Security and Reliability Council

Further development of the SRC's risk management framework

Using a bowtie method to record and assess potential risk events

15 March 2016

Note: This paper has been prepared for the purpose of discussion. Content should not be interpreted as representing the views or policy of the Electricity Authority.

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Executive summary

The function of the Security and Reliability Council (SRC) is to provide independent advice to the Electricity Authority (Authority) on the performance of the electricity system and the system operator, and reliability of supply issues. The SRC has considered the structures through which the electricity industry manages supply reliability risks and how it might use a risk management framework (RMF) to assist it in identifying, understanding, communicating and advising on significant security and reliability risks.

The SRC has considered, at a conceptual level, how the use of a RMF could assist the SRC in undertaking its monitoring role and provide benefits through its application in the broader risk management process. For example, the RMF could improve the communications between risk owners and stakeholders and allow risks arising from multiple triggers to become more visible.

The SRC has discussed criteria for probability and consequence of identified risks which has enabled the SRC to better define and prioritise the security and reliability risks that fall within its terms of reference. Risks that are identified as high priority are now able to be assessed using a bowtie approach.

This paper provides:

- a summary of progress on the development of the RMF demonstration model
- the criteria for filtering and assessing risk priority developed following the RMF workshop at the 22 October 2015 SRC meeting
- examples of how the bowtie approach is applied in the RMF
- questions for the SRC to consider.

1 Introduction

1.1 The purpose of this paper is to provide a demonstration of the RMF

- 1.1.1 The SRC has been considering the potential value that a RMF could provide for its role as advisor to the Electricity Authority on security and reliability matters.
- 1.1.2 This paper demonstrates the RMF that has been developed on the basis of the discussions with the SRC to-date, and provides an opportunity for the SRC to review the input assumptions and the output bowtie briefing sheets for a sample of security and reliability risk events.
- 1.1.3 The paper concludes with some questions that the secretariat intends should clearly identify the next steps for the RMF.

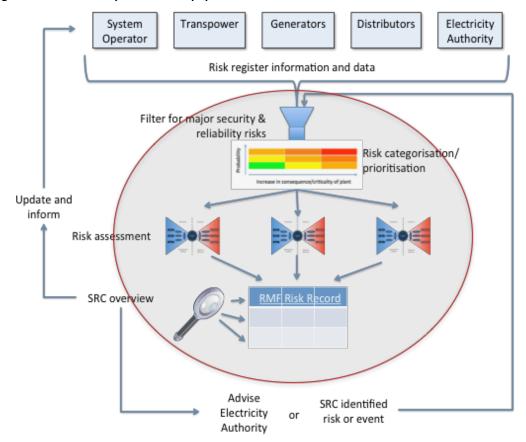
1.2 This paper builds on previous papers, workshop and discussions

- 1.2.1 On 1 July 2015, the SRC discussed the concept of a framework through which material security and reliability risks and their management could be made more visible.
- 1.2.2 The SRC agreed that there is potentially some value in a RMF for the group, and discussed:
 - establishing processes that facilitate a meaningful SRC discussion at an appropriately high level
 - b) ensuring that the next development steps stay small and exploratory at this stage
 - the potential for the RMF to become big and bureaucratic if it was not appropriately managed, with the risk of it creating unwarranted cost on the industry (particularly in terms of data collection)
 - d) the need to trust that individual risk owners will appropriately manage their own risks.
- 1.2.3 The Authority considers¹ that, consistent with the international standard ISO 31000, risk management processes should:
 - a) identify potential risks
 - b) assess the probability and impact of an identified risk
 - c) rank the priority of identified risks
 - d) form and implement plans to control or mitigate identified risks.
- 1.2.4 At the 22 October 2015 SRC meeting, a workshop session was held to consider metrics that will be used to identify, assess, prioritise and monitor control of security and reliability-related risks.
- 1.2.5 Consistent with the SRC's guidance, the next steps in the development of the RMF are to:
 - a) establish criteria through which identified risks can be prioritised
 - b) using a sample of identified risks, demonstrate how the bowtie approach can be used to monitor the management of individual risks
 - c) assess the steps and potential costs required to fully develop the RMF.

Report on the inquiry conducted by the Electricity Authority on the Penrose substation fire 5 October 2014, paragraph 5.28 https://www.ea.govt.nz/dmsdocument/20148

1.2.6 The highlighted part in Figure 1 indicates the specific RMF development areas that this paper addresses. Section 2 of this paper deals with the prioritisation of risks. Section 3 deals with demonstrating the risk assessment stage using the 'bowtie' method.

Figure 1 - RMF development in this paper



1.3 The SRC provided guidance on risk filtering and prioritisation metrics for the RMF

- 1.3.1 During the 22 October session the SRC provided its views on metrics that could be used to categorise risks. These views have been used to guide the development of criteria for use in the filtering and prioritisation of identified risks.
- 1.3.2 The responses and views given by SRC members at the 22 October 2015 workshop session have been distilled to the following key points:
 - a) the SRC should act both proactively (prior to an event occurring) and reactively (post event) when considering risks
 - b) economic cost to consumers is the most important criteria
 - c) impact on the system was the next highest ranked metric. System event risks were ranked in an order that seems to reflect economic cost to consumers, as follows:
 - i) North or South Island outage
 - ii) extended outage of a major city CBD
 - iii) loss of major industrial load for 2 days or longer
 - iv) loss of supply to a residential area for 2 days or longer

- loss of supply to a rural area for 2 days or longer
- risks of frequently occurring events are considered as higher priority than those that may lead to rare major events. Accordingly, systemic factors with the potential to cause multiple events should be taken into account with an elevated weighting
- e) risks of total system events are considered as higher priority than component-specific risks (e.g. transformer failure). A criterion relating to an extended reserve activation has therefore been added to those identified at the workshop session.

1.4 Workshop outputs have helped create a list of identified risk events

- 1.4.1 The output from the workshop has been used as guidance to produce a non-exhaustive list of 'risk events' that are within the SRC's terms of reference and should be included in the RMF. Even if an apparently exhaustive list is produced in the future, it will be important that the identified risk events are periodically reviewed to ensure the list remains complete.
- 1.4.2 As the SRC noted the need to take into account the frequency with which related events may occur, a criterion to account for multiple related events has been included for extended reserve events and long duration residential outages. These categories of risk events can be due to potentially systemic factors that, for example, can occur in risk management systems, asset health monitoring and maintenance practices, network design and regulatory incentives and controls.
- 1.4.3 Table 1 provides the risk events identified for inclusion in the RMF.

Table 1 - Risk events identified to be within the SRC's terms of reference

Identified risk events
North and/or South Island outage
Major CBD outage
2 or more extended reserve activations within a 2 year period
Extended reserve activation
Extended period of conservation measures implemented due to failure of supply to meet demand
Short period of conservation measures implemented due to failure of supply to meet demand
Loss of major industrial load 5 days or longer
3 or more events within a 1 year period of loss of supply to a residential area of >100,000 ICPs for 3 days or longer
Loss of supply to a residential area of > 100,000 ICPs for 3 days or longer
Loss of supply to a rural area > 30,000 ICPs for 5 days or longer

1.4.4 The next step in the RMF process is to consider the probability of an identified risk event occurring and the likely consequences if it does.

2 The metrics have been developed into criteria

- 2.1.1 In previous discussions on the RMF, the SRC has considered Transpower's, and other electricity network business' approaches to prioritising risks. At a high level, it was found to be common practice to consider risk events on the basis of probability and consequence (and/or criticality). The potential causes of supply security and reliability risk can be numerous so the criteria for prioritising risk in the RMF have been set at a high level (risk event). Criteria are applied using a simple probability/consequence assessment.
- 2.1.2 The SRC's guidance summarised in paragraph 1.3.2 have assisted the secretariat in developing criteria for assessing the probability and consequence of risk events. These criteria are set out in Table 2 below.

Table 2 - Criteria for assessing probability and consequence

Probability of occurrence						
Very Low	Less often than once in every 50 years					
Low	Between once in every 25 years and 50 years					
Medium	Between once in every 10 years and 25 years					
High	Between once in every 5 years and 10 years					
Very High	More often than once every 5 years					
Consequence of o	ccurrence					
Extreme	Potential loss of life, major economic impact, NZ and industry serious reputation damage, political intervention and scrutiny of the industry, government initiated inquiry					
High	Major economic impact, industry reputation damage, potential government initiated inquiry					
Medium	Material economic impact, potential industry reputation damage					
Low	Some economic impact, inconvenience to consumers, erosion of consumer confidence					
Very Low	Low economic impact, inconvenience to relatively small group of consumers					

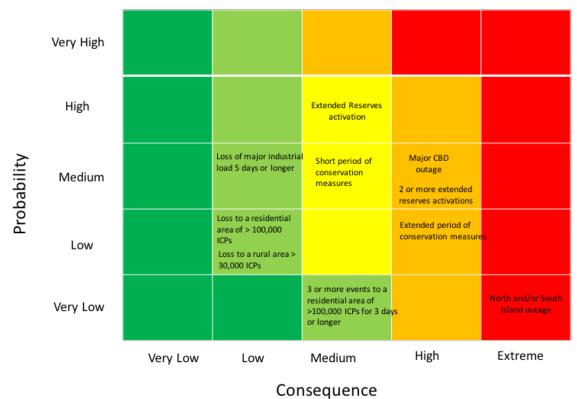
2.1.3 The probability and consequence criteria have been applied to each of the identified risk events. To apply the criteria for each risk event, actual historical events and design parameters (e.g. reliability standards) were taken into account. However, the application of the criteria, to an extent, relies on judgement.

Table 3 – Probability and consequence assessment of identified risk events

Risk event	Probability	Consequence
North and/or South Island outage	Very Low	Extreme
Major CBD outage	Medium	High
2 or more extended reserve activations within a 2 year period	Medium	High
Extended period of conservation measures implemented due to failure of supply to meet demand	Low	High
Extended reserve activation	High	Medium
Short period of conservation measures implemented due to failure of supply to meet demand	Medium	Medium
Loss of major industrial load 5 days or longer	Medium	Low
3 or more events within a 1 year period of loss of supply to a residential area of >100,000 ICPs for 3 days or longer	Very Low	Medium
Loss of supply to a residential area of > 100,000 ICPs for 3 days or longer	Low	Low
Loss of supply to a rural area > 30,000 ICPs for 5 days or longer	Low	Low

2.1.4 Figure 2 below illustrates the assessment from Table 3 when mapped onto a matrix of possible assessments. The colour coding in Figure 2 determines the overall prioritisation, and is another decision involved in the RMF where some subjectivity exists.

Figure 2 – RMF risk event prioritisation matrix



- 2.1.5 Table 4 below shows the risk events in a risk prioritisation table. The reasons for prioritisation are that higher-rated risk events can be assessed first, reassessed more frequently, and to give the SRC and its stakeholders with a clear understanding of what the SRC sees as its primary areas of focus. Prioritisation could also assist the SRC and the secretariat to establish a forward programme for the SRC's review of security and reliability risks.
- 2.1.6 Risk events that fall in the 'other risks' prioritisation category (dark green) are unlikely to ever warrant detailed risk assessment by the SRC. However, the SRC could make exceptions to this, especially if it is confident such an exception will not detract from its oversight of higher priority risks.

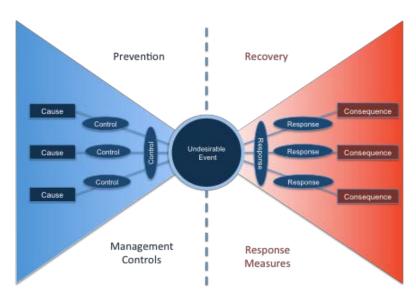
Table 4 - Prioritisation of identified risk events

Priority 1	North and/or South Island outage
	2 or more extended reserves activations within a 2 year period
Priority 2	Major CBD outage
	Extended period of conservation measures implemented due to failure of supply to meet demand
	Extended reserves activation
Priority 3	Short period of conservation measures implemented due to failure of supply to meet demand
	3 or more events within a 1 year period of loss of supply to a residential area of >100,000 ICPs for 3 days or longer
	Loss of supply to a residential area of >100,000 ICPS for 3 days or longer
Priority 4	Loss of major industrial load 5 days or longer
	Loss of supply to a rural area > 30,000 ICPs for 5 days or longer
Other risks	All risks below priority 4 are considered to be outside the terms of reference of the SRC by default, unless an exception is made.

3 The bowtie risk assessment method has been used for a sample of risk events

- 3.1.1 The final stage in establishing the demonstration RMF has been to populate a bowtie briefing sheet for a selection of identified risk events.
- 3.1.2 Figure 3 below shows an archetype structure of a generic bowtie briefing sheet.

Figure 3 – An archetype structure of a bowtie briefing sheet



Cause/scenario	Individual control	Group control	ole	Group response	Individual response	Consequence
			Undesira Event			
			_			

- 3.1.3 A classic bowtie revolves around a hazard which has the potential to cause damage or harm, and the top event which describes an undesired system state. In the SRC bowtie the hazard and top event have been collectively called 'the undesirable event'.
- 3.1.4 The bowtie model records the:
 - a) threats, which are possible direct cause for the undesirable event
 - b) controls, which are actions that can be applied to mitigate or eliminate the threat
 - c) consequences, which are the loss or damage resulting if the undesirable event occurs
 - d) responses, which are the measures which reduce the likelihood or mitigate the severity of the consequence arising from the undesirable event.
- 3.1.5 When interpreting a bowtie, it is useful to know that:
 - a) individual controls are linked to individual threats
 - b) individual responses are linked to individual consequences

- individual threats are not necessarily linked to individual consequences
- group controls apply to some or all of the individual threats d)
- group responses apply to some or all of the individual threats.
- 3.1.6 A range of proprietary bowtie software, apps and databases are available to be used for creating bowtie briefing sheets. However, until the extent of the information that will need to be held on the SRC's RMF is known, an Excel workbook has been used to demonstrate how the bowtie assessment can be applied to the identified risk events. This is discussed further in section 3.3.

3.2 Of the ten risk events listed, four bowtie briefing sheets have been produced

- 3.2.1 To enable the SRC to consider how it might use the RMF and its value to the SRC's role, the secretariat has populated four bowtie briefing sheets. The four briefing sheets have one risk event from each of the four priority levels. At this stage, the research and assessment has been limited to publically available information and the briefing sheets will require much more work should RMF be developed further.
- 3.2.2 The four briefing sheets appear in Appendix A.
- 3.2.3 Any SRC members who would prefer to view these briefing sheets in Microsoft Excel should contact the secretariat to request a soft copy.

The presentation of bowtie briefing sheets could be further developed 3.3

- 3.3.1 The secretariat has undertaken preliminary research on the type of risk management systems that are available. The research found that:
 - a range of systems exist from very detailed and complex models for providing very detailed systems analysis of complex processes to relatively simple and basic options that provide a basic risk identification and assessment framework
 - the complex systems hold more information than the SRC is expected to require and would be 'data hungry' and expensive to implement and maintain
 - the simpler models provide a lower cost option and would be relatively simple to populate and maintain, although these models can be quite rigid in design and difficult to adapt to specific requirements.
- 3.3.2 Transpower, including the system operator, is currently reviewing its risk management process which includes the bowtie approach. The Authority is keen to identify areas for synergies between its processes and those of the system operator. Aligning the RMF with the system operator's process is likely to realise synergy benefits.
- 3.3.3 Similarly, the better the SRC's RMF aligns with standard industry practice the lower the costs involved would be if the SRC were to decide that sourcing some risks (and their assessments) from participants is desirable.
- 3.3.4 The secretariat will continue to assess how best to manage and present the RMF's bowtie risk assessment.

4 Questions for the SRC to consider

- 4.1.1 The SRC is asked to consider the following questions for discussion at its 15 March 2016 meeting.
- Q1. Does the SRC consider the identified risk events (Table 1) are set at an appropriately high level? Are there any modifications or additions the SRC would like to make to this list at this time?
- Q2. Does the SRC consider the criteria for assessing probability and consequence of the risk events (Table 2) are appropriate?
- Q3. Does the SRC consider that the criteria have been applied correctly to each risk event in Table 3?
- Q4. Does the SRC consider that the risk event prioritisation method (the colour-coding in Figure 2) is appropriate?
- Q5. Does the SRC consider that the format and presentation of the bowtie briefing sheets is adequate in the short-term?
- Q6. Does the SRC consider that the bowtie briefing sheets will be a useful way of presenting the components that form the current management of risk events?
- Q7. Does the SRC consider that the bowtie briefing sheets will be a useful method of identifying omissions and gaps in the current management of risk events?
- Q8. Does the SRC consider that the information contained in the bowtie briefing sheets is at an appropriate level of detail or should additional detail be added?
- Q9. Overall, does the SRC consider that the continued development of the RMF is likely to be of worthwhile benefit to the SRC?
- Q10. What further information, if any, does the SRC wish to have provided to it by the secretariat?
- What advice, if any, does the SRC wish to provide to the Authority? Q11.

Appendix A: Bowtie briefing sheets

Priority 1 Bowtie assessment

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May provide generator back up supply							
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Other response Other consequence Other consequence	Other						Oth
	Otner cause	Otner individual response				Other response	Otner consequence

Priority 2 Bowtie assessment

Threat (cause/scenario)	Individual control	Group control	Undesirable Event	Group response	Individual response	Consequence
Energy storage in South Island hydro lakes at	• • •	Electricity Authority		System operator	Public information campaign	Risks of a fatality or serious injury to members
	The Authority publishes the standing reserve	Security of supply policy framework		Implement the emergency management policy (EMP)	<who and="" how?=""></who>	of the public increases - e.g. medically
rainfall,	supply determination to ensure continued access	Specifies the system operator's security of supply functions and		Increased monitoring of hydro storage levels		dependent consumers may be affected as
(Risk of shortage (as assessed under the SOSFIP) exceeds 10% and is forecast to	to hydro lakes at a trigger point that reflects the original expectations of the consenting authorities.	how they are to be performed and reported on • Security and Reliability Council to provide independent advice to us		by system operator and generators	Emergency and back-up generation	duration of outage is likely to be longer than
continue to do so for at least one week.)	original expectations of the consenting authorities.	on the performance of the electricity system, the performance of the		Official consequation campaigns	Emergency and back up generation is considered for use and if appropriate, connected and operated. by whom and how>	
Upper North Island peak demand at record		system operator, and reliability of supply issues		Official conservation campaigns System operator calls on New Zealanders to voluntarily	in appropriate, connected and operated. Sby whom and now	equipment.
levels for extended daytime periods due to		system operator, and renability of supply issues		reduce their electricity usage.	Consumers having difficulty	
high use of air conditioning		security of supply forecasting and information policy		The system operator may declare an official conservation		
0		, , , , , , , , , , , , , , , , , , ,		campaign in respect of the South Island only, or all of New		
				Zealand.	distributors	
					Issues with critical electrical medical equipment - contact	
				Public information campaign	health professional, community support or emergency	
				<who and="" how?=""></who>	services	
				Customer compensation scheme		
				When an official conservation campaign is in force,		
Availability of region specific generation (e.g.	Reserve Sunnly Determination	Probability of an event is significantly reduced by market price signals		retailers are required to compensate qualifying	Electricity distributors	Consumers lose benefits of electricity supply
North Island hydro) is limited.	The Authority publishes the standing reserve	and incentives on participants through customer compensation		consumers in accordance with the customer compensation scheme	Operational management responding to event	leading to inconvenience and comfort. If the
	supply determination to ensure continued access	campaign		See retailer obligations under a customer compensation	Provides advice to its customers (e.g. electricity retailers)	event occurs in cold weather In winter the
the region is constrained (e.g. HVDC pole	to hydro lakes at a trigger point that reflects the			scheme	(-g,	effects on the elderly and young can be
outage, low South Island hydro storage)	original expectations of the consenting authorities.	Impact of outages reduced		Salience	Electricity distributors	severe.
Affected region's peak demand at record		Improved information and communications assists consumers to			Coordinate restoration including ensuring safety as supplies	
levels for extended daytime periods due to		better manage conservation period			are restored	Probable economic costs for consumers e.g.
high use of air conditioning						inability to cook at home may cause additional
		Improved management of the conservation leading to greater			Electricity retailers	cost to provide meals.
		responses to the conservation campaign .			Obtain information from the electricity distributor on outages	
					and forecast duration and pass this onto their customers - the	²
		Period of required conservation campaign likely to be shorter due to			communication medium will differ between retailers	
		swifter response and improved coordination.				
Limited region specific generation is limited		System operator		Rolling outages	Participant Rolling Outage Plans (PROP)	Consumers implement individual energy
	Wholesale prices provide a locational signal which	security of supply forecasting and information policy (SOSFIP)		Last resort measure in which the system operator is	Distribution networks, direct connect consumers implement	conservation initiatives
	indicates where and when opportunities exist for	an emergency management policy (EMP)		required to plan and implement compulsory electricity	PROPs	
thermal generation capacity constructed),	investment in generation.	system operator rolling outage plan (SOROP)		outages in order to prevent a complete system failure	Web-steed band over the state of the state o	
The region is experiencing voltage support	Hadas and fishings manifests are side languages.	Note the Electricity Authority approve or decline any SOSFIP, EMP or	Francisco de Composições	If the columbar continue of an official concernation	Voluntary load management	
issues during extended periods due to high energy transfers and limited generation	Hedge and futures markets provide longer term signals for generation investments.	SOROP that the system operator puts forward.	measures implemented due to	If the voluntary savings of an official conservation campaign are insufficient, then compulsory savings in the	Customers encouraged to undertake voluntary load shedding	
capacity within the region.	signals for generation investments.	System operator modeling and monitoring reduces risk of an event	i i	form of rolling outages may be required.	at peak demand times (by whom:>	
The region's peak demand is at record levels	Transmission infrastructure investment	through improved information to participants.	lunare or suppry to meet demand	Torri or rolling oddages may be required.	Use of backup and emergency generation	
for extended daytime periods due to high	Commerce Commission regulatory approval of	The second secon			Customers run existing backup and emergency generation.	
use of air conditioning	reliability investments through the GIT for	Probability of an event is significantly reduced by market price signals			Local emergency generation is sourced, connected and	
_	reliability investments.				operated during peak demand times. <by and="" how="" whom=""></by>	
		PROPs provide improved management of regional conservation				
	Energy and network price structures	efforts as rolling outage sequences are preplanned.				
	Time of use price structures for energy,					
	distribution and transmission provide incentives	Customer compensation scheme			<how be="" coordinated?="" media="" responses="" to="" will=""></how>	Media enquiries and questions intensify -
	for consumers to reduce demand at system peak	Incentives created through retailer obligations under a customer			Electricity Authority communications plan ??	media seeking an 'industry spokesperson' for
	times.	compensation scheme			System operator - technical systems spokes person < is there	
					a plan for this?>	emerge through unanswered questions.
		Wholesale market price incentives			Electricity Authority communications plan - relevant	Questions raised by government - opposition
		The wholesale electricity market provides price signals to participants			components implemented	begins strong questioning of the government
		to appropriately manage the balance of supply and demand.			<does a="" have="" role="" src="" the=""> System operator role in providing information on the status</does>	performance record on energy - calling for
		System operator applial security of supply assessment				neads to role and felolitis.
		System operator annual security of supply assessment Electricity Authority sets assumptions that the system operator must			of energy situation and system issues	
		use when preparing the annual security of supply assessment.			<now coordinated?="" is="" this=""></now>	
		The system operator may use alternative assumptions, though it must				
		always include an assessment against the Authority's assumptions.				
				Simultaneous conservation campaign and rolling	Electricity distributors	Lifeline organisations and systems may be
				outages	Operational management planning with lifeline organisations	
				In the event of catastrophic asset failure, it is possible	for responding to an event is implemented	Traffic control systems may not function
				that an official conservation campaign and rolling outages		Fuel supply systems may be adversely effected
				will be implemented simultaneously.	May provide generator back up supply	(e.g. pumps at petrol stations cannot operate)
					Other response	Other consequence
					- I - I - Coponico	The consequence
Other threat	Other control	Wholesale market price incentives			Other response	Other consequence
		The wholesale electricity market provides price signals to participants				
		to appropriately manage the balance of supply and demand.				

Priority 3 Bowtie assessment

Threat (cause/scenario)	Individual control	Group control	Undesirable Event	Group response	Individual response	Consequence
Loss of generation >500MW leads to	Generator performance	Part 8 Common Quality provision			Transpower (grid owner)	Consumers lose benefits of electricity supply
tripping of AUFLS block 1 - this could occur	The Code requires generators to remain	Part 8 relates to common quality. In particular, Part			Operational management responding to event	leading to inconvenience and comfort. As
under normal operating conditions or under	connected within the specified frequency limits	8 concerns the performance obligations of asset		Code provisions for restoration of supply	Provides advice to its customers who in turn	restoration of supplies is likely to be achieved
testing and commissioning of		owners, arrangements concerning ancillary		Clause 8.5 If an event disrupts the system	communicate with affected consumers on	within 60 minutes the impact on consumers
assets/systems		services, a process for procuring extended reserve,		operator's ability to comply with the	coping without power	will be limited.
		and technical codes.		principal performance obligations, the		
				system operator must act as a reasonable	Transpower (grid owner) and transmission	Extent of the outages will be broader if blocks
		System operator and asset owner principal		and prudent system operator to re-	customers	1 and 2 are activated .
		performance objectives		establish normal operation of the power		
		The Code requires that the system operator, grid		system as soon as possible		
Transmission equivalent to a loss of	Grid owner	owner and asset owners comply with their			Electricity distributors	Media enquiries and questions intensify -
>500MW leads to tripping of AUFLS block 1	- Grid owner is required to meet its AOPOs .	performance objectives as defined in the Code		System Operator	Operational management responding to event	media seeking information and an 'industry
this could occur under normal operating	Grid owner risk management practices aligned			Manages return to operation within	Provides advice to its customers (e.g. electricity	spokesperson' . Potential for reputation
conditions or under testing and	with ISO 31000	Code provisions for management of frequency		required frequency range:	retailers)	issues if information is not timely and
commissioning of assets/systems		(Part 8)		Communication and coordination with		questions remain unanswered.
		Part 8 provisions for the management of frequency		distribution networks and directly	Electricity distributors	
		Covering for the single larges credible event		connected loads	Coordinates restoration including ensuring	Extent of media attention will be greater if
Insufficient load tripped in block 1 during a	Extended reserves development	Clause 8.17 Contribution by injections to overall		System operator undertakes a post event	safety as supplies are restored	blocks 1 and 2 are activated .
response to an under frequency event	Move to 4 block scheme better matches load	frequency management		review		
leading to trip of block 2 with a resulting	trip with frequency event minimises economic	Clause 8.18 Contributions by purchasers to overall			Electricity retailers	
loss of supply to 1200MW of load	cost of an event	frequency management			Obtain information from the electricity	
		Clause 8.19 Contributions to frequency support in		SRC review of System Operator post	distributor on outages and forecast duration and	
		under-frequency events		event review report	pass this onto their customers - the	
		Clause 8.20 Contributions by grid owners to			communication medium will differ between	
		frequency support			retailers	
		Compliance monitoring			Consumers having difficulty	
		Clause 8.28 Responsibility for compliance			< what do they do?>	
		Each asset owner must comply with the asset			safety concerns with power system -	
		owner performance obligations and technical codes	Extended reserves (or AUFLS)		distributors	
		at all times	activation		Issues with critical electrical medical equipment	
					health professional or emergency services	
	,	Clause 8.27 System operator to monitor compliance		Communication with affected customers		Risks of a power outage related fatality or
event that leads to frequency fall below	Undertakes modelling, forecasting and planning	To the extent possible, given the information made		Electricity distribution networks use local	•	serious injury to members of the public
47Hz Insufficient load tripped during a	to ensure that sufficient extended reserves are	available by asset owners, the system operator		communication channels to provide		increases - e.g. medically dependent
response to an under frequency event		must monitor, in the manner set out in the policy				consumers may be affected, however the
leading to trip of block 2 with a resulting	The state of the s	statement, the ongoing compliance of asset owners		Electricity distribution networks inform	identified breaches of the Code.	duration of outage is likely to be within the
loss of supply to 1200MW of load	to arm feeders to provide the required schedule	with the asset owner performance obligations and		electricity retailers of affected customers		capability of backup features for critical
	load.	the technical codes		Electricity retailers communicate with	Asset owners	medical equipment.
				their affected customers	Relevant asset owners undertake reviews and if	
					appropriate notify the Authority of a breach of	
					the Code requirements	
Operation at RAFS at zero leads to	Reserves providers	System Operator security of supply Role		Electricity Authority	Electricity distributors	Lifeline organisations and systems may have
·	Are required under the Code to arm feeders to	Clause 8.15 Requirement for the system operator		May initiate an Code Compliance		temporary disruptions but the impact should
avoid frequency falling below 47Hz		to prepare and review system security forecast			organisations for responding to an event is	be manageable.
avoid frequency failing below 47 Hz	provide the required schedule lodd.	to prepare and review system security forecast			implemented	oc manageable.
		Extended reserves development and		of the system operator under the	·	The impact of the outages will be broader if
		implementation		provisions of the relevant service provider		blocks 1 and 2 are activated .
		Economic merit order of feeder arming resulting in		contracts		J. J
Insufficient load tripped in block 1 during a	Extended reserves development and	a lower economic cost of an extended reserves			Other response	Other consequence
response to an under frequency event	implementation	event		Has published guidelines for the		
leading to trip of block 2	Implementation of 4 block structure will more			management of medically dependent		
5 p	closely match arming of extended reserves to			consumers		
	requirement.			S. Sumers		
Follows of a country of	<u> </u>			Electricity Distributors and direct	Oth	Other
Failure of a critical component of the HVDC				connected loads	Other response	Other consequence
assets and/or control/protection systems	Must comply with AOPOs			Electricity distributors and directly		
	Risk management assessment should identify			connected loads cooperate with system		
	risks and eliminate or mitigate the potential			some seed rouge cooperate with system		
	causes of a critical component failure					

Priority 4 Bowtie assessment

Threat (cause/scenario)	Individual control	Group control	Undesirable Event	Group response	Individual response	Consequences
Major failure of a transmission asset	Transpower	Commerce Commission		Transpower (grid owner)	Electricity distributors	Risks of a fatality or serious injury to members
affecting Transpower's ability to provide the	Submission for Commerce Commission	Suppliers of electricity lines services are		Operational management	Provide safety communication through media	of the public increases - e.g. medically
required energy transfer capacity to a single	approval of grid investment proposals	subject to regulatory provisions under the		responding to event	and rapid response to safety related enquiries.	dependent consumers may be affected as
large and/or multiple small distribution	required to maintain reliability of supply	Commerce Act 1986. The relevant		Provides advice to its customers		duration of outage is likely to be longer than
networks.	Asset management practices that includes	components of the Commissions regulation		who in turn communicate with		capability of backup features on their
Examples include		of electricity lines businesses are:		affected consumers on coping		equipment.
failure and loss of a regional substation (e.g.		- information disclosure (e.g. asset		without power		
double transformer failure at Edgecombe in		management plans)		_ , , , , , ,		
2000)	falling and flying material during a storm	- price/quality (monitoring and		Transpower (grid owner) and		
loss of an important substation, for example		enforcement of reliability performance		transmission customers		
due to fire, subsidence, weather event,	responding to an event	SAIDI and SAIFI measures		Coordinate restoration including		
earthquake. flood etc. Failure of a major electricity distribution	Electricity distributors	- customised price path determinations for distribution businesses		ensuring safety as supplies are Government	Electricity distributor	Consumers lose benefits of electricity supply
asset (e.g. Penrose tunnel) that causes	Asset management practices aligned with ISO			Provisions to request an inquiry	Operational management responding to event	leading to inconvenience and comfort. If the
damage and failure to multiple assets (e.g.	55000 and good electricity industry practice -	Transnower		under section 18 of the Electricity	Provides advice to its customers (e.g. electricity	event occurs in cold weather In winter the
zone substations, cables or overhead lines)	including asset health monitoring and	- approval of major grid reliability		Industry Act 2010	retailers)	effects on the elderly and young can be
, , , , , , , , , , , , , , , , , , , ,	appropriate asset lifecycle management	investment projects				severe.
	Risk management practices aligned with	estiment projects			Electricity distributor	
	ISO:31000 and good electricity industry	Note that not consumer owned distributors			Coordinates restoration including ensuring	Probable economic costs for consumers e.g.
		are exempt from the price/quality			safety as supplies are restored	contents of freezers may be lost and inability
	Contingency planning - e.g. network	regulation.				to cook at home may cause additional cost to
	switching and interconnection plan to				Electricity retailers	provide meals.
	provide an alternative to the damaged				Obtain information from the electricity	
	subtransmission	industry associations			distributor on outages and forecast duration and	
	Operational management planning - for	Industry associations undertake researched			pass this onto their customers - the	
	responding to an event	and provide advice and guidance to the			communication medium will differ between	
		electricity industry.			retailers	
		Examples include:				
		ENA, EEA, CIGRE			Consumers having difficulty	
Systemic failure of critical distribution sub	Electricity distributors	-	Loss of supply to a residential		< what do they do?>	
transmission assets leading to loss of			area of >100,000 ICPS for 3 days		safety concerns with power system -	
capacity in multiple zone substations (e.g.	Asset management practices aligned with ISO 55000 and good electricity industry practice -		or longer		distributors Issues with critical electrical medical equipment -	
age related mode type failure of	including asset health monitoring and	medically dependent consumers			health professional or emergency services	
subtransmission cables)	appropriate asset lifecycle management	The Guideline articulates the Electricity Authority's expectations of electricity		Electricity distributors	Commerce Commission	Transpower or the electricity distributor is
For example systemic failures may become	Risk management practices aligned with	retailers in respect of medically dependent		Communicate with electricity	Investigations into specific breaches of quality	likely to breach its quality limits set under the
apparent following earthquakes and/or	ISO:31000 and good electricity industry	consumers. It represents a minimum		retailers and the community on the		Commerce Commission's price/quality
floods or extended periods of high	practice - including HILP risk assessment	standard that the Authority expects retailers		affect of the outage and forecast	Potential legal action for enforcement.	regulation,
temperature and high loading.	Contingency planning - e.g. network	to meet.		restoration times	, and the second	
	switching and interconnection plan to	The guideline includes expectations			Identifies potential actions to mitigate future	
	provide an alternative to the damaged	regarding the establishment of planning for		May have customer compensation	events	
	subtransmission	back up of critical electrical medical		schemes		
	Operational management planning - for	equipment during supply outages.				
	responding to an event	The guideline states that DHBs, private				
Serious weather event causing significant	Electricity distributors	hospitals and GPs should check that the		Electricity Authority	<how be="" coordinated?="" media="" responses="" to="" will=""></how>	Media enquiries and questions intensify -
damage to distribution networks	Asset management practices aligned with ISO	patient/caregiver has been informed of all		<no role??=""></no>	Electricity Authority communications plan ??	media seeking an 'industry spokesperson' for
	55000 and good electricity industry practice -	relevant aspects of using the critical			System operator - technical systems spokes	live interviews. Reputation issues beginning to
	including asset health monitoring and	electrical medical equipment.			person < is there a plan for this?>	emerge through unanswered questions.
	appropriate asset lifecycle management				'	5 5 1
	Risk management practices aligned with	Electricity distributors		Energy Safety	Electricity Authority communications plan ??	Questions raised by government - opposition
	ISO:31000 and good electricity industry	Set network planning criteria for their		May investigate if the event gives		begins strong questioning of the government
	practice - including HILP risk assessment	individual networks.		rise to or risks a death or injury.		performance record on energy - calling for
	Vegetation management - controls risks of	Network planning criteria generally define the level of redundancy (e.g. N-1) that is				heads to role and reforms.
	falling and flying material during a storm	provided for different load groups (size and				
	Operational management planning - for	importance)			Electricity distributors	Lifeline organisations and systems may be
	responding to an event				Operational management planning with lifeline	disrupted by the loss of electricity supply.
		Planning criteria is usually disclosed by			organisations for responding to an event is	Traffic control systems may not function
		electricity distributors in their published			implemented	Fuel supply systems may be adversely
		asset management plans			Provide advice to consumers on coping without	effected (e.g. pumps at petrol stations cannot
					power	operate)
					May provide generator back up supply Other response	Other consequence
					отпет георопос	Sandi consequence