

Reliability monitoring in the electricity sector

Advice to the SRC, to help it decide what
information it may wish to obtain

30 May 2014

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1 Purpose of this paper

- 1.1.1 The statutory functions of the Security and Reliability Council (SRC) include providing the Electricity Authority (Authority) with advice about reliability. In the process of carrying out this function, the SRC may wish to obtain information from the Authority and participants about their reliability monitoring activities.
- 1.1.2 The SRC has indicated that it wants to regularly receive information on the reliability of the power system in order to assist it to provide advice to the Authority on this topic. However, the SRC is unsure what information it should seek, with regard to reliability monitoring. In particular, it is unclear about the inter-organisational boundaries between the reliability monitoring activities carried out by the Authority and participants. Further, it is not yet confident that the industry is applying the learnings gained through reliability monitoring activities.
- 1.1.3 This paper provides a high level summary of the reliability monitoring activities that are carried out by the Authority and participants, and the arrangements that are made for applying the learnings gained from these activities.

2 Introduction

2.1 Background

- 2.1.1 A recurring theme in SRC discussions has been the role that the SRC should play in providing the Authority with advice about power system reliability, and the information it needs to do so. Previous advice to the SRC on this topic has included:
 - a) Supply Reliability Risk Management (May 2012)¹
 - b) The Electricity Authority's role in reliability (August 2012)²
 - c) Supply-side reliability – credible event data (August 2012)³
 - d) Reliability dashboard and reliability-centred monitoring (May 2013)⁴
 - e) Reliability-centred monitoring (February 2014)⁵
 - f) Transpower event review (February 2014).⁶
- 2.1.2 The SRC meeting on 25 February 2014 included an agenda item "Reliability centred monitoring". The SRC "discussed what its role should be with regard to event monitoring" and indicated that it needed "further information... to help it decide what its reporting needs are". It requested the "secretariat and Transpower to jointly prepare a paper to the SRC that describes inter-organisational boundaries, Transpower's top ten risks and the potential for reporting of historic events that may show common mode failures".
- 2.1.3 The usual definition of 'common mode failure' is "a single event which could lead to the simultaneous failure of several components". The secretariat and Transpower consider, and this paper assumes, that the SRC's request related not only to common mode failures but to *all events*

¹ <http://www.ea.govt.nz/dmsdocument/13011>

² <http://www.ea.govt.nz/dmsdocument/13602>

³ <http://www.ea.govt.nz/dmsdocument/13594>

⁴ <http://www.ea.govt.nz/dmsdocument/14892>

⁵ <http://www.ea.govt.nz/dmsdocument/18106>

⁶ <http://www.ea.govt.nz/dmsdocument/18107>

that have the potential to recur at another time and in another location. For example, if a component was observed to fail, this might suggest that more components of the same type might fail at other locations in the future.

2.2 The content and structure of this paper

2.2.1 The secretariat and Transpower have therefore prepared this paper, which describes the reliability monitoring activities taking place in the electricity industry, in order to assist the SRC to decide what information it may wish to obtain from participants and the Authority.

2.2.2 In this paper, ‘reliability monitoring activities’ is taken to include both:

- a) trend analysis to support reliability (i.e. using data from multiple events to identify risks⁷ that may lead to loss of load, and putting measures in place to mitigate the identified risks), and
- b) reliability event investigations (i.e. identifying the causes of an actual loss of load event, and drawing conclusions about what changes should be made in future).

2.2.3 The scope of this paper excludes the topics set out below in Table 1.

Table 1: Topics excluded from the scope of this paper

Topic excluded	Reason why excluded
Market-based and market-like arrangements to support reliability, including operating in the spot market, responding to directions from the system operator, procuring and providing ancillary services, and providing AUFLS	Each of these markets, and market-like arrangements, is a separate and largely self-contained topic in its own right
Security of supply monitoring, covering energy and capacity adequacy	Based on previous discussions, it seems that security of supply is a discrete area where information is regularly available that enables the SRC to provide the Authority with advice
Power quality monitoring	The focus of this paper is around the risk of lost load – poor power quality is not primarily manifested through lost load
Monitoring of the system operator’s performance	This paper focuses on the SRC’s first statutory function of providing advice to the Authority about reliability, rather than the SRC’s second statutory function of providing advice to the Authority about system operator performance
A list of Transpower’s top ten risks, as requested by the SRC at its February 2014 meeting	On reflection, Transpower and the secretariat have jointly formed a view that it may not be useful to provide the SRC with this information. The reason is that most of the items on the list are <i>business risks to Transpower</i> rather than <i>reliability risks to the power system</i> . However, if the SRC still considers that it requires

⁷ References to risk in this paper specifically mean the risk of *loss of load*. Electricity industry participants also need to manage other types of risk – including health and safety, reputational and financial risks – but these are not relevant to the SRC’s statutory function.

	this information, Transpower staff will seek internal approval to release the list and prepare a paper on this separate topic.
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2.2.4 The paper covers reliability monitoring activities carried out by:

- a) the Authority's Market Performance team
- b) the system operator
- c) asset owners, including Transpower, generators and distributors
- d) cross-industry initiatives.

2.2.5 The discussion focuses on:

- a) the perceived boundaries between the responsibilities of different parties
- b) the arrangements that are made for applying the learnings gained from reliability monitoring
- c) the extent to which the SRC might wish to obtain information from each party (or type of parties) about their reliability monitoring activities.

2.2.6 Appendix A provides a diagram showing a high level view of obligations on, and interactions between, these types of organisations.

3 The Authority

3.1 Roles

3.1.1 The Authority has two relevant roles with respect to reliability monitoring:

- a) market monitoring, which is carried out by the Market Performance team
- b) monitoring compliance with the Electricity Industry Participation Code 2010 (Code), which is carried out by the Compliance team.

3.2 Market monitoring

Inter-organisational boundaries

3.2.1 The scope of the Market Performance team's investigations is not limited by inter-organisational boundaries within the electricity sector. The Authority has a broad mandate to *"undertake industry and market monitoring, and carry out and make publicly available reviews, studies, and inquiries into **any matter** relating to the electricity industry."*⁸

Activities

3.2.2 The Authority's Market Performance team seeks to assess the level of reliability, in pursuit of the Authority's objective of promoting an efficient level of reliability of supply. It achieves this through:

- a) investigating the causes of specific events in which there was, or might have been, a loss of supply
- b) using trend analysis, which involves:

⁸ Section 16(1)(g) of the Electricity Industry Act 2010 (Act). The Act includes provisions for the Authority to be able to require industry participants to provide the Authority with the information it needs to undertake its monitoring.

- i) investigating the occurrence of failures in the network, broken down by cause (distinguishing between primary and secondary failures)
- ii) monitoring aggregate measures such as unserved energy.

3.2.3 Where the Market Performance team identifies problems, it can:

- a) publish a report to aid industry understanding of the issue
- b) recommend that changes should be made to the Code.

Information that the SRC might seek

3.2.4 The SRC need not proactively seek information from the Authority about its investigations. The Market Performance team will seek to bring its investigations before the SRC when the Authority considers it is useful to do so.

3.2.5 The SRC can make recommendations to the Authority Board for any action that is needed with respect to reliability and security. For example, the SRC could consider recommending:

- a) reviewing whether the existing regulatory arrangements satisfactorily deal with the issue
- b) market facilitation measures, such as information papers or guidelines
- c) voluntary auditing and reporting.

3.2.6 The SRC might wish to seek further information from participants following an Authority investigation, such as ensuring that appropriate steps are being taken to action the findings of the investigation.

3.2.7 The SRC has previously determined that it does not want to receive reports from the Authority on a 'security and reliability dashboard' including statistics on unserved energy, outage frequencies and SAIDI and SAIFI.

3.3 Compliance monitoring

Inter-organisational boundaries

3.3.1 The Compliance team's activities—including monitoring, investigation and enforcement of participant obligations under the Code—extend across all participants.

Activities

3.3.2 The Compliance team is responsible for investigation and enforcement of compliance with participant obligations under the Code. This process is triggered by an allegation that a participant has breached its obligations, or by a self-breach⁹ (so it will not cover events where there is a reliability risk but no breach allegation). The Compliance team publishes the decisions of the Authority's Compliance Committee. Participants can learn from these decisions what other participants are failing to comply with and some of the root causes.

3.3.3 The Compliance team also seeks to educate participants about their obligations. To this end, the Compliance team publishes occasional case studies that highlight risks, particularly where those risks relate to system security and reliability.

3.3.4 Finally, the team carries out monitoring of compliance. This monitoring is proactive, with the areas for monitoring prioritised in accordance with the risks of non-compliance. A current focus of

⁹ Quality and security breaches must be reported by the participant in breach.

this monitoring is on the compliance of asset owners to routinely test their equipment in accordance with the Code. This process has identified non-compliances by some generators. The Compliance team will begin monitoring the asset testing practices of other asset owners in the near future.

Information that the SRC might seek

- 3.3.5 The Authority does not anticipate that the SRC will proactively seek information from the Authority about its compliance monitoring programme.
- 3.3.6 It is possible that the Compliance team may brief the SRC on the results of its investigations, though this has not happened to date.

4 Transpower

4.1 Roles

- 4.1.1 Transpower has two relevant roles with respect to reliability monitoring:

- a) system operator
- b) grid owner.

4.2 Transpower, as the system operator

Inter-organisational boundaries

- 4.2.1 Transpower has a broad responsibility, as the system operator for the entire New Zealand electricity system.
- 4.2.2 The Code sets out some situations where the system operator's responsibilities end and other parties' responsibilities begin. For instance, clause 8.4 of the Code sets out that:

“for the purposes of the Code, the system operator may rely on the assets and information about the assets made available to the system operator by asset owners, and may assume that asset owners are complying with the asset owner performance obligations and the technical codes or complying with a valid dispensation or equivalence arrangement.”

Activities

- 4.2.3 The system operator has a framework for carrying out reliability monitoring and ensuring that the learnings from reliability monitoring activities are put into effect.
- 4.2.4 A key part of this framework is the five-yearly review of the system operator's credible event policy (as set out in the Policy Statement).
 - a) The review identifies events that could occur within the power system that, if not appropriately managed, could subsequently result in wide spread, or cascade, failure within the power system. The process focuses on the identification, classification and management of credible events, and includes a review of international planning and operational standards.
 - b) As part of the credible event policy review, a review of asset failure information is undertaken. Asset failure rates are compared over a period from 1990 to present, in order to determine whether there have been significant changes that could drive a change to the credible event policy.

- c) The last substantive review of the credible event policy occurred in 2009; the next will be completed in 2014. The process is integrated with the grid owner's planning process, and also involves extensive engagement with other participants.

4.2.5 Another key part of the system operator's reliability framework is event reporting and investigation.

- a) All system operator staff have a responsibility to report events or potential breaches for investigation. The system operator also relies on industry participants (primarily asset owners) notifying issues and or events.
- b) The event reporting framework includes investigating events from a Code compliance perspective, but is also used to drive continuous improvement in performance throughout the organisation.
- c) The system operator finds that there is generally a good level of engagement from asset owners in event investigations.
- d) In the case of under-frequency events, the Code¹⁰ mandates that the system operator determine the event causer after consultation with stakeholders.

4.2.6 Further, the system operator publishes reports on:

- a) performance against its principal performance obligations
- b) grid emergencies and other important system events that have occurred
- c) outages with possible consequences for reliability that have occurred
- d) under-frequency events that have occurred.

4.2.7 Further, the system operator has a role in the commissioning process, and coordinates industry outage planning through the Planned Outage Coordination Process.

Information that the SRC might seek

4.2.8 The SRC may request information on any aspect of the system operator's reliability-related activities (for example, whether there are any repeating issues or trends affecting reliability).

4.2.9 Sometimes the system operator has been invited to provide information to the SRC. In the past the system operator has provided presentations on Rugby World Cup preparedness and the 13 December 2011 AUFLS event.

4.2.10 The SRC might wish to seek further information from participants following a system operator investigation to ensure that appropriate steps are being taken to action the findings of the investigation.

4.3 Transpower, as the grid owner

Inter-organisational boundaries

4.3.1 Transpower is responsible for its own assets, and monitors reliability on its own network.

4.3.2 Responsibilities with regard to the interface between Transpower's network and connected parties' assets are dealt with in connection contracts.

¹⁰ Refer to clauses 8.60-8.65 of the Code.

4.3.3 Transpower (in its capacity as an asset owner) also participates in industry-wide outage planning processes.

Activities

4.3.4 There is extensive public domain information about the frameworks used by Transpower (in its capacity as an asset owner) for carrying out reliability monitoring, and ensuring that the learnings from reliability monitoring activities are put into effect. Key documents include:

- a) the Asset Management Strategy which:
 - i) explains Transpower's asset management framework at a high level
 - ii) sets out Transpower's intention to achieve accreditation of its asset management framework to the PAS 55/ISO55000 standard
 - iii) sets out Transpower's commitment to ongoing improvement, including training, fostering innovation, improving knowledge of its own assets, and integrating its approach to corrective and preventive action across all asset management activities
- b) fleet strategies (such as the Outdoor Circuit Breakers Fleet Strategy) which describe the asset fleet and set out objectives for future performance and strategies being adopted to achieve these objectives
- c) lifecycle strategies which cover Transpower's strategies for planning, maintenance, operations, delivery, disposal and divestment of its assets
- d) the annual Quality Performance Report which:
 - i) brings together a range of high-level information on the performance of Transpower's network and the level of reliability delivered
 - ii) explains how Transpower benchmarks its performance against its peers internationally
 - iii) describes the actions that Transpower is taking to improve reliability on the basis of this information.

4.3.5 Transpower uses reliability monitoring and analysis for purposes such as:

- a) providing assessments of asset reliability to inform investment analysis and long term asset management planning
- b) providing asset reliability information to direct engineering investigations and preventive maintenance initiatives
- c) undertaking strategic and tactical reliability analysis to identify improvement opportunities.

4.3.6 Transpower also publishes up-to-date information about network performance, reliability and service levels in its information disclosures under the Commerce Commission regulatory framework. If Transpower did not meet its quality standards, it is possible that the Commerce Commission could review its performance.

4.3.7 The Controller and Auditor General also has a role in oversight of Transpower's asset management.

4.3.8 Transpower's responsibilities under the Code also include:

- a) publishing up-to-date information about network performance and reliability

- b) complying with technical requirements, performing tests, and providing information about its assets to the system operator (under Part 8)
- c) following commissioning requirements
- d) meeting the Grid Reliability Standards set by the Authority
- e) preparing, publishing and complying with the Outage Protocol
- f) supplying information to the SO in the course of a under-frequency event investigation.

4.3.9 Transpower also coordinates with other asset owners to plan asset outages.

Information that the SRC might seek

4.3.10 The SRC may seek information on the grid owner's reliability-related activities (for example, whether there are any repeating issues or trends affecting reliability).

4.3.11 Sometimes the grid owner has been invited to provide information to the SRC. Previous presentations provided by the grid owner have covered the Christchurch earthquake, the 13 December 2011 AUFLS event, and customer transmission service measures.

5 Distributors

Inter-organisational boundaries

5.1.1 Within the distribution area, inter-organisational boundaries are straightforward – each distributor is responsible for its own assets, and monitors reliability on its own network.

5.1.2 Responsibilities with regard to the interface between distribution networks and Transpower's network are dealt with in connection contracts. Where a generation asset is embedded in a distribution network, the interface is again dealt with through contractual means.

Activities

5.1.3 There is extensive public domain information about distributors' frameworks for carrying out reliability monitoring and ensuring that the learnings from reliability monitoring activities are put into effect.

5.1.4 Each distributor must publish and keep updated an asset management plan (AMP). The AMPs are informative about distributors' reliability monitoring activities. For instance, the Vector AMP:

- a) states that "Managing risk is one of Vector's highest priorities - risk management is practiced at all levels of the organisation and is overseen by the Board Risk and Assurance Committee, the Executive Risk and Assurance Committee and Vector's Chief Risk Officer"
- b) describes Vector's risk management practices, noting that they are consistent with the AS/NZS ISO31000:2009 standard (which is used by most New Zealand distributors)
- c) identifies Vector's 'top five risks'¹¹ and 'top eighteen asset-related risks'
- d) explains Vector's strategy for managing asset-related risks, including:

¹¹ The 'top five risks' in Vector's 2013 AMP are noted here, since the SRC recently took an interest in Transpower's 'top ten risks'. They can be summarised as: (1) external events such as natural disasters or man-made disasters, (2) a breach of the AUFLS requirements in the Code, (3) power quality performance falling below compliance levels, (4) Inability to identify network operational issues due to poor / corrupted field data, and (5) failure to comply with Commerce Commission regulation.

- i) “reducing the probability of failure through the capital and maintenance work programme and enhanced work practices”
- ii) “reducing the impact of failure through the application of appropriate network security standards and network architecture, selected use of automation, robust contingency planning and performance management of field responses”
- e) explains Vector’s maintenance planning and asset renewal policies. The AMP notes that “root cause analysis is normally undertaken as a result of faulted equipment. This is also supplemented by fault trend analysis. If performance issues with a particular type of asset are identified, and if the risk exposure warrants it, a project will be developed to carry out the appropriate remedial actions. The asset and maintenance standards are also adapted based on learning from such root cause analysis”
- f) explains that Vector “is continually monitoring local and international developments in asset maintenance”
- g) provides reporting on the network performance, reliability and service levels achieved by Vector, including trend analysis and root cause analysis
- h) provides extensive information on the condition of Vector’s assets, and implications for reliability.

5.1.5 Other distributors’ AMPs also provide information about their reliability monitoring activities.

5.1.6 Distributors also publish up-to-date information about network performance, reliability and service levels in their regulated information disclosures.

5.1.7 The Commerce Commission may review a distributor’s reliability performance, with a focus on the reasons for any deterioration in performance, and may require the distributor to undertake actions to remedy identified problems. These reviews are published.

5.1.8 The Commerce Commission may also review reliability performance across the distribution sector.

5.1.9 As asset owners, distributors also have responsibilities under Part 8 of the Code. These include complying with technical requirements, performing tests, and providing information about their assets to the system operator.

Information that the SRC might seek

5.1.10 The Commerce Commission is the primary regulator of the reliability of distributors’ networks. As such, this may limit what advice the SRC can usefully offer to the Authority.

5.1.11 The SRC could seek information on distributors’ reliability-related activities. For example, in 2011 the SRC asked Orion to present to it on learnings from the Christchurch earthquakes.

5.1.12 It is also possible that distributors might proactively provide information to the SRC.

5.1.13 The SRC could also seek information about distributor reliability from the Commerce Commission.

6 Generators

Inter-organisational boundaries

- 6.1.1 In the generation area, inter-organisational boundaries are straightforward – each generator is responsible for its own assets.
- 6.1.2 Responsibilities with regard to the interface between grid-connected generation assets and Transpower's network are dealt with in connection contracts. Where a generation asset is embedded in a local network, the interface is again dealt with through contractual means.
- 6.1.3 Generators also participate in industry-wide outage planning processes on a voluntary basis.

Activities

- 6.1.4 Major generators have sophisticated frameworks for managing risk and reliability, in areas including:
 - a) asset management
 - b) asset operation within the market.
- 6.1.5 However, there is limited public information about the reliability monitoring frameworks used by generators. Unlike distributors, generators are not required by the Commerce Commission to publish asset management plans or reliability statistics.
- 6.1.6 Some generators publish information on their practices that support reliability, on an ad hoc basis,¹² but there is no regulatory requirement on them to do so.
- 6.1.7 Generator obligations under the Code include:
 - a) complying with technical requirements, performing tests, and providing information about their assets to the system operator (under Part 8)
 - b) following commissioning requirements
 - c) supplying information to the system operator in the course of a under-frequency event investigation.
- 6.1.8 Generators also coordinate with other asset owners to plan asset outages.

Information that the SRC might seek

- 6.1.9 The SRC could seek information on generators' reliability-related activities.¹³
- 6.1.10 It is possible that generators might proactively provide information to the SRC, although this has not happened to date.

¹² For example, 'Meridian's Road to Predictive Maintenance' (delivered to Asset Health Indicators Forum in 2012) available from http://www.eea.co.nz/Attachment?Action=View&Attachment_id=1259

¹³ The generators would not be under any compulsion to provide the information that is sought. If the SRC considered the information to be important to the issue of reliability they could recommend that the Authority's Market Performance team investigate (as discussed in paragraph 3.2.1).

7 Cross-industry initiatives

7.1 Civil defence

- 7.1.1 The Civil Defence Emergency Management Act 2002 (CDEM Act) sets out that generators and network companies are lifeline utilities. Lifeline utilities are entities that provide essential infrastructure services to the community. They support communities, enable business, and underpin the provision of public services.
- 7.1.2 Lifeline utilities must comply with the CDEM Act, must have their own emergency plans and should also follow the National Civil Defence Emergency Management Plan. They have planning and operational relationships with Civil Defence Emergency Management (CDEM) Groups.
- 7.1.3 In a civil defence emergency:
 - a) lifeline utilities should follow their pre-defined operational plans
 - b) the Minister of Civil Defence has broad powers to require further actions.
- 7.1.4 Following a civil defence emergency, industry participants could be required to provide information to assist in civil defence reporting about how the electricity industry responded.

7.2 Cyber-security

- 7.2.1 Key electricity industry participants, including Transpower, major generators, some distributors and some providers of smart metering participate in a National Cyber Security Centre forum and are encouraged to comply with the Voluntary Cyber Security Standard for Industrial Control Systems.

7.3 Gas contingencies

- 7.3.1 When a gas contingency occurs that impacts on the main gas pipelines to the extent that gas pressure falls below certain critical levels, the gas Critical Contingency Operator (CCO)¹⁴ implements a demand curtailment regime designed to maintain gas supply to residential and other small consumers for as long as possible.
- 7.3.2 This regime typically requires gas-fired electricity generation to immediately curtail all gas demand, except for transitional amounts required to ensure safety and avoid damage to plant during any shut-down process. Gas-fired electricity generators can also apply for designation as “electricity system security providers” if they require gas in order to synchronise a unit to provide voltage support, or to start up a unit to run on an alternative fuel, during a gas contingency.
- 7.3.3 During any critical contingency the CCO is required to consult with the electricity system operator over the impacts on the electricity supply system and the possible need for electricity system security providers.
- 7.3.4 Following any gas critical contingency event the CCO is required to prepare and publish a performance report that assesses the effectiveness of the critical contingency arrangements and identifies any possible improvements to the arrangements. To the extent that the contingency impacted upon the electricity system, the performance report is expected to consider and report on those issues.

¹⁴ The Critical Contingency Operator is a specific role set out in the Gas Governance (Critical Contingency management) Regulations and is currently filled by a party independent of Vector, the gas system operator.

The SRC may wish to consider the following questions.

- | | |
|------------|--|
| Q1. | Does the SRC consider that there are any aspects of inter-organisational boundaries that may lead to sub-optimal reliability outcomes? |
| Q2. | What reporting might the SRC need to discharge its role? |

Appendix A: High-level reliability risk management structure (reproduced from 'Supply Reliability Risk Management', provided to the SRC in April 2012)

