Ancillary Service Report 2013 prepared under clause 3.11.11 of the Market Rules by System Management – 26 June 2013

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1 Introduction

1.1 System Management

Western Power is established under section 4(1)(b) of the *Electricity Corporations Act 2005* and has the functions conferred under section 41 of that act.

Part 9 of the *Electricity Industry Act 2004* makes provision for a wholesale electricity market and provides for the establishment of Market Rules.

One of the core functions undertaken by Western Power is the management of the electricity transmission and distribution networks. Regulation 13 of the *Electricity Industry (Wholesale Electricity Market) Regulations 2004* provides that the Market Rules may confer on an entity the function of operating the South West Interconnected System (SWIS) in a secure and reliable manner.

Clause 2.2 of the *Wholesale Electricity Market Amending Rules (September 2006)* (**Market Rules**) confers this responsibility upon the segregated ("ringfenced") business unit of Western Power known as System Management. Amongst these responsibilities, the functions of System Management include the need to:

- operate the SWIS in a secure and reliable manner; and
- provide regular reports to the IMO and other market participants.

Included in the requirement to report is the Ancillary Service Report which is described in clause 3.11.11 of the Market Rules.

1.2 Ancillary Service Report

System Management has prepared this report pursuant to its obligations under clause 3.11.11 of the Market Rules, for the two year period 1 July 2012 to 30 June 2014. The Ancillary Service Report comprises of three parts to meet each of these requirements:

(a) the quantities of each of the Ancillary Services provided in the preceding year, including Ancillary Services provided under Ancillary Service Contracts, and the adequacy of these quantities (Chapter 2);

(b) the total cost of each of the categories of Ancillary Services provided, including Ancillary Services provided under Ancillary Service Contracts, in the preceding year (Chapter 3); and

(c) the Ancillary Service Requirements for the coming year and the Ancillary Services plan to meet those requirements (Chapter 4).

2 Quantities of Ancillary Services in the Preceding Year (2012/13)

2.1 Load Following and Spinning Reserve

The average Load Following Raise enabled during the period 1 July 2012 to 30 April 2013 was 96 MW. The average Load Following Lower enabled during the same period was 90MW. Note that prior to the start of the Load Following Market on 1 July 2013, only combined Spinning Reserve/Load Following Raise requirements were recorded and so for the period 1 May 2013 to 30 June 2013 are not available.

It must be noted that more Load Following than the minimum requirement used for the Load Following Market will often be enabled. This is because generators are enabled for Load Following Service bring on line large increments of Load Following, rather than amounts that just meet the minimum requirement. For example when a Gas Turbine is enabled for load following service it is enabled to provide the service between the minimum and maximum output limits not a defined Load Following quantity.

Spinning Reserve Service (SRS) supplied for the period 1 May 2012 to 30 April 2013 inclusive was 317 MW (inclusive of 96MW of Load Following Raise) during Peak intervals and 291 MW (inclusive of 96MW of Load Following Raise) during Off-Peak intervals.

The 2012/13 SRS requirement was for the sum of the load following and spinning reserve to be greater than 70% of the maximum output of any generator. This is up to 240MW being 70% of Collie Power Station which has a maximum output of 340MW

The amount of spinning reserve that was provided was above the minimum requirement.

It must be noted that more spinning reserve than the minimum requirement will often be enabled. This is because generators are committed/decommitted to the system that bring on line large increments of spinning reserve rather than amounts that just meet the minimum requirement.

During 2012/13 there was one involuntary Under Frequency Load Shedding event on 6 March 2013. On this occasion sufficient SRS was enabled however two generators were lost simultaneously, a contingency not covered by the SRS requirement. This results in customers being disconnected in order to ensure the security of the SWIS.

More details may be found on the Western Power Website at

http://westernpower.com.au/documents/retailersgenerators/systemManagement/Information_flyer_system_disturbance_6_march_2013.pdf

The adequacy of the load following service can be determined by analysing the distribution of the system frequency. The historic performance is given in Table 1 below.

Table 1 – Historic Frequency Performance

Month	Time Within 49.80-50.20Hz	Average Hz	Standard Deviation Hz
May-11	99.98%	50.00	0.022
Jun-11	100.00%	50.00	0.025
Jul-11	99.98%	50.00	0.026
Aug-11	99.98%	50.00	0.024
Sep-11	100.00%	50.00	0.020
Oct-11	100.00%	50.00	0.019
Nov-11	99.97%	50.00	0.020
Dec-11	99.97%	50.00	0.021
Jan-12	100.00%	50.00	0.018
Feb-12	99.96%	50.00	0.022
Mar-12	99.99%	50.00	0.017
Apr-12	99.99%	50.00	0.017

For 2012/13 the LFS was required to be sufficient to maintain the system frequency between 49.80Hz and 50.20Hz for 99.9% for each month as determined by last years Ancillary Service Report.

Table 1 shows that for each month the frequency requirement was achieved with the frequency distribution being 99.96% or better with an average enablement of +96/-90MW of Load Following. This frequency performance is consistent with other power systems, including the National Electricity Market, whose frequency performance is well above their LFS requirement.

2.2 Load Rejection

Load Rejection Reserve Service (LRRS) is calculated for dispatch purposes, with quantities of this service being dynamic and not currently recorded for historic analysis.

For 2012/13 the LRRS was required to be sufficient to maintain the system frequency below 51.0 Hz, returned to less than 50.5 Hz within two minutes and returned to 49.8 - 50.2 Hz within 15 minutes.

The amount of Load Rejection Reserve is not currently recorded in realtime and so no quantative value is presented. System Management will endeavour to start recording this value to provide this for the next ancillary service report.

No overfrequency events above 51Hz were recorded during 2012/13. The highest recorded overfrequency event was 50.44Hz.

2.3 Dispatch Support

Dispatch Support Services (DSS) were procured from Verve Energy for Power System Security.

The quantities of DSS for the period 1 May 2012 to 30 April 2013 inclusive as well as the quantities from the previous year are given in Table 2.

Table 2 –Historic Dispatch Support Service Provision

Dispatch Support Facility	1/5/2012-30/4/2013	1/5/2011-30/4/2012
Mungarra Gas Turbines	51,834 MWh	46,790 MWh
Kalgoorlie Gas Turbines	3,106 MWh	299 MWh
Geraldton Gas Turbine	0 MWh	0 MWh

The use of the Mungarra Gas Turbines increased by about 10% over the previous year. This was a result of increased transmission line maintenance in the Geraldton Area.

The use of the Kalgoorlie Gas Turbines increased significantly as there was an outage of the Muja-Kalgoorlie 220kV transmission line in 2012/13. This outage in April 2013 lasted for 5 days. The outage occurred between Merredin and Kalgoorlie and in order to minimise the use of DSS the circuit was returned to service overnight.

2.4 System Restart

No System Restart Services were used in 2012/13.

Two Verve Energy and one Perth Energy Black Start facilities are allocated for this purpose. These facilities are Kwinana GT1, PerthEnergy Kwinana GT1 and Pinjar GT3 & Pinjar GT5.

Note Pinjar GT3 & Pinjar GT5 are considered one black start facility as they are at the same site.

These gas turbines are in the range of 20-30MW which is sufficient to start other generators in the area.

3 Cost of Ancillary Services in the Preceding Year (2012/13)

The cost of each ancillary service for the period 1 April 2012 to 31 March 2013 as well as the cost for the previous year is given in Table 3. The costs are defined in Market Rule 3.13.1 and are calculated and collected by the IMO on behalf of System Management.

It should be noted that the price of Spinning Reserve and Dispatch Support Services for each trading interval is dependent on the Balancing Price during the trading intervals.

Table 3 – Cost of Ancillary Services

Ancillary Service	1/4/2012 – 31/3/2013 Total Payment (excluding GST)	1/4/2011 – 31/3/2012 Total Payment (excluding GST)
Load Following	$ 12,352,161.14 (Capacity) $ 44,764,743.06 (Availability) $ 57,116,904.20 (Total)	$ 10,388,823.40 (Capacity) $ 5,176,946.61 (Availability) $ 15,565,770.01 (Total)
Spinning Reserve	$ 21,468,550.36	$ 19,944,645.90
Load Rejection	$ 0.00	$ 0.00
System Restart	$ 497,046.68	$ 451,210.41
Dispatch Support	$ 6,011,828.22	$ 8,137,848.95
TOTAL	$ 90,494,045.14	$ 44,099,475.26

The quantities of ancillary services in 2012/13 have remained at around the same levels compared to the previous year. With the exception of Load Following Ancillary Service (Availability) there have been slight rises in costs in line with inflation.

Since the establishment of new LFS market on 1 July 2012 the price of this service rose significantly. System Management is working with the IMO to explore ways of promoting new entrants to this market and reducing LFS costs.

It should be noted that the DSS price is based on a differential between the contract price and the balancing price, as the balancing price rises this differential decreases resulting in a drop in the DSS price and hence cost.

The Load Following costs were incurred from provision of the load following values in the LFAS market for the period 1 July 2012 to 31 March 2013 being:

LFAS market quantity requested ahead of the trading interval : average +/- 79/79MW, Maximum +/-90MW, Minimum +/- 72MW.

LFAS market quantity provided during the trading interval : average +/- 74/73MW. Maximum +/-90MW, Minimum +/-25MW. See Note 1

The Spinning Reserve costs were incurred from an ancillary service parameter submission of 224.8MW on-peak and 198.1 MW off-peak for the period 1/4/2012 to 30/6/2012 and 221.49 MW on-peak and 205.78 MW off-peak for the period 1/7/2012 to 31/3/2013.

Note 1 the values given in this section are different form that given in section 2.1 because the values in section 2.1 are those determined by the technical characteristics of the generators selected for LFAS duty, whereas the values in section 3 are those that the values that are cleared to run to meet the requested requirements in the LFAS market. The market costs are based on the values in this section, rather than those given in Section 2.1

4 Ancillary Service Requirements and Plan for Coming Year (2013/14)

4.1 Ancillary Service Requirements for Coming Year 2013/14 Overview

Under Market Rule 3.11.1 the Ancillary Service Requirements must be determined by System Management in accordance with the:

- SWIS Operating Standards (as defined in Market Rule 3.1) and
- Ancillary Service Standards (as defined in Market Rule 3.10.)

The SWIS Operating Standards for system frequency are given by the Technical Rules Table 2.1. Frequency Operating Standards for the South West Interconnected Network. This is given in Appendix 1 for reference.

The requirements for each of the ancillary services have been developed to meet this requirement for the upcoming year, having regard to the requirements of the Power System Operation Procedure: Ancillary Services.

Except as otherwise noted in this section, the ancillary service requirements are not:

- location specific;
- variable for different SWIS load levels or other scenarios;
- variable by the type of day and time of day; or
- variable across the year.

4.2 Load Following Service

LFS Requirement

The need for LFAS services are caused by forecasting inaccuracies and inherent variability of loads and generators. More information may be found on this topic on the IMO website at

http://imowa.com.au/f6825,3193559/WE_n9973825_v1_Review_of_Load_Following_Quantity_Requirements_by_Brendan_Clarke.pdf

The SWIS Operating Standard is specified in the Technical Rules as “Table 2.1 Frequency Operating Standards for the South West Interconnected Network”. The “Normal Range” requirement is that system frequency shall be maintained at above 49.80 Hz and below 50.20 Hz for 99% of the time.

The Ancillary Service Standard is specified in Market Rule 3.10.1(a):-

> "*a level which is sufficient to:*
>
> *provide Minimum Frequency Keeping Capacity, where the Minimum Frequency Keeping Capacity is the greater of:*
>
> *i. 30 MW; and*
>
> *ii. the capacity sufficient to cover 99.9% of the short term fluctuations in load and output of Non-Scheduled Generators and uninstructed output fluctuations from Scheduled Generators, measured as the variance of 1 minute average readings around a thirty minute rolling average."*

To be in accordance with both standards the requirement has previously been set to be "maintain the system frequency between 49.8 and 50.2 hertz for at least 99.9% of the time for each month".

System Management performed a survey of generator and users in regard to relaxing the frequency standard. It presented this to the Market Advisory Committee at its meeting of March 2013, the details can be found on the IMO's website at

http://www.imowa.com.au/f7324,3854315/Combined_MAC_Meeting_59_Papers.pdf

System Management received a range of responses to the survey. Support for the relaxation of the frequency standard could not be conclusively determined. As such System Management does not consider it has the necessary mandate to implement the proposal at this time, but commits to engage with industry to investigate options to reduce the cost of the LFS service.

System Management has been advised by the IMO that the IMO has sought direction on this issue with the Public Utilities Office.

The Load Following Service Requirement for 2013/14 is such that the Load Following Service should be sufficient to maintain the system frequency between 49.80Hz and 50.20Hz for at least 99.9% of the time for each month. This requirement is unchanged from the previous year.

LFS Plan

System Management has observed that various dispatch configurations provide sufficient frequency control to meet the LFS Requirement. The number of these configurations is expected to increase as more LFS facilities enter the LFS market. It should be noted that the LFS can not be supplied from facilities that do not respond to continuously varying control signals.

LFS can presently be sourced from Verve or Newgen, the total capacity of these facilities to provide LFS is in the order of +/- 800MW. The maximum requirement for LFS services is when commissioning generators need to perform ramp up/down tests.

This is not envisaged to be more than 232MW up or down (depending on the test), thus there is no shortage of LFS facilities envisaged in 2013/14. For example during the ramp of

a gas turbine from minimum load to maximum load of 160MW, with a normal LFAS requirement of 72MW would equate to a total LFS requirement of 232MW.

Note further information on the changes to ancillary services may be found in the Commissioning and Testing Power System operating procedure at

http://www.imowa.com.au/f709,2377904/Commissioning_and_Testing_PSOP_July_2012.pdf

LFS Market Operation

Market Rule 7B.1.4 requires System Management to specify a LFS raise and lower amounts in MW in order to meet its obligations to meet the LFS requirement given above.

At this stage System Management has not been able with any reasonable accuracy to forecast the minute by minute fluctuations of system frequency due to load and intermittent generator variations in the short or long term. Although not specifically envisaged under Market Rule 3.10.1(a)ii, System Management has found that balancing generators must be ramped at rates based on their offers rather than those required to meet balancing market requirements, hence giving rise to an additional LFS raise and lower amounts.

As such future load following requirements are set with reference to historical results for raise and lower. These results are modified by a qualitative assessment of the impacts of upcoming developments.

The 2013 Ancillary Service Report expected that the LFAS quantity would be +/- 80MW prior to a new large Intermittent Generator at Mumbida entering service. This value was on the basis that Load Following was provided by two Frame 9 gas turbines.

In March 2013 after completion of commissioning of the High Efficency Gas Turbines at Kwinana System Management has observed that operation of these generators for Load Following duty provide adequate frequency control to meet the LFS requirement. The Load Following quantity that these generators provide is +/-72MW, being the range of control between their minimum and maximum outputs.

Susbsequent to March 2013 observations of the frequency deviations with Mumbida operating have shown no need to increase the Load Following Quantity above the above value of +/- 72MW.

System Management believes that this will be the general requirement for 2013/14.

System Management may reduce this quantity should it foresee that the causes of frequency variations are likely to be low, for example during periods of calm wind.

The IMO and System Management are currently working together to improve the methodology in which the LFS service quantity is determined and examine ways of minimising the LFS requirements. The deliberations of this working group are expected to be completed prior to the release of the next Ancillary Service Report.

4.3 Spinning Reserve Service

SRS Requirement

The SWIS Operating Standard is specified in the Technical Rules as "Table 2.1 Frequency Operating Standards for the South West Interconnected Network". The "Single Contingency Event" requirement is that the system frequency shall be maintained not to fall below 48.75 Hz and to return to 49.8 - 50.2 Hz within 15 minutes.

The Ancillary Service standard is specified in Market Rule 3.10.2 -

> *"is a level which satisfies the following principles:*
>
> *(a) the level must be sufficient to cover the greater of:*
>
> *i. 70% of the total output, including parasitic load, of the generation unit synchronised to the SWIS with the highest total output at that time; and*
>
> *ii. the maximum load ramp expected over a period of 15 minutes;*
>
> *(b) the level must include capacity utilised to meet the Load Following Service standard under clause 3.10.1, so that the capacity provided to meet the Load Following requirement is counted as providing part of the Spinning Reserve requirement;"*

Last year's SRS requirement was that "the spinning reserve level is at least 70% of the largest contingency" which does not meet the SWIS Operating Standard, (as defined in the Technical Rules) of 100% of the single contingency event. To enable this Operating Standard to be met there must be sufficient spinning reserve dispatch to equal the generation lost during the Single Contingency Event. For example if the largest Single Contingency Event is a failure of Collie Power Station operating at 340MW, to ensure the frequency does not fall below 48.75 Hz, 340MW of spinning reserve must be dispatched.

As this is a possible but rare event historically only 240MW (70% of 330MW, rounded) of spinning reserve is dispatched. This is consistent with Market Rule 3.10.2 that requires 70% of the individual contingency to be the spinning reserve dispatch quantity.

To use the level set by the SWIS Operating Standard would impose a much greater cost to the market customers to further reduce the risk of loss of supply compared to the Ancillary Service Standard which requires only 70% of the output of the contingency would need to be enabled.

The requirement is determined by the largest contingency being the greater of the largest output of any unit on the system and the largest network event which causes loss of generation. This will vary with the dispatch and commissioning plans of the various participants and network outages.

The Spinning Reserve Service Requirement for 2013/14 is the Spinning Reserve Service that is sufficient to equal at least 70% of the quantity of the largest contingency.

SRS Plan

For 2013/14 Collie Power Station is the largest unit on the SWIS with a maximum generated output of 340MW. Hence, the maximum spinning reserve level that may be required is 0.7 multiplied by 340MW which is approximately 240MW.

The largest network event is the loss of a transmission line when a power station is only being supplied by a single line. The largest instance of this is when Bluewaters Terminal is supplied by either the MU-BLW 91 or BLW-SHO 91 line. A forced outage of this line would result in the loss of about 430MW if both Bluewaters generators were dispatched at their full output. Hence the requirement would rise if this should occur.

It is noted that the SRS requirement is the necessary Spinning Reserve level less any Load Following Ancillary Service Raise requirement. For example the general minimum spinning reserve service required is 240 – 72 = 168MW.

This SRS level can be provided by such facilities as synchronised generation and interruptible loads.

There is an existing interruptible load contract for 42MW of Spinning Reserve.

The Verve Portfolio of approximately 3,000MW of Scheduled generators also can be used to supply spinning reserve, and is adequate in itself to provide the SRS Requirement.

Temporary increases in spinning reserve during commissioning tests of large generators are normally made to cover the extra risk to security. In 2013/14 no new large generators are expected to be commissioned and so this is not foreseeable. However requests for commissioning tests from existing large generators may be received and System Management would schedule more spinning reserve during these times.

Note further information on the changes to ancillary services may be found in the Commissioning and Testing Power System operating procedure at

http://www.imowa.com.au/f709,2377904/Commissioning_and_Testing_PSOP_July_2012.pdf

4.4 Load Rejection Reserve Service

LRRS Requirement

The SWIS Operating Standard is specified in the Technical Rules as “Table 2.1 Frequency Operating Standards for the South West Interconnected Network”. The “Single Contingency Event” requirement is that the system frequency shall not rise above 51.0 Hz, returned to less than 50.5 Hz within two minutes and returned to 49.8 - 50.2 Hz within 15 minutes.

The Ancillary Service Standard is specified in Market Rule 3.10.4

“The standard for Load Rejection Reserve Service is a level which satisfies the following principles:

(a) the level sufficient to keep over-frequency below 51 Hz for all credible load rejection events;"

The SWIS Operating Standard, as defined in the Technical Rules, encompasses the Ancillary Service Standard so the SWIS Operating Standard is used to set the LRRS requirement

The Load Rejection Reserve Service Requirement for 2013/14 is the Load Rejection Service that is sufficient to maintain the system frequency below 51.0 Hz, returned to less than 50.5 Hz within two minutes and returned to 49.8 - 50.2 Hz within 15 minutes.

LRRS Plan

The requirement is determined by the amount of load that is lost during a network fault. This requirement is set at 120MW, which is unchanged from last year. The network faults are, generally from a short circuit on a transmission line generally due to environmental impact. These causes severe voltage dips which in turn cause customer loads to automatically disconnect. The value is set by examining the load reductions that have historically occurred during a network fault event. Previously the internal failure of a large load was also considered, however since to date this contingency has not eventuated this no longer considered a contingency to be considered.

Market Rule 3.10.4(b) allows the LRRS level (of 120MW) to be reduced by 25% at times when the risk of load rejection is low. This occurs when the prevailing weather conditions as a result of the risk of a network fault causing a load rejection is being significantly reduced at times of low lightning activity. Thus this level may be reduced to 90MW during these times.

System Management sets the LRRS requirement at the necessary Load Rejection Reserve level less any Load Following Ancillary Service Lower requirement. For example the general minimum load rejection reserve service required is 120 – 72 = 48MW.

The Verve Portfolio of approximately 3,000MW of Scheduled Generators can be used to supply Load Rejection Reserve Service, which is adequate in itself to provide the LRRS Requirement.

The amount of load rejection reserve in future years may increase if certain network events, such as the forced outage of a transmission line, will cause disconnection of larger amounts of loads. For example an increasing load in the Kalgoorlie area may result in the need to increase the LRRS since loss of a single transmission line will cause immediate disconnection of a large amount of load (circa 150MW).

Currently the LRRS scheduling is performed manually, System Management is currently implementing an automated system to perform this function through development of its Dispatch Planning Software.

4.5 Dispatch Support Service

DSS Requirement

Dispatch Support Services are forecast to be required for 2013/14. System Management does not at this time anticipate entering into additional arrangements for dispatch support during 2013/14.

DSS Plan

At this stage System Management anticipates continuing to obtain this service from the existing providers being the Verve Energy facilities at Mungarra, West Kalgoorlie and Geraldton.

The need for this service is not easily predictable as it depends on the long term transmission outage requirements. System Management does not expect a significant increase in the use of this service from the current levels.

Load increase in the Geraldton Area are expected to require the need to have more support from Mungarra from its historic levels of around 50,000MWh/year. This is expected to increase in the order of 2% per year in line with the general energy consumption increase.

Load increases in the Kalgoorlie Area are not expected to require the need to have more support from Kalgoorlie from its historic levels of 3,000MWh/year. This is based on further Muja-Kalgoorlie transmission line outages in the upcoming year.

4.6 System Restart

System Restart Requirement

System Management has proposed that there should be at least three generating stations that can start upon black system conditions and can energise the rest of the system. Three services are required to ensure that a service is available to cover one planned and one unforced outage amongst the service providers.

In addition System Management has determined that if possible the black start generators should not be at the same location to mitigate the risk of common failure at the same power station or sub-networks. The requirement for system restart is based on having restart capability in each of three electrical sub-networks being North Metropolitan, South Metropolitan and South Country.

It should be noted that certain generators with self-start facilities, such as those at Kalgoorlie, cannot restart the rest of the system due to network constraints.

The details of these requirements are given on the System Management Webpage at:

http://www.westernpower.com.au/retailersgenerators/systemManagement/System_Restart_Services.html.

System Restart Plan

System Management has obtained 3 System Restart Services as a result of a public tender process or by direct negotiation if there was insufficient response to the tender.

System Management is still assessing the feasibility of options for System Restart in the South Country region. There are no existing or proposed black start facilities in this subregion so sites are being studied where new facilities could be installed. To date one potential supplier in this region has being identified as being feasible. System Management has a range of issues to be addressed prior to finalising a contract with this facility.

In 2013/14 the service will be provided by Verve Energy gas turbines located at Kwinana and Pinjar. In addition it will be provided by Western Energy gas turbines located at Donaldson Rd.

The cost of this service for 2013/14 is expected to be $508,000.

This cost is approved by the ERA and details may be found on its website at

http://www.erawa.com.au/cproot/11215/2/20130318%20-%20Publication%20-%20Determination%20of%20Values%20for%20Ancillary%20Service%20Cost_LR%20Parameters%20-%20Final%20Decision.pdf

Appendix 1

Technical Rules Table 2.1 Frequency Operating Standards for the South West Interconnected Network

TECHNICAL RULES FOR THE SOUTH WEST INTERCONNECTED NETWORK

SECTION 2 – TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMANCE AND PLANNING CRITERIA

Table 2.1 *Frequency operating standards* for the *South West Interconnected Network*.

Condition	***Frequency* Band**	**Target Recovery Time**
Normal Range:		
South West	49.8 to 50.2 Hz for 99% of the time	
Island[(1)]	49.5 to 50.5 Hz	
Single contingency event	48.75 to 51 Hz	Normal Range: within 15 minutes. For over-*frequency* events: below 50.5 Hz within 2 minutes
Multiple *contingency event*	47.0 to 52.0 Hz	Normal Range within 15 minutes For under-*frequency* events: (a) above 47.5 Hz within 10 seconds (b) above 48.0 Hz within 5 minutes (c) above 48.5 Hz within 15 minutes. (d) For over-*frequency* events: (e) below 51.5 Hz within 1 minute (f) below 51.0 Hz within 2 minutes (g) below 50.5 Hz within 5 minutes

Note:

An island is formed when the *interconnection* between parts of the *interconnected transmission system* is broken, for example if the *interconnection* between the Goldfields region and remainder of the power system is broken.