorised.

A de-energisation generally occurs when: consumers move out; electrical works are due to be conducted on the mains; non-payment of a bill; abolishment of a site; or other reasons for needing and authorising power to be discontinued.

Re-energisation or de-energisation is conducted by a remote command from a Network Management System to the smart meters, as shown in Figure 2.

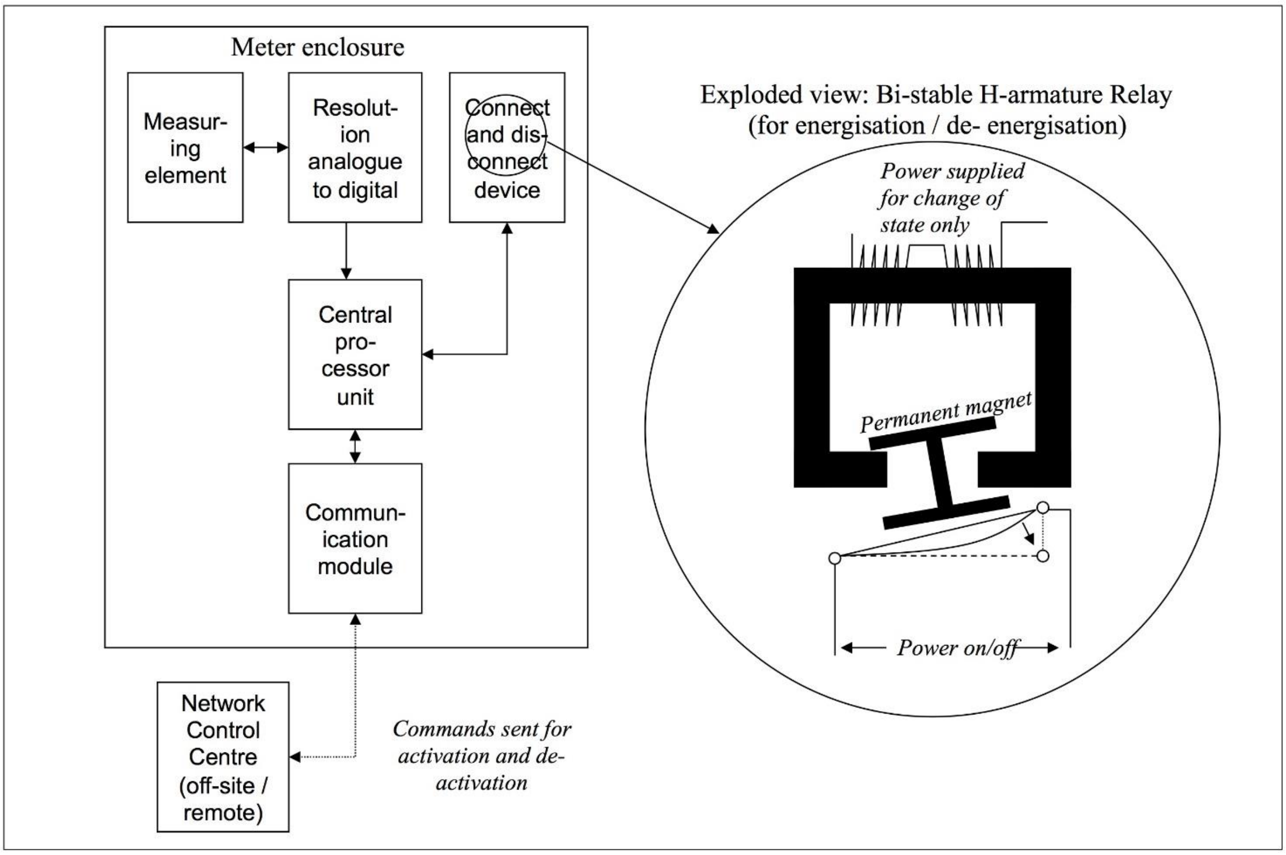

Figure 2 Smart Meter Schematic

The Network Management System sends a command to the smart meter and during this short command period only, current flows to the bi-stable relay winding, effecting a change in position of the permanent magnet. This change of position results in either a re-energisation or a de-energisation. After the change of state, current does not flow to the winding.

2.3 Smart Meter Technical Specifications

The technical specifications for smart meters are presented in approved standards. A summary of those requirements includes the following items.

- Generic meters are built to applicable Australian and international metering standards.
- They support various types of communications platforms (Fixed line / 2G / 3G / 4G / Wimax / RF mesh etc.) and each platform has different performance and latency.
- Internal Load control and main supply control contactor.
- Non-Volatile memory.
- Various kind of external and internal antenna solution for communications.
- Electronic Display on meter.
- Physical buttons on the meter for scrolling the display, closing the supply contactor once the meter is armed or engaging LC Boost if customer runs out of hot water.
- Arm function.
- Immediate disconnection after reconnection capability (renamed as meter condition check {conditions check, current flow check, comparison threshold & action}).
- Events and alerts.

3. Results

The SQRA® workshop was conducted on the 3rd and 4th October 2017 at AGL's and Origin's offices in Melbourne, and was attended by industry staff, meter equipment design suppliers and meter systems personnel. The group comprised a comprehensive selection of people knowledgeable about meter design, configuration and operation, and experienced with operational customer and retailer transactions and business processes. Refer to Appendix E for the workshop attendance list and the biography of participants.

3.1 Identify Hazards

3.1.1 Hazard Discussion

Key hazards were initially identified during a pre-workshop meeting and then developed through a workshop analysis task. Public safety hazards associated with loss of control events regarding smart meter remote services were identified as follows.

- Inadvertent electrical contact.
- Electricity-triggered ignition and fire.
- Customer harm accessing meter locations.
- Denial of electricity to an asset that the public may be dependent on. Specifically:
  - Life-support equipment;
  - A carriage device in a premises, such as a lift or stair-lift;
  - Heating and air-conditioning (especially cooling in extreme temperature conditions); and
  - Security systems such as CCTV, gates, electric fences etc. the loss of which may lead to psychosocial trauma.

Two additional hazards were also discussed during the workshop. Whilst they remained on the bowties they were not considered a credible scenario in the re-energisation / de-energisation process. These two hazards were:

- Electro-magnetic interference; and
- A gas explosion triggered by a meter failure.

3.1.2 Base Rate Data

The base rate data was agreed by the AEC representatives which is based on the experience of remote energisation and de-energisation of smart meters services in New Zealand on 1.1 million meters by Vector Advanced Metering Services. In the recent 12 months to January 2017, a total of 370,000 meter transactions a year was performed in New Zealand. Further, no safety incident has been encountered in the seven (7) years of isolation and reconnection services in New Zealand.

The following asset numbers for generic smart meters were taken as base rates for risk calculations.

- Total number of meters = 1,000,000 (one million)
- People per dwelling = 2.6 on average
- Annual meter transactions per year (re-energisation and de-energisation) = 350,000
- Annual re-energisations = 175,000
- Annual de-energisations = 175,000

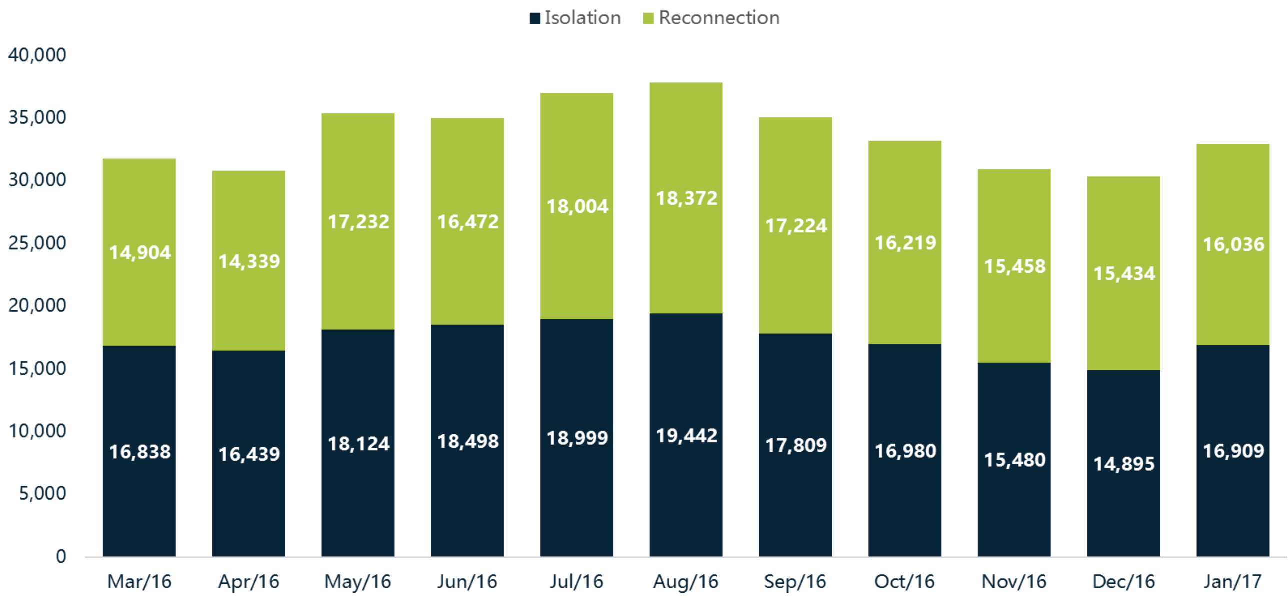

Figure 3 Recent Smart Meter Transactions in New Zealand by Vector Advanced Metering Services

3.1.3 Hazard Identification (HAZID)

In total, nine risk scenarios were identified as shown in Table 1.

Table 1 Hazard Identification Results

Risk ID No	Hazard Type	Risk Scenario > Consequence
1-1	Re-energisation	A transaction error (e.g. transposed meter) > Electrical contact
1-2	Re-energisation	Customer accessing meter > Physical site hazard (fall, snake)
1-3	Re-energisation	Customer accessing meter > Electrical contact
1-4	Re-energisation	Customer accessing main switch > Electrical contact
1-5	Re-energisation	Ignition from electrical device (stove, iron, heater > Fire
1-6	Re-energisation	A firmware / software fault > Electrical contact
1-7	Re-energisation	Meter device fault (contactor failing) > Electrical contact
2-1	De-energisation	Critical load depend customer > Loss of power to medical device
2-2	De-energisation	Critical load depend customer > Loss of heating / air conditioning

The SQRA participants elected not to examine hazards associated with stranded lifts or carriage devices, or security system failures, as they did not consider them material risks.

The probability rate utilised in the assessment was the consensus deliberation of the group at the workshop without empirical evidence as the scenario had not occurred at that time. The assessment examined some hypothetical scenarios, which did not have historical precedent, and so were estimated by the group using 'reasonable estimated projection of future probabilities'. Refer to Appendix C for further data/ details on the base rate data captured in the SQRA database for each risk scenario identified.

3.2 Describe Hazard Dynamics (Bowtie Diagrams)

Bowtie diagrams were generated from the SQRA® database for all risk scenarios analysed as part of the hazard identification. The diagrams provide the team with a comprehensive understanding of the dynamics of each risk scenario and are a useful communication tool (see Appendix A for a full explanation).

3.3 Determine Current Risk Profile

The risk score represents the Potential Loss of Life (PLL) for each risk scenario. The PLL is the calculated fatality rate per annum for each risk scenario. The PLL for each risk may be summed to give a cumulative risk for the hazard type. This is referred to as the Critical Risk Score.

The Critical Risk Score for the overall Current Risk was estimated to be 1.83×10^{-03} fatalities per annum or approximately one fatality every 546 years.

A summary of the Current Risk results for each of the risk scenarios is shown in Table 2.

Table 2 SQRA® Results Summary (Current Risk)

Risk Rank	Risk ID	Risk Scenario	Current Risk	1 Fatality Every X years	% of Overall Current Risk
1	1-2	Customer accessing meter > Physical site hazard (fall, snake)	1.75×10^{-03}	571	95.60%
2	2-2	Critical load depend customer > Loss of heating / air conditioning	5.60×10^{-05}	17857	3.06%
3	1-4	Customer accessing main switch > Electrical contact	1.75×10^{-05}	57143	0.96%
4	2-1	Critical load depend customer > Loss of power to medical device	2.80×10^{-06}	357143	0.15%
5	1-5	Ignition from electrical device (stove, iron, heater > Fire	1.84×10^{-06}	543478	0.10%
6	1-6	A firmware / software fault > Electrical contact	1.75×10^{-06}	571429	0.10%
7	1-7	Meter device fault (contactor failing) > Electrical contact	5.00×10^{-07}	2000000	0.03%
8	1-3	Customer accessing meter > Electrical contact	1.75×10^{-07}	5714286	0.01%
9	1-1	A transaction error (e.g. transposed meter) > Electrical contact	3.50×10^{-08}	28571429	<0.01%
		Total:	$\mathbf{1.83 \times 10^{-03}}$	**546**	**100%**

The Current Critical Risk Score Profiles for Re-energisation and De-energisation are shown in Figure 5 and Figure 6.

3.3.1 Individual Risk

In order to compare the PLL to risk criteria, the PLL must be converted to an individual risk level. This is determined by sharing the PLL over the entire population that could be exposed. It was estimated that 2.6 people per meter could be exposed. This equates to 2.6 million people for a cohort of one million meters.

The individual risk level for smart meters remote de-energisation and re-energisation was estimated to be 7.04×10^{-10} chance of fatality in one year for one person (which equates to a period of 1420 million years between fatalities).

To put this into context the risk level can be compared to regulatory risk criteria. The NSW Department of Planning states that an individual fatality risk of 1×10^{-6} per year (which equates to one fatality every 1 million years) is the limit of risk acceptability for residential area exposure. WorkSafe Victoria considers individual risk levels below 1×10^{-7} per year (which equates to one fatality every 10 million years) to be broadly tolerable.

The individual risk level that smart meters pose to the public is approximately 1,000 times safer than the above mentioned regulatory risk criteria.

One method of comparing relative individual risks is to consider the risks of commuter transport options typically used in Australia in an average year (e.g. 40 km round trip, five days a week, 50 work weeks a year). Defining a micromort [mM][4] as a one in one million probability of a fatality in one year, Figure 3 shows the risks to an individual in Australia associated with different commuter transport modes, compared with living with a smart meter.

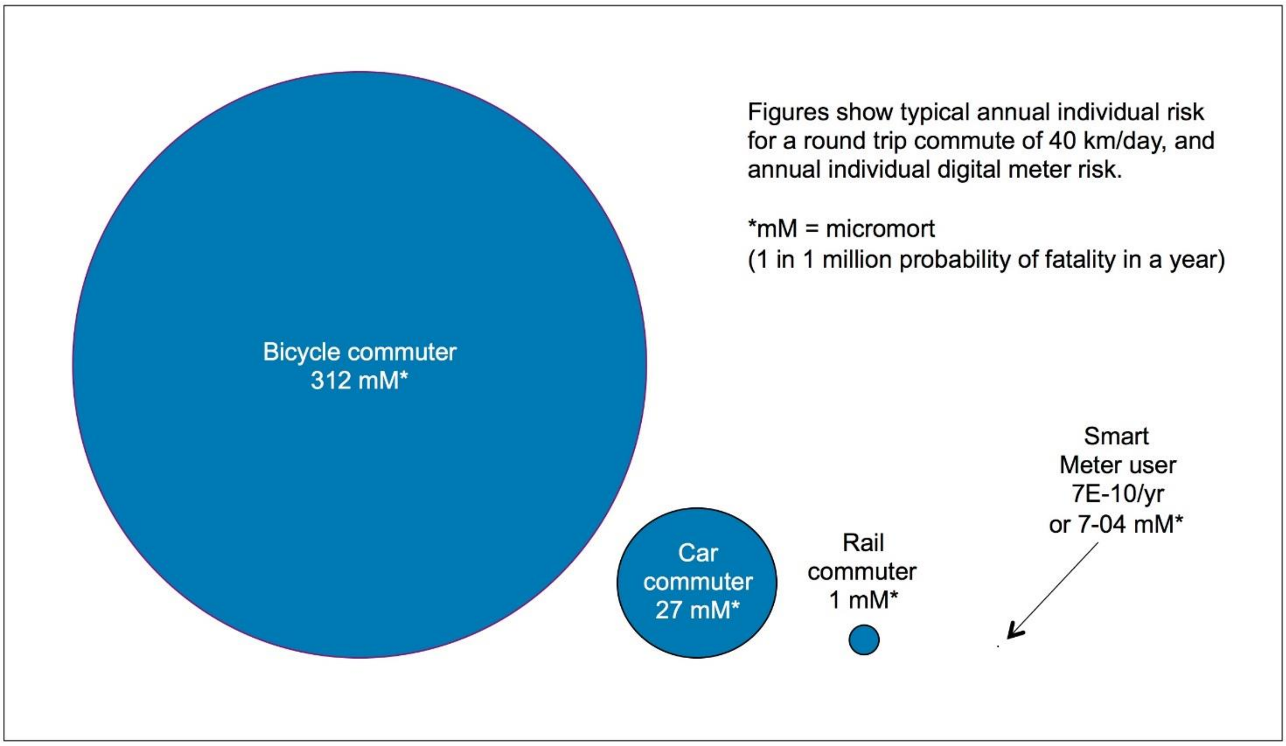

Figure 4 Relative individual risks in one year in Australia

[4] See https://en.wikipedia.org/wiki/Micromort (link accessed 9th October 2017)

Figure 4 shows the PLL risk for the seven risk scenarios examined for re-energisation of smart meters.

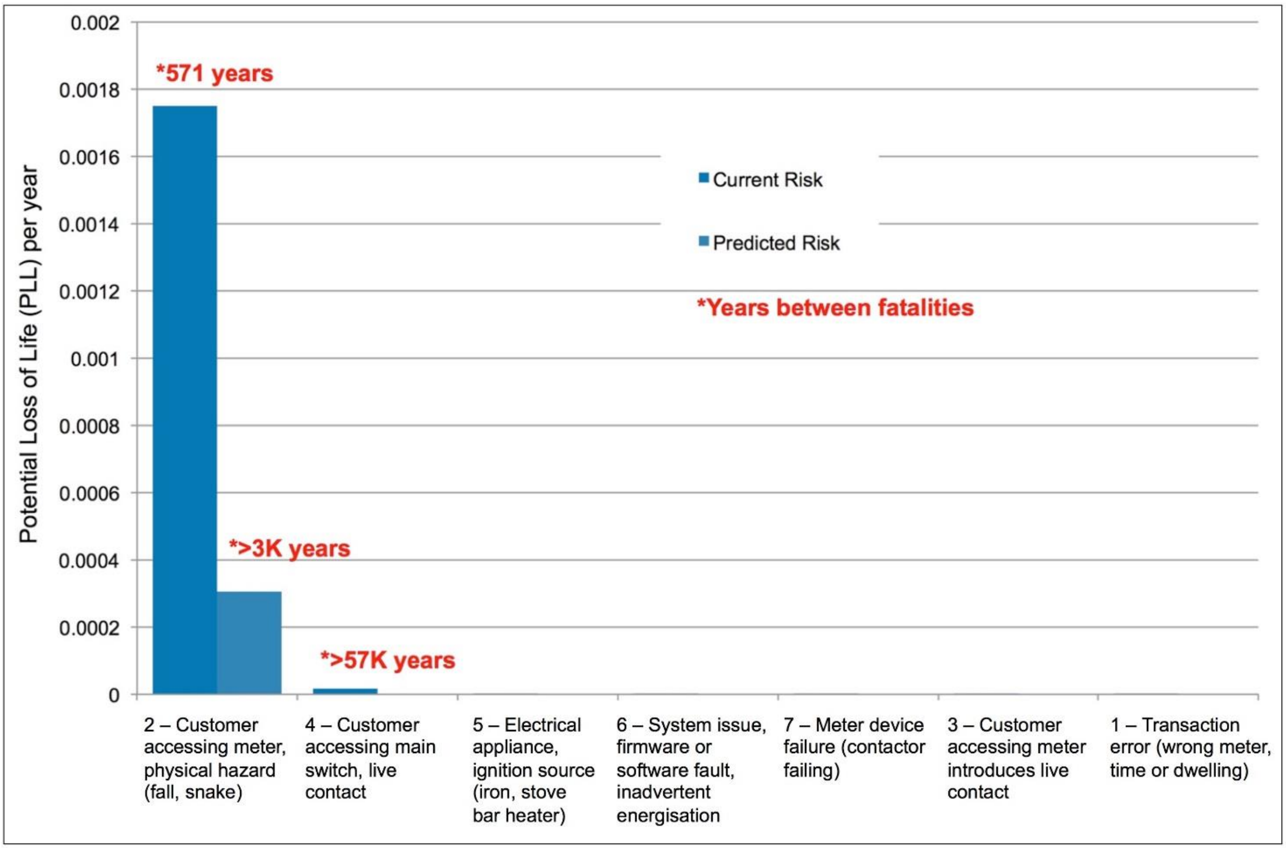

Figure 5 Critical Risk Score Profile – Re-energisation

Figure 5 shows the PLL risk for the two risk scenarios examined for de-energisation of smart meters.

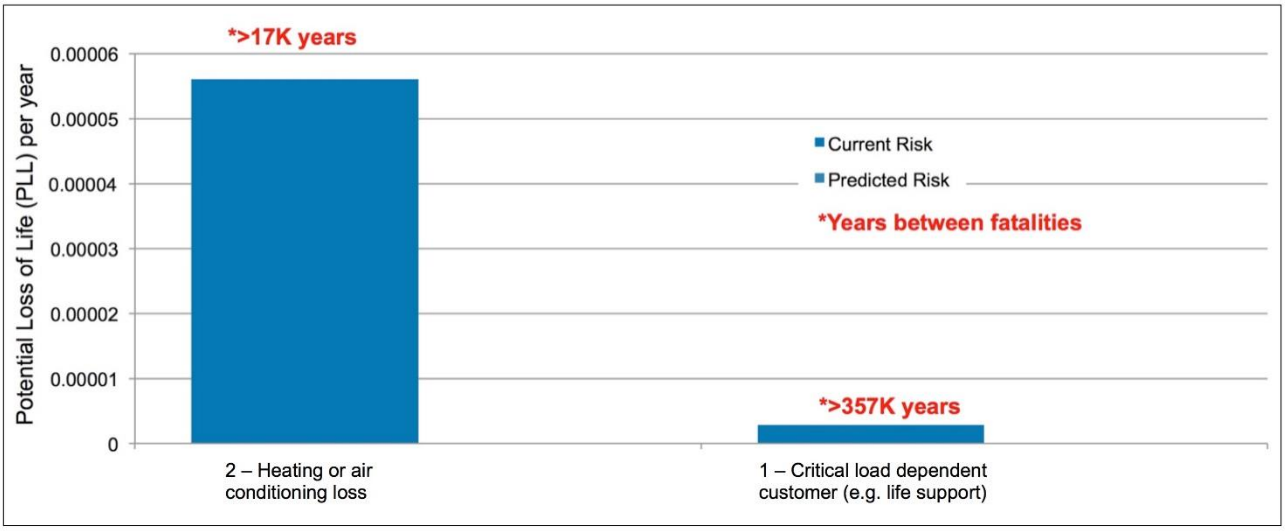

Figure 6 Critical Risk Score Profile – De-energisation

3.4 Identify Critical Controls

In total two controls were identified as critical on the bowtie diagrams (Service Order Process and Retailer Scripts).

The adequacy of critical controls was qualitatively rated by the team on a scale from Poor, Fair, Adequate, High to Very High.

The adequacy of each critical control was rated as High, reflecting the nature of service operational and retailer script standards.

The description and categorisation whether the control is required or option, was not part of the scope of work. The code of practice will identify the controls that are seen and 'critical', which must be implemented by signatories to the code.

3.5 Select Potential Considerations and Estimate the Predicted Risk Profile

3.5.1 Risk Management Considerations

A total of 12 risk management considerations were identified during the SQRA®. The risk management considerations consist of:

1. For life support service request, the high reliability notification of a vulnerable customer is currently not fully defined. At the point of acquisition, a customer is asked if life support service is required. However, if circumstances change, this is identified as a gap. Retailer script could be updated.
2. Create precedence logic for multiple service orders lined up during the retailer script to meter actioning period (up to 100 days).
3. Reconciliation of life support between MPs & retailers.
4. The retailer can determine the safety of the customer approaching the meter based on meter position, conditions and capability of customer.
5. Consider the appropriateness of the references to retailer scripting and the inclusion of scripting/ questions. Customer competency assessment can be based on: Are you familiar with your switchboard? Can you safely access? Do you know where the meter is?
6. Create a decision tree to guide the type of outcome from a retailer script.
7. Customer confirmation for a transaction does not have to be restricted to a meter button press. (This would eliminate the risk of customer harm when accessing the meter, and so was not considered during risk reduction stages.)
8. Prequalify customers that should not be asked to interact with the meter or switchboard to energise the site.
9. Follow-up check on a customer who is unsure of the site after energising the site.
10. Devise real world user centred training for retailers e.g. approaching a meter. Consider videos of field installation conditions.
11. Acknowledgement of transfer of responsibility to customer post re-energisation via retail script.
12. Meter condition check (conditions check, current flow check, comparison threshold & action).

The SQRA® Risk Reduction Spreadsheet outlines each of the risk management considerations and can be used as an action tracking tool.

3.5.2 Available Critical Risk Score

If all risk control considerations were to be implemented the overall Predicted Critical Risk Score was estimated to be 3.06×10^{-04} fatalities per annum or approximately one fatality every 3265 years.

This represents an expected 83% reduction in the Critical Risk Score as highlighted in Figure 6.

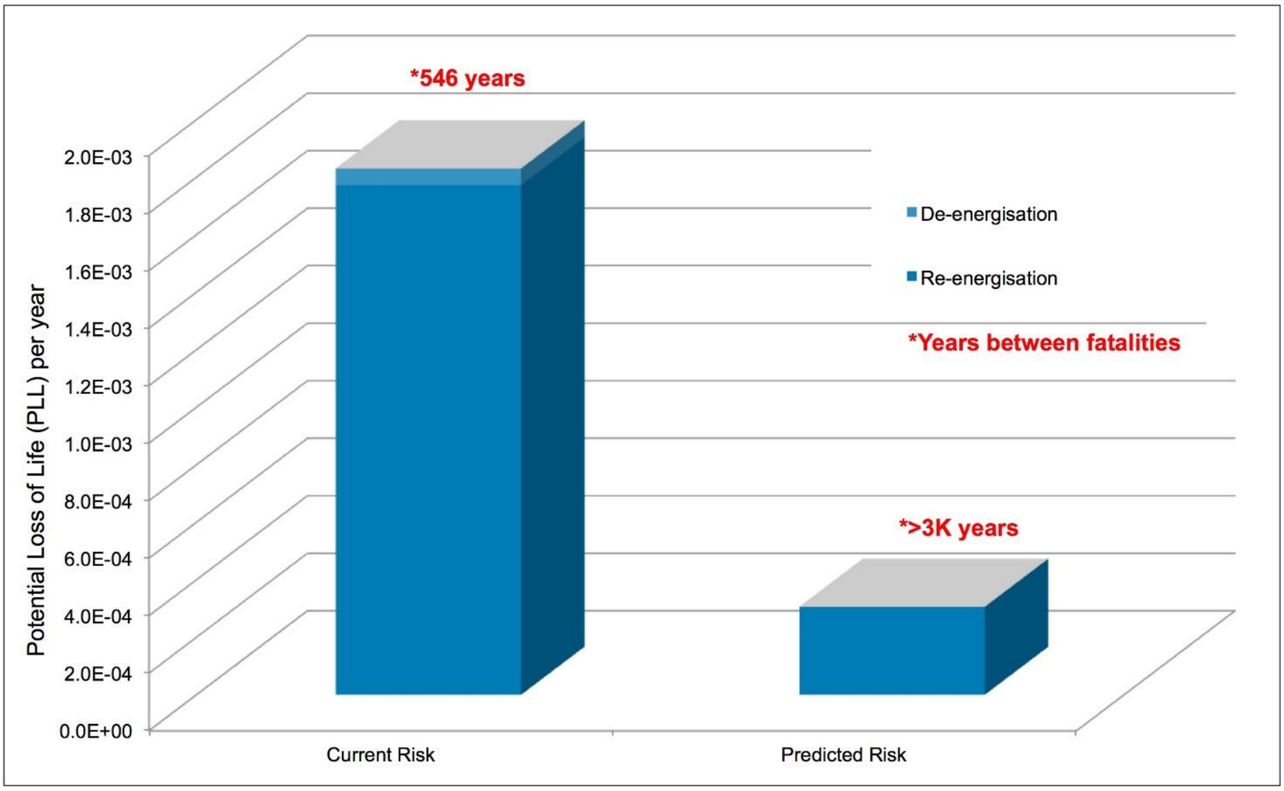

Figure 7 Current Risk vs. Available Risk (Critical Risk Score)

4. Outcomes

The outcomes arising from the SQRA® are described below.

- Smart meter remote services risks, as estimated through the SQRA® team-based process, are currently 1.83 x 10^{-03} PLL (Potential Loss of Life) per annum, which equates to a period of 546 years between fatalities.
- For a notional user cohort of 2.6 million people, this represents an Individual Risk Level (the chance of a fatality for one person in a year) of 7.04 x 10^{-10}, which is approximately 1,000 times safer than the individual public risk tolerability level suggested by regulatory bodies around Australia.
- Additional risk management considerations have been developed that offer a potential 83% reduction in PLL risk.
- It was also recognised that smart meters reduce truck trips to customer sites, which is an additional worker safety benefit.
- The AEC can review the potential risk control considerations listed in Section 3.5.1 to determine which will be pursued in terms of the development of the industry code for smart meters.

5. Conclusions

The Semi Quantitative Risk Assessment (SQRA®) process identified and analysed public safety risks associated with smart meters remote de-energisation and re-energisation. It also facilitated the development of a risk-relative profile to identify risk reduction strategies targeting the risks in the Critical Risk Score.

The current Critical Risk Score for smart meter re-energisation and de-energisation was estimated to be 1.83 x 10^{-03} per year, or one potential fatality every 546 years. Of the nine risk scenarios analysed during the SQRA® the concentration of the risk profile is within one risk, which accounted for over 95% of the Critical Risk Score and related to the hazards of a customer accessing a meter location.

In total two controls were identified as critical and assessed for adequacy. It was found that both critical controls currently meet the adequacy rating required (i.e. high).

Although risks are very extremely small, opportunities were identified to further reduce risks. If pursued, these opportunities could potentially reduce risk by 83%, resulting in a predicted Critical Risk Score of 3.06 x 10^{-04} per year, or one potential fatality every 3265 years.

The process of demonstrating risks within the operation are at ALARP (As Low As Reasonably Practicable) should be continuous. Through the implementation of the SQRA® process, the operation has:

- Identified an overall risk level for generic smart meters;
- Identified the dominant smart meter safety risk;
- Assessed the risks and developed Critical Risk Score profiles.
- Created a 'point-in-time' risk assessment, with structure that can be re-applied periodically to assess changes in risk over time due to changes in meter design, customer types or operational procedures.

The proposed risk management considerations can inform the development of the industry code for remote services with smart meters.

6. Glossary of Terms and Abbreviations

Term	Description
Adequacy assessment	A detailed analysis process, completed in a workshop, which determines and records how effective critical controls are in protecting against the hazards for which they are selected.
Base rate	The number of smart meters considered as a standard asset set for this SQRA®.
Bowtie diagram	A graphical representation of a risk scenario, displaying causes, controls, outcomes and the inter-linkages between these.
Cause	Undesired occurrences that could lead to the hazard becoming uncontrolled e.g. transaction error.
Consequence	The impact of an event expressed qualitatively or quantitatively, being a loss, harm, disadvantage or gain. There may be a range of possible impacts associated with an event. Threats (or hazards) have unfavourable consequences (downside), and opportunities have favourable consequences (upside).
Control	Any process, policy, device, practice or other measure that acts to minimise negative risk or enhance positive opportunities. This is aligned with the Hierarchy of Control.
Critical control	A control that is heavily relied upon to prevent a major hazard incident or mitigate the severity of its consequence(s). A critical control demands a high degree of adequacy is demonstrated.
Critical Risk Score	The cumulative Potential Loss of Life (PLL) for an asset. Presented as the predicted fatality rate per annum i.e. risk per operating year.
Current Risk	The risk as it currently exists considering the effectiveness of the existing controls.
Event	A single or series of actions/circumstances or exposures that have taken place that leads to a result.
Frequency	A measure of the rate of occurrence of an event expressed as the number of occurrences of an event in a given time. The most common timeframe in risk assessment is per annum.
Hazard	A source of potential harm or a situation with a potential to cause actual or perceived loss or damage to people, the environment, or plant and equipment.
Hazard Identification	A structured process to identify threats and individual risk scenarios.
Hazard list	A list of identified hazards.
Maximum reasonable consequence	The largest realistic or credible consequence from an event, considering the credible failure of controls.
Micromort	A measure of risk equal to a one in one million probability of a fatality in a year.
Outcome	A description of the severity and type of the end impact e.g. fatality from electricity contact.
Pathway	A grouping of hazard’s causes or outcomes for the purpose of analysis.

Term	Description
Potential Loss of Life (PLL)	The predicted fatality rate per annum. This is the product of the initiating event frequency (IEF), by the probability of the range of potential consequences (distribution of fatalities).
Predicted Risk	The predicted or forecasted risk remaining after controls and risk reduction (or enhancement) measures have been implemented.
Probability	Probability is expressed as a number between 0 and 1, with 0 indicating an impossible event or outcome and 1 indicating an event or outcome that is certain.
Risk	An uncertain event that if it occurs will have an impact upon the achievement of objectives (both upside and downside). It is measured in terms of the likelihood of occurrence and its potential consequences, and assigned an overall risk classification.
Risk analysis	The overall process of risk identification and risk evaluation.
Risk assessment	The method of evaluating the consequence and likelihood of identified hazards, aspects or opportunities and comparing against a defined risk acceptance threshold.
Risk evaluation	The process of estimating the consequences and likelihood of identified hazards, aspects or opportunities and comparing against a defined risk acceptance threshold.
Risk management	The process of taking appropriate decisions and implementing appropriate considerations in response to known risks, based on the results of a risk analysis.
Risk Management Considerations	In the SQRA® context, this refers to the considerations targeting control improvement and safety risk reduction. These considerations are drawn from the critical control adequacy assessment and the introduction of new control strategies.
Risk reduction	The selective application of appropriate techniques and management principles to reduce either the frequency / likelihood of an occurrence or its consequences, or both.
Safety Improvement Plan	In the SQRA® context, this relates to the agreed plan of Risk Management Considerations targeting control improvement and safety risk reduction.

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
HAZID	Hazard Identification Study
IEF	Initiating Event Frequency
mM	Micromort (one in one million probability of a fatality in a year)
MP	Meter Provider
PLL	Potential Loss of Life in a year
QRA	Quantitative Risk Analysis
SQRA®	Semi Quantitative Risk Analysis

Appendices

Appendix A – SQRA® Methodology

The methodology used to assess the hazards is known as Semi Quantitative Risk Assessment (SQRA®) SQRA® is based on operational experience, supplemented by industry statistics where they are known and considered valid. It is generally perceived as being the most rigorous form of risk assessment available for those industries where reliable and accurate failure statistics have not been well recorded on an industry wide basis and where operation-specific conditions can predominate.

The SQRA® process involves the following seven steps:

8 Identify hazards

9 Describe hazard dynamics (bowtie diagrams)

10 Determine Current Risk profile

11 Identify critical controls

12 Assess the adequacy of critical controls

13 Select risk management considerations and estimate the Predicted Risk profile

14 Reporting and Improvement Planning

Hazard Identification (HAZID)

The first stage in the SQRA® process involves the identification of the process safety and other major safety hazards present. This includes the identification of the individual risk scenarios that may result in exposure to the hazard. The development of this list, which includes a review to remove duplication in hazards and risk scenarios, is a key step in the SQRA® process as it determines which hazards are carried through the rest of the process.

Existing hazard studies and risk assessment information can be used along with a number of prompts / guidewords by the facilitator to ensure that all aspects of the operation are considered.

Understanding the Dynamics of the Hazards

The next stage of the SQRA® process requires that a comprehensive understanding of the dynamics of each hazard be developed. As for the initial identification of the hazards, this step is performed in a workshop format.

The workshop, under the guidance of the GHD facilitator and using the experience of those present, looks at each hazard individually to detail the potential causes and pathways that lead to each, as well as the consequences should the event occur. The controls that are in place to prevent the event eventuating, or to mitigate the consequences, are also identified.

The data from these workshops is represented pictorially using a Bowtie diagram. The Bowtie diagram is used as a visual tool to assist with the risk assessment workshops throughout the remaining stages of the process.

Figure 8 below shows an example Bowtie diagram. At the centre of the Bowtie is the initiating event (or incident). As mentioned above, the position of the initiating event shows the point of loss of control of the hazard (e.g. rock fall, dropped object, fire, collision etc.).

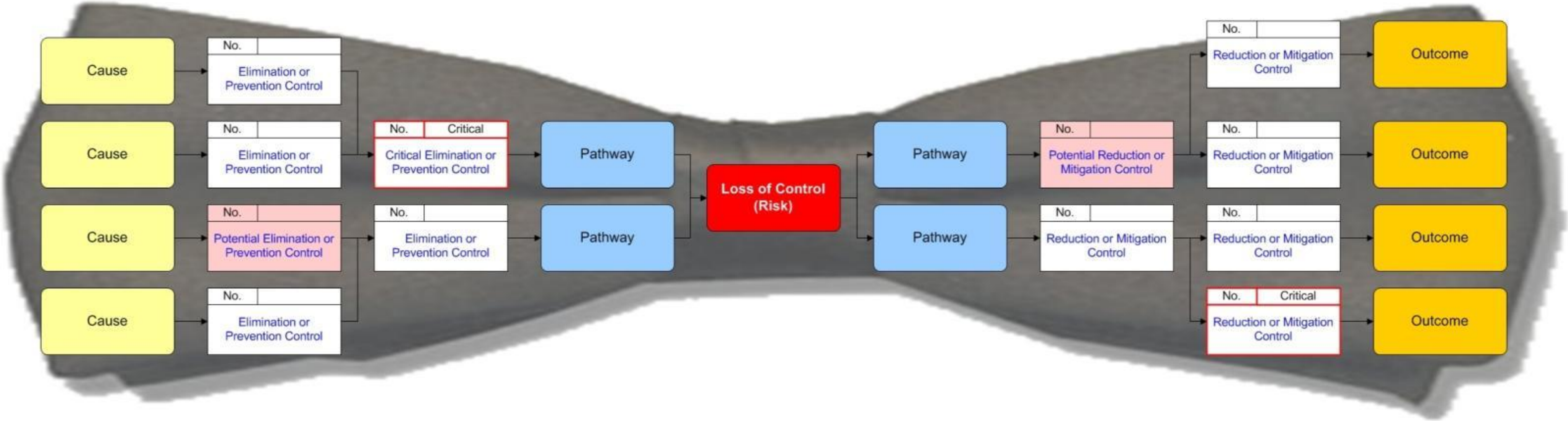

Figure 8 Example Bowtie Diagram

No probabilities are included directly on the Bowtie diagram, as its purpose is to represent the dynamics of the hazard in order to assist with further analysis. Information generated later in the process, such as which controls are identified as being critical, are also included on the Bowtie.

Assessment of Risks from the Hazards (Current Risk)

A semi quantitative risk assessment is carried out for each risk scenario carried forward from the hazard identification study. The SQRA® provides a semi quantitative estimate of the risk for each risk scenario based on:

Information from the Hazard Identification Study;

Knowledge of operation-specific (incident and operating history) and industry-wide data; and

Experience and knowledge of personnel involved in the risk assessment process.

The risk value estimated is the Potential Loss of Life (PLL) – calculated as fatalities per annum (i.e. per operating year). PLL in this assessment gives an indication of the predicted number of fatalities per year due to the major safety hazards. PLL is determined for each risk scenario as well as overall. The overall PLL is referred to as the Critical Risk Score.

For a given risk scenario, PLL is a product of the likelihood of occurrence and consequence:

Risk (PLL) = Likelihood ×Consequence

It is generally calculated via the formula:

PLL=Event Frequency ×Probability of Fatality ×Average Number of Fatalities

Likelihood is estimated as the frequency of the initiating event (occurrences per year) for a risk scenario. This could be based on incident data for the operation, comparison with similar operations or an order-of-magnitude estimate based on the experience and knowledge of the personnel in attendance.

The consequence analysis requires workshop attendees to assess the distribution of fatalities for that risk scenario by assigning an estimate of the percentage occurrence of each fatality scenario. Several fatality scenarios are considered:

1: Single fatality

2: Two fatalities

3 – 5: Between three and five fatalities

6 – 9: Between six and nine fatalities

10+: Ten or more fatalities

It should be noted that there is no absolute criterion or target for PLL. However in the case of SQRA®, PLL provides the platform for risk-based selection of critical controls for the dominant causal pathways in a given hazard. It is the analysis of the critical controls via detailed Adequacy Assessment that ultimately demonstrates risk acceptability as being ALARP (As Low As Reasonably Practicable). Calculating the PLL for each risk scenario also allows the hazards to be ranked and prioritised based on their level of risk. This enables the operation to focus on and target the dominant hazards in the fatality risk profile during the risk reduction process.

The Current Risk provides an estimate of the risk, as it exists for current operations (i.e. a snapshot of the risk at the time of the risk assessment). It considers all current controls, procedures, personnel and existing risk reduction measures for the identified hazards.

An example output risk profile is shown below in Figure 9.

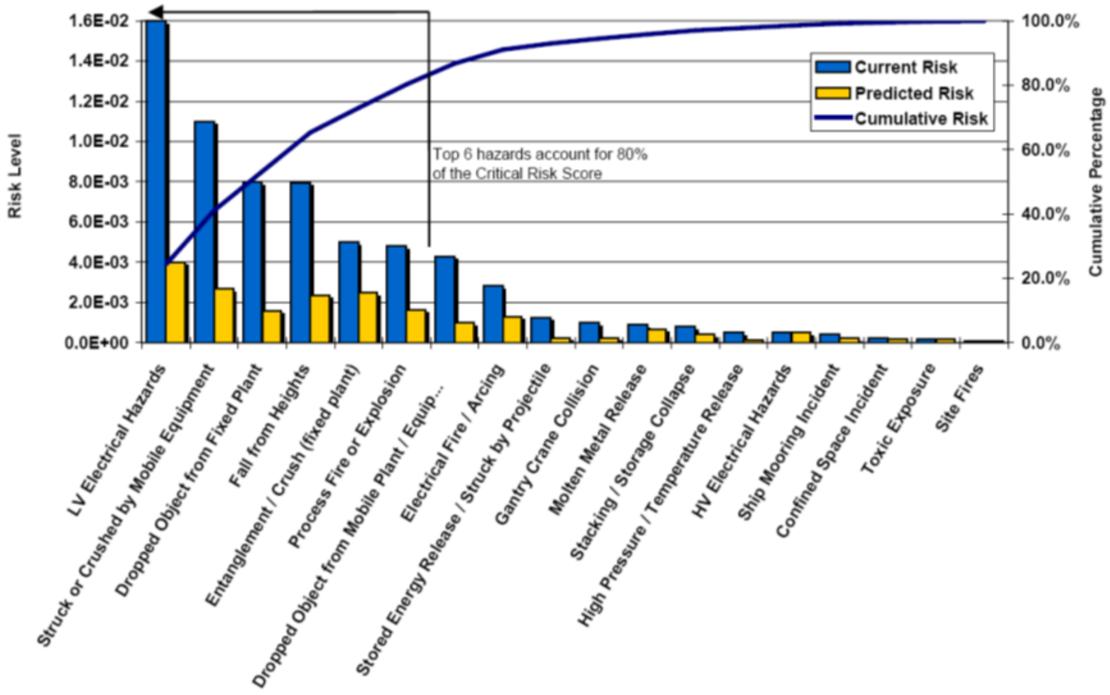

Figure 9 Example Critical Risk Score Profile

Identification of Critical Controls in Managing Risks

Following establishment of the current case risk profile, each risk scenario is analysed to determine dominant causal pathways and identify critical controls for those pathways.

Dominant pathways for a risk scenario are determined by dividing the overall risk of the hazard across the various causal pathways by way of percentage risk. In assigning percentage of hazard risk to causal pathways workshop participants take into account:

- The likelihood assessment for the hazard;
- The hierarchy of controls on the pathway; and
- Consideration of the likelihood of the event occurring due to one pathway over another.

In identifying the critical controls for a given pathway, workshop participants refer to the Bowtie diagrams and consider the following:

- Comparison of risk level for each pathway against pre-determined criticality criteria, which in turn generates a control classification for the pathway (i.e. number of critical controls required for that pathway);
- The hierarchy of controls (e.g. Elimination; Substitution, Engineering & Process, PPE/Receptor Protection); and
- Control duplication/repeatability throughout the hazards.

The SQRA® database is updated throughout the process to show which controls are critical. It is also used to record the allocation of hazard risk to the causal pathways.

Critical Control Adequacy Assessment

The next step in the SQRA® process is to review the adequacy of the critical controls.

The critical control adequacy assessment is a detailed assessment of the current adequacy of each critical control and includes the identification of recommended considerations required to improve a controls adequacy. The target for each critical control is to achieve a high adequacy rating where practicable.

The adequacy assessment reviews the control against detailed checklists under the headings:

- Planning / Design;
- Implementation;
- Workforce Involvement; and
- Monitoring.

An adequacy rating (Very High, High, Adequate, Fair, Poor) is given to each of the above areas and each rating is considered in relation to the overall adequacy of the control. Notes and assumptions supporting the adequacy assessment are recorded under each heading and recommended considerations are recorded in the same module.

Risk Management Considerations & Revision of SQRA® (Predicted Risk)

Following identification of risk management considerations in the control adequacy review, the SQRA® for each risk scenario is revisited and a Predicted Risk assessment completed. This revision takes into account the effect of any relevant considerations on the frequency of the initiating event and/or the consequence/s of the outcome event.

Considerations assessed in the predicted SQRA® may include:

- Relevant recommended considerations from the control adequacy review; and
- Potential additional controls identified during the HAZID (Bowtie development).

The methodology of the predicted SQRA® is the same as the current case SQRA® approach described above. A qualitative assessment (high, medium, low) of the contribution to the risk reduction by each action is also recorded in the SQRA® database.

Safety Improvement Plan

After completion of the SQRA® workshops, a review of the risk management considerations is undertaken by the management team of the operation. Based on this review, a Safety Improvement Plan may be developed which involves the details of the considerations to be completed, responsibilities and due dates. The SQRA® database may be used in conjunction with the SQRA® Risk Reduction spreadsheet to assist in the development of the Safety Improvement Plan for the organisation and the ongoing management of the considerations.

Appendix B – Bowties

GHD SQRA® Software

SQRA Bowtie V4.0

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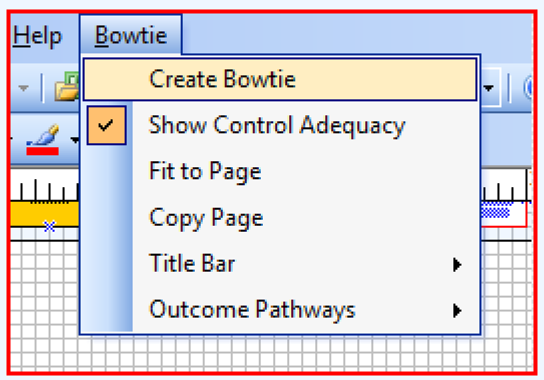
AUSTRALIAN ENERGY COUNCIL

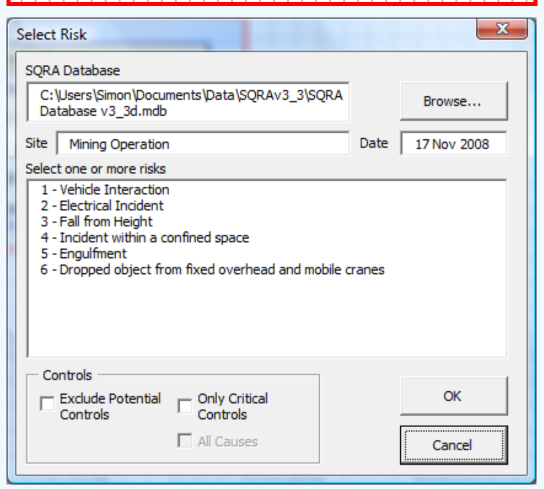
Operation	Management of Remote Services
Facilitator	
Scribe	
Last saved date	12 Oct 2017
SQRA Date	4 Oct 2017
GHD Job No	

Table of Contents

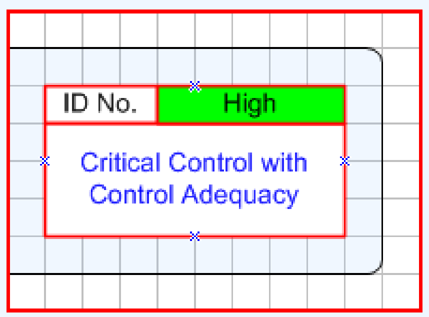
Bowtie Instructions – Quick Reference

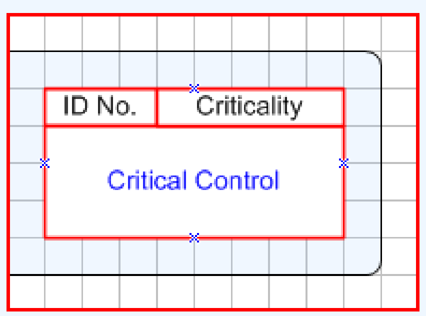
Create Bowtie



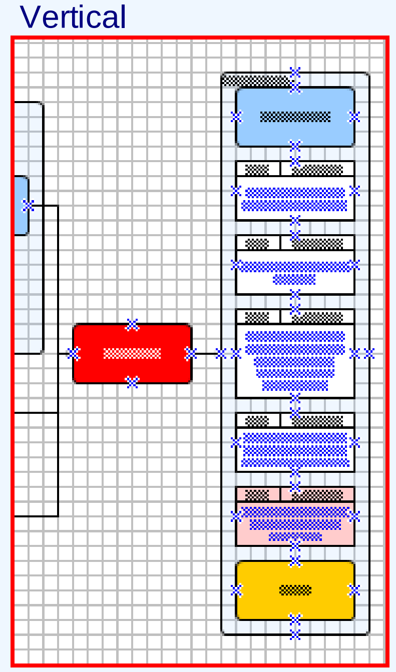


Show Control Adequacy

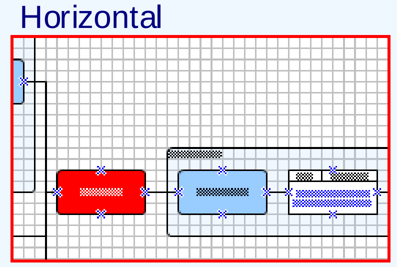




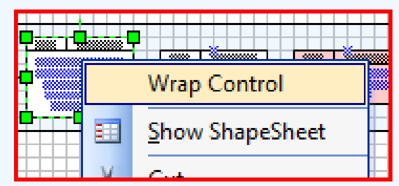
Outcome Pathways: Vertical

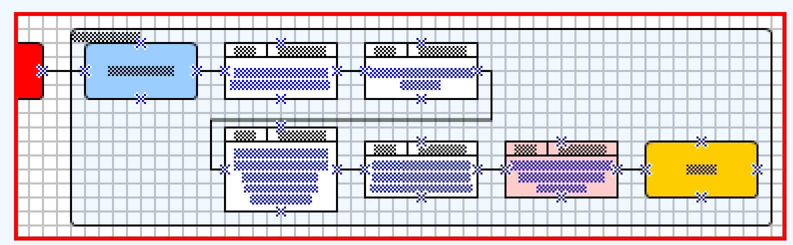


Outcome Pathways: Horizontal

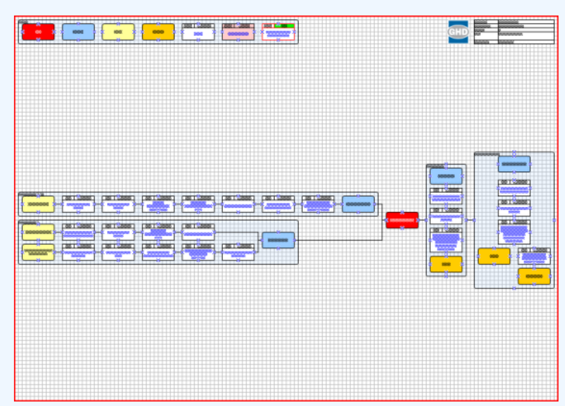


Wrap Control

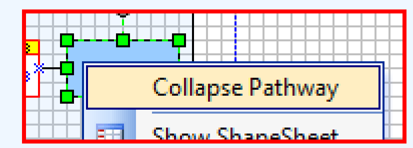




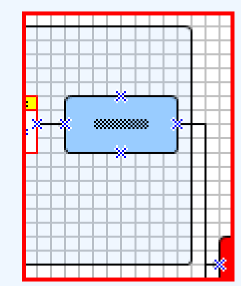
Fit to Page



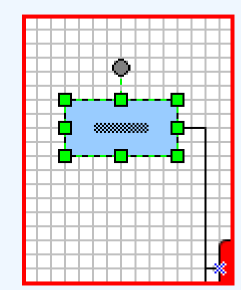
Collapse/Expand Pathway

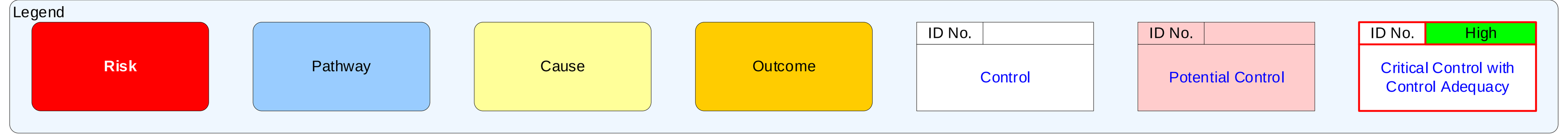


Expand Pathway



Collapse Pathway

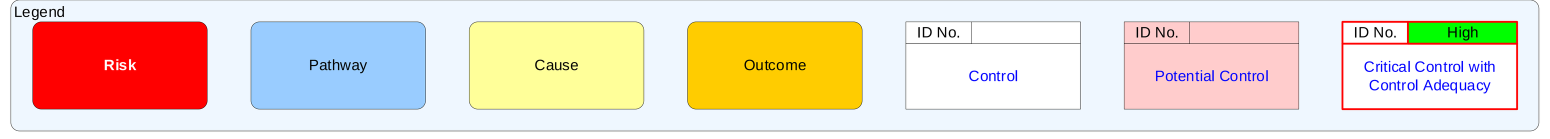




AUSTRALIAN ENERGY COUNCIL

GHD

Operation	Management of Remote Services
Guideword	Public Safety
Risk No	1
Catastrophic Risk	**Re-energisation of smart meters LOC**
SQRA Date	4 Oct 2017



Operation	Management of Remote Services
Guideword	Public Safety
Risk No	2
Catastrophic Risk	**De-energisation of smart meters LOC**
SQRA Date	4 Oct 2017

Appendix C – SQRA Report

SQRA Report — Management of Remote Services

1 Re-energisation of smart meters LOC

Current Risk: *1.77E-03*

Predicted Risk: *3.06E-04*

Risk to public safety from loss of control during re-energisation activities

1 Transaction error (e.g. transposed meter, wrong time/place) — Current Risk — Safety

	Frequency		
Initiating Event:	35	35 per yr	Base rate data of 1million gives 175k re-ens of which: less than 10 in 50k (NSW 2016/2017) = 10/50k*175k = 35. This is a conservative figure.

Scenario	**Probability**		
Wrong meter is in the de-en position	0.001	1 in 1,000	Reason for being it so slow: It has to be in the den-en position; of which it will be rectified due to customer complaint. Abandoned property or delinquent client. Data sample of 200 out of 210k meters gives approximately 1/1000.
Re-en leads to a live electrical contact	0.001	1 in 1,000	Proportion of dwellings with a live load
Person contacts load	0.001	1 in 1,000	E.g. builder working on property

Fatality

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
35	x	1E-09	x	1	=	3.5E-08	Once every 28,571,429 years

Risk to public safety from loss of control during re-energisation activities

2 Customer accessing the meter or main switch introduces a physical site hazard (e.g. basement, poor lighting, hazardous materials - asbestos, heights, flora/fauna, slips, electrical hazard) — Current Risk — Safety

	Frequency		
Initiating Event:	175000	175000 per yr	Total of 175k/yr of transactions.If every re-energization transaction requires a customer to attend the switchboard/meter; then 175k visits per year of which 100% of the time needs customer intervention.

Scenario	**Probability**		
Physical hazard at meter (e.g. height etc.)	0.01	1 in 100	At NSW, event occurrence is 30%.
Customer does not control hazard (e.g. leave site, gets a ladder, torch etc.)	0.01	1 in 100	1% fails to identify the hazards present.
Hazard turns into a harm	0.001	1 in 1,000	Most people survive dangerous tasks.
Injury	0.1	1 in 10	Minor injury

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175000	x	0.00000001	x	1	=	0.00175	Once every 571 years

2 Customer accessing the meter or main switch introduces a physical site hazard (e.g. basement, poor lighting, hazardous materials - asbestos, heights, flora/fauna, slips) — Predicted Risk — Safety

	Frequency		
Initiating Event:	61250	61250 per yr	C = Total of 175k/yr of transactions.If every re-energization transaction requires a customer to attend the switchboard/meter; then 175k visits per year of which 100% of the time needs customer intervention. P = Reduced number of transactions. 35% of the initial transactions will push the switch/ button.

Scenario	**Probability**		
Physical hazard at meter (e.g. height etc.)	0.01	1 in 100	At NSW, event occurrence is 30%.
Customer does not control hazard (e.g. leave site, gets a ladder, torch etc.)	0.005	1 in 200	C = 1% fails to identify the hazards present P = 0.5% fails to identify the hazards present; with scripting available
Hazard turns into a harm	0.001	1 in 1,000	Most people survive dangerous tasks.
Injury	0.1	1 in 10	Minor injury

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
61250	x	5E-09	x	1	=	0.00030625	Once every 3,265 years

3	Customer accessing the meter introduces a live contact (e.g. poor or degraded wiring, poor workmanship, broken equipment, poor insulation)	Current Risk	Safety

	Frequency		
Initiating Event:	175000	175000 per yr	Assume 100% of 175k a year.
Scenario	**Probability**		
Poor wiring	0.0001	1 in 10,000	Assume that the meter has been exchanged prior. During changeout, significant hazards have been rectified and be 'made safe'. The standard of electrical safety after changeout, anything that could affect meter operability has to be electrically sound.
Poor wiring is contactable	0.00001	1 in 100,000	Proportion of wiring that is contactable (e.g. exposed wiring, broken enclosure). Wiring is usually covered and contained.
Customer contacts wiring	0.01	1 in 100	Only a proportion of customers will inadvertently contact wiring.
Electrocution resulting in fatality	0.1	1 in 10	Electrocution resulting in fatality

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175000	x	1E-12	x	1	=	1.75E-07	Once every 5,714,286 years

1 Re-energisation of smart meters LOC **Current Risk:** *1.77E-03*

Predicted Risk: *3.06E-04*

Risk to public safety from loss of control during re-energisation activities

4	Customer accessing the main switch introduces a live contact (e.g. poor or degraded wiring, poor workmanship, broken equipment, poor insulation)	Current Risk	Safety

	Frequency		
Initiating Event:	175000	175000 per yr	Assume 100% of 175k a year.
Scenario	**Probability**		
Poor wiring at main switch	0.001	1 in 1,000	Exposed parts, broken enclosures, degraded fixtures, state of mainswitch. Less durability.
Poor wiring is contactable	0.0001	1 in 10,000	Proportion of wiring that is contactable (e.g. exposed wiring, broken enclosure). Wiring is usually covered and contained. Less frequent checks performed for main switch. More likely to be in contact.
Customer contacts wiring	0.01	1 in 100	Only a proportion of customers will inadvertently contact wiring.
Electrocution resulting in fatality	0.1	1 in 10	Electrocution resulting in fatality

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175000	x	1E-10	x	1	=	0.0000175	Once every 57,143 years

5 Ignition of an electrical appliance following re-energization (e.g. electric stove top, bar heater, iron) Current Risk Safety

	Frequency		
Initiating Event:	175000	175000 per yr	175k a year of re-en
Scenario	**Probability**		
Electrical appliance is in the on position	0.001	1 in 1,000	Prior to re-en, device is left powered on.
Electrical appliance starts a fire	0.0001	1 in 10,000	Any flammable material in contact with electrical appliance. Self combust or ignites a fuel source. (induction ovens become more popular, and it will be a less of an ignition source over time.)
Fire propagates	0.5	1 in 2	Fire event propogates if no people are present. People may be present because theyre moving in, new rental, building worker just finished.
Egress or escape is not possible	0.0001	1 in 10,000	People are capable of escaping from dwelling fires most times (e.g. fatality due to smoke asphyxiation, middle of the night,).

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	10.0%	80.0%	10.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175000	x	5E-12	x	2.1	=	1.8375E-06	Once every 544,218 years

6	System issue (e.g. firmware fault, software fault) leads to inadvertent energization state change	Current Risk	Safety

	Frequency		
Initiating Event:	350000	350000 per yr	All transactions
Scenario	**Probability**		
Software or firmware failure mode	0.0000001	1 in 10,000,000	Software or firmware failed to do what's asked.
Unnotified failure	0.5	1 in 2	For example, notification for doing what's asked is not received. - Re-ens generally fail in a notifiable way; whereas de-ens could potentially fail without notification.
Exposure to electrocution	0.001	1 in 1,000	Electrocution (e.g. builder/ electrician contacts inadvertently)
Fatality	0.1	1 in 10	Electrocution

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
350000	x	5E-12	x	1	=	0.00000175	Once every 571,429 years

1 Re-energisation of smart meters LOC **_Current Risk:_** _1.77E-03_

Predicted Risk: _3.06E-04_

Risk to public safety from loss of control during re-energisation activities

7	Metering device failure (e.g. contactor failing)			Current Risk	Safety

	Frequency		
Initiating Event:	0.01	1 in 100 yrs	Load or temperature fusing of contactors. Contributing factors for contactor failure include: environmental moisture, humidity, load, open & closing, exposure, infestation of ants, manufacturing defects.

Scenario	**Probability**		
Unnotified failure	0.5	1 in 2	For example, notification for doing what's asked is not received. - Re-ens generally fail in a notifiable way; whereas de-ens could potentially fail without notification.
Exposure to electrocution	0.001	1 in 1,000	Electrocution (e.g. builder/ electrician contacts inadvertently)
Fatality	0.1	1 in 10	Electrocution

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
0.01	x	0.00005	x	1	=	0.0000005	Once every 2,000,000 years

2 De-energisation of smart meters LOC — ***Current Risk:*** *5.88E-05*

Predicted Risk:

Risk to public safety from loss of control during de-energisation activities

1	Critical load dependent customer (e.g. life support, traffic lights, nursing home) loss due to inadvertent transaction	Current Risk	Safety

	Frequency		
Initiating Event:	175	175 per yr	Current estimate of critical load customer base is 0.1%. Two samples confirm a base load of 0.1%: 20k of life support out of 3.6 mil customers; whereas 6k of life support out of 4mil. 175k/yr of de-en times 0.1%

Scenario	**Probability**		
Transaction error	0.0002	1 in 5,000	Transaction error due to incorrect life support notification. Life support from the retailers are treated as high priority, with exception handlings. The customer's touch point is 3 times greater than a normal customer.
Small site no current transformer (CT) & no UPS	0.8	4 in 5	Sites without CT & UPS (e.g. residential)
Loss of power leads to a health threat	0.0001	1 in 10,000	No nurse, no mobile communication, no carer, no social network
Fatality	1	1	Fatality

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175	x	1.6E-08	x	1	=	0.0000028	Once every 357,143 years

2 De-energisation of smart meters LOC ***Current Risk:*** *5.88E-05*

Predicted Risk:

Risk to public safety from loss of control during de-energisation activities

2 HVAC Loss Current Risk Safety

	Frequency		
Initiating Event:	175000	175000 per yr	All de-en transactions per year
Scenario	**Probability**		
Inadvertent de-en of HVAC	0.0002	1 in 5,000	Database error. Life support from the retailers are treated as high priority, with exception handlings. The customer's touch point is 3 times greater than a normal customer.
Hot weather conditions	0.16	4 in 25	Heat related days estimate of 60 per year
Weather vulnerable person	0.01	1 in 100	Older people, infants and infirmed without family & social support or ambulance
Fatality	0.001	1 in 1,000	Heat related fatality with most people surviving due to local measures (e.g. opening of fridge door, wet tea towels etc.)

	10+	6-9	3-5	2	1	Remaining Outcomes
Distribution of consequences:	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%

Initiating Frequency		Scenario Probability		Mean Consequence		Risk	
175000	x	3.2E-10	x	1	=	0.000056	Once every 17,857 years

Appendix D – Risk Register

CLIENTS|PEOPLE|PERFORMANCE

AUSTRALIAN ENERGY COUNCIL

Risk Register **Management of Remote Services**

No.: 1	Ref No: 1	Current Risk:	1.77E-03	Predicted Risk	3.06E-04
Risk:	**Risk to public safety from loss of control during re-energisation activities**				

	%	Risk	Criticality
Causal Pathway **Transaction error**	0	0.00E+00	NA

Wrong premise

Control

0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0001 Data entry procedure	
0002 Service order process (inc validation)	Critical
0005 Records management protocol (retailer)	
0032 Customer friendly times verification	
0033 Credit cycle process verification	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

Wrong meter

Control

0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0001 Data entry procedure	
0002 Service order process (inc validation)	Critical
0005 Records management protocol (retailer)	
0032 Customer friendly times verification	
0033 Credit cycle process verification	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

No.: 1	Ref No: 1	Current Risk:	1.77E-03	Predicted Risk	3.06E-04

Risk: ***Risk to public safety from loss of control during re-energisation activities***

Wrong time or date

Control

0007 Life support / sensitive load data entry flag and protocol

0003 Meter command verification protocol

0004 Database integrity

0006 Fail point response & close out process

0001 Data entry procedure

0002 Service order process (inc validation) — Critical

0005 Records management protocol (retailer)

0032 Customer friendly times verification

0033 Credit cycle process verification

0035 Meter type validation (National Meter ID or NMI)

0036 Meter energisation status verification

0037 Connection point verification

Wrong customer type

Control

0007 Life support / sensitive load data entry flag and protocol

0003 Meter command verification protocol

0004 Database integrity

0006 Fail point response & close out process

0001 Data entry procedure

0002 Service order process (inc validation) — Critical

0005 Records management protocol (retailer)

0032 Customer friendly times verification

0033 Credit cycle process verification

0035 Meter type validation (National Meter ID or NMI)

0036 Meter energisation status verification

0037 Connection point verification

Manual site visit error

Control

0008 Manual field work order process (inc verification) and site visit procedures

0001 Data entry procedure

0002 Service order process (inc validation) — Critical

0005 Records management protocol (retailer)

0034 Customer accessing meter box verification

0035 Meter type validation (National Meter ID or NMI)

0036 Meter energisation status verification

0037 Connection point verification

		%	*Risk*	*Criticality*
Causal Pathway	**Firmware / software fault**	0	0.00E+00	NA

Upgrade error

Control

0009 QA testing

0010 System security (meter / server / software)

Programming error

Control

0009 QA testing

0010 System security (meter / server / software)

	%	Risk	Criticality
Causal Pathway **Site activation issue**	0	0.00E+00	NA

Customer contacts natural hazard in meter enclosure

Control

0034 Customer accessing meter box verification

0039 Pre-existing meter hazard information (e.g. asbestos, known access issues, electrical hazards)

Access (i.e. basement)

Control

0039 Pre-existing meter hazard information (e.g. asbestos, known access issues, electrical hazards)

0008 Manual field work order process (inc verification) and site visit procedures

Age of dwelling

Control

0039 Pre-existing meter hazard information (e.g. asbestos, known access issues, electrical hazards)

0008 Manual field work order process (inc verification) and site visit procedures

0035 Meter type validation (National Meter ID or NMI)

Customer capability

Control

0002 Service order process (inc validation)	Critical
0040 Retailer script	Critical

	%	Risk	Criticality
Causal Pathway **System fault**	0	0.00E+00	NA

Meter failure

Control

0008 Manual field work order process (inc verification) and site visit procedures

0022 Meter design & reliability

Insulation failure (short)

Control

0023 Insulation standards

0022 Meter design & reliability

Meter operating hazard (EMI etc.)

Control

0022 Meter design & reliability

Security failure (penetration)

Control

0009 QA testing

0010 System security (meter / server / software)

No.: 1	Ref No: 1	Current Risk:	1.77E-03	Predicted Risk	3.06E-04

Risk: *Risk to public safety from loss of control during re-energisation activities*

		%	Risk	Criticality
Causal Pathway	**Dwelling hazards**	0	0.00E+00	NA

Ignition source exist

Control

0040 Retailer script		Critical

Exposed wires

Control

0040 Retailer script		Critical

		%	Risk	Criticality
Outcome Pathway	**Electricity contact**	0	0.00E+00	NA

Fatality

Control

0011 Residual Current Device

0012 Emergency services

0013 Electrical supply isolation procedure

0014 Fuse

		%	Risk	Criticality
Outcome Pathway	**Fire**	0	0.00E+00	NA

Fatality

Control

0011 Residual Current Device

0015 Meter condition check (conditions check, current flow check, comparison threshold & action)	Potential	

0012 Emergency services

0014 Fuse

0041 Smoke alarm

0042 Egress escape

		%	Risk	Criticality
Outcome Pathway	**Life support failure**	0	0.00E+00	NA

Fatality

Control

0016 Communication procedure and escalation / follow up protocol

0012 Emergency services

0017 Social support

0018 Uninterrupted power supply (continuality of supply not guaranteed)

0043 Time of day specified

		%	Risk	Criticality
Outcome Pathway	**Customer security system failure**	0	0.00E+00	NA

Injury

Control

0012 Emergency services

0017 Social support

No.: 1	Ref No: 1	Current Risk:	1.77E-03	Predicted Risk	3.06E-04
Risk:	Risk to public safety from loss of control during re-energisation activities				

	%	Risk	Criticality
Outcome Pathway **Gas Explosion**	0	0.00E+00	NA

Fatality

Control

0024 Gas fitting standards

0025 Gas detection

0026 Extended disconnect period protocols

	%	Risk	Criticality
Outcome Pathway **Internal carriage failure**	0	0.00E+00	NA

Injury

Control

0012 Emergency services

0027 Carriage design

0044 Return to floor function

0017 Social support

	%	Risk	Criticality
Outcome Pathway **Heating, Ventilation, Air**	0	0.00E+00	NA

Fatality

Control

0012 Emergency services

0017 Social support

No.: 2	Ref No: 2	Current Risk:	5.88E-05	Predicted Risk
Risk:	***Risk to public safety from loss of control during de-energisation activities***			

	%	Risk	Criticality
Causal Pathway **Transaction error**	0	0.00E+00	NA

Wrong premise

Control

Control	Criticality
0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0028 Site visit to validate meter number for life support / sensitive load	
0029 Data reconciliation with retailers for life support / sensitive load customers	
0001 Data entry procedure	
0032 Customer friendly times verification	
0002 Service order process (inc validation)	Critical
0033 Credit cycle process verification	
0005 Records management protocol (retailer)	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

Wrong meter

Control

Control	Criticality
0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0028 Site visit to validate meter number for life support / sensitive load	
0029 Data reconciliation with retailers for life support / sensitive load customers	
0001 Data entry procedure	
0032 Customer friendly times verification	
0002 Service order process (inc validation)	Critical
0033 Credit cycle process verification	
0005 Records management protocol (retailer)	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

No.: 2	Ref No: 2	Current Risk:	5.88E-05	Predicted Risk

Risk: ***Risk to public safety from loss of control during de-energisation activities***

Wrong time or date

Control

0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0028 Site visit to validate meter number for life support / sensitive load	
0029 Data reconciliation with retailers for life support / sensitive load customers	
0001 Data entry procedure	
0032 Customer friendly times verification	
0002 Service order process (inc validation)	Critical
0033 Credit cycle process verification	
0005 Records management protocol (retailer)	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

Wrong customer type

Control

0007 Life support / sensitive load data entry flag and protocol	
0003 Meter command verification protocol	
0004 Database integrity	
0006 Fail point response & close out process	
0028 Site visit to validate meter number for life support / sensitive load	
0029 Data reconciliation with retailers for life support / sensitive load customers	
0001 Data entry procedure	
0032 Customer friendly times verification	
0002 Service order process (inc validation)	Critical
0033 Credit cycle process verification	
0005 Records management protocol (retailer)	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

Manual site visit error

Control

0008 Manual field work order process (inc verification) and site visit procedures	
0001 Data entry procedure	
0002 Service order process (inc validation)	Critical
0005 Records management protocol (retailer)	
0034 Customer accessing meter box verification	
0035 Meter type validation (National Meter ID or NMI)	
0036 Meter energisation status verification	
0037 Connection point verification	

No.: 2	***Ref No: 2***	***Current Risk:***	***5.88E-05***	***Predicted Risk***

Risk: ***Risk to public safety from loss of control during de-energisation activities***

		%	*Risk*	*Criticality*
Causal Pathway	**Firmware / software fault**	0	0.00E+00	NA

Programming error

Control

0009 QA testing

0010 System security (meter / server / software)

Upgrade error

Control

0009 QA testing

0010 System security (meter / server / software)

		%	*Risk*	*Criticality*
Causal Pathway	**System fault**	0	0.00E+00	NA

Insulation failure (short)

Control

0023 Insulation standards

0022 Meter design & reliability

Meter failure

Control

0008 Manual field work order process (inc verification) and site visit procedures

0022 Meter design & reliability

Meter operating hazard (EMI etc.)

Control

0022 Meter design & reliability

		%	*Risk*	*Criticality*
Causal Pathway	**Dwelling hazards**	0	0.00E+00	NA

Ignition source exist

Control

0040 Retailer script	Critical

Exposed wires

Control

0040 Retailer script	Critical

		%	*Risk*	*Criticality*
Outcome Pathway	**Electricity contact**	0	0.00E+00	NA

Fatality

Control

0011 Residual Current Device

0012 Emergency services

0014 Fuse

0013 Electrical supply isolation procedure

No.: 2	Ref No: 2	Current Risk:	5.88E-05	Predicted Risk

Risk: ***Risk to public safety from loss of control during de-energisation activities***

	%	Risk	Criticality
Outcome Pathway **Fire**	0	0.00E+00	NA

Fatality

Control

0011 Residual Current Device

0015 Meter condition check (conditions check, current flow check, comparison threshold & action) Potential

0012 Emergency services

0014 Fuse

0030 Fire detection

0041 Smoke alarm

0042 Egress escape

	%	Risk	Criticality
Outcome Pathway **Life support failure**	0	0.00E+00	NA

Fatality

Control

0018 Uninterrupted power supply (continuality of supply not guaranteed)

0016 Communication procedure and escalation / follow up protocol

0012 Emergency services

0017 Social support

0043 Time of day specified

	%	Risk	Criticality
Outcome Pathway **Internal carriage failure**	0	0.00E+00	NA

Injury

Control

0012 Emergency services

0027 Carriage design

0044 Return to floor function

0017 Social support

	%	Risk	Criticality
Outcome Pathway **Gas explosion**	0	0.00E+00	NA

Fatality

Control

0024 Gas fitting standards

0025 Gas detection

0026 Extended disconnect period protocols

	%	Risk	Criticality
Outcome Pathway **Customer security system failure**	0	0.00E+00	NA

Injury

Control

0012 Emergency services

0017 Social support

No.: 2	***Ref No: 2***	***Current Risk:***	***5.88E-05***	***Predicted Risk***
Risk:	***Risk to public safety from loss of control during de-energisation activities***			

	%	*Risk*	*Criticality*
Outcome Pathway **Heating, Ventilation, Air**	0	0.00E+00	NA

Fatality

Control

0012 Emergency services

0017 Social support

0031 Limit de-energisation transactions on extreme weather

Appendix E – Workshop Participants

GHD

AUSTRALIAN ENERGY COUNCIL

ATTENDANCE LIST

Project:	Australian Energy Council – Smart Meter Risk Assessment	**Job No:** 91/10475
Workshop/Study:	Smart Meter Risk Assessment	
Location:	AGL Offices, 699 Bourke Street, Melbourne VIC 3008	
Date:	3rd October 2017	

Name	Position/Role	Department/ Company	Years' Experience	Contact Number
MARK ANDREW	FACILITATOR	GHD	30	0419183113
RACHEL CHONG	SCO-FACILITATOR	GHD	4	0432274775
DARREN BAILEY	METER OPERATIONS	ORIGIN	15	0410441243
Joe Cardellino	Ind & Net Manager	Origin	5	0459881285
DOUG ROSS	METER PROVIDER	VECTOR.	25.	0417205395
ROBERT LoGIUDICE	MANAGER. MC OPERATIONS	ACUMEN	20	0419 539638
RAJESH TRIPATHY	HSEQ	EA	20	0424756286
AAKASH SEMBEY	INDUSTRY OPS	SIMPLY	10	0418415313
Balwant Singh	Engineering manager.	Active Stream	22	0439060166
FATIMA DIZON	CONNECTIONS LEAD	AGL	10	
CHRIS BOER	CTO	METROPOLIS	12	0416164735

ATTENDANCE LIST

Project:	Australian Energy Council – Smart Meter Risk Assessment	**Job No:** 91/10475	
Workshop/Study:	Smart Meter Risk Assessment		
Location:	Origin Energy's Office, 321 Exhibition Street, Melbourne VIC 3000		
Date:	4th October 2017		

Name	Position/Role	Department/ Company	Years' Experience	Contact Number
MARK ANDREW	FACILITATOR	GHD	30	0419 183 113
Balwant Singh	Engineering manager	Active Stream	22	0439060166
RESBERT LOGIUDICE	MANAGER MC/OPERATIONS	ACUMEN METERING	25	0414 539 638
RAJESH TRIPATHY	HSEQ Sp.	EA	20	0424756286
DOUG ROSS	MARKET DEV. MAN	VECTOR	25	0417 205 395
AAKASH SEMBEY	INDUSTRY OPS	SIMPLY ENERGY	10	0418415313
FATIMA DIZON	CONNECTIONS LEAD	AGL	10	
Jude Cozzolino	INDUSTRY NETWORKS	ORIGIN	5	0459881265
RACHEL CHONG	CO-FACILITATOR	GHD	4	0433344775

Biography of Participants

Name	Biography
Robert Lo Giudice Manager, Metering Coordinator & Operations – Acumen Metering	Rob has 20 years' experience in the energy industry. Operated in the capacity of the LNSP/RP for 15 years with a Victorian based Network Business and heavily involved in the roll out of Victorian AMI meters. More recently – RP for Origin Energy for 2 years and currently the Manager - Metering Coordinator & Operations for Acumen metering encompassing MC & MPB responsibilities. Regardless of the office held Rob has been a consistent representative on Industry Forums for a wide variety of industry sensitive topics.
Chris Boek Chief Technology Officer - Metropolis	Chris Boek is a founder and CTO of Metropolis Metering. Chris has degrees in Electrical and Electronic Engineering and in Computer Science. Since commencing metering installations in 2007, Chris has been directly involved with meter installation processes and field scenarios during the last ten years. He has a deep understanding of the capabilities of modern meters, having worked closely with meter manufacturers on their protocols, and was the chief designer and developer of Metropolis' head end system for reading meters. He currently oversees all technological development at Metropolis and is responsible for ensuring that Metropolis is up to date with modern technological progress both with software and systems, and the meters and communication devices that are deployed.
Joe Castellano Manager, Industry & Network Relations – Origin Energy	Joe has 5 years' experience and worked on the VIC AMI rollout for Jemena Electricity Networks. This included working with customers to ensure installation of AMI meters. Joe managed the remote services on-boarding for Jemena Electricity Networks. This included the set-up of 19 Retailers in the Network. Joe has experience on both the Network and Retailer side of the provision of remote services. Joe has also been Industry representative for Origin during the Power of Choice program.
Paul Atkins Lead Business Consultant – Vector Advanced Metering Services	Paul has 17 years of energy industry experience including energy market reconciliation, retail service design, key account management and 12 years in energy metering infrastructure and services. As solution manager and product development manager Paul was instrumental in the concept, design and implementation of Vector's advanced metering services in 1 million homes and businesses across New Zealand and for the advanced metering service designs implemented for Australia.
Balwant Singh Metering Asset & Engineering Manager – Active Stream	Subject matter expert on metrology, installation, testing and commissioning of all metering equipment as they relate to Advance Metering Infrastructure and metering types 1 to 7 within the National Electricity Market. Held engineering leadership roles in various companies over the last 20 plus years. Have been part of Active Stream journey from start in Feb 2015. Got MP accreditation/ build systems / processes / metering solutions and services and lead the team as part of Active Stream leadership team from being 0 metering business to become the largest type 4 metering business in NEM. Have successfully lead the business as part of Active Stream leadership team and became the first accredited MC / MP and MDP business in NEM ahead of Power of Choice (PoC) changes starting 1st Dec 2017.

Name	Biography
	Current nominated Australian Energy Council (AEC) representative in EL-011 Standards Australia committee. Nominated as Active Stream MP in NEM and accountable to support and maintain MP accreditation. Metering domain expert in metering and related field work within AGL and Active Stream. Formulation of action & remediation plans and associated Project Management (including statistical analysis and reporting). Monitor and manage the team to meet business performance & service levels. Assisting the business in meeting the regulatory compliance obligations associated with meter asset management and to achieve its AEMO MPB Metering obligations on behalf of the Responsible Persons, stakeholders and customers. Business owner of creation of “Smart Meter” programs. Testing, validation and deployment strategy of issuing those programs. Planning and deploying advance metering technologies in AusNet Services Distribution Network. Help Smart Networks, Corporate Strategy and Business Development divisions in developing Smart Network strategy, roadmaps, plans and documentation. Asset strategy for electricity metering. Broad industry knowledge, regulatory framework and business model (regulated and non-regulated revenue). Thorough technical knowledge of electricity metering. Write specifications / business processes and technical documents. Technical evaluation of vendors and review industry documents. Create AMI trials test methodology, scope & test scripts. Provide input for strategic AMI meter deployment planning. Vendor liaison. Evaluate multi-utility meter reading solution. Knowledge of various Advance Infrastructure Metering technologies (e.g. WiMax/3G/RF Mesh/ others). Hands on experience in SAP-ISU, GridNet WiMax based MMS solution PolicyNet. Evaluate multi-utility meter reading solution. Data collection, validation and delivery for settlement purposes as per the obligations defined by the relevant Market Rules and Metering Code(s). Exception handling & Diagnosis of Communication faults. Settlement extracts as per the AEMO requirements as defined by the relevant Market Rules. Ensure that market and business objectives are met. Project management activities including conceiving, planning, scheduling & meeting critical milestones of the project. Establish priorities, coordinate resources, monitor project status & report progress of project. Customer Management, Team Management & responsible for process compliance. Analyse technical feasibility of the project & monitor technical component of project management work. Monitor market trends & evaluate suitability for metering services business to the utilities. Tendering activities, preparing quotations, making comparative statements and associated work. Looking after Dealer network for promotion of metering solutions. Products included electronic energy meters, field calibrators, hand held meter reading instruments, voltmeters, ammeters, maximum demand controller, software solutions for energy monitoring and management. Institutional sales of metering products, major electricity boards in India were the target customers. Acquire new accounts, maintain existing clients and monitor customer satisfaction.

Name	Biography
	Energy accounting, auditing techniques for conservation of energy. Calculation of energy losses (technical & non-technical). Power quality analysis at various distribution levels (w.r.t voltage, current, power factor energy etc.). Checking efficiency of electrical machines w.r.t rating, losses etc. identify responsible factors & remedies for system improvement. Testing & Calibration of measuring instruments (Energy meters, volt meters, ammeter, portable energy calibrators, CT's & PT's at site. Preventive / breakdown repair & maintenance of metering panels at various substations and consumer sites. Installation and commissioning of metering panels at customer sites including wiring, testing and final commissioning.
Doug Ross Market Development Manager – Vector Advanced Metering Services	Doug is currently responsible for managing Vector's engagement activities in the Australian competitive metering market leading up to the commencement of the Power of Choice reforms in the NEM on the 1st of December 2017. This has included engagements with, Government, Regulators, Retailers and Networks to ensure the emergence of a market and regulatory environment that supports the development of an effective competitive metering market for the deployment of advanced meters to residential customers in the NEM. Doug has been instrumental in the initiation in 2015 of the Standards Australia Road Map for Advanced Meters which has resulted in the reconstitution of the Standards Australia Committee for Metering Equipment (EL-011) of which Doug is a member. Doug has also authored and obtained industry support for Standards Project proposals for modified adoption of the new IEC Metering Safety Standard (IEC 62052-31) and the review of the complete suite of Australian standards identified as priority 1 in the Road Map for Advanced Meters (IEC 62052-11 & 21 and IEC 62053-21, 22, 23, & 24). Doug is currently authoring the project proposals for the priority 2 standards identified in the Road Map for Advanced Meters. Doug has also been instrumental in the creation of the Competitive Metering Industry Group (CMIG) whose members are all ten (10) of the Metering Service providers participating in the NEM. The objective of the CMIG is to develop technical standards to support the Australian Metering Industry. Doug currently chairs the CMIG and also Chairs a CMIG working group developing an Industry Code of Practice for the Safe Installation of whole current meters. Doug also represents CMIG on an Australian Energy Council (AEC), working group developing and Industry Code of Practice for the delivery of remote services on Advanced Meters (remote de-energisation and re-energisation). Doug is also a member of the AEC's Technology Working Group. Prior to joining Vector in 2013, Doug was Managing Director of EDMI Australasia for 9 years. During his time as Management Director, Doug held directorships for EDMI's 3 trading companies in Australasia, being, EDMI Pty Ltd, EDMI Gas Pty Ltd and EDMI NZ Limited which jointly contained 160 staff with annual revenue of AUD 60 million. Doug has more than 30 years of energy industry experience and extensive metering knowledge accumulated from prior executive and management roles with Australian utilities and energy metering companies. Doug holds a Master of Business Administration from Deakin University in Australia which complements an Associate Diploma in Electrical and Electronic Engineering from the University of Southern Queensland. Doug is also a licensed electrical contractor and is a Director,

Name	Biography
	business representative and technical representative for his own Electrical contracting and consulting business.
Darren Baily Manager Metering Operations – Origin Energy	While at Origin Energy Darren has been Responsible for the effective management of Network Relationships and Industry Development to deliver successful outcomes for both customers and Origin. Darren has lead Origin's Industry Development through AEMO working groups Power of Choice, NSW/ACT B2B. he has also managed process and compliance of B2B procedures Darren was also manager of Retailer Relationships for Jemena Elec and Gas, United Energy and Multinet. Management of Customer Relations team resolving escalated customer issues (Elec, Gas and AMI Roll Out) and Ombudsman investigations.
Rajesh Tripathy HSEQ Metering Services – Energy Australia	Rajesh Tripathy is a Safety, Environment & Risk management leader with a combined experience of more than 15 years in these disciplines. He has qualifications in safety & engineering and has worked for Australian companies in the industries of Construction, Infrastructure, Building, Engineering, Asset Management, Telecom, Energy and Rail. He has successfully implemented projects in safety culture & governance, safety improvement, safety leadership and sustainability awareness. Rajesh has had extensive experience in stakeholder engagement with Regulators (Worksafe, ESV, ONRSR and EPA), Clients, Union Reps, Contractors and Line Managers to resolve complex risk management and safety issues.
Aakash Sembey Industry Operations Lead – Simply Energy	Aakash Sembey is an Industry Operations specialist and an active voted Retailer member of the B2B Working Group, representing electricity retailers in various industry-based forums. After spending over a decade working in the utility industry, Aakash has developed subject matter expertise in retail operations' functions, with a key focus on end-to-end implementation of regulatory-based projects. He has been involved in some of the major projects across various retailers, including National Energy Consumer Framework and more recently on Power of Choice reforms. Aakash holds a Bachelor's degree in Electronics & Communication Engineering and Master's in Information Technology & Management from Swinburne University of Technology, Melbourne.
Fatima Dizon Senior Operational Analyst – AGL Energy	Fatima has been working in the utility industry (AGL) for about 10 years, with majority of my involvement in retail sector – currently working in AGL as a Connections Lead. My expertise lies in B2B and B2M processes, including consumer connection life-cycle for residential and large customers. In addition to day-to-day operations, I have been actively involved in major projects across the electricity and gas industry, leading various streams, including Power of Choice (metering competition), WA Gas, NSW Gas Reforms, etc. I hold a Bachelor's degree in Economics and my key interests lies in the development of energy sector.

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Rev. No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Draft	R. Chong	M. Andrew	*Original signed	H. Reynolds	*Original signed	12/10/2017
Final	R. Chong	M. Andrew		H. Reynolds		12/01/2018

GHD Advisory

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