

Meeting Date: 22 June 2018

RELIABILITY INFORMATION AS OF EARLY 2018

SECURITY AND RELIABILITY COUNCIL

This is the first of a series of annual reports, providing the SRC with reliability information.

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

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1. The purpose of this paper

1.1 This is an annual report to provide the SRC with reliability information

1.1.1 The Security and Reliability Council (SRC) agreed that its secretariat should prepare an annual report comprising various reliability measures and associated commentary. This is the first such report.

1.1.2 The secretariat expects that these reports will typically be delivered to the second SRC meeting of each calendar year (usually June or July).

1.2 The list of measures in this report was discussed by the SRC in 2017

1.2.1 The SRC meeting of 28 July 2017 considered a paper “Monitoring reliability: Measures available for reporting to the SRC to monitor reliability of electricity supply” (‘the July 2017 paper’).

1.2.2 The July 2017 paper included a list of measures that could be provided to the SRC, reproduced below:

- a) the count of under-frequency events (UFE)
- b) the count of grid warning notices
- c) the count of voltage and frequency excursion notices
- d) the count of times when reserves are less than required for security
- e) primary and secondary transmission outage counts
- f) primary and maximum transmission outage duration in minutes
- g) key metrics derived from the Authority’s electricity distribution business (EDB) monitoring of disclosed data, including the average system availability index (ASAI)
- h) changes in embedded generation volumes and trends.

1.2.3 All the above measures are included in this paper.

1.2.4 The July 2017 paper also noted that the following information sources are publicly available:

- a) Authority reports into automatic under-frequency load shedding (AUFLS) events
- b) the Annual Security Assessment (ASA) and any ad hoc system operator studies
- c) hydro risk curves, which are available from the system operator and on EMI
- d) Transpower information disclosures.

1.2.5 These publicly available information sources have not been reproduced in this paper.

2. Reliability measures

2.1 Measures of system events

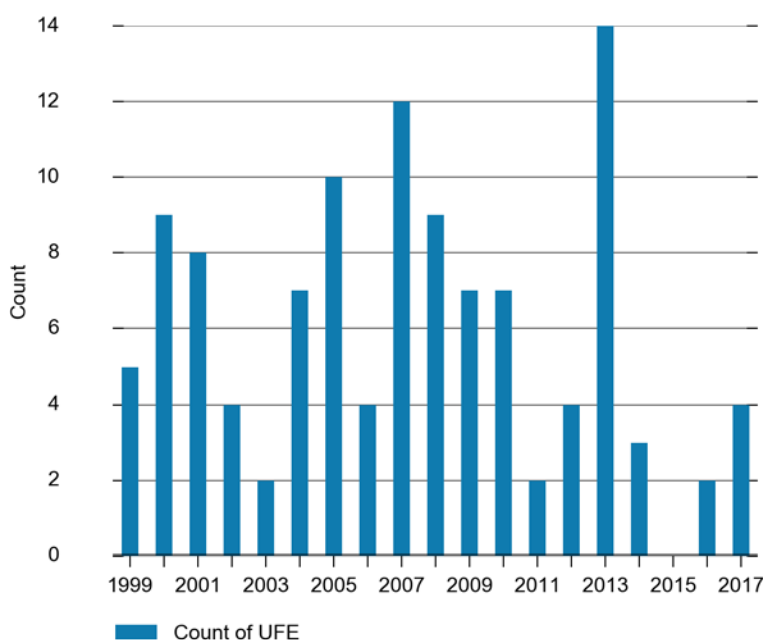
2.1.1 This section provides information on:

- a) the count of under-frequency events
- b) the count of grid warning notices
- c) the count of voltage and frequency excursion notices
- d) the count of times when reserves are less than required for security.

Count of under-frequency events

2.1.2 The number of UFEs occurring each year is shown in Figure 1. For the purposes of this reporting, a UFE occurs when the system frequency falls below 49.25 Hz. UFE counts provide information on how the frequency of incidents is trending, and can drive more detailed enquiries.

Figure 1: Number of under frequency events

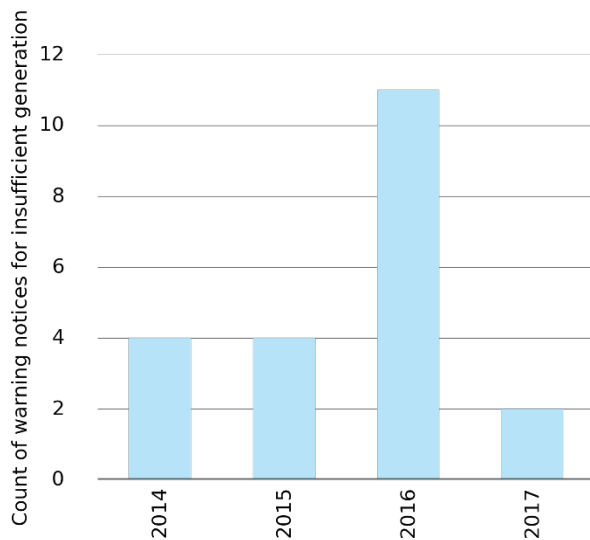


2.1.3 Four UFEs occurred in 2017 – below the median for the preceding decade. The spike in 2013 is most likely due to HVDC testing.

Count of grid warning notices

2.1.4 The number of grid warning notices for insufficient generation issued each year is shown in Figure 2. These notices are issued by the system operator when there are insufficient offers to meet forecast demand. Trends in the numbers of grid warning notices can drive more detailed enquiries.

Figure 2: Number of grid warning notices

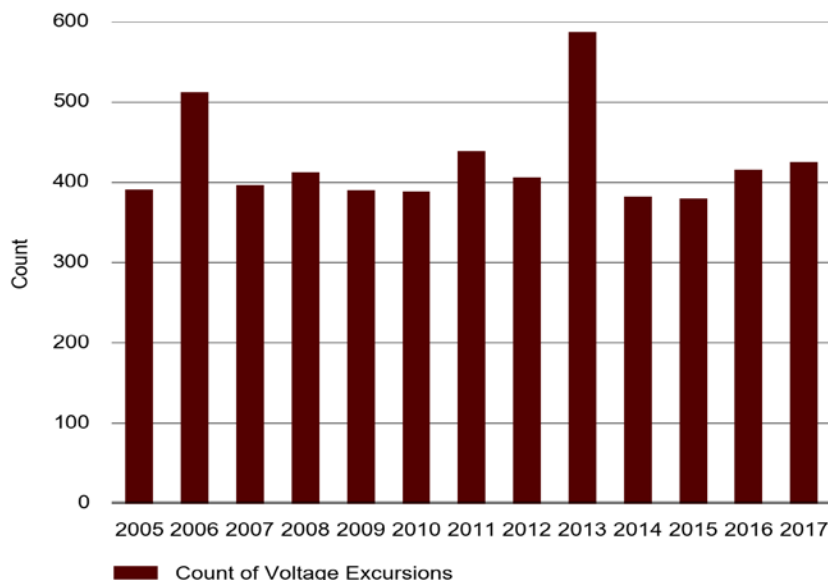


2.1.5 Only two such notices were issued in 2017, less than in each of the three preceding years.

Count of voltage and frequency excursion notices

2.1.6 Figure 3 and Figure 4 show the annual counts of frequency and voltage notices. Transpower sends excursion notices when voltage or frequency measures exceed stated limits. Excursion notice counts reflect the state of transmission and generation equipment, and can drive more detailed enquiries.

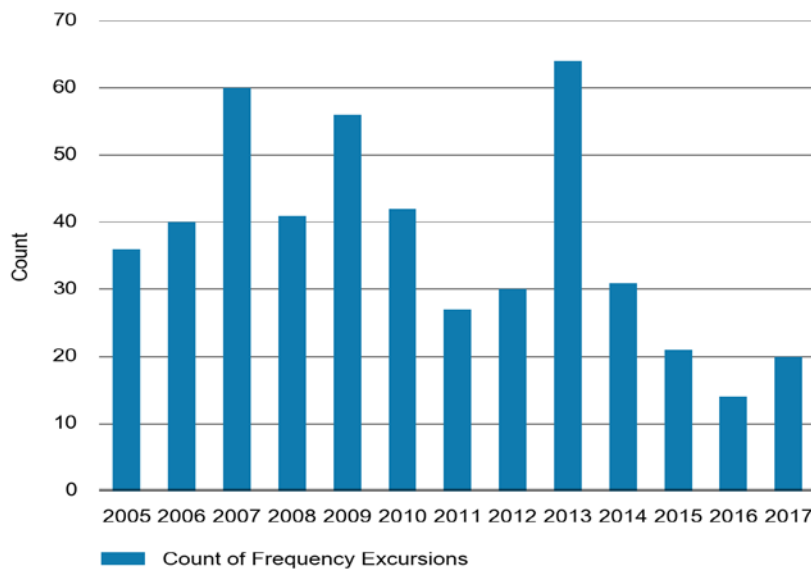
Figure 3: Voltage excursion notices



2.1.7 The number of voltage excursions in 2017 was similar to most previous years.

2.1.8 A frequency excursion notice is issued only if frequency is lower than 49.5 Hz or higher than 50.5 Hz.

Figure 4: Frequency excursion notices

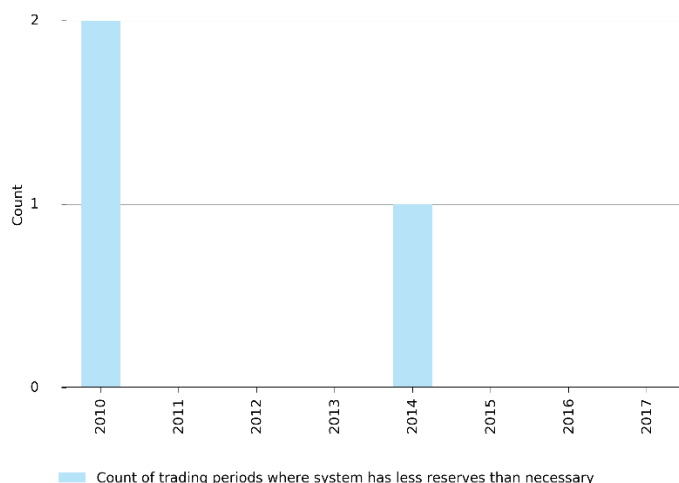


2.1.9 The number of frequency excursions in 2017 was below the median for the preceding decade.

Count of times when reserves are less than required for security

2.1.10 Figure 5 shows the annual number of occasions on which insufficient reserve was dispatched. Reserves are required to cover the largest risk in the system, usually a large generator or the HVDC. The system operator may not have enough reserve to cover the largest risk, after an event or due to inaccuracies in forecasting of supply and demand.

Figure 5: Number of occasions on which insufficient reserve was dispatched



2.1.11 No such events have occurred since 2014.

2.2 Measures of transmission grid reliability

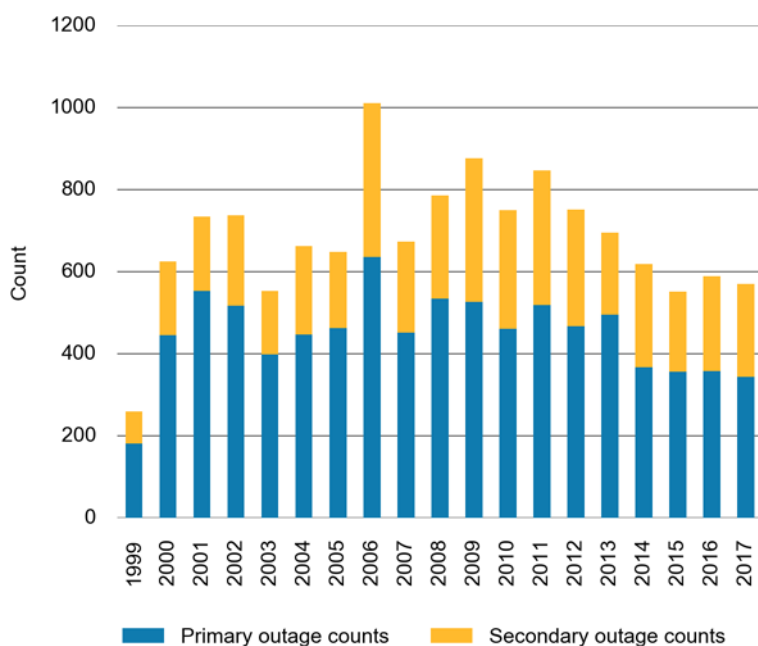
2.2.1 This section provides information on:

- a) primary and secondary transmission outage counts
- b) primary and maximum transmission outage duration in minutes.

Primary and secondary transmission outage counts

- 2.2.2 The information in this section specifically refers to forced outages, defined as those for which the equipment was tripped or manually taken out of service within 24 hours of the fault occurring or being discovered.
- 2.2.3 'Primary outage' refers to the first piece of equipment to go out; a 'secondary outage' is a different piece of equipment that went out as a result of the primary outage.
- 2.2.4 A number of outages within a relatively short space of time, sharing a cause, are generally recorded as a single incident. If a second fault occurs or is discovered when attempting to return equipment to service, it is counted as a second outage.
- 2.2.5 Annual counts of primary and secondary outages are shown in Figure 6.

Figure 6: Transmission forced outages

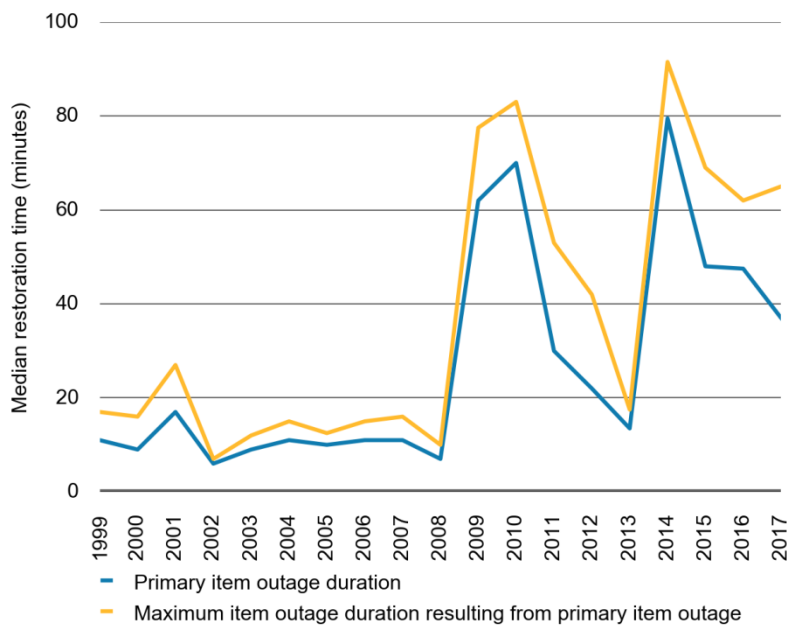


- 2.2.6 There has been a generally decreasing trend in the number of forced outages since 2011. The number of forced outages in 2017 was the second lowest in a decade.

Primary and maximum transmission outage duration in minutes

- 2.2.7 Trends in the typical duration of transmission forced outages are shown in Figure 7. The blue line indicates the annual median of the duration of primary outages (in minutes). The orange line indicates the annual median of the *maximum* duration of all outages (primary or secondary) relating to a single primary outage – arguably a better measure of how long it takes to return the grid to normal operation.

Figure 7: Median transmission outage duration



2.2.8 In 2017, both measures were at or near the median for the preceding decade.

2.3 Measures of distribution grid reliability

2.3.1 This section provides information on:

- a) EDB network reliability
- b) the increase in capacity of small distributed generation.

EDB network reliability

2.3.2 EDB network reliability is expressed in terms of the average system availability index (ASAI), which is the percentage of customer-hours that were supplied. This measure takes into account both the frequency and the duration of outages. A high value means that the network was usually supplying power to customers.

2.3.3 Figure 8 compares ASAI between EDBs, with the highest level of reliability on the right hand side. Figure 9 compares ASAI between years, for all EDBs combined.

Figure 8: ASAI by EDB, for 2017

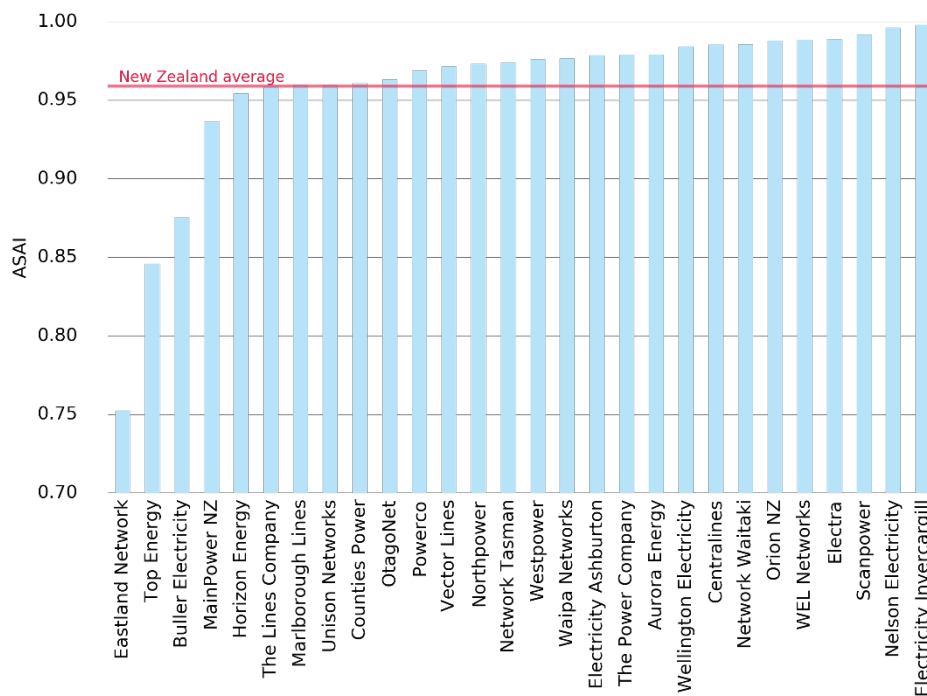
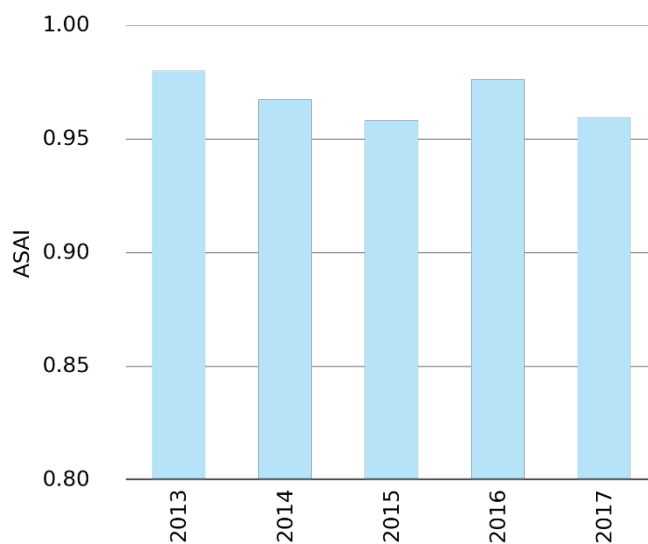


Figure 9: ASAI by year, for all EDBs combined



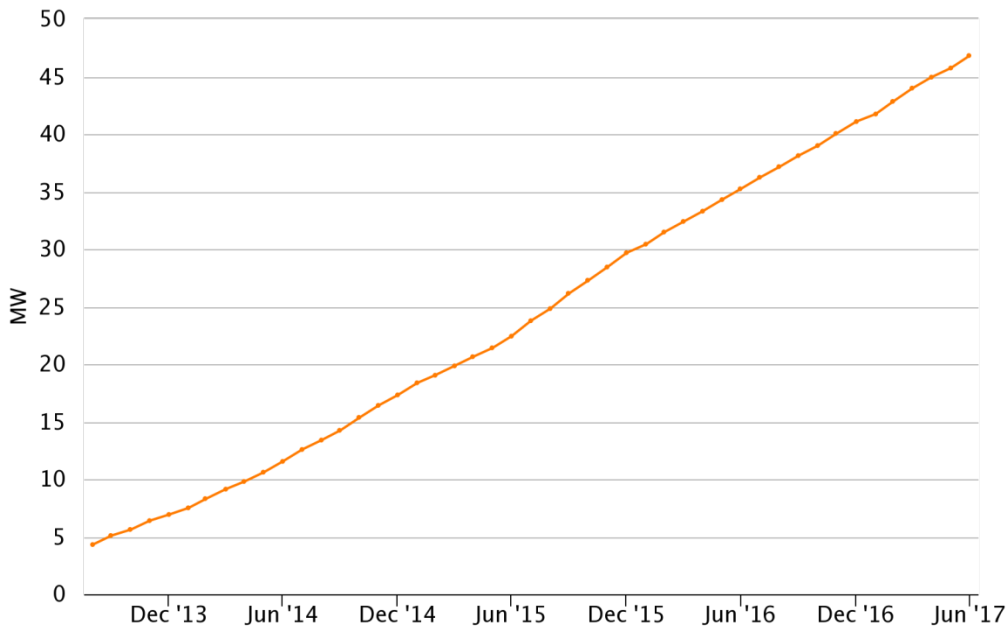
2.3.4 ASAI in 2017 was slightly below the median of the preceding four years.

Increase in capacity of small distributed generation

2.3.5 Distributed generation can have positive or negative impacts on reliability.

2.3.6 Figure 10 shows the trend in total distributed generation capacity at residential ICPs, nationwide. It covers installations under 10 kW capacity only.

Figure 10: Distributed generation under 10kW capacity at residential ICPs



2.3.7 Such distributed generation capacity has been increasing roughly linearly over the last few years with no discernible impact on reliability.

3. Questions for the SRC to consider

3.1.1 The SRC is asked to consider and provide advice on the following questions:

- Q1. Does the SRC wish to receive any further reliability measures at this point?
- Q2. Does the SRC want anything done differently in the 2019 version of this report?
- Q3. Having considered this report, what advice (if any) does the SRC wish to provide to the Authority?