The Frequency operating standard

The Panel has made a determination to amend, in accordance with clause 8.8.3(a)(1) of the Rules and section 38 of the NEL, the NEM Mainland frequency operating standards which form part of the *power system security standards*. These amendments are contained in this Appendix A. This standard is effective from 14 November 2017.

A.1 Frequency operating standards for the mainland NEM

A.1.1 Part A Summary of the Frequency operating standards for the mainland NEM

The NEM Mainland *frequency operating standards* set out in Part B are summarised in the following tables for convenience. To the extent of any inconsistency between these tables and Part B below, Part B prevails. The following table applies to any part of the NEM Mainland *power system*, other than an *island* or during periods of supply scarcity during load restoration:

Table A.1.1 NEM Mainland Frequency Operating Standards – interconnected system

Condition	Containment	Stabilisation	Recovery
Accumulated time error	15 seconds	n/a	n/a
No contingency event or load event	49.75 to 50.25 Hz, 49.85 to 50.15 Hz - 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Generation event or load event	49.5 to 50.5 Hz	49.85 to 50.15 Hz within 5 minutes	
Network event	49 to 51 Hz	49.5 to 50.5 Hz within 1 minute	49.85 to 50.15 Hz within 5 minutes
Separation event	49 to 51 Hz	49.5 to 50.5 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Protected event	47 to 52 Hz	49.5 to 50.5 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	47 to 52 Hz (reasonable endeavours)	49.5 to 50.5 Hz within 2 minutes (reasonable endeavours)	49.85 to 50.15 Hz within 10 minutes (reasonable endeavours)

Table A.1.2 NEM Mainland Frequency Operating Standards – island system

Condition	Containment	Stabilisation	Recovery
No contingency event, or load event	49.5 to 50.5 Hz		
Generation event, load event or network event	49 to 51 Hz	49.5 to 50.5 Hz within 5 minutes	
The separation event that formed the island	49 to 51 Hz or a wider band notified to AEMO by a relevant Jurisdictional Coordinator	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
Protected event	47 to 52 Hz	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
Multiple contingency event including a further separation event	47 to 52 Hz (reasonable endeavours)	49.0 to 51.0 Hz within 2 minutes (reasonable endeavours)	49.5 to 50.5 Hz within 10 minutes (reasonable endeavours)

Table A.1.3 NEM Mainland Frequency Operating Standards – during supply scarcity

Condition	Containment	Stabilisation	Recovery
No contingency event or load event	49.5 to 50.5 Hz		
Generation event, load event or network event	48 to 52 Hz (Queensland and South Australia) 48.5 to 52 Hz (New South Wales and Victoria)	49 to 51 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
Protected event	47 to 52 Hz	49.0 to 51.0 Hz within 2 minutes	49.5 to 50.5 Hz within 10 minutes
Multiple contingency event or separation event	47 to 52 Hz (reasonable endeavours)	49.0 to 51.0 Hz within 2 minutes (reasonable endeavours)	49.5 to 50.5 Hz within 10 minutes (reasonable endeavours)

The mainland *frequency operating standards* during *supply scarcity* apply if:

1. A situation of *supply scarcity* is current.
2. In cases where an island incorporates more than one region then the critical frequency to be adopted is to be the maximum value of the critical frequencies for

these regions (e.g. for an island comprised of the regions of Victoria and South Australia the critical frequency would be 48.5 Hz)

3. The power system has undergone a contingency event, the frequency has reached the Recovery frequency band and AEMO considers the power system is sufficiently secure to begin load restoration.

4. The estimated amount of load available for under-frequency load shedding within the power system or the island is more than the amount required to ensure that any subsequent frequency excursions would not go below the proposed Containment and Stabilisation bands as a result of a subsequent generation event, load event, network event or a separation event during load restoration.

5. The amount of generation reserve available for frequency regulation is consistent with AEMO's current practice.

A.1.2 Part B - The frequency operating standards for the mainland

For the purposes of the Rules, the *frequency operating standards*, forming part of the power system security and reliability standards that apply in the mainland are:

(a) except in an island or during supply scarcity, the accumulated time error should not exceed 15 seconds;

(b) except as a result of a contingency event or a load event, system frequency should not exceed the applicable *normal operating frequency excursion band* and should not exceed the applicable *normal operating frequency band* for more than five minutes on any occasion and not for more than 1% of the time over any 30 day period;

(c) as a result of a generation event or a load event, system frequency should not exceed the applicable generation and load change band and should not exceed the applicable *normal operating frequency band* for more than five minutes;

(d) as a result of any network event, system frequency should not exceed the applicable *operational frequency tolerance band* and should not exceed the applicable generation and load change band for more than one minute or exceed the applicable *normal operating frequency band* for more than five minutes;

(e) as a result of any separation event, system frequency should not exceed the applicable island separation band and should not exceed the applicable generation and load change band for more than two minutes or exceed the applicable *normal operating frequency band* for more than ten minutes; and

(f) as a result of any *protected event*, system frequency should not exceed the *extreme frequency excursion tolerance limits* and should not exceed the applicable generation and load change band for more than two minutes while there is no *contingency event* or exceed the applicable *normal operating frequency band* for more than ten minutes while there is no *contingency event*.

(g) following the occurrence of any *non-credible contingency event* or multiple *contingency event* that is not a *protected event*, AEMO should use reasonable endeavours to:

i. maintain system frequency within the *extreme frequency excursion tolerance limits* and

ii. avoid the system frequency exceeding the applicable generation and load change band for more than two minutes while there is no *contingency event* or exceeding the applicable *normal operating frequency band* for more than ten minutes while there is no *contingency event*.

A.1.3 Part C - Application of Rules Terms for the mainland

For the purposes of these *frequency operating standards* and Chapters 4, 5 and 10 of the Rules, a term shown in Column 1 of the following table:

i) has the corresponding range shown in Column 3 of the table for an island;

ii) has the corresponding range shown in Column 4 during supply scarcity; and

iii) has the corresponding range shown in Column 2 of the table otherwise.

Table B.4 NEM mainland frequency operating standards – Rule terms

Column 1	Column 2	Column 3	Column 4
Term	**Normal range (Hz)**	**Island range (Hz)**	**Supply scarcity range (Hz)**
normal operating frequency band	49.85 to 50.15	49.5 to 50.5	49.5 to 50.5
normal operating frequency excursion band	49.75 to 50.25	49.5 to 50.5	49.5 to 50.5
operational frequency tolerance band	49.0 to 51.0	49.0 to 51.0	48.0 to 52.0
extreme frequency excursion tolerance limit	47.0 to 52.0	47.0 to 52.0	47.0 to 52.0[1]

[1] Previously this table incorrectly listed the extreme frequency excursion tolerance limit during supply scarcity as 47.0Hz – 55.0Hz. The upper limit has been corrected to 52.0Hz in this FOS.

A.2 Frequency operating standards for Tasmania

A.2.1 Part A Summary of the Standards for Tasmania

The Tasmanian *frequency operating standards* set out in Part B of this appendix are summarised in the following tables for convenience. To the extent of any inconsistency between these tables and Part B below, Part B prevails. Table A.2.1 applies to any part of the Tasmanian power system:

Table A.2.1 Tasmanian frequency operating standards – interconnected system

Condition	Containment	Stabilisation	Recovery
Accumulated time error	15 seconds		
No contingency event or load event	49.75 to 50.25 Hz 49.85 to 50.15 Hz, 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Load event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Generation event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Separation event	47 to 55 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Protected event	47 to 55 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	47 to 55 Hz (reasonable endeavours)	48.0 to 52.0 Hz within 2 minutes (reasonable endeavours)	49.85 to 50.15 Hz within 10 minutes (reasonable endeavours)

Table A.2.2 applies to an island within the Tasmanian power system:

Table A.2.2 Tasmania frequency operating standards – island operation

Condition	Containment	Stabilisation	Recovery
No contingency event or load event	49.0 to 51.0 Hz		
Load and generation event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Separation event	47 to 55 Hz	48.0 to 52.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes

Condition	Containment	Stabilisation	Recovery
Protected event	47 to 55 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	47 to 55 Hz (reasonable endeavours)	48.0 to 52.0 Hz within 2 minutes (reasonable endeavours)	49.0 to 51.0 Hz within 10 minutes (reasonable endeavours)

A.2.2 Part B: the Frequency operating standards for Tasmania

For the purposes of the Rules, the frequency operating standards, forming part of the power system security and reliability standards, that apply in Tasmania are:

(a) except in an island or following a multiple *contingency event,* the accumulated time error should not exceed 15 seconds;

(b) except as a result of a *contingency* or a l*oad* event*,* system frequency should not exceed the applicable *normal operating frequency excursion band* and should not exceed the applicable *normal operating frequency band* for more than five minutes on any occasion and for not more than 1% of the time over any 30 day period;

(c) as a result of a generation event, system frequency should not exceed the applicable generation change band and should not exceed the applicable *normal operating frequency band* for more than 10 minutes;

(d) as a result of a load event, system frequency should not exceed the load change band and should not exceed the applicable *normal operating frequency band* for more than 10 minutes;

(e) as a result of any network event, system frequency should not exceed the applicable *operational frequency tolerance band* and should not exceed the applicable *load change band* for more than one minute or the applicable *normal operating frequency band* for more than 10 minutes;

(f) as a result of any separation event, system frequency should not exceed the applicable island separation band and should not exceed the applicable load change band for more than two minutes or the applicable *normal operating frequency band* for more than 10 minutes;

(g) as a result of any *protected event,* system frequency should not exceed the *extreme frequency excursion tolerance limits* and should not exceed the applicable generation and load change band for more than two minutes while there is no *contingency event* or exceed the applicable *normal operating frequency band* for more than ten minutes while there is no *contingency event*.

(h) following the occurrence of any *non-credible contingency event* or multiple *contingency event* that is not a *protected event*, AEMO should use reasonable endeavours to:

i. maintain system frequency within the applicable *extreme frequency excursion tolerance limits* and

ii. avoid the *system frequency* exceeding the applicable *load change band* for more than two minutes while there is no *contingency event* or exceeding the applicable *normal operating frequency band* for more than 10 minutes while there is no *contingency event*;

(i) the size of the largest single generator event is limited to 144 MW,[2] which can be implemented for any *generating system* with a capacity that is greater than 144 MW by the automatic tripping of load;

A.2.3 Part C Application of Rules terms

For the purposes of these *frequency operating standards* and the Rules, a term shown in column 1 of the following table has the corresponding range shown in column 3 of the table for an island and has the corresponding range shown in column 2 of the Table otherwise.

Tasmanian Frequency Operating Standards – Rule terms

Term	Normal range (Hz)	Island range (Hz)
normal operating frequency band	49.85 to 50.15	49.0 to 51.0
normal operating frequency excursion band	49.75 to 50.25	49.0 to 51.0
operational frequency tolerance band	48.0 to 52.0	48.0 to 52.0
extreme frequency excursion tolerance limit	47.0 to 55.0	47.0 to 55.0

2 AEMO may in accordance with clause 4.8.9 direct a Generator to exceed the 144 MW contingency limit if AEMO reasonably believes this would be necessary in order to maintain a reliable operating state.

A.3 Part D - Definitions for the frequency operating standards

Term	Definition
accumulated time error	means, in respect of a measurement of *system frequency* that AEMO uses for controlling *system frequency*, the integral over time of the difference between 20 milliseconds and the inverse of that *system frequency*, starting from a time *published* by *AEMO*.
available capacity	has the meaning given to it in the Rules.
connection point	has the meaning given to it in the Rules.
contingency event	has the meaning given to it in the Rules.
credible contingency event	has the meaning given to it in the Rules.
extreme frequency excursion tolerance limits	has the meaning given to it in the Rules.
frequency operating standards	has the meaning given to it in the Rules and are the standards set out in Part B of this document.
Generating system	has the meaning given to it in the Rules.
generating unit	has the meaning given to it in the Rules.
generation	has the meaning given to it in the Rules.
Generation change band	for the mainland - means the frequency range of 49.0 to 51.0 Hz in respect of an island and the frequency range of 49.5 to 50.5 Hz otherwise. for Tasmania - means the frequency range of 48.0 to 52.0 Hz in respect of an island and otherwise.
generation event	means: 1. a *synchronisation* of a *generating unit* of more than 50 MW, or 2. an event that results in the sudden, unexpected and significant increase or decrease in the *generation* of one or more *generating systems,* totalling more than 50MW in aggregate, within a period of 30 seconds or less, or 3. a *credible contingency event*, not arising from a load event, a *network event*, a *separation event* or a part of a *multiple contingency event*."

Term	Definition
Interconnector	A *transmission line* or group of *transmission lines* that connects the *transmission networks* in adjacent regions.
island	means a part of the *power system* that includes *generation*, *networks* and *load*, for which all of its alternating current network connections with other parts of the *power system* have been disconnected, provided that the part: (a) does not include more than half of the combined *generation* of each of two *regions* (determined by available capacity before disconnection); and (b) contains at least one whole inertia sub-network.
island separation band	for the mainland - means: (a) in respect of a part of the power system that is not an island, the operational frequency tolerance band; (b) in respect of an island that includes a part of the power system to which no notice under paragraph (c) applies, the operational frequency tolerance band; and (c) otherwise in respect of an island, the frequency band determined by the most restrictive of the high limits and low limits of frequency ranges outside the operational frequency tolerance band notified by Jurisdictional Coordinators to AEMO with adequate notice to apply to a nominated part of the island within their respective jurisdictions. for Tasmania - means the *extreme frequency excursion tolerance limits*
Jurisdictional Coordinator	has the meaning given to it in the Rules.
load	has the meaning given to it in the Rules.
Load change band	for the mainland - means the frequency range of 49.0 to 51.0 Hz in respect of an island and the frequency range of 49.5 to 50.5 Hz otherwise. for Tasmania - means the frequency range of 48.0 to 52.0 Hz in respect of an island and otherwise.
load event	for the mainland - means an identifiable connection or disconnection of more than 50 MW of customer load (whether at a *connection point* or otherwise), not arising from a *network event, a generation event, a separation event* or a part of a *multiple contingency event*. for Tasmania - means an either an identifiable increase or decrease of more than 20 MW of customer load (whether at a *connection point* or otherwise), or a rapid change of flow by a *high voltage* direct current interconnector to or from 0 MW for the purpose of

Term	Definition
	starting, stopping or reversing its power flow, not arising from a network event, a *generation event, a separation event* or a part of a *multiple contingency event*
Market network service provider	has the meaning given to it in the Rules.
multiple contingency event	means either a *contingency event* other than a *credible contingency event,* a sequence of *credible contingency events* within a period of 5 minutes, or a further *separation event in an island.*
National grid	has the meaning given to it in the Rules.
AEMO	has the meaning given to it in the Rules.
network	has the meaning given to it in the Rules.
network event	means a *credible contingency event* other than a *generation event*, a separation event or a part of a *multiple contingency event.*
normal operating frequency band	has the meaning given to it in the Rules.
normal operating frequency excursion band	has the meaning given to it in the Rules.
operational frequency tolerance band	has the meaning given to it in the Rules.
power system	has the meaning given to it in the Rules.
power system security and reliability standards	has the meaning given to it in the Rules.
publish	has the meaning given to it in the Rules.
region	has the meaning given to it in the Rules.
Rules	The Rules means National Electricity Rules
separation event	means a *credible contingency* event in relation to a *transmission element* that forms an *island.*
supply scarcity	means the condition where *load* has been disconnected either manually or automatically, other than in accordance with dispatch instructions or service provision, and not yet restored to supply.
Synchronisation	The act of synchronising a *generating unit* or a scheduled network service to the *power system*
synchronisation	has the meaning given to it in the Rules.
system frequency	means the frequency of a part of the *power system,* including the *frequency* of an *island.*

Term	Definition
Technical envelope	has the meaning given to it in the Rules.
transmission element	has the meaning given to it in the Rules.