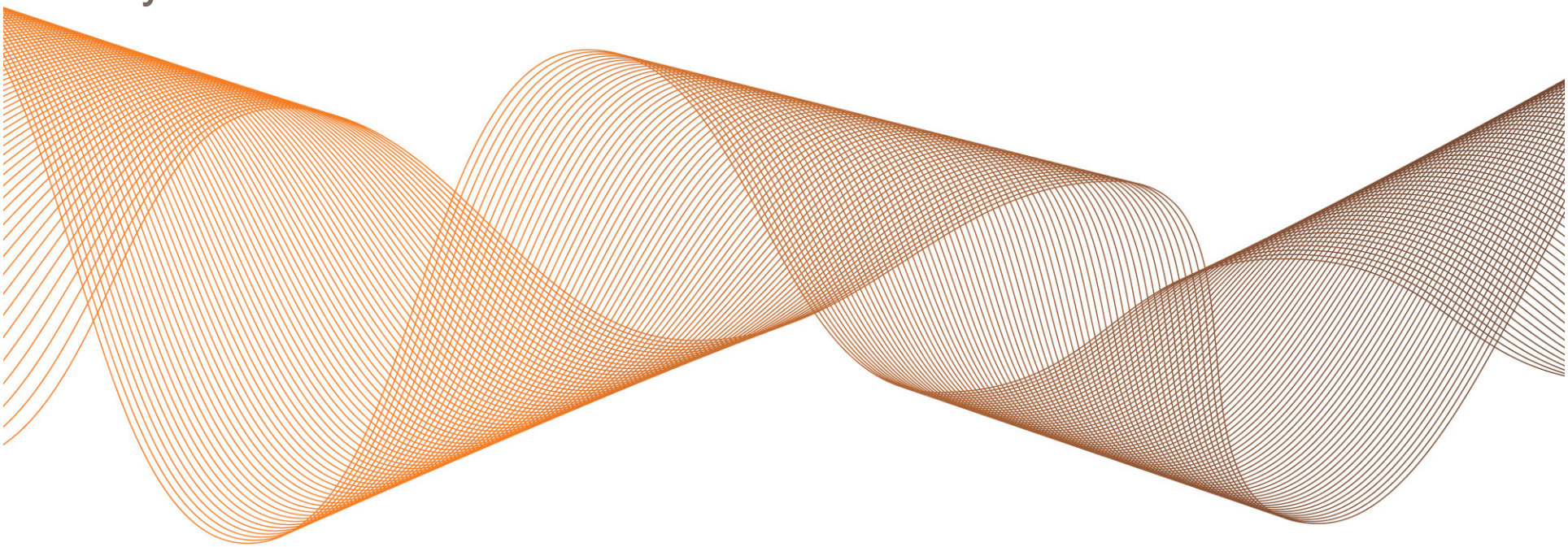
Review of Load Following Ancillary Service Quantity Requirements

Presentation to MAC Meeting 12 December 2012
by Brendan Clarke



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Topics for Today

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2 System Frequency Control Overview
3 LFAS Overview
4 Background to current Requirements
5 Current Requirements
6 Options for Change
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8 Way Forward

Drivers for Review Now

PRC 2010 27 is being progressed by IMO based on 2010 ROAM Consulting Reports.

ROAM Consulting recommended options to be investigated for reducing the quantity of Load Following Ancillary Service (LFAS).

One of five options is to relax the System Frequency control limits by accepting larger/more frequent deviations of System Frequency from 50.0 Hertz (Hz).

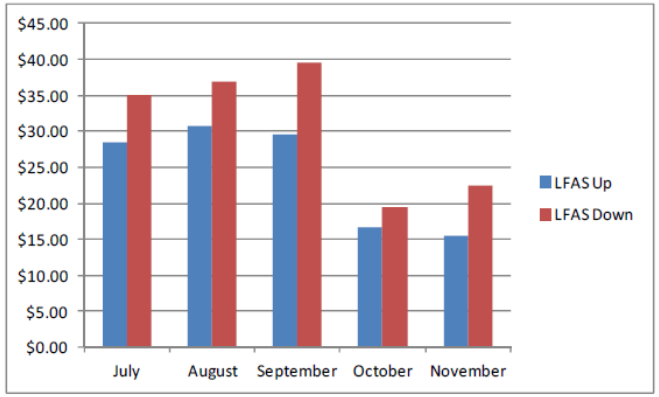
LFAS prices have been made transparent via the new LFAS market. These are significantly higher that those before the LFAS market which were set under an administered regime.

Drivers for Review Now

LFAS Prices

- LFAS costs (capacity and market)
  - $6.6m in July
  - $7.4m in August
  - $7.6m in September
- Average LF prices in October reduced by 44% (up) and 51% (down) compared with September
  - Since Verve HEGTs came online

AVERAGE	LFAS Up	LFAS Down
July	$28.42	$35.01
August	$30.72	$36.94
September	$29.61	$39.50
October	$16.60	$19.48
November	$15.50	$22.53



System Frequency Control Overview - 1

System Frequency has been traditionally been kept within a tight band around 50.0 Hz

Keeping the frequency so close to 50.0 Hz has multiple benefits:

► **it provides reasonable certainty for the starting point for any disturbance, allowing the amount of contingency services to be determined on the assumption that frequency is close to 50 Hz prior to the incident; this allows load following to be confidently used as part of spinning reserve**

► **keeping the frequency close to 50 Hz and within the governor deadband permitted by the Code (+/- 0.025 Hz) minimises wear of governor systems and therefore generation maintenance costs.**

► it minimises the chance that frequency will exceed the normal band for simultaneous occurrence of minor load and generation changes;

► time error is much easier to keep within specified limits (less than 10 seconds)

System Frequency Control Overview - 2

Historically (since mid 1990s when AGC was introduced) performance of the annual System Frequency Control has been of a very high standard for the reasons given previously.

SWIS System Frequency has remained in the Normal Band (between 49.8Hz and 50.2Hz) for about 99.95% of the time (about 20 minutes per month are not within these limits). The variation in frequency , measured as the standard deviation, is around 0.025Hz.

Note: Historic performance is published yearly in the annual Ancillary Service Report published on the IMOWA website.

System Frequency Control Overview - 3

Comparison with Overseas Markets

An examination of the NZ market requirements shows no specific requirement for the 49.8 - 50.2Hz normal band.

Principal Performance Objectives (PPO) for over/under frequency events are 50/60 per year. Year to date as of October 2012 showed actual performance is 11/18 events, well within the PPO.

http://www.ea.govt.nz/dmsdocument/13978

To enable comparisons with WEM discussions were held with Transpower. It has advised that the actual System Frequency Control performance across both islands is 49.8 – 50.2Hz for 99.7% of the time.

System Frequency Control Overview - 4

Comparison with NEM

The NEM rule requirement is to maintain frequency 49.85 - 50.15 Hz, no less than 99.0% of the time and 48.75 - 51.25 Hz, 100% of the time, with no excursion outside 49.85 – 50.15 Hz being more than 5 minutes.

Sample comparative performance is shown below

	WEM	NEM
Jun-12	99.98%	99.99%
Jul-12	99.96%	99.96%
Aug-12	99.97%	99.99%

Actual performance is in the order of 99.97%(WEM), 99.98% (NEM) (about 10-9 minutes per month are not within these limits).

http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/Power-System-Performance-Monitoring

► Essentially, Power System Operators keep System Frequency within very tight limits, well within stated standards and this has been the same in WA

.

LFAS Overview - 1

Load Following Ancillary Service is defined as

"*Load Following Service is the service of frequently adjusting:*
(a) the output of one or more Scheduled Generators; or
(b) the output of one or more Non-Scheduled Generators,

within a Trading Interval so as to match total system generation to total system load in real time in order to correct any SWIS frequency variations."

refer Market Rule 3.9.1

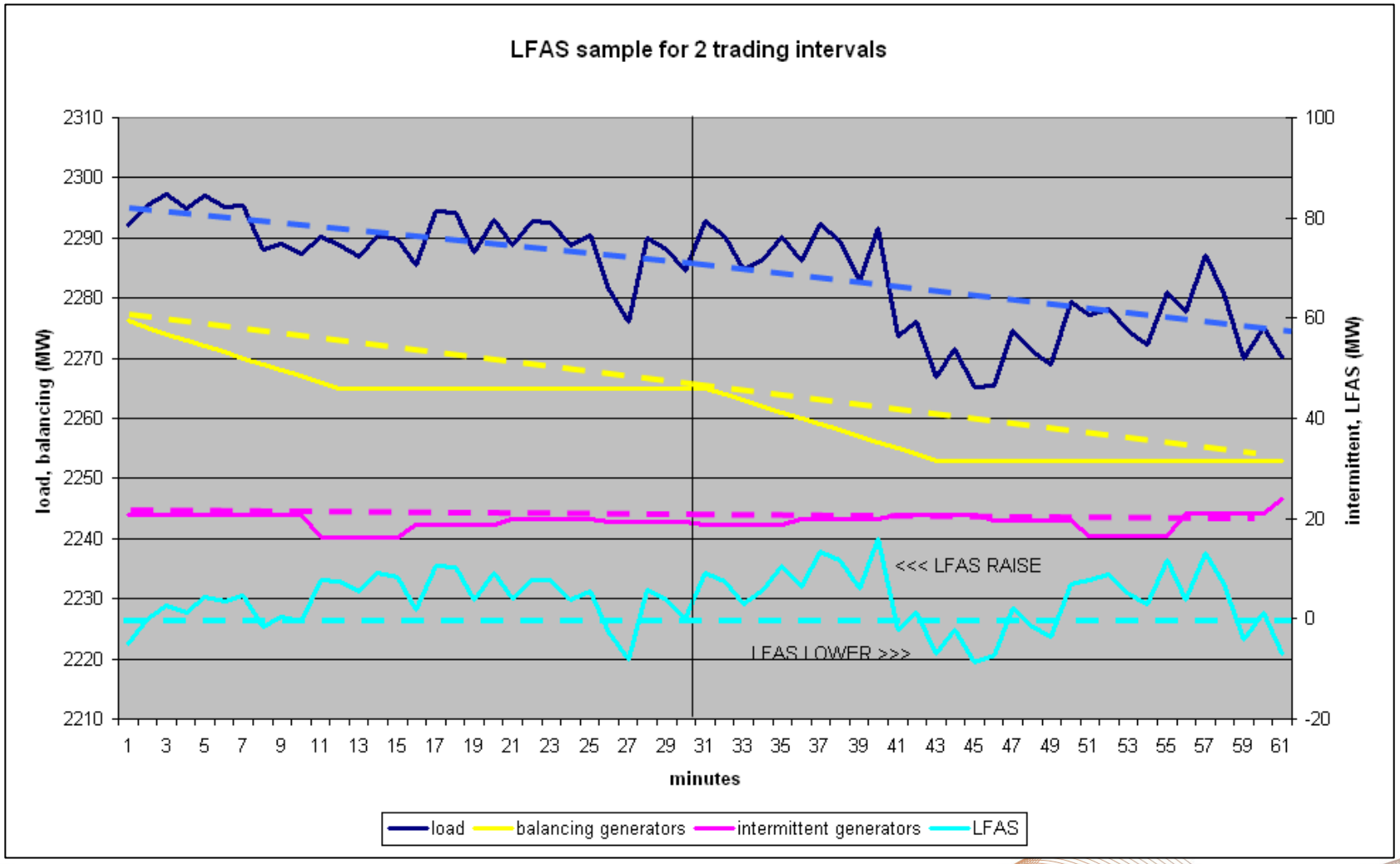
The need for LFAS arises from variability in generation, load and uncertainty in forecasts of generation and load.

LFAS is implemented by having finely controllable generators that can react in response to signals from System Management on a continuous basis (every 4 seconds). The signals are derived by System Management based on the system frequency deviations away from 50.0 hertz (Hz).

Note the LFAS signals are in addition to dispatch instructions which balance generation and load from trading interval to trading interval.

LFAS Overview - 2

Graphical representation of the variability of load and generators offset by LFAS generators



Background to current LFAS Quantity Requirements - 1

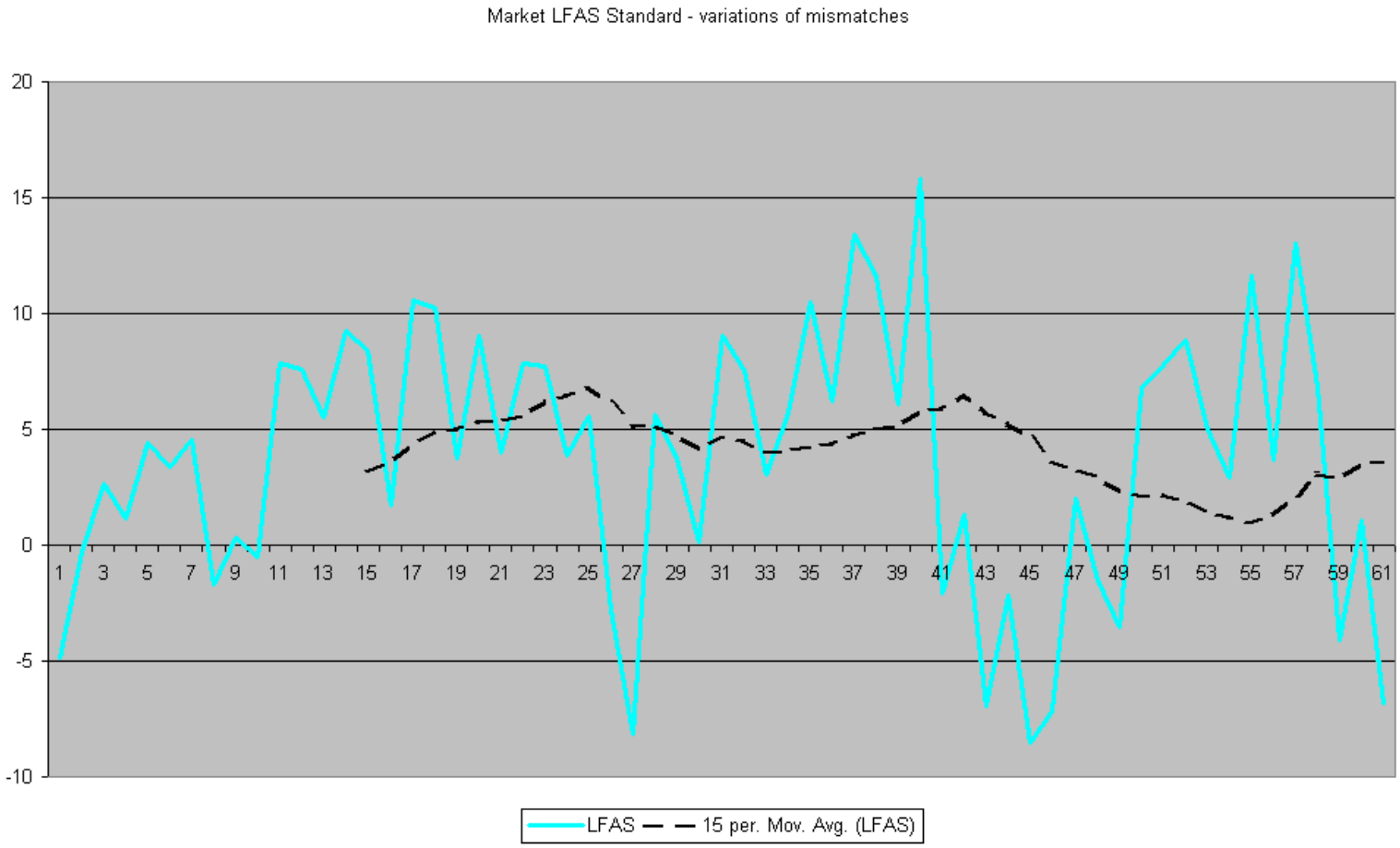
System Management must determine the LFAS quantity requirement in accordance with Market Ancillary Service Standard and SWIS Operating Standard – refer MR 3.11.1

Market Ancillary Standard is causer based being:
Capacity to cover short term generator and load fluctuations, for 99.9% of the time – a definition of the difference between LFAS and Balancing. Note does not cover forecasting uncertainty or balancing generator variations (gives a minimum LFAS requirement of about 35-40MW)

SWIS Operating Standard is customer impact based being:
A need to have Normal System Frequency Band 49.8 - 50.2 Hz, for no less than 99.0% of the time
- Technical Rules has obligations for Network Service Providers and their Consumers, to ensure their facilities are designed to operate correctly within these limits. The Market Rules has an implied obligation on System Management not to operate outside these limits (gives a minimum LFAS requirement of about 55-60MW)

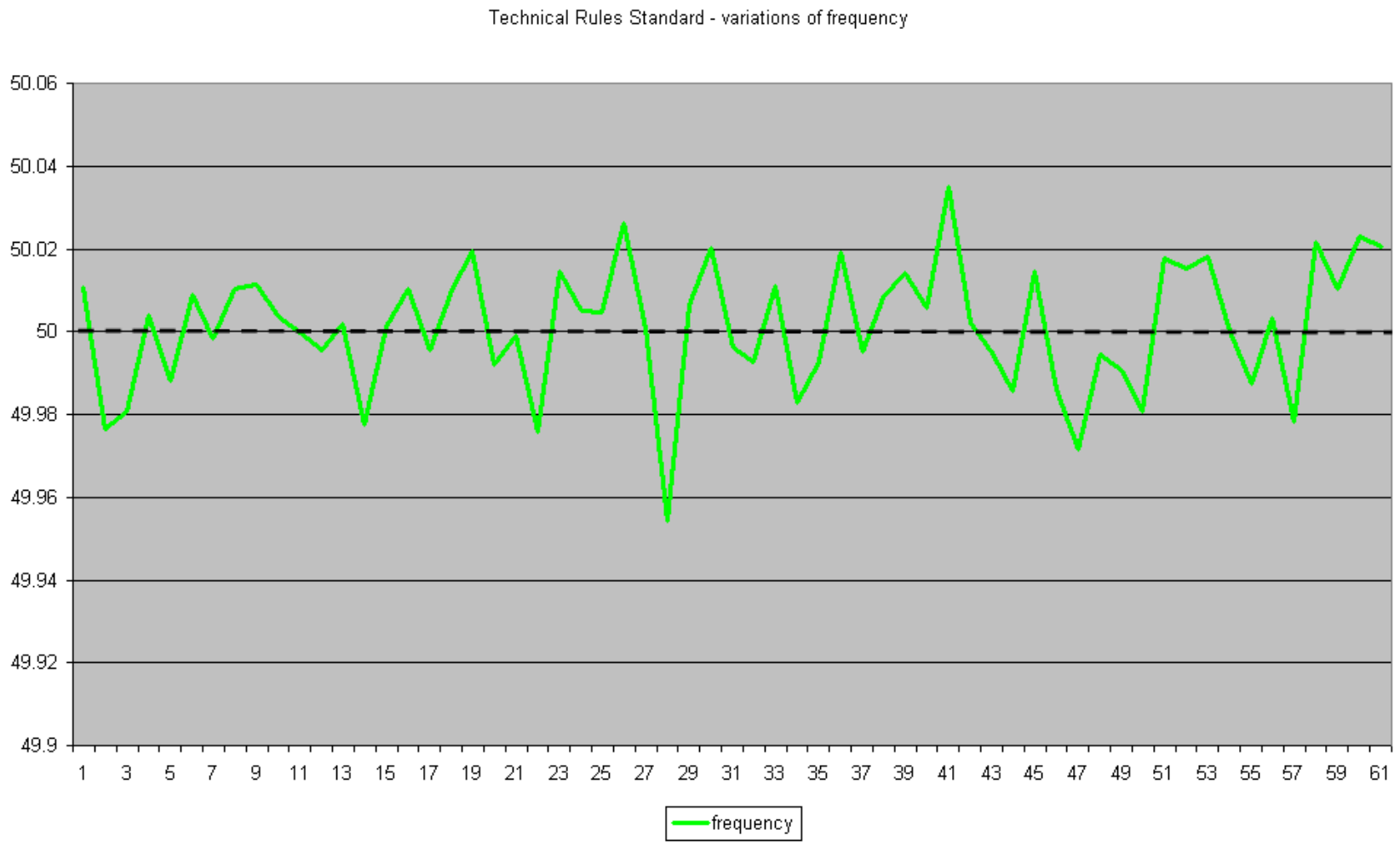
Background to current LFAS Quantity Requirements - 2

Graphical representation



Background to current LFAS Quantity Requirements - 3

Graphical representation



Current LFAS Quantity Requirements 1

System Management uses a customer impact based metric (frequency variation) that is in accordance with the Ancillary Service Standard, the SWIS Operating Requirements with a safety margin and reflects historic frequency performance.

The 2012/13 requirement is

“Ensure Sufficient LFAS is enabled to maintain System Frequency 49.8 - 50.2 Hz, 99.9% of the time for each month”

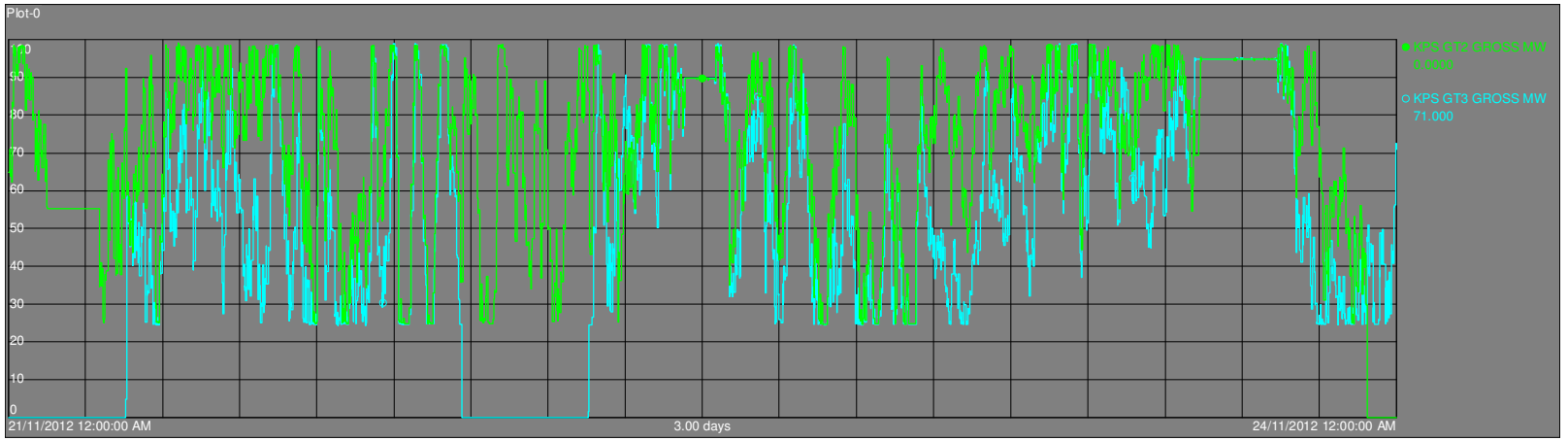
Note this accepts that 45 minutes per month it may be outside the 49.8 - 50.2 Hz range, twice the historical average performance. The maximum requirement of LFAS Raise/Lower is 80MW.

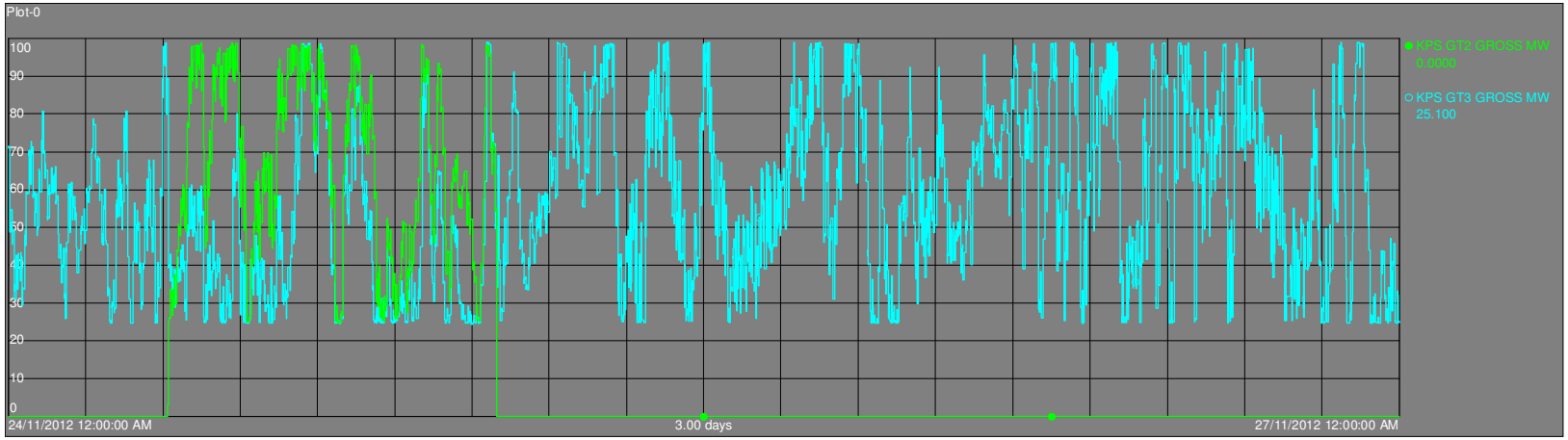
Note System Management can reduce this quantity in realtime if the forecast is for low Intermittent Generation variability 3 hours in advance.

LFAS Quantity Requirements are determined annually by System Management in the form of an Ancillary Service Report - MR 3.11.1&2. System Management must seek approval of the requirements from the IMO – refer MR 3.11.6

Current LFAS Quantity Requirements 2

Samples of the output MW of 2 LFAS machines over 3 days





Questions in regard to where we are now

The options to reduce the LFAS quantity -1

A ROAM Consulting Report to the IMO of November 2010 provided the basis for the changes considered in PRC 2010 27.

This report concluded that if the cost of LFAS is considered high, the following options may be considered to reduce the LFAS quantity.

"*Investigating opportunities to minimise load following requirements, such as through*

1 Effective wind forecasting

2 Allowing expanded frequency limits

3 Limiting aggregate maximum ramp-up rates for wind farms

4 Varying the load following requirement by time of day, or depending upon the current output level of intermittent generation

The options to reduce the LFAS quantity - 2

5 More nuanced management of aggregate intermittent generation

Geographical distribution of wind farm development to minimise generation correlation is an important way of minimising load following requirements. The collection and publishing of more detailed information on wind correlation in the SWIS is recommended, combined with appropriate incentives to developers to minimise correlations."

The following two options may also be considered

1 Reduce the dispatch interval from its current 30 minutes to shorter time to reduce variability and uncertainty e.g. in the NEM it is 5 minutes

2 Reduce the variability of Balancing Generators from the linear change in output in response to dispatch instructions.

Frequency Relaxation Option – 1

NEM Review

"The task of setting frequency standards is largely a matter of making a trade-off between quality, security and cost. The appropriate balance depends on the impact on consumers' equipment (such as loss of production or operating efficiency), its impact on generation equipment (such as consequential failure), the cost of ancillary services and the impact of any constraints imposed on the energy market.

In a market environment, an appropriate process for setting standards would be to quantify the supply cost and service impact for various levels of standard, and find the level at which these match. That is, find the level of service that the industry and consumers are prepared to pay for. However, none of these service impacts and costs is sufficiently well known or able to be determined in advance in a manner that would allow standards to be set to achieve an ideal cost-effective outcome for the industry and our consumers."

Source : NECA RELIABILITY PANEL Frequency operating standards Determination 2001 for NEM

►Hence, the optimal setting is a trade-off, but is unlikely to be an empirical analysis

Frequency Relaxation Option - 2

It is possible to relax the current requirement to reduce the margin between the current requirement and the minimum requirement , currently set by the SWIS Operating Standard.

In the extreme this accepts that the System Frequency may be outside the 49.8 - 50.2 Hz limits for 7.5 hours per month (up from the current acceptable level of 45 minutes per month and historic performance level of 20 minutes per month).

It must be noted that this goes beyond the WEM as this will be the frequency for all networks both Western Power and Non-Western Power networks connected to the SWIS, e.g. ALCOA refineries, BP Refinery, Worsley, BHP/Western Mining at Kalgoorlie

Frequency Relaxation Option - 3

Consequences for Consumers

Reduced LFAS lower quantity - Frequency occurrences higher than 50.2Hz will be more regular.

► Some generators are sensitive to over frequency events and so may trip out more regularly. This is especially true of intermittent generators.

► Increased wear on governors of generators

► There may be effects on frequency sensitive loads, i.e. industrial processes with older regenerative drives.

► More intra interval dispatch instructions to Balancing Generators as LFAS generators will be at their limit more often

Frequency Relaxation Option - 4

Consequences for Consumers

Reduced LFAS Raise quantity - Frequency occurrences lower than 49.8Hz will be more regular.

► Some loads are sensitive to under frequency events and so may trip out more regularly. This is especially true of interruptible loads which are also used for spinning reserve. If these are used up extra spinning reserve must be funded

► Increased wear on governors of generators

► Increased risk of load shedding due to generator trips because initial system frequency is not close to 50.0 Hz. Governor Responses is more critical.

► There may be effects on frequency sensitive loads, i.e. industrial processes with older regenerative drives, fluidised bed boilers

► More intra interval dispatch instructions to Balancing Generators as LFAS generators will be at their limit more often

► More Spinning Reserve is required to be funded as the LFAS Raise quantity comprises part of Spinning Reserve quantity

Questions in regard to the frequency relaxation option

Way Forward – 1

Feedback from Industry

IMO/System Management is seeking feedback in regard to the proposition –

"The LFAS cost/tight frequency control benefit trade-off currently appears unsuitable for industry and consumers."

Additionally as the effects of frequency variations on customers are not readily observable. IMO/System Management is seeking information in regard to -

► *Do you have specific requirements for frequency performance?*

► *How do customers expect their requirements in respect of power system frequency to change in future?*

► *What form of customer plant is sensitive to frequency, such as motor drives & generators?*

► *Are there any material impacts caused by frequency variations in the range 49.5 to 50.5 Hz which can cause economic loss to customers?*

Way Forward – 2

Feedback from Industry

Please provide submissions by 12 February 2013

Please mark confidential if you do not wish your submission to be made public, it will be shared only between IMO and System Management.

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Way Forward – 3

Possible Relaxation Testing / Transition

The consumers acceptability of a relaxed frequency control has not been tested previously anywhere to our knowledge. Any changes will need monitoring and taken in small steps.

If Industry feedback and information shows a minimal reduction in benefits the effects of a relaxed frequency limits can be tested.

This could start in February 2013. In order to judge its effects test may be performed to relax the frequency control slowly over time, e.g. 99.8%, 99.7%, etc and review the effects on customers

The submissions, any testing and feedback will form an input to the System Management Recommendation/ IMO Approval of the LFAS requirements for the 2013/14 financial year prepared by 1 June 2013.

Summary

► Frequency Control has been traditionally kept very close to 50.0Hz in WA and Power Systems within the region.

► If the cost of LFAS is considered high relative to the benefits, there are a range of options to reduce the quantity of the LFAS needed

► One untried option is to allow larger and more frequent variations in System Frequency compared to those previously experienced

► Industry feedback is sought with a view to relaxing the Frequency Control

► Positive feedback can initiate a test whose result will feed into the 2013 Ancillary Service Report Recommendation/Approval in June 2013.