

## A FREQUENCY OPERATING STANDARD

The *frequency operating standard* forms part of the *power system security standards*.

The Panel has determined to amend the *frequency operating standard*, in accordance with clause 8.8.3(a)(1) of the *Rules* with effect from 1 January 2020.

In this document:

- Section A.1 specifies the *frequency* bands for the purpose of *frequency operating standard* and the *Rules*.
- Section A.2 specifies the required **system frequency** outcomes following specified events.
- Section A.3 contains the definitions used in this document.

### A.1 Frequency bands

The *frequency* bands are shown in Table A.1.

For the purpose of the *frequency operating standard* and the *Rules*, a term in Column 1 means the *frequency* range in Column 3 for an **island**, Column 4 during **supply scarcity** in the mainland and Column 2 in all other conditions (**Normal**).

**Table A.1: Frequency bands**

COLUMN 1	COLUMN 2		COLUMN 3		COLUMN 4
	NORMAL (HZ)		ISLAND (HZ)		SUPPLY SCARCITY (HZ)
	MAINLAND	TASMANIA	MAINLAND	TASMANIA	MAINLAND <sup>1</sup>
<i>normal operating frequency band</i>	49.85 – 50.15		49.5 – 50.5	49.0 – 51.0	49.5 – 50.5
<i>normal operating frequency excursion band</i>	49.75 – 50.25		49.5 – 50.5	49.0 – 51.0	49.5 – 50.5
<i>operational frequency tolerance band</i>	49.0 – 51.0	48.0 – 52.0	49.0 – 51.0	48.0 – 52.0	48.0 – 52.0
<i>extreme frequency excursion tolerance limit</i>	47.0 – 52.0	47.0 – 55.0	47.0 – 52.0	47.0 – 55.0	47.0 – 52.0

Note: 1. The Reliability Panel has not determined separate *frequency bands* for periods of **supply scarcity** in Tasmania. Where a state of **supply scarcity** exists for the Tasmanian *power system*, the *frequency bands* set out in column 2 of table A.1 apply for an intact *power system*, and the *frequency bands* set out in column 3 of table A.1 apply for an **island** with the Tasmanian *power system*.

## A.2 Required frequency outcomes

The *power system* is expected to experience a range of different operating conditions. Tables A.2 — A.7 detail the required **system frequency** outcomes following the occurrence of the events specified in each Table.

**Table A.2:** System frequency outcomes following specified conditions

	REQUIREMENT	MAINLAND	TASMANIA
1	<b>Accumulated time error</b> limit.	<15 seconds, except for an <b>island</b> or during <b>supply scarcity</b>	<15 seconds, except for an <b>island</b> or following a <b>multiple contingency event</b>
2	<p>Except as a result of a <i>contingency event</i> or a <b>load event</b>, <b>system frequency</b>:</p> <p>a) shall be maintained within the applicable normal operating frequency excursion band, and</p> <p>b) shall not be outside of the applicable <i>normal operating frequency band</i> for more than 5 minutes on any occasion and not for more than 1% of the time over any 30-day period.</p>		
3	Following a <b>generation event</b> or a <b>load event</b> , <b>system frequency</b> shall be maintained within the applicable <b>generation and load change band</b> , and shall not be outside of the applicable <i>normal operating frequency band</i> for more than...	...5 minutes	...10 minutes
4	Following a <b>network event</b> , <b>system frequency</b> shall be maintained within the applicable <i>operational frequency tolerance band</i> , and shall not be outside of ...	...the applicable <b>generation and load change band</b> for more than 1 minute, or be outside of the applicable <i>normal operating frequency band</i> for more than 5 minutes.	...the applicable <i>normal operating frequency band</i> for more than 10 minutes.
5	Following a <b>separation event</b> , <b>system frequency</b> shall be maintained within the applicable <b>island separation band</b> , and shall not be outside	... <b>generation and load change band</b> for more than 2 minutes, or be outside of the applicable <i>normal operating frequency band</i> for more than 10 minutes.	

	REQUIREMENT	MAINLAND	TASMANIA
	of the applicable...		
6	Following a <i>protected event</i> , <b>system frequency</b> shall be maintained within the applicable extreme frequency excursion tolerance limit, and shall not be outside of the applicable <b>generation and load change band</b> for more than 2 minutes while there is no <i>contingency event</i> , or be outside of the applicable <i>normal operating frequency band</i> for more than 10 minutes while there is no <i>contingency event</i> .		
7	Following a <i>non-credible contingency event</i> or <b>multiple contingency event</b> that is not a <i>protected event</i> , AEMO should use reasonable endeavours to:  (a) maintain <b>system frequency</b> within the applicable <i>extreme frequency excursion tolerance limits</i> ; and  (b) avoid <b>system frequency</b> being outside of the applicable...	<b>...generation and load change band</b> for more than 2 minutes while there is no <i>contingency event</i> , or being outside of the applicable <i>normal operating frequency band</i> for more than 10 minutes while there is no <i>contingency event</i> .	
8	The size of the largest single <b>generation event</b> in the absence of a <i>transmission element outage</i> is limited to...	N/A	...144 MW measured a) at the <i>connection point</i> for a <i>generating system</i> ; b) at the <i>connection point</i> for one or more <i>generating systems</i> in an <i>identified user group</i> which share a <i>dedicated connection asset</i> .  This limit can be implemented in relation to any <i>generating system</i> with a capacity greater than 144 MW, or to one or more <i>generating systems</i> with a combined capacity greater than 144 MW which are <i>connected</i> to the <i>transmission network</i> by a <i>single</i>

	REQUIREMENT	MAINLAND	TASMANIA
			<i>dedicated connection asset, by automatic load shedding or any other arrangements approved by AEMO that would effectively reduce any <b>generation event</b> in relation to the relevant <i>generating system(s)</i> to 144MW or below.<sup>1</sup></i>

Note: 1. Under clause 4.8.9 of the *Rules*, AEMO may direct a *Generator* to exceed the 144 MW limit following a *contingency event* if AEMO reasonably believes this would be necessary to maintain a *reliable operating state*.

**Table A.3:** Summary of mainland system frequency outcomes for an interconnected system

CONDITION	CONTAINMENT BAND (HZ)	STABILISATION BAND (HZ)	RECOVERY BAND (HZ)
No <i>contingency event</i> or <b>load event</b>	49.75 – 50.25 49.85 – 50.15 <sup>1</sup>	49.85 – 50.15 within 5 minutes	
<b>Generation event</b> or <b>load event</b>	49.5 – 50.5	49.85 – 50.15 within 5 minutes	
<b>Network event</b>	49.0 – 51.0	49.5 – 50.5 within 1 minute	49.85 – 50.15 within 5 minutes
<b>Separation event</b>	49.0 – 51.0	49.5 – 50.5 within 2 minutes	49.85 – 50.15 within 10 minutes
<i>Protected event</i>	47.0 – 52.0	49.5 – 50.5 within 2 minutes	49.85 – 50.15 within 10 minutes
<b>Multiple contingency event</b>	47.0 – 52.0 (reasonable endeavours)	49.5 – 50.5 within 2 minutes (reasonable endeavours)	49.85 – 50.15 within 10 minutes (reasonable endeavours)

Note: 1. 99% of the time.

**Table A.4:** Summary of Mainland system frequency outcomes for an island within the Mainland other than during supply scarcity

<b>CONDITION</b>	<b>CONTAINMENT BAND (HZ)</b>	<b>STABILISATION BAND (HZ)</b>	<b>RECOVERY BAND (HZ)</b>
No <i>contingency event</i> or <b>load event</b>	49.5 – 50.5	N/A	
<b>Generation event, load event</b> or <b>network event</b>	49.0 – 51.0	49.5 – 50.5 within 5 minutes	
The <b>separation event</b> that resulted in the <b>island</b>	49.0 – 51.0 <sup>1</sup>	49.0 – 51.0 within 2 minutes	49.5 – 50.5 within 10 minutes
<i>Protected event</i>	47.0 – 52.0	49.0 – 51.0 within 2 minutes	49.5 – 50.5 within 10 minutes
<b>Multiple contingency event</b> including a further <b>separation event</b>	47.0 – 52.0 (reasonable endeavours)	49.0 – 51.0 within 2 minutes (reasonable endeavours)	49.5 – 50.5 within 10 minutes (reasonable endeavours)

Note: 1. Or a wider band as notified to AEMO by a JSSC for a *region*.

Table A.5 applies in the **Mainland** during **supply scarcity** if:

1. Following a *contingency event*, the *frequency* has reached the **Recovery Band** set out in Table A.2.3, and AEMO considers the *power system* is sufficiently secure to begin *reconnection of load*.
2. The estimated *load* available for *under frequency schemes* within the **island** is more than the amount required to ensure that any subsequent *frequency excursion* would not go below the **Containment Band** and **Stabilisation Band** set out in Table A.5 as a result of a subsequent **generation event, load event, network event** or a **separation event** during *reconnection of load*.
3. The *generation reserve* available for *frequency regulation* is consistent with AEMO's current practice.

**Table A.5: Summary of Mainland system frequency outcomes during supply scarcity**

<b>CONDITION</b>	<b>CONTAINMENT BAND (HZ)</b>	<b>STABILISATION BAND (HZ)</b>	<b>RECOVERY BAND (HZ)</b>
No <i>contingency event</i> or <b>load event</b>	49.5 – 50.5	N/A	
<b>Generation event, load event</b> or <b>network event</b>	Qld and SA: 48 – 52.0 NSW and Vic.:48.5 – 52.0 <sup>1</sup>	49.0 – 51.0 within 2 minutes	49.5 – 50.5 within 10 minutes
<i>Protected event</i>	47.0 – 52.0	49.0 – 51.0 within 2 minutes	49.5 – 50.5 within 10 minutes
<b>Multiple contingency event</b> or <b>separation event</b>	47.0 – 52.0 (reasonable endeavours)	49.0 – 51.0 within 2 minutes (reasonable endeavours)	49.5 – 50.5 within 10 minutes (reasonable endeavours)

Note: 1. For the operation of an **island** that incorporates *power system* elements from more than one *region*, the Containment Band for a **generation event**, a **load event** or a **network event** is the narrower of the Containment Bands for the affected *regions*. For example, following a **generation event, load event** or **network event** during **supply scarcity** for an **island** that is partly within the Victoria *region* and partly within the South Australia *region*, the Containment band would be 48.5 – 52.0 Hz.

The frequency outcomes for Tasmania during supply scarcity are equivalent to the requirements set out in Table A.6 for an intact *power system* and in Table A.7 for an island within the Tasmanian *power system*.

**Table A.6: Summary of Tasmania system frequency outcomes where the Tasmanian power system is intact**

<b>CONDITION</b>	<b>CONTAINMENT BAND (HZ)</b>	<b>STABILISATION BAND (HZ)</b>	<b>RECOVERY BAND (HZ)</b>
No <i>contingency event</i> or <b>load event</b>	49.75 – 50.25 49.85 – 50.15 <sup>1</sup>	49.85 – 50.15 within 5 minutes	
<b>Generation event, load event</b> or <b>network event</b>	48.0 – 52.0	49.85 – 50.15 within 10 minutes	
<b>Separation event</b>	47.0 – 55.0	48.0 – 52.0	49.85 – 50.15

<b>CONDITION</b>	<b>CONTAINMENT BAND (HZ)</b>	<b>STABILISATION BAND (HZ)</b>	<b>RECOVERY BAND (HZ)</b>
		within 2 minutes	within 10 minutes
<i>Protected event</i>	47.0 – 55.0	48.0 – 52.0 within 2 minutes	49.85 – 50.15 within 10 minutes
<b>Multiple contingency event</b>	47.0 – 55.0 (reasonable endeavours)	48.0 – 52.0 within 2 minutes (reasonable endeavours)	49.85 – 50.15 within 10 minutes (reasonable endeavours)

Note: 1. 99% of the time.

**Table A.7:** Summary of Tasmania system frequency outcomes where an island is formed within Tasmania

<b>CONDITION</b>	<b>CONTAINMENT BAND (HZ)</b>	<b>STABILISATION BAND (HZ)</b>	<b>RECOVERY BAND (HZ)</b>
<i>No contingency event</i> or <b>load event</b>	49.0 – 51.0	N/A	
<b>Load event, generation event or Network event</b>	48.0 – 52.0	49.0 – 51.0 within 10 minutes	
<b>Separation event</b>	47.0 – 55.0	48.0 – 52.0 within 2 minutes	49.0 – 51.0 within 10 minutes
<i>Protected event</i>	47.0 – 55.0	48.0 – 52.0 within 2 minutes	49.0 – 51.0 <sup>1</sup> within 10 minutes
<b>Multiple contingency event</b>	47.0 – 55.0	48.0 – 52.0 within 2 minutes (reasonable endeavours)	49.0 – 51.0 within 10 minutes

Note: 1. In the FOS that came into effect on 14 November 2017, the Recovery band following a protected event for an island within Tasmania was incorrectly listed as 49.85 Hz – 50.15 Hz.



## A.3 Definitions

In this document:

- *Italicised* terms are defined in the National Electricity Rules.
- **Bold** terms are defined in table A.8.

**Table A.8: Definitions**

<b>TERM</b>	<b>DEFINITION</b>
<b>accumulated time error</b>	For a measurement of <b>system frequency</b> that <i>AEMO</i> uses, the integral over time of the difference between 20 milliseconds and the inverse of that <b>system frequency</b> , starting from a time <i>published</i> by <i>AEMO</i> .
<b>generation and load change band</b>	For the <b>Mainland</b> : <ol style="list-style-type: none"> <li>1. 49.0 – 51.0 Hz for an <b>island</b></li> <li>2. during <b>supply scarcity</b>: <ol style="list-style-type: none"> <li>a. 48.0 – 52.0 in an island incorporating South Australia or Queensland; and</li> <li>b. 48.5 – 52.0 in an island incorporating Victoria or New South Wales</li> </ol> </li> <li>3. 49.5 – 50.5 Hz otherwise.</li> </ol> For <b>Tasmania</b> : 48.0 – 52.0 Hz.
<b>generation event</b>	<ol style="list-style-type: none"> <li>1. a <i>synchronisation</i> of a <i>generating unit</i> of more than 50 MW;</li> <li>2. an event that results in the sudden, unexpected and significant increase or decrease in the <i>generation</i> of one or more <i>generating systems</i> totalling more than 50MW in aggregate within no more than 30 seconds; or</li> <li>3. the <i>disconnection</i> of <i>generation</i> as the result of a <i>credible contingency event</i> (not arising from a <b>load event</b>, a <b>network event</b>, a <b>separation event</b> or part of a <b>multiple contingency event</b>), in respect of either a single <i>generating system</i> or a single <i>dedicated connection asset</i> providing <i>connection</i> to one or more <i>generating systems</i>.</li> </ol>
<b>island</b>	A part of the <i>power system</i> that includes <i>generation</i> , <i>networks</i> and <i>load</i> , for which all of its alternating current <i>network connections</i> with other parts of the <i>power system</i> have been <i>disconnected</i> , provided that the part: <ol style="list-style-type: none"> <li>1. does not include more than half of the combined <i>generation</i> of each of two <i>regions</i> (determined by available capacity before <i>disconnection</i>); and</li> </ol>

TERM	DEFINITION
	2. contains at least one whole <i>inertia sub-network</i> .
<b>island separation band</b>	<p>For the <b>Mainland</b>:</p> <ol style="list-style-type: none"> <li>1. for a part of the <i>power system</i> that is not an <b>island</b>, the <i>operational frequency tolerance band</i>;</li> <li>2. for an <b>island</b> that includes a part of the <i>power system</i> to which no notice under paragraph (3) applies, the <i>operational frequency tolerance band</i>; and</li> <li>3. otherwise in respect of an <b>island</b>, the <i>frequency band</i> determined by the most restrictive of the high limits and low limits of <i>frequency ranges</i> outside the <i>operational frequency tolerance band</i> notified by a <b>JSSC</b> to AEMO with adequate notice to apply to a nominated part of the <b>island</b> within the <b>JSSC's</b> <i>region</i>.</li> </ol> <p>For <b>Tasmania</b>: the <i>extreme frequency excursion tolerance limits</i>.</p>
<b>JSSC</b>	<i>Jurisdictional System Security Coordinator</i>
<b>load event</b>	<p>For the <b>Mainland</b>: <i>connection</i> or <i>disconnection</i> of more than 50 MW of <i>load</i> not resulting from a <b>network event</b>, <b>generation event</b>, <b>separation event</b> or part of a <b>multiple contingency event</b>.</p> <p>For <b>Tasmania</b>: either a change of more than 20 MW of <i>load</i>, or a rapid change of flow by a <i>high voltage</i> direct current <i>interconnector</i> to or from 0 MW to start, stop or reverse its power flow, not arising from a <b>network event</b>, <b>generation event</b>, <b>separation event</b> or part of a <b>multiple contingency event</b>.</p>
<b>multiple contingency event</b>	Either a <i>contingency event</i> other than a <i>credible contingency event</i> , a sequence of <i>credible contingency events</i> within 5 minutes, or a further <b>separation event</b> in an <b>island</b> .
<b>mainland</b>	The Queensland, New South Wales, Victoria and South Australia <i>regions</i> .
<b>network event</b>	A <i>credible contingency event</i> other than a <b>generation event</b> , <b>load event</b> , <b>separation event</b> or part of a <b>multiple contingency event</b> .
<b>separation event</b>	A <i>credible contingency event</i> affecting a <i>transmission element</i> that results in an <b>island</b> .
<b>supply scarcity</b>	Where <i>load</i> has been <i>disconnected</i> other than in accordance with <i>dispatch instructions</i> or a <i>direction</i> or <i>clause 4.8.9</i>

<b>TERM</b>	<b>DEFINITION</b>
	<i>instruction</i> , or the provision of a <i>market ancillary service</i> , and not yet restored.
<b>system frequency</b>	The <i>frequency</i> of the <i>power system</i> , or an <b>island</b> (as applicable).
<b>Tasmania</b>	The <i>Tasmania region</i> .