Operating Procedure

Frequency Control Ancillary Services

Prepared by: Power System Operations

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Version Control

VER	DATE	REVISION DESCRIPTION	AUTHOR	CHECKED	RESPONSIBLE MANAGER [1]	APPROVED
v12	01/07/09	Change to AEMO document. VOLL changed to MPC, Market Price Cap.	Alethia Stephens Martin Hoarau	Pablo Uribe	Chris Brownlee	Martin Hoarau
v11	19/06/09	Reliability Panel Determination 15 April 2009. Co-optimisation of regulation and delayed FCAS.	Peter Biddle	Chris Brownlee	Chris Brownlee	Martin Hoarau
v10	23/02/09	Updated Section 6.1.1.2 to include direction to reduce FCAS risk. Remove hyperlinks from Section 3.	Shivani Mathur	Chris Brownlee	Chris Brownlee	Martin Hoarau
Note [1]: The Responsible Manager is aware of the document content and has verified that the changes in this revision have been checked against the “PSO Standard TPA Checklist”.						

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1. Purpose

The purpose of this procedure is to provide operational staff with information and guidelines relating to the principles, operational application and management of Frequency Control Ancillary Services (FCAS).

Specifically these procedures set out to generally describe methods for:

- determining the system requirements for FCAS
- entering FCAS requirements into the Market Management Systems
- issuing FCAS dispatch instructions
- logging FCAS events and instructions

2. Definitions

Refer to the Glossary Document SO_OP2000 and Chapter 10 of NER for definitions.

Refer to Frequency Operating Standards for the Tasmanian Power System, February 2006 (published by: Office of the Tasmanian Energy Regulator; Reliability and Network Planning Panel)

3. References

- Control of Power System Frequency and Time Error SO_OP3151(Available on the AEMO web Site)
- **Guide to Ancillary Services in the National Electricity Market** (Available on the AEMO web Site)
- Market Ancillary Services Specification (Available on the AEMO web Site)
- FCAS Constraints Guides (Available on the AEMO web Site)

4. General Principles of Ancillary Services

Ancillary Services are essential to the management of power system security and to ensure that electricity supplies are of acceptable quality.

The requirements for Ancillary Services are divided into 4 categories:

- Frequency Control
- Voltage Control
- Network Loading Control

- System Restart

The Ancillary Services Review has grouped and named ancillary services as follows:

- Ancillary services concerned with balancing power supply and demand over short time intervals throughout the power system; the Frequency Control Ancillary Services (FCAS) group; The ancillary services types traditionally used were Automatic Generation Control (AGC), Governor Control, Load Shedding, Rapid Generator Unit Unloading (RGUU) and Rapid Generator Unit Loading (RGUL) services

- Ancillary services concerned with maintaining and extending the operational efficiency and capability of the network within secure operating limits; the Network Control Ancillary Services group (NCAS); The ancillary services types traditionally used are AGC, Reactive Power and Load Shedding services.

- The Ancillary service concerned with recovery from a partial or total power system failure; the System Restart Ancillary Service group (SRAS). The ancillary services types traditionally used are System Restart services

The remainder of this document is dedicated to the FCAS group of ancillary services in the NEM. The latter two groups are covered further in separate AEMO Operating Procedures.

There are eight sub-markets for the different components of Frequency Control Ancillary Services (FCAS). Regional half-hourly clearing prices are set for each of the sub-markets. All Providers in a region are paid at the same rate.

Service Providers bid their FCAS capabilities via market bidding systems. Capability and price can be re-offered.

AEMO will centrally dispatch using NEMDE co-optimisation, which will select Provider's Units to be enabled each 5-minute dispatch interval.

4.1 Frequency Control Ancillary Service (FCAS)

Frequency Control Ancillary Services are required to maintain appropriate levels of contingency reserve and regulating reserve.

- *Contingency Service* is required to ensure that the frequency remains within the frequency operating standards, following credible contingency events as established by the Reliability Panel.

- *Regulating Service* is required to maintain frequency within the frequency operating standards during typical load and generation variations within a 5 -minute Dispatch Interval.

The system requirements for each FCAS service will need to be forecast in advance. AEMO must publish weekly, a forecast of the requirements for each type of market ancillary service for each region for the following week. (Refer NER Clause 3.13.4A)

The following table summarises the eight FCAS services

TABLE 4-1 FCAS SERVICE DEFINITIONS

SERVICE	PURPOSE	BRIEF DESCRIPTION
Fast Raise Service (6 second raise)	Large Deviation Contingency Service	Rapid generation / load response to locally sensed low frequency
Fast Lower Service (6 second lower)	Large Deviation Contingency Service	Rapid generation / load response to locally sensed high frequency
Slow Raise Service (60 second raise)	Large Deviation Contingency Service	Generation / load response to locally sensed low frequency
Slow Lower Service (60 second lower)	Large Deviation Contingency Service	Generation / load response to locally sensed high frequency
Delayed Raise Service (5 minute raise)	Large Deviation Contingency Service	Generation / load response to locally sensed low frequency beyond a threshold
Delayed Lower Service (5 minute lower)	Large Deviation Contingency Service	Generation / load response to locally sensed high frequency beyond a threshold
Regulating Raise Service	Regulation Deviation	Generation / load response to remote signals from AEMO in order to control frequency
Regulating Lower Service	Regulation Deviation	Generation / load response to remote signals from AEMO in order to control frequency

() Denotes MMS terminology

The fast, slow and delayed services are used to ensure that post contingent frequency deviations are maintained within the frequency operating standards established by the Reliability Panel and the Tasmanian Reliability and Network Planning Panel (RNPP) for defined system conditions.

The following tables 4.2 and 4.3 summarise the various categories of the FCAS, indicating the dispatch method

Table 4-2 Frequency Control categories

CONTINGENCY REQUIREMENTS			
	DISPATCH METHOD FOR:		
FREQUENCY CONTROL SERVICE	SINGLE UNIT CONTINGENCY	OTHER CREDIBLE CONTINGENCY	TYPICAL METHOD OF PROVISION
Fast raise (6 second raise)	NEMDE	NEMDE	Governor, Load Shedding
Fast lower (6 second lower)	NEMDE	NEMDE	Governor

CONTINGENCY REQUIREMENTS			
Slow raise (60 second raise)	NEMDE	NEMDE	Governor, Load Shedding
Slow lower (60 second lower)	NEMDE	NEMDE	Governor
Delayed raise (5 minute raise)	NEMDE	NEMDE	Rapid Gen Unit Loading, Load Shedding
Delayed lower (5 minute lower)	NEMDE	NEMDE	Rapid Gen Unit Unloading

() Denotes MMS terminology

TABLE 4-3

REGULATION REQUIREMENTS		
Frequency Control Category	Dispatch Method	Typical Method of Provision
Regulating raise	NEMDE	AEMO's AGC
Regulating lower	NEMDE	AEMO's AGC

The system requirements for fast, slow and delayed services are determined by considering credible contingency events. NEMDE co-optimises each FCAS service separately as discrete products. However, the delayed raise and lower requirements entered into NEMDE will take into account the amount of regulating raises and lowers, respectively, dispatched as illustrated in Section 4.1.1.

4.1.1 Contingency Service Requirements

The requirement for contingency service is a function of the largest generation output or load blocks on the power system, as well as the combined system demand. In most instances, the largest generation and load blocks on the power system will be relatively constant, and so the contingency service requirement becomes a simple function of the System Demand.

The requirement for FCAS can generally be distributed globally, i.e. NEMDE will source the requirement for a service (globally) from all interconnected regions in a co-optimised manner. For the case of the Tasmanian region, which is not part of the interconnected power system, NEMDE will source FCAS locally within the Tasmanian region.

Under some system conditions the FCAS service may be required to be sourced solely within a Region (locally). Also a capability to limit FCAS flow across interconnectors (to zero) is incorporated to reflect certain power system conditions such as potential islands and separation.

Constraint equations are employed as the primary method used by AEMO to determine actual FCAS requirements. The secondary method is for AEMO staff to manually calculate actual requirements based on conditions at the time and apply simple constraint equations which directly apply the actual requirements.

NEMDE co-optimises each fast and slow FCAS service separately as discrete products. However, the delayed raise and lower requirements dispatched by NEMDE will take into account the amount of regulating raises and lowers, respectively, dispatched, as illustrated by the following example;

Regulation Requirement >= X

Contingency Requirement + Regulation requirement >= Y

For example, a regulation raise requirement of 50MW may also contribute 50MW towards the delayed raise requirement

The same applies to the delayed Lower / Regulation requirements.

4.1.2 Regulating Service Requirements

Minor variation in frequency around the 50 Hz occurs continually as a result of normal fluctuations in consumer demand and generating unit performance.

The dispatch process uses forecast demand and establishes a linear path for generating units to follow every five-minute dispatch interval. However, consumer demand does not vary linearly between five-minute dispatch cycles, and the imbalance between generation and demand causes frequency to vary (even without contingency events).

4.1.2.1 Dispatch Time frame

The regulating raise and lower services are used to correct such frequency variations within each five-minute period. AEMO will determine the amount of regulation FCAS based on the time error. The principle is that the FCAS dispatch constraints will set regulation to 130/120MW (raise/lower) if the time error within the +/- 1.5 second band. If the time error is outside this band then an extra 60MW of regulation per 1 second deviation outside the band will be added with an upper limit of 250MW.

Dispatch raise requirement = Min (250,130 + (-1 x Min(-1.5, Time Error) – 1.5) x 60)

Dispatch lower requirement = Min (250,120 + (Max(1.5, Time Error) – 1.5) x 60)

The time error used is the average value of the QLD and NSW time error values from AEMO’s Energy Management System.

This process applies to the global and NEM Mainland regulation requirement but does not apply to the regulation requirements for the Tasmanian region. Regulation for Tasmania is nominally set to 50MW.

4.1.2.2 Pre-dispatch Time Frame

Regulating Raise FCAS

The following requirements apply to global, eastern and southern configurations.

Monday - Friday

250 MW 00:30 hrs to 01:30 hrs

250 MW 04:30 hrs to 08:30 hrs

250 MW 21:30 hrs to 23:30 hrs

130 MW at other times on weekdays.

Saturday & Sunday

250 MW 00:30 hrs to 01:30 hrs

250 MW 21:30 hrs to 23:30 hrs

130 MW at other times on Saturday and Sunday.

The NEM mainland global regulation raise FCAS requirements will be 130 MW.

The regulation raise FCAS requirements for the following island conditions are set to align with the NEM mainland global requirements and also 130 MW:

- Southern regions post Queensland separation;
- Eastern Regions post South Australian separation;
- Queensland/New South Wales island post separation at Snowy; and
- Victoria/South Australia island post separation at Snowy.

The regulation raise FCAS requirements for a Queensland island are 110 MW.

The regulation raise FCAS requirements for a South Australia island are 70 MW.

The regulation raise FCAS requirements for Tasmania are 50 MW.

Regulating Lower FCAS

As no significant power system frequency issues relating to regulation lower FCAS have been identified, AEMO does not propose to introduce time sculpting for this service at this time.

The regulation lower FCAS requirements are as follows:

The NEM mainland global regulation lower FCAS requirements are 120 MW.

The regulation lower FCAS requirements for the following island conditions will be set to align with the NEM mainland global requirements and are also 120 MW:

- Southern regions post Queensland separation;

- Eastern Regions post South Australian separation;
- Queensland/New South Wales island post separation at Snowy; and
- Victoria/South Australia island post separation at Snowy.

The regulation lower FCAS requirements for a Queensland island are 110 MW.

The regulation lower FCAS requirements for a South Australia island are 70 MW.

The regulation lower FCAS requirements for Tasmania are 50 MW.

4.2 Calculating FCAS Requirements

This Section is intended to provide a general summary only of how AEMO calculates requirements for FCAS, and should not be relied upon solely.

4.2.1 General Form Of Requirement Calculations

The calculations for all categories of large deviation FCAS are based on the following general formula:

> Requirement = Contingency Risk – Load Relief
>
> Where the Contingency Risk is the potential contingency MW change (eg loss of largest generator or load block, loss of single network element etc).
>
> Load Relief is the change in demand due to the frequency deviation. Refer to Section 4.2.3 for information on Load Relief.

For most system configurations, AEMO is able to utilise service providers from anywhere in the NEM to meet the Large Deviation FCAS requirement. However under some network configurations, such as potential system separations, AEMO may need to obtain some Large Deviation FCAS service from particular locations within Regions.

4.2.2 Frequency Standards

The frequency standards for containment, stabilisation and recovery (refer to AEMO Operating Procedure: Control of Power System Frequency and Time Error SO_OP3151; Section 6) determine the required amounts for the different FCAS categories

Following a contingency, the FCAS are used as follows:

- fast raise/lower FCAS are used for controlling frequency to the containment band
- slow raise/lower FCAS are used for controlling frequency to the stabilisation band
- delayed raise/lower FCAS are used for controlling frequency to the recovery band

Until a contingency event occurs which requires large deviation contingency services, the regulating services are the primary frequency control services.

4.2.3 Load Relief

Frequency in an AC power system is a measure of the rotational speed of AC motors connected to the power system. Thus, when the frequency falls, many of the motors connected to the power system will slow down. As the amount of power consumed by these machines is proportional to their rotational speed, the demand for power seen by the power system will thus fall as frequency falls. Various other equipment may also consume less power as the frequency falls. Conversely, if the frequency is increased, the demand for power will be seen to increase.

The change in demand for a given frequency deviation is thus related to the number of motors connected to the power system, and the size of the frequency deviation. This effect is referred to as 'load relief', and is taken into account when calculating the requirements for FCAS.

The term 'relief' is used, as any demand change due to a frequency deviation will always be in a direction that will tend to alleviate the frequency deviation. In other words, if the frequency falls, the load relief is negative (decrease in demand), which tends to alleviate the falling frequency. On the other hand, if the frequency increases, the load relief is positive (increase in demand), which also tends to alleviate the frequency deviation. Thus, the load relief is always acting to relieve the frequency deviation.

AEMO has assessed the load relief effect factor as follows:

For the mainland regions:

If the frequency changes by 1%, the demand changes by 1.5%. The load relief factor is thus 1.5%, which represents the percentage change in demand for every 1% (0.5 Hz) of frequency deviation.

For the Tasmanian region

If the frequency changes by 1%, the demand changes by 1.0%. The load relief factor is thus 1.0%, which represents the percentage change in demand for every 1% (0.5 Hz) of frequency deviation.

The following sample calculations use the load relief value of 1.5%.

> An example to calculate the load relief following a ***generator event***:
>
> Suppose that the demand is 20,000 MW, and that a generator trips causing the frequency to fall to 49.5 Hz. The load relief will be:
>
> Load Relief = 0.015 x 20,000
>
> = 300 MW

Note that in this example, the demand effectively reduces by 300 MW.

> An example to calculate the load relief following a ***network event***:
>
> Assuming the same demand as the previous example of 20,000 MW, if network event causes a large loss of load, causing the frequency to increase to 51.0 Hz. The load relief will be:
>
> Load Relief = 2 x 0.015 x 20,000
>
> = 600 MW
>
> Note that in this example the load relief factor is multiplied by 2, since the frequency deviation is 1.0 Hz, or 2%. Also note that as in this example, the frequency has increased, the demand effectively increases by 600 MW.

4.2.4 Requirement For Fast Raise Services (6 Sec Raise)

Below is a summary of how requirements for Fast Raise are calculated, for the different frequency events described in the Reliability Panel frequency standards.

For Tasmania; the Tasmanian frequency standards and a load relief factor of 1% should be used.

4.2.4.1 Generation Event

The requirement for fast raise service is determined as follows:

Fast Raise Requirement = Contingency Risk – Load Relief

- Where the Contingency Risk is the largest single generator.
- The frequency standard defines the containment band for generation events as 49.5 Hz. Therefore, the load relief factor is 1.5%.

> An example to calculate the fast raise requirement: for a generation event:
>
> If largest generator = 660 MW, , and the combined NEM demand = 20,000 MW:
>
> Fast Raise Requirement = (660) – (0.015 x 20,000)
>
> = 660 – 300 = 360 MW

4.2.4.2 Network Event (requiring raise services)

The requirement for fast raise service is determined as follows:

Fast Raise Requirement = Contingency Risk – Load Relief

- Where the Contingency Risk is total sum of generation at risk for the worst single credible contingency (other than the largest single generator).
- The frequency standard defines the containment band for network events as 49.0 Hz. Therefore, the load relief factor is 3.0%.

An example to calculate the fast raise requirement: for a network event:

If generation at risk due to a network event = 800 MW, , and the combined NEM demand = 20,000 MW:

Fast Raise Requirement = 800– (0.03 x 20,000)

= 800 – 600 = 200MW

4.2.4.3 Separation Event

The requirement for fast raise service in the importing region is determined as follows:

Fast Raise Requirement = Contingency Risk – Load Relief

- Where the contingency risk is the flow on an interconnector that is classified as a credible contingency event.
- The frequency standard defines the containment band for separation events as 49.0 Hz. Therefore, the load relief factor is 3.0%.

[Note: the Jurisdictional Coordinator for South Australia has notified AEMO that the frequency band for separation of the South Australian power system is 47 to 52 Hz. Therefore the load relief factor is 9% for an event that causes South Australia to become separated. The reliability panel has anticipated that under frequency relays will operate at frequency levels in the low end of this range. The fast raise requirement for the South Australian Region will thus be reduced by the expected amount of involuntary load shedding.

An example to calculate the fast raise requirement: for a ***separation event***:

If the interconnector flow is 500 MW and the demand of the importing region is 6400 MW (including any load that would remain connected to the island):

Fast Raise Requirement = 500 – (0.03 x 6400)

= 500 – 192

= 308 MW

All FCAS services need to be sourced from within each of the separating regions to manage a separation event. In particular, the importing region has a fast raise requirement. The exporting region will have a requirement for fast lower service – refer to below.

Following a separation event the FCAS requirements are re-assessed according to the frequency standards for an island. Refer to Appendix 1 for the frequency standards.

4.2.5 Requirement For Slow Raise Services (60 Sec Raise)

Where the frequency standards do not specify a frequency level for stabilisation within 60sec, then the 60sec requirement is referenced on the containment frequency.

The requirement for slow raise service is determined in a similar manner as for fast raise service.

For the mainland NEM regions the load relief factor for the stabilisation band is 1.5% based on a reference frequency of 49.5 Hz.

For Tasmania the load relief contribution is based on the containment frequency for the generation and load events and the stabilisation frequency for the network event.

4.2.6 Requirement For Delayed Raise Services (5 Min Raise)

The requirement for delayed raise service is determined in a similar manner as for fast raise service except the load relief factor for the recovery band is based on a reference frequency of 49.85 Hz in all regions.

Although the response of the regulation service providers is not included in consideration of the fast and the slow contingency requirement, the regulation service providers are expected to respond within 5 minutes to a large frequency deviation. For this reason, when the overall requirement for delayed raise has been determined as above, the amount of regulation raise service enabled is then subtracted, to give the net additional amount of delayed raise required.

4.2.7 Requirement For Fast Lower Services (6 Sec Lower)

Below is a summary of how requirements for Fast Lower are calculated, for the different frequency events described in the Reliability Panel frequency standards.

The examples are based on the NEM mainland frequency standards.

4.2.7.1 Load Event

The requirement for fast lower service, is determined as follows:

Fast Lower Requirement = Contingency Risk – Load Relief

- Where the Contingency Risk is the net contribution from the largest single load.

The frequency standard defines the containment band for load events as 50.5 Hz. Therefore the load relief factor is 1.5%.

An example to calculate the fast lower requirement: for a ***load event***:
If largest load = 350 MW, and the = 20,000 MW:
Fast Lower Requirement = 350 – (0.015 x 20,000)
= 350 – 300 = 50 MW

4.2.7.2 Network Event (requiring lower services)

The requirement for fast lower service, is determined as follows:

Fast Lower Requirement = Contingency Risk – Load Relief

- Where the Contingency Risk is total sum of load blocks at risk for the worst credible contingency (other than the largest single load block).

The frequency standard defines the containment band for network events as 51.0 Hz. Therefore, the load relief factor is 3.0%.

An example to calculate the fast lower requirement: for a ***load event***:
If load at risk due to a network event = 600 MW, and the demand = 20,000 MW:
Fast Lower Requirement = 600 – (0.03 x 20,000)
= 600 – 600 = 0 MW

4.2.7.3 Separation Event

The requirement for fast lower service in the exporting region is determined as follows:

Fast Lower Requirement = Contingency Risk – Load Relief

- Where the contingency risk is the flow on an interconnector that is classified as a credible contingency event.
- The frequency standard defines the containment band for separation events as 51 Hz. Therefore the load relief factor is 3%.

[Note: the Jurisdictional Coordinator for South Australia has notified AEMO that the frequency band for separation of the South Australian power system is 47 to 52 Hz. Therefore the load relief factor is 6% for an event that causes South Australia to become separated.]

An example to calculate the fast lower requirement: for a ***separation event***:

If the interconnector flow is 500 MW and the demand of the exporting region is 15,000 MW:

Fast Lower Requirement = 500 – (0.03 x 15,000)

= 500 – 450 = 50

All FCAS services need to be sourced from within each of the islanded regions to manage a separation event. In particular, the exporting region has a fast lower requirement. The importing region will have a requirement for fast raise service above.

Following a separation event the FCAS requirements are re-assessed according to the frequency standards for an island. Refer to Appendix 1 for the frequency standards.

4.2.8 Requirement For Slow Lower (60 Sec Lower)

Where the frequency standards do not specify a frequency level for stabilisation within 60sec, then the 60sec requirement is referenced on the containment frequency.

The requirement for slow lower service is determined in a similar manner as for fast lower service.

For the mainland NEM regions the load relief factor for the stabilisation band is 1.5% based on a reference frequency of 50.5 Hz.

For Tasmania the load relief factor for the stabilisation band is 2.0% based on a reference frequency of 51.0 Hz.

4.2.9 Requirement for Delayed Lower (5 Min Lower)

The requirement for delayed lower service is determined in a similar manner as for fast lower service except the load relief factor for the recovery band is based on a reference frequency of 50.15 Hz in all regions.

Although the response of the regulation service providers is not included in consideration of the fast and the slow contingency requirement, the regulation service providers are expected to respond within 5 minutes to a large frequency deviation. For this reason, when the overall requirement for delayed lower has been determined as above, the amount of regulation lower service enabled is then subtracted, to give the net additional amount of delayed lower required.

4.2.10 Post Separation Event Operation

Following a separation event it is necessary to dispatch FCAS separately for the islanded region and the remainder of the power system. Under these conditions NEMDE must source all FCAS for the islanded region from within that Region. The calculations for all categories of FCAS are still based upon the same general formula except that the frequency standards to be applied are varied as detailed Appendix A.

4.2.11 FCAS requirements during load restoration during a period of supply scarcity

The Reliability Panel has released a Determination that allows a revised frequency standard to be applied during periods of supply scarcity. Refer to SO_OP3151 for details.

Use of this revised standard relies on the use of Under Frequency Load Shedding (UFLS) in place of contingency raise FCAS. Essentially the quantum of the contingency risk is reduced by the amount of UFLS available above the specified containment frequency.

4.3 Bid Parameters

Each of the 8 FCAS services are defined in NEMDE by bid parameters according to the FCAS offer model in figure 1:

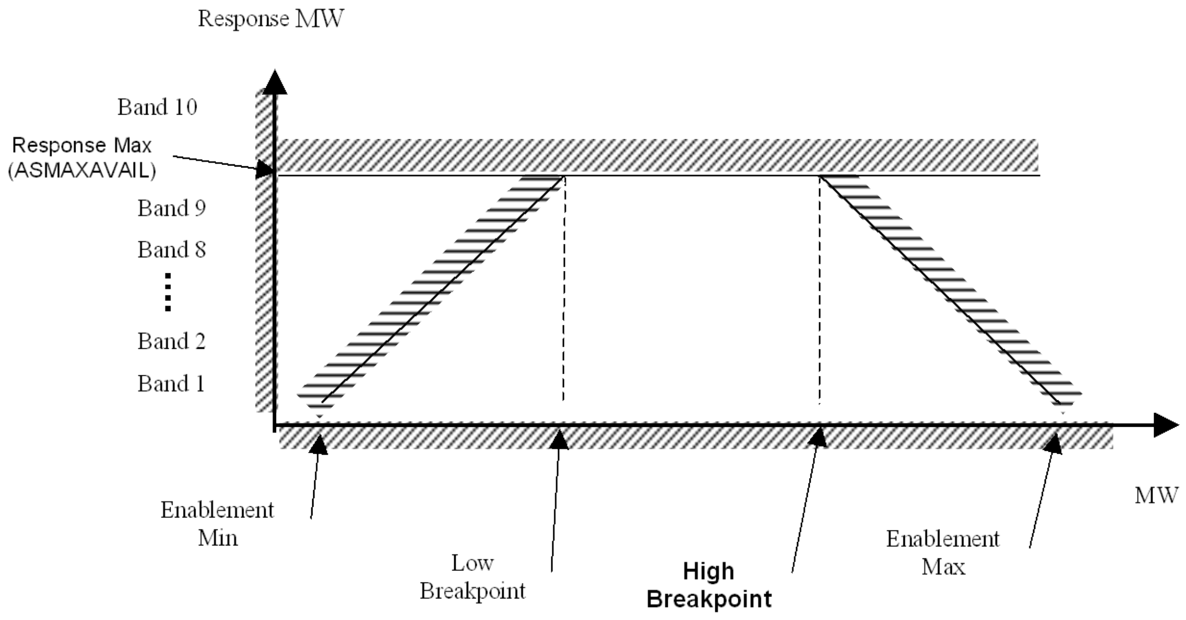

Figure 1. FCAS offer model

This service offer model is generic and is used for both raise and lower services. In general, raise service providers would not need to use the low breakpoint or enablement minimum, and would therefore offer these in at 0 MW or at the minimum registered capability. Similarly lower service providers would not need to use the high breakpoint and enablement max, and would tend to offer these in at their maximum MW output.

4.4 Ancillary Services Pricing

The market ancillary services, FCAS, are co-optimised in NEMDE, with a common clearing price produced for each region for each FCAS product. These prices would not normally vary between regions unless there is a break of the interconnection between regions. It may be possible for the clearing price in a region to diverge from other regions due to local requirements being met within that region.

The common clearing price is applicable only to Service Providers within a region. Under normal conditions, the regional common clearing price will be the same for all connected regions. Islanded regions will have a different common clearing price.

A Price Cap (currently set to MPC) for each of the FCAS services has been imposed.

The application of MPC Override in the energy market will not affect FCAS clearing prices.

If an Administered Price Period is notified in relation to **energy**, then the administered price cap and floor must be set so that.

The market ancillary service price for all market ancillary services does not exceed the administered price cap.

If an Administered Price Period is notified in relation to a **market ancillary service** then the administered price cap must be set for that market ancillary service so that the market ancillary service price does not exceed the administered price cap.

A trading interval is to be an administered price period for a market ancillary service if the sum of the prices for that service in the previous 2016 dispatch intervals exceeds 6 times the cumulative price threshold.

5. Responsibilities

Ancillary Service providers are responsible for the following:

- Submit FCAS offers in respect of market ancillary services in accordance with NER clause 3.8.7A
- Provide FCAS services as instructed by AEMO

Ensure that AEMO are advised at all times of the availability and capability of any FCAS services by the AS bidding process (for FCAS)

AEMO is responsible for the following (NER clause 3.2):

- AEMO must do all things necessary to operate and administer a spot market for the sale and purchase of market ancillary services in accordance with the Market rules

AEMO must use reasonable endeavours to ensure adequate ancillary services are available in accordance with NER clause 3.11

6. Power System Operations Actions and Processes

The actions and processes of ancillary services will vary for the different services, and so these procedures are presented separately for each of the system requirements.

POWER SYSTEM OPERATIONS is responsible for

- Determining the ancillary service requirements based on forecast system conditions as defined in the Reliability Panel Frequency Standards
- Managing constraint sets and equations associated with ancillary services
- Verifying ancillary service requirements in MMS
- Issuing dispatch instructions for ancillary services
- Conformance monitoring of ancillary services

6.1 FCAS Procedures

All of the following FCAS services will be co-optimised and dispatched by NEMDE:

- Fast raise and lower

- Slow raise and lower
- Delayed raise and lower
- Regulating Raise and lower

6.1.1 Pre-dispatch Schedule (PRD)

The PRD will include forecasts of enabled range for all market ancillary services co-optimised and dispatched by NEMDE.

6.1.1.1 Determining Power System Risks and Requirement

FCAS is assigned by the use of constraint equations formulated to meet each actual FCAS requirement. Two basic methods involving constraint equation application are employed. Either or both of the methods may be implemented depending on the circumstances at any time. The constraint equation method of application allows the co-optimisation of local FCAS requirements against inter-connector flows if both of these are located on the left hand side of a constraint equation. This may be required where an inter-connector represents a credible contingency event risk.

The primary method of application utilises constraint equations which are formatted in a similar manner to the FCAS requirement descriptions in this document. That is, they include factors associated with each requirement such as demand, generation, local loads, etc. In this case it is the constraint equation that is calculating the actual requirement based on actual and/or forecast conditions. POWER SYSTEM OPERATIONS staff monitor the result of this method.

The secondary method involves the application of simple format constraint equations which are used to directly assign actual requirements. The actual requirements in this case being manually calculated by POWER SYSTEM OPERATIONS staff based on conditions at that time. An example would be of the form “(Service) ≥ (Value)”. This format of equations may be created and applied in a similar manner to ‘Quick Constraints’ used within the energy market.

The general naming convention for FCAS constraint equation ID’s is similar to the existing convention for energy constraint equation ID’s. Additions to the convention are :

- All FCAS constraint equation ID’s have the prefix F
- For system normal and discretionary style constraints the event is identified (MG, MLOAD, TG, TL)
- The service is identified by R5, R6, R60, RREG, L5, L6, L60, LREG

The constraint equation ID will contain a +

Some examples are :

- for System Normal NEM MG for the Raise 5 Min service: F_I+NIL_MG_R5

- for a Raise Regulation of 100MW for NEM discretionary: F_I+RREG_0100
- for an outage of Heywood - South East 275kV line for the Eastern Raise 6 second service: F_V+S_HYSE_R6

6.1.1.2 Insufficient FCAS

This section of the procedure describes the required action that may be taken when the amount of FCAS available is insufficient to meet the power system requirements.

POWER SYSTEM OPERATIONS shall use reasonable endeavours to ensure that all available Service Providers are fully utilised to the extent necessary to meet the system requirements for ancillary services before directing any Service Providers. This will include advising Service Providers whose Units or loads are trapped or stranded outside their enablement limits by means of a Market Notice.

Where the PRD Schedule identifies Trading Intervals where the amount of FCAS enabled is less than the power system requirement, POWER SYSTEM OPERATIONS shall adopt the following procedure:

- Identify the region/s with insufficient FCAS enabled, the amount by which the requirement exceeds the enabled range as well as the expected duration of the shortfall.
- POWER SYSTEM OPERATIONS will then assess what reasonable action should be taken in response to the FCAS shortfall. All the following conditions would generally need to be met before direction for ancillary service would be deemed reasonable:
    - The FCAS shortfall is sufficient to cause the post contingent frequency deviation to exceed the reliability panel standard by more than 0.1 Hz, **and**
    - The FCAS shortfall must be expected to persist for more than 1 trading interval, **and**

No deterioration of system security is caused as a result of not meeting the FCAS requirement

- If an FCAS shortfall is deemed to require a direction for ancillary services, then POWER SYSTEM OPERATIONS will identify the latest possible time to direct plant to overcome the FCAS shortfall, and issue a Market Notice detailing
    - Which FCAS service is insufficiently covered
    - Which region/s have insufficient FCAS enabled,
    - The expected duration and quantity of the shortfall
    - A request for Service Providers to revisit their AS offers for Units or Loads that are stranded outside their enablement limits.
    - The latest possible time at which POWER SYSTEM OPERATIONS will issue an AS direction under Rules clause 4.8.9

- POWER SYSTEM OPERATIONS shall commence preliminary discussions (**non-binding**) with those Service Providers who are considered likely to be available to be directed. Such discussions would be aimed at establishing:
    - The capability of the participant to adequately comply with the direction,
    - Estimate of the likely financial impact on the participant of a direction,
    - Any other matters considered relevant by either POWER SYSTEM OPERATIONS or the participant.
- POWER SYSTEM OPERATIONS will then decide which Service Providers to direct, taking into account the information gained, with a view to meeting the FCAS shortfall in a manner which minimises the cost of meeting that shortfall.
- POWER SYSTEM OPERATIONS will then direct Units to provide additional AS to meet the shortfall. When directing Providers, POWER SYSTEM OPERATIONS will ensure that each directed Service Provider understands that it is being directed for AS.
- If POWER SYSTEM OPERATIONS establishes that there are no units available for direction for FCAS, it may, as a last resort, direct for a reduction in the size of the generation or load at risk.

6.1.2 Procedure for post contingency event (when to restore load etc)

Following a contingency event, which results in a frequency excursion, there will have been a response from those Service Providers that had been enabled to provide FCAS. In particular, automatic load shed Service Providers that were enabled may have been interrupted.

Following the stabilisation of frequency, any load shed as an ancillary service is to be restored as soon as possible.

It is possible that the power system may no longer be in a condition that could be considered secure on the occurrence of a further contingency event.

Following a contingency event, POWER SYSTEM OPERATIONS should take all reasonable actions to adjust the operating conditions with a view to returning the power system to a secure operating state as soon as it is practical to do so, and, in any event, within thirty minutes.

In general, when the load shed block can be restored without causing the frequency to fall outside the ‘normal frequency excursion band’, then the load shed block must be promptly restored.

It would generally be expected that FCAS load shed blocks would be restored within 15 minutes of the contingency event occurring.

6.1.3 Islanding Events

In the case of islanding events or risk of islanding events occurring at points which are not aligned with a regional boundary then generic constraint equations representing such local market ancillary service requirements should be formulated such that ancillary service providers which are unable to meet a local FCAS requirement at their region's RRN are constrained out of the relevant ancillary service markets whilst that requirement applies. Such providers would be those located in the region such that the point of islanding or potential islanding lies between that generating unit and its RRN.

6.2 FCAS Conformance

If a FCAS Service Provider is enabled to provide a service and fails to respond in the manner expected by the market ancillary services specification (as determined in POWER SYSTEM OPERATIONS' reasonable opinion), then:

- The FCAS generating unit or FCAS load is to be declared and identified as non-conforming;
- POWER SYSTEM OPERATIONS must advise the relevant Market Participant that the FCAS generating unit or FCAS service load is identified as non-conforming, and request a reason for the non-conformance. The relevant Market Participant must promptly provide a reason if requested to do so, and the reason is to be logged; and
- POWER SYSTEM OPERATIONS may set a fixed constraint for the relevant ancillary service for the ancillary service generating unit or ancillary service load. The relevant Market Participant must ensure that the ancillary service generating unit or ancillary service load complies with the fixed constraint set by POWER SYSTEM OPERATIONS.

Any apparent deficiencies in terms of Ancillary Service conformance should in the first instance be discussed with the Service Provider concerned.

If POWER SYSTEM OPERATIONS suspects that a non-conformance situation may exist, or any information that is brought to the attention of POWER SYSTEM OPERATIONS, either by way of direct communication with a Service Provider or through other data that can be retrieved, will be logged and a constraint shall be applied. This event will then be forwarded to Power System Performance division for further consideration.

7. Ancillary Services Dispatch Instructions

Instructions for FCAS are issued by NEMDE. When NEMDE identifies that a particular Service Provider should be enabled for a given service, a flag and/or target will be automatically sent to that participant by the MMS. This flag and/or target is considered to be an AEMO dispatch instruction.

If any manual dispatch instructions for FCAS are given, they must include the following details:

- Time the service is enabled,
- Particular service to be enabled
- Amount of service required (if applicable)
- Mode of operation, if applicable