Load Following Ancillary Service Monitoring Specification

Version 0.1 February 2014

Versioning

V0	Original draft for discussion	4 February 2014
V0.1	First Working Group Review Modifications	21 February 2014

Introduction

This document outlines the way Load Following Ancillary Service (LFAS) is monitored in the Wholesale Electricity Market (WEM) in Western Australia's South West Interconnected System (SWIS)

The LFAS Quantities monitored are

1. Usage (frequency/missing events removed & frequency/missing/suspect forecast removed)

2. Sources
   - 2.(a) Load Variation from Forecast (Source 1)
   - 2.(b) Non Scheduled Generation Variation from Forecast (Source 2)
   - 2.(c) Scheduled Generator Variation from Dispatch Instruction (Source 3)

   - 2.(d) Scheduled Generator Ramp Variation from Preferred Ramp (Source 4)
   - 2.(e) Generator Auxiliary Load Variation from Forecast (Source 5)???
   - 2.(f) Residual Errors????

Usage

This quantity is the variation of the LFAS facility output whilst enabled for LFAS from their basepoint. The basepoint is defined as

Start of Interval quantity (SOI) = previous trading interval Dispatch Instruction Target MW

End of Interval quantity (EOI) =

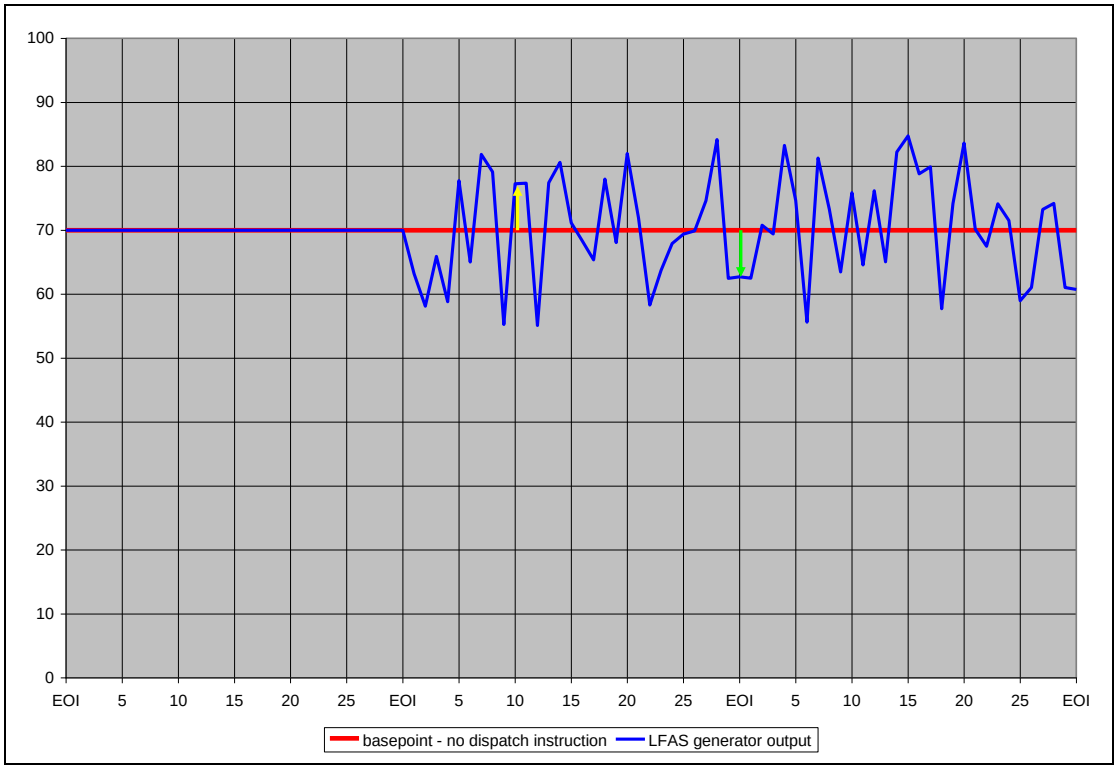
if no current trading interval Dispatch Instruction current trading interval SOI
if current trading interval Dispatch Instruction Target MW or if no Dispatch Instruction

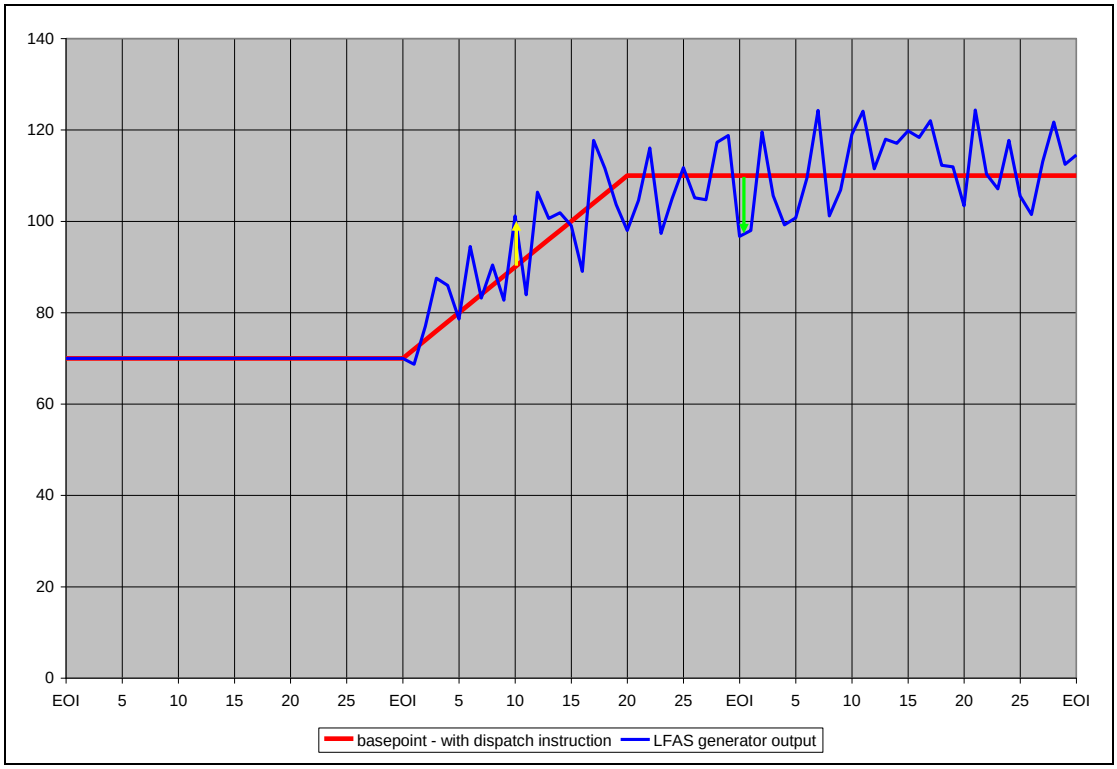
Intra Interval quantity minute t =

if no current trading interval Dispatch Instruction current trading interval SOI
if current trading interval Dispatch Instruction SOI + Dispatch Instruction Ramp Rate x t until Target MW reached then Target MW

All measurements are based on average reading for 1 minute intervals

This is shown graphically below, the LFAS up usage is the yellow arrow and the LFAS down usage is shown by the green arrow



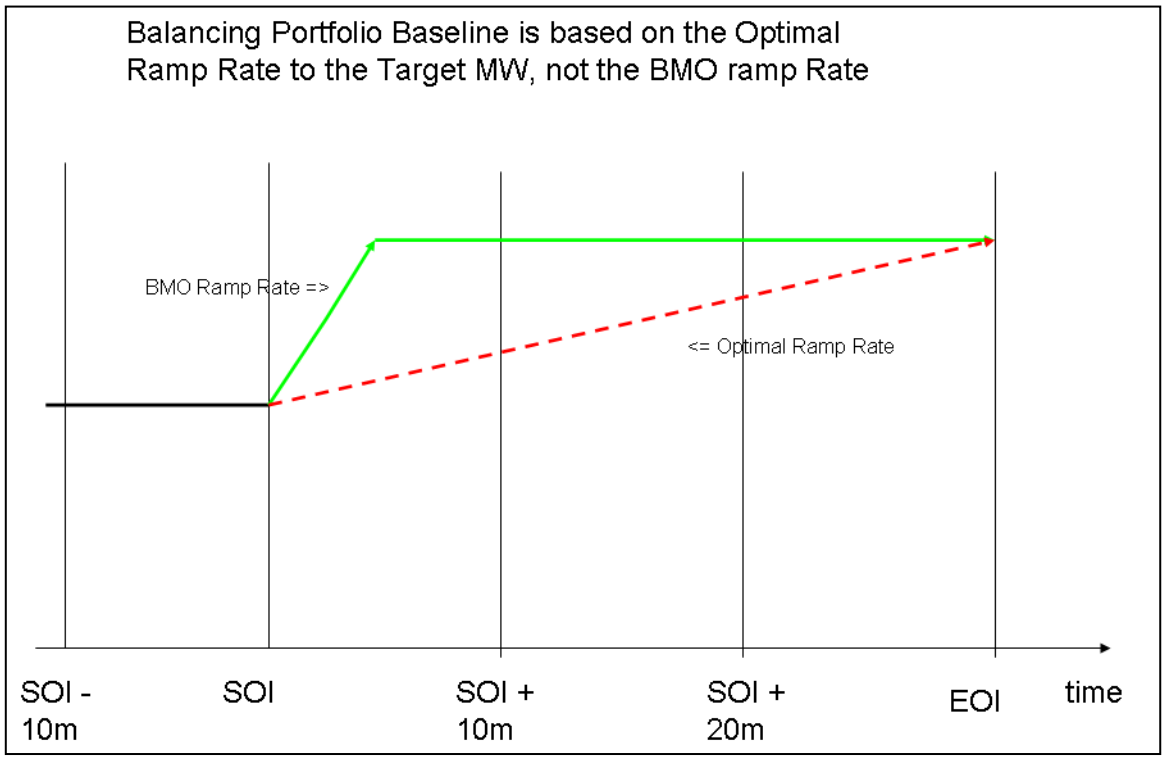


Where multiple facilities are enabled to provide LFAS the contributions are added to provide the LFAS Usage

Note the Ramp Rate is:

For Individual Facilities – the BMO Ramp Rate

For Balancing Portfolio – a ramp rate that provides a linear trajectory between the previous Dispatch Interval EOI Target MW and the current Dispatch Interval Target MW. (see diagram below)



Also the basepoint is not sent physically sent to the Balancing Portfolio, but represents a notional value for the purpose of measuring LFAS Usage.

SOURCES

There are five sources identified as giving rise to the need for LFAS. Each is monitored as described.

Note due to differences in each source baseline specification these are not added together to form a requirement baseline.

Load Variation From Forecast

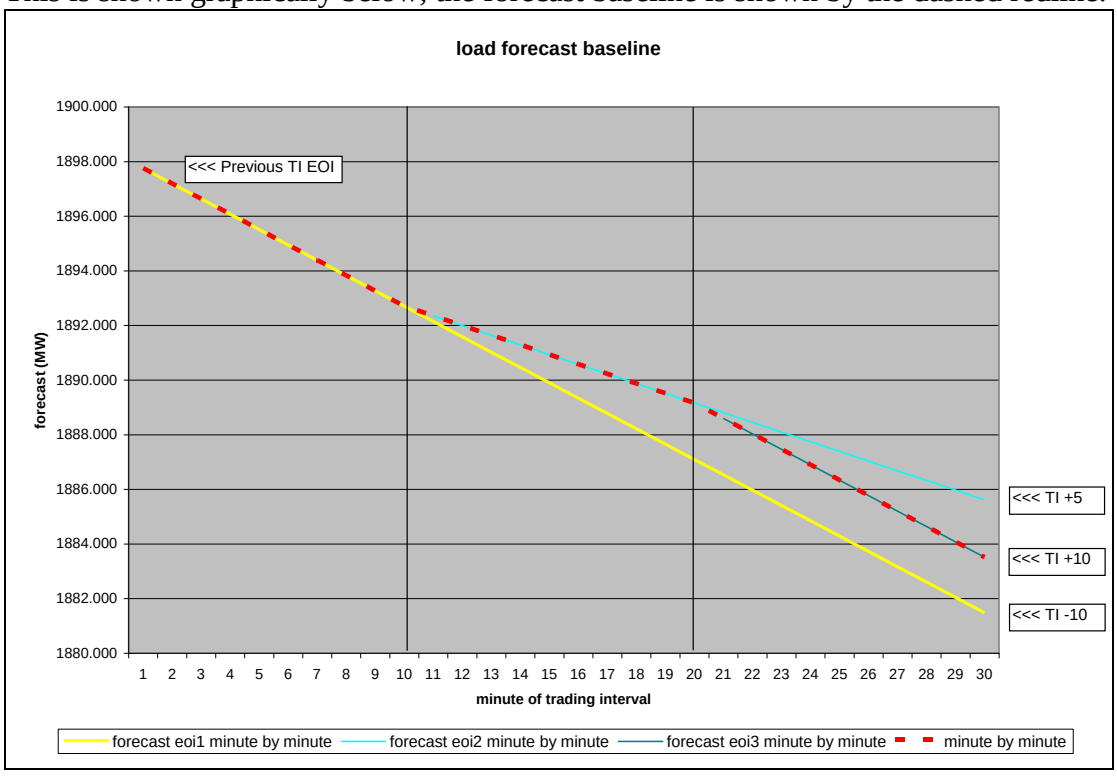
This quantity is the actual load MW variation from the load forecast baseline.

Load forecasts are made 10 or 5 minutes ahead of the Dispatch Interval for the Trading Interval EOI quantity.

Dispatch Intervals are
0 – 10 minutes within a Trading Interval
10 – 20 minutes within a Trading Interval
20 – 30 minutes within a Trading Interval

The Trading Interval EOI quantity is converted to a minute by minute quantity by a linear projection from the previous End of Dispatch Interval quantity to the Trading Interval EOI forecast. The load forecast baseline is defined as a linear path from the previous Dispatch Interval EOI quantity to the current Dispatch Interval EOI quantity.

This is shown graphically below, the forecast baseline is shown by the dashed redline.



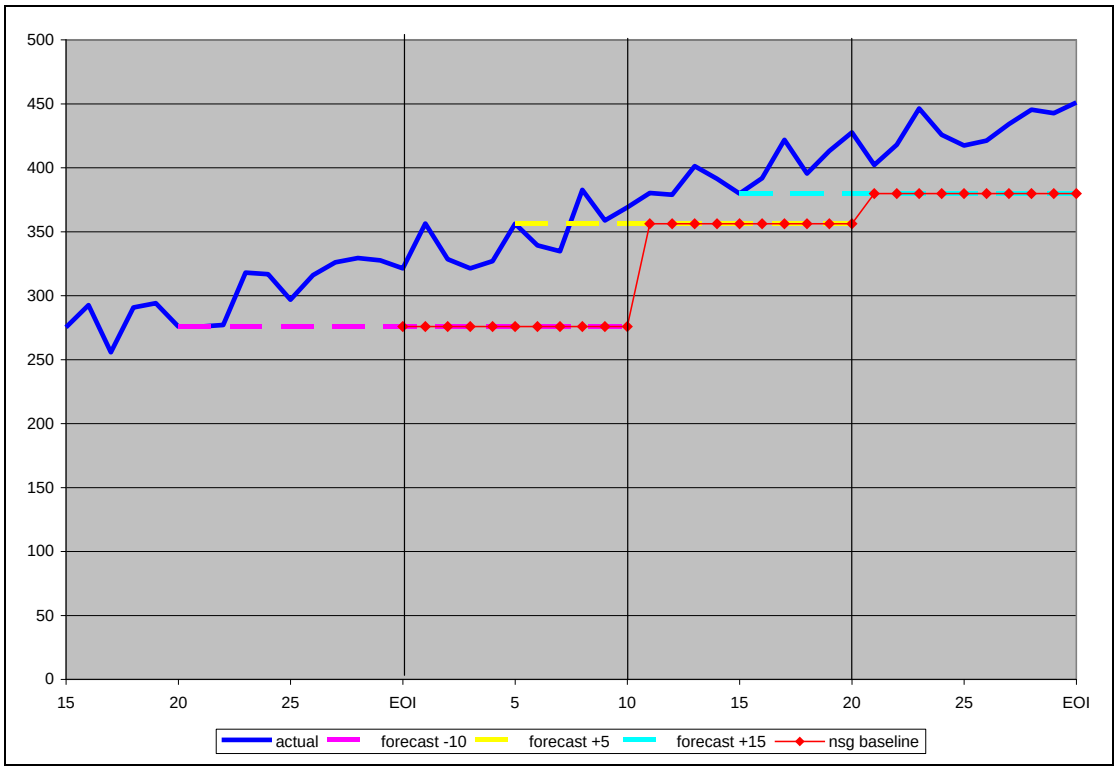
LFAS up usage is the variation of load above the baseline and the LFAS down usage is the variation of load below the redline.

Note the load measurements are based on 1 minute averages and the load is defined as the system load less “behind the fence” loads. The load does include the generator auxiliary loads (aka “used on works”)

Non Scheduled Generation From Forecast

This quantity is the actual non scheduled generation MW variation from the non scheduled generation forecast. The non scheduled generation forecasts are made 10 or 5 minutes ahead of the Dispatch Interval for the remainder of the Dispatch Interval

This is shown graphically below, the LFAS down usage is the variation above the redline and below the blueline and the LFAS up usage is variation above the blueline and below the redline.



Note the discontinuity in the baseline at the start of each Dispatch Interval

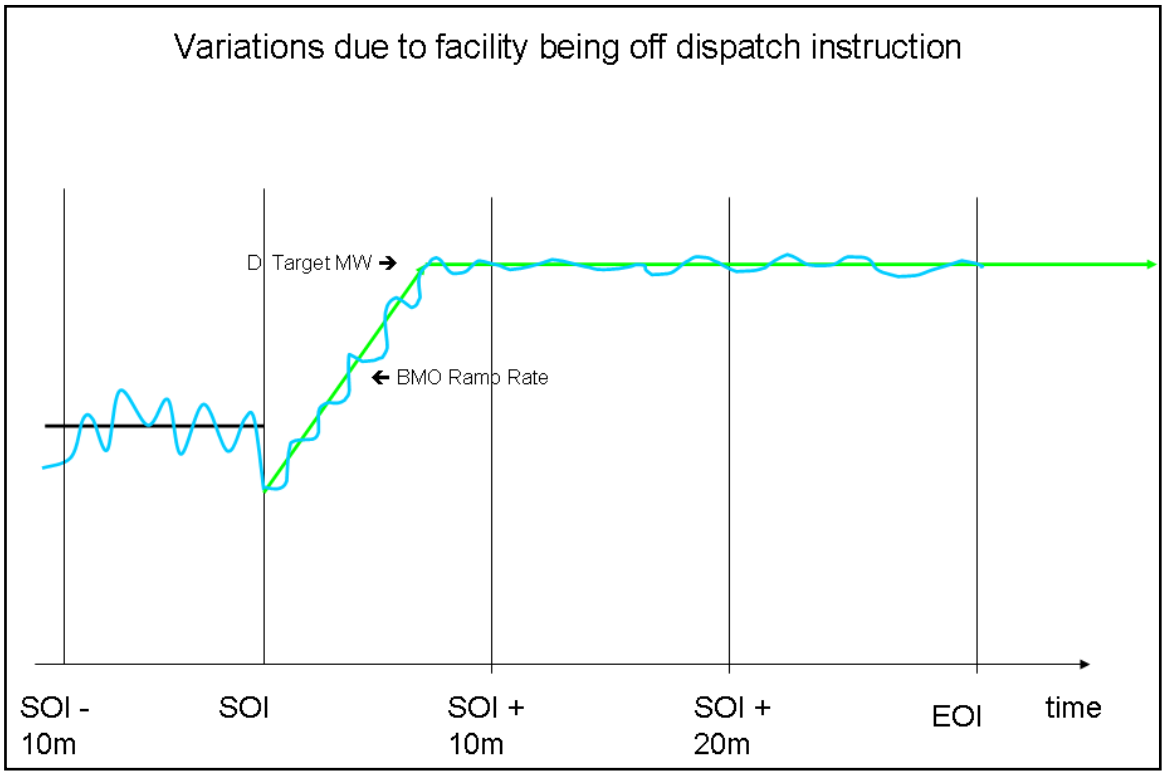
Note the non scheduled generation measurements are based on 1 minute averages

Scheduled Generator Variation from Dispatch Instruction

This quantity is the variation of the scheduled generator output from its dispatch instruction baseline.

The dispatch instruction baseline is a linear ramp from the actual start of Dispatch Interval Scheduled Generator output to the target output.

This is shown graphically below, the LFAS up usage is the variation above the blueline and below the greenline and the LFAS down usage is variation below the blueline and above the greenline.



Note the discontinuity in the baseline when a new Dispatch Instruction is issued.

Note this only applies to Facilities other than the Balancing Portfolio which is constantly providing load following. Note also this calculation excludes the output and dispatch instructions of Newgen Kwinana when it is providing the LFAS service.

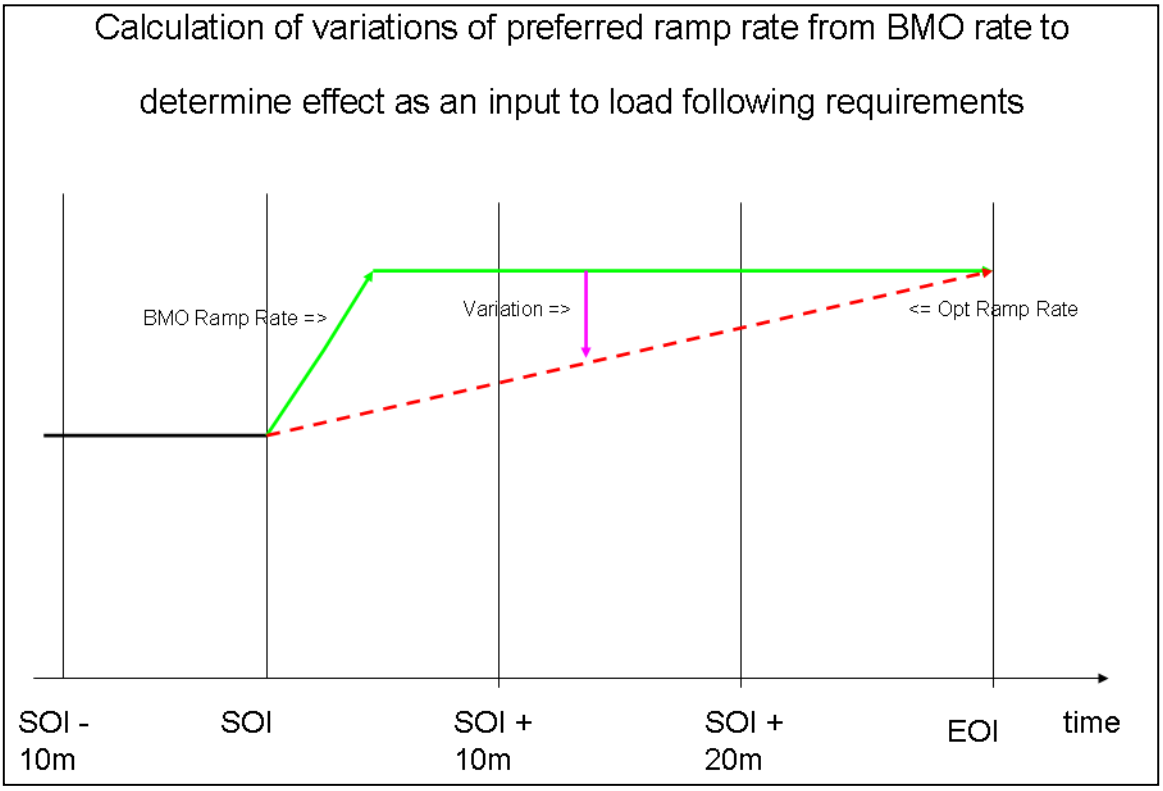
Note the scheduled generation variation measurements are based on 1 minute averages

Scheduled Generator Ramp Variation from Preferred Ramp

Dispatch Instructions are currently issued at the Ramp Rate stated in the Balancing Merit Order, rather than that preferred by SM to meet the forecast need from scheduled generators. This is done to minimise the constrained on/off quantities.

This quantity is the variation between the "BMO Ramp Rate" trajectory and the "Optimal (Opt)" trajectory that would be chosen to provide a smooth transition between dispatch interval SOI and EOI Target MW.

This is shown illustratively below BMO ramp rate trajectory in green, Optimal trajectory in red.

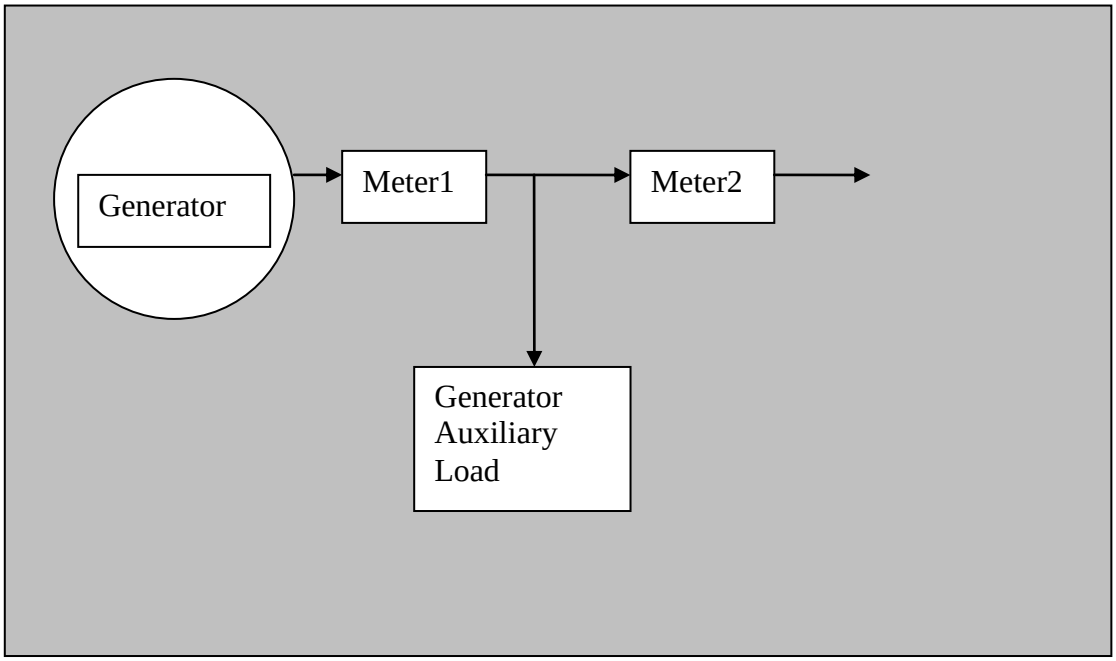


Note that the "BMO Ramp Rate" trajectory starts at the previous EOI target MW not the actual output MW.

Note the ramp rate variation measurements are based on 1 minute averages

Generator Auxiliary Load Variation from Forecast?????

Initially dispatch instructions are calculated by System Management on a "generated" basis, that is, the target the facility should be at the EOI including its own auxiliary consumption needs. Final Dispatch Instructions are defined on a "sentout" basis which is net of the auxiliary needs. This calculation is done by a linear conversion which provides a forecast of what the auxiliary loads will be. This is shown graphically below. The "generated" value is measured by Meter1 and the "sentout" value is measured by Meter2. The generator auxiliary load is determined by Meter1 MW minus Meter2 MW



The actual auxiliary load is Meter1 – Meter 2 (from SCADA)

The forecast auxiliary load is Meter2 multiplied by Z%

Where Z is in the order of 7.5% for steam turbine facilities and 0.5% for gas turbine facilities

For the Balancing Portfolio, which comprise multiple facility types,

Facility Auxiliary load =

7.5% for Sentout Outputs for outputs below 1000MW and

75 + 0.5% for Sentout Output above 1000MW for outputs above 1000MW

The LFAS quantity is the variation of the sum of the actual generator auxiliary loads from the sum of the forecast generator auxiliary loads.

Residual Errors?????

Measurement Statistics

Excluded events

Frequency Deviations and Missing Forecasts

When the system frequency is in the high or emergency operating state the LFAS measurements are excluded. Thus Trading Interval which include system frequencies above 50.32 or below 49.68 hertz are excluded. These limits are equal to the high risk state definitions

Where no forecast is produced for a Dispatch Interval the associated Trading Interval is removed from the statistical calculation.

This exclusion applies for both Source and Usage statistics.

Forecast Errors

When the load forecast error is large the trading intervals are also removed

This removal occurs when the variation between actual and forecast load exceeds 150MW at the end of the Dispatch interval. Note the whole Trading Interval (30 minutes) is removed, not just the Dispatch Interval (10 minute).

This exclusion is additionally supplied for Usage statistics to provide an alternative measurement.