Dispatch procedure

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Current version release details

Version	Effective date	Summary of changes
94	3 June 2024	Updates to reflect National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021 No.13 and National Electricity Amendment (Implementing integrated energy storage systems) Rule 2023 No.2. Removed reference to Mandatory Restrictions.

Note: There is a full version history at the end of this document.

1. Introduction

1.1. Purpose and scope

This Dispatch procedure is a power system *operating procedure* under clause 4.10 of the National Electricity Rules (**NER**).

This procedure has effect only for the purposes set out in the NER. The NER and the National Electricity Law prevail over this procedure to the extent of any inconsistency.

The purpose of this procedure is to provide instructions and guidelines covering *market* operations in relation to the operation of the *power system*.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the National Electricity Law and the NER have the same meanings in this procedure unless otherwise specified in this clause.

Terms defined in the NER are intended to be identified in this procedure by italicising them, but failure to italicise a defined term does not affect its meaning.

The words, phrases and abbreviations in the table below have the meanings set out opposite them when used in this procedure.

Table 1 Glossary

Term	Definition
AEMC	Australian Energy Market Commission
AGC	Automatic Generation Control
ADG_ID	Aggregate Dispatch Group Identifier, as used in AEMO's EMMS
Aggregate, or Aggregate System	A *generating system* or *integrated resource system,* or part of a *generating system* or *integrated resource system,* that is registered for aggregated dispatch conformance under section 2.6 of this procedure. Also referred to as an Aggregate Dispatch Group
Aggregate Active Power, Aggregate Actual MW	Equal to: Sum of SCADA Active Power for all *scheduled generating units*, *scheduled bidirectional units,* and *semi-scheduled generating units* in an Aggregate minus Sum of SCADA Active Power for all *scheduled loads* in an Aggregate
Aggregated dispatch conformance	A requirement for *scheduled resources* in an Aggregate to conform in aggregate with the *dispatch instructions* for those *scheduled resources*
Aggregate Dispatch Target	Equal to: Sum of Dispatch Targets for all *scheduled generating units*, *scheduled bidirectional units*, *and semi-scheduled generating units* in an Aggregate minus Sum of Dispatch Targets for all *scheduled loads* in an Aggregate
ASEFS	Australian Solar Energy Forecasting System
AWEFS	Australian Wind Energy Forecasting System
BDU	Bidirectional Unit

Term	Definition
Cap Aggregate	An Aggregate that only comprises *semi-scheduled generating units*
Dispatch Target	The *active power* outcome specified in a *dispatch instruction* for *a scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or *scheduled network service*, which represents the level to be achieved at the end of the relevant *trading interval*. For *semi-scheduled generating units*, this is the same as the *dispatch level.* For a *wholesale demand response unit*, this is the *active power* reduction specified in a *dispatch instruction*, which represents the level of *baseline deviation* to be achieved at the end of the relevant *trading interval*
DUID	Dispatchable Unit Identifier, as used in AEMO's EMMS
EMMS	Electricity Market Management System
FCAS	Frequency Control Ancillary Service
Conformance Mode	Part of a *dispatch instruction* for a *scheduled resource* in an Aggregate that indicates whether aggregated or individual dispatch conformance is required
Individual dispatch conformance	A requirement for a *scheduled resource* in an Aggregate to conform with its *dispatch instructions*. In the NER this requirement is referred to as 'resource level compliance'
LHS	Left Hand Side (of a constraint equation)
Local Limit	For an *intermittent generating unit*, the lower of its *plant availability* and all technical limits on the capacity of its connection assets to export energy, in accordance with its *energy conversion model*
Mixed Aggregate	An Aggregate that comprises *scheduled generating units* or *scheduled bidirectional units* and which may also include *semi-scheduled generating units or scheduled loads* (but excluding a *scheduled generating unit* and *scheduled load* pair for a single physical plant, which is a Target Aggregate)
Max Avail	Maximum Availability in the energy bid
MPC	*Market Price Cap*
NEMDE	National Electricity Market Dispatch Engine, used in the *central dispatch* process
NER	National Electricity Rules, and 'NER' followed by a number denotes that numbered rule or clause of the NER
Net Scheduled Active Power	Equal to: Sum of SCADA Active Power for all *scheduled generating units* and *scheduled bidirectional units* in an Aggregate minus Sum of SCADA Active Power for all *scheduled loads* in an Aggregate
Net Scheduled Dispatch Target	Equal to: Sum of Dispatch Targets for all *scheduled generating units* and *scheduled bidirectional units* in an Aggregate minus Sum of Dispatch Targets for all *scheduled loads* in an Aggregate
NSP	*Network Service Provider*
Participant	*Market Participant*
RHS	Right Hand Side (of a *constrain*t equation)
RTU	Remote Terminal Equipment
SCADA	Supervisory Control and Data Acquisition
Scheduled Resource	A *scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit, wholesale demand response unit*, *scheduled network service,* or *scheduled load*
Semi-dispatch cap	The Dispatch Target for a *semi-scheduled generating unit* when its semi-dispatch cap flag is set to 'TRUE'

Term	Definition
Semi-dispatch cap flag	A flag in a *dispatch instruction* indicating whether the relevant interval is a *semi-dispatch interval*
Target Aggregate	An Aggregate that comprises a *scheduled generating unit* and *scheduled load* pair, for a single physical plant
UIGF	*Unconstrained intermittent generation forecast*
VRE	Variable Renewable Energy generator

1.2.2. Interpretation

This procedure is subject to the principles of interpretation set out in Schedule 2 of the National Electricity Law.

1.3. Related documents

Table 2 Related policies and procedures

Reference	Title	Location
SO_OP_3707	Intervention, Direction and Clause 4.8.9 Instructions	AEMO | Power system operating procedures
SO_OP_3708	Non Market Ancillary Services	AEMO | Power system operating procedures
SO_OP_3710	Load Forecasting	AEMO | Power system operating procedures
	Over-Constrained Dispatch Rerun Process	AEMO | Policy and process documentation
	Constraint Implementation Guidelines	AEMO | Congestion information resource
	Constraint Formulation Guidelines	AEMO | Congestion information resource
	Intervention Pricing Methodology	AEMO | Policy and process documentation
	Fast Start Unit Inflexibility Profile Model	AEMO | Policy and process documentation
	Automated procedures for identifying intervals subject to review	AEMO | Policy and process documentation

2. Dispatch instructions

2.1. Content of dispatch instructions

(a) A *dispatch instruction* to produce, consume, reduce or transfer *active power* includes:

(i) for a *scheduled resource* , a Dispatch Target;

(A) dispatch targets for *scheduled generating units* and *semi-scheduled generating units* are always positive and represent the amount of power to be injected

(B) dispatch targets for *scheduled load* are always positive and represent the amount of power to be consumed

(C) dispatch targets for *wholesale demand response units* are always positive and represent the decrease in the amount of power to be consumed

(D) dispatch targets for *scheduled bidirectional units* and *scheduled network services* may be positive or negative depending on whether the amount of power is to be produced or consumed

(ii) for a *semi-scheduled generating unit*, a semi-dispatch cap flag; and

(iii) for each *scheduled resource* in an Aggregate, a conformance mode. This indicates whether aggregated or individual dispatch conformance is required – refer section 2.6 for further details.

(b) Dispatch Targets for all *scheduled resources* are determined by NEMDE after co-optimising the *energy market* with the FCAS markets.

(c) A *dispatch instruction* will also include a Dispatch Mode for *scheduled resources* with a bid *dispatch inflexibility profile.* The Dispatch Mode is a number which indicates the required target mode of the *scheduled resource* at the end of the *trading interval* based on the unit's progression through its bid *dispatch inflexibility profile*. *Semi-scheduled generating units*, *scheduled bidirectional units*, and *scheduled network services* cannot have *dispatch inflexibility profiles*.

(i) For *scheduled generating units*, the Dispatch Mode represents a commitment dispatch instruction to start, synchronise and follow their *dispatch inflexibility profile*.

(ii) For *scheduled loads* and *wholesale demand response units*, the Dispatch Mode represents a commitment dispatch instruction to prepare for and follow their *dispatch inflexibility profile*.

(d) *Scheduled resources* in an Aggregate with a bid *dispatch inflexibility profile* can commit and follow *dispatch instructions* in aggregate when the Dispatch Mode of the *scheduled resource*(s) indicate that the resource(s) are in normal operation (i.e., after synchronisation, ramping up to the minimum loading level and spending minimum time required at or above the minimum loading level). The relevant *Market Participant* must ensure that its latest *dispatch bid* reflects the actual intentions for the relevant inflexible *scheduled resource*(s).

2.2. Issue of dispatch instructions

(a) *Dispatch instructions* will be issued electronically via the AEMO Electricity Market Management System (EMMS) interfaces.

(b) Where possible, *dispatch instructions* for *scheduled resources* will also be issued electronically via the *automatic generation control system* (AGC). A *scheduled resource* providing *regulation services* must be set up to receive and respond to *dispatch instructions* issued via the AGC. For a *scheduled resource* not providing *regulation services,* it is the responsibility of the Participant to notify AEMO whether they wish to be set up to receive *dispatch instructions* via the AGC.

(c) *A scheduled resource* will not be issued *dispatch instructions* via AGC unless the *scheduled resource* indicates via SCADA that its AGC is available for remote control and AEMO selects the unit to remote AGC.

(d) AEMO may issue *dispatch instructions* in some other form if in its reasonable opinion the normal processes are not available.

(e) AEMO's AGC may issue a single *dispatch instruction* covering all *scheduled resources* in an Aggregate, in respect of a Target Aggregate which is a two-DUID *scheduled*

generating unit and *scheduled load* pair (e.g. a battery) - refer to section 2.6.5 for further details.

2.3. Automatic Generation Control

The AGC serves two purposes in the NEM. They are:

(a) *Energy market dispatch* of *scheduled resources* which are on remote control:

Dispatch results from the NEMDE run are ramped into the AGC (to prevent any large step change in megawatt output). In general:

(i) any *scheduled resource* not *dispatched* for regulation FCAS will be ramped to its Dispatch Target

(ii) in respect of a Target Aggregate that receives a single AGC set-point, if no *scheduled resources* in the Aggregate are dispatched for regulation FCAS then AGC will ramp the Aggregate to its Aggregate Dispatch Target.

(b) Regulating FCAS *dispatch*:

(c) Actual *frequency* and time error values are compared to the desired *frequency* and time error to calculate the Area Control Error (ACE). This value is then used by the AGC to determine the desired megawatt outputs of *generating units dispatched* for regulation FCAS

2.4. Semi-Scheduled Generating Units

(a) *Semi-scheduled generating units* will generally be *intermittent* generation (typically, wind and solar farms) greater than 30 MW.

(b) The *central dispatch* process determines the *dispatch* of *semi-scheduled generating units* in a similar manner to *scheduled generating units,* on the basis of bid *price bands* and availability. However, for *semi-scheduled generating units*, the availability information is calculated as the lower of the bid energy Maximum Availability (Max Avail) and the *unconstrained intermittent generation forecast* (UIGF) provided either by AEMO's AWEFS/ASEFS or by the participant. SCADA is a primary input to the production of AWEFS/ASEFS dispatch forecasts and the Generator must rectify failed SCADA as soon as possible[1].

(c) The *central dispatch* process determines for each *semi-scheduled generating unit* both a Dispatch Target and an associated semi-dispatch cap flag, and electronically issues these confidentially in a *dispatch instruction* to the relevant *Semi-Scheduled Generator*. If the *semi-scheduled generating unit is in a Cap Aggregate, then the* semi-dispatch cap flag is replaced by the conformance mode.

(d) The *dispatch instruction* for a *semi-scheduled generating unit* not in an Aggregate requires that unit's *active power* output to be capped at the Dispatch Target value set by AEMO only when its *semi-dispatch cap* flag is set to 'TRUE'. This value is called its "semi-dispatch cap".

(e) Otherwise, if its *semi-dispatch cap* flag is set to 'FALSE' the *semi-scheduled generating unit's active power* output may only deviate from its Dispatch Target due to energy

[1] Further information and resources for *Semi-Scheduled Generators* on forecasting and dispatch requirements, SCADA signals, etc. can be found at: https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/operational-forecasting/solar-and-wind-energy-forecasting

source availability, physical capability or when providing any service required under the NER.

(f) For a *semi-scheduled generating unit* in a Cap Aggregate, the requirement in paragraph (d) applies, except that the conformance mode is used instead of the semi-dispatch cap flag. The conformance mode indicates whether the *semi-scheduled generating unit* must either individually conform or conform in aggregate with other units in the Aggregate – refer to section 2.6.1 for further details.

(g) For a *semi-scheduled generating unit* in a Mixed Aggregate, both the conformance mode and the semi-dispatch cap flag are used:

- if conformance mode = 2, then *the semi-scheduled generating unit* must individually conform in accordance with paragraph (d)
- if conformance mode = 1 and the *semi-dispatch cap* flag is set to 'TRUE', then the *semi-scheduled generating unit* must either conform in accordance with paragraph (d) or conform in aggregate with other units in the Aggregate – refer to section 2.6.2 for further details.
- if conformance mode = 1 and the *semi-dispatch cap* flag is set to 'FALSE', then the *semi-scheduled generating unit* must either conform in accordance with paragraph (e) or conform in aggregate with other units in the Aggregate – refer to section 2.6.2 for further details.

(h) The semi-dispatch cap flag is set to 'TRUE' for a *semi-scheduled generating unit* when either one of the following conditions is satisfied for a *trading interval* (called a *semi-dispatch interval*):

(i) The Dispatch Target is limited by Binding or Violated Network or FCAS Constraint:

The *generating unit's* forecast output (its UIGF) is explicitly limited by any binding or violated *network constraint* or *ancillary service constraint* equation, and if the actual output were to exceed the value of the semi-dispatch cap, this would result in violating (or further violating) that constraint equation; or

(ii) The Dispatch Target is otherwise below the UIGF:

The *generating unit's* forecast output (its UIGF) is not explicitly limited by a binding or violated *network constraint* or *ancillary service constraint* equation, but is limited as a result of either a purely inter-regional limitation, or a bid or market-related limitation, the latter including:

(A) Unit Ramp Rate

(B) Unit Fixed Loading Level

(C) Non-dispatch of uneconomic price bands

(D) Marginal dispatch of economic price bands

(E) Bid Max Avail

(i) For all other *trading intervals* where neither of the above conditions is met for a particular *semi-scheduled generating unit*, its semi-dispatch cap flag is set to 'FALSE' for that *trading interval* (called a *non semi-dispatch interval*).

2.5. Wholesale Demand Response Units

NER clause 4.9.2B(e) requires AEMO to make, as a *power system operating procedure*, a procedure setting out arrangements for notifying a *Demand Response Service Provider* whether

it is being given a *dispatch instruction* in relation to its *wholesale demand response* in a *trading interval*.

This section makes provision for this requirement, as well as the information in relation to the *central dispatch process*.

(a) The *central dispatch* process determines a Dispatch Target for each *wholesale demand response unit*, and electronically issues this confidentially in a *dispatch instruction* to the relevant *Demand Response Service Provider*.

(b) A *dispatch instruction* is issued for every *trading interval* regardless of the Dispatch Target value. For example, when a *wholesale demand response unit* is bid unavailable for dispatch for a period of time, a Dispatch Target of 0 MW is issued for every *trading interval* in that period.

(c) The *central dispatch* process determines Dispatch Targets for *wholesale demand response units* in a similar manner to *scheduled generating units,* on the basis of bid *price bands* and availability with both treated as a *supply* when balancing electricity *supply* and demand.

(d) A Dispatch Target for a *wholesale demand response unit* is the required reduction in *active power* consumption (in MW) below the *baseline* consumption of the *wholesale demand response unit*, to be achieved at the end of the *trading interval* to which it relates. This differs to a Dispatch Target for a *scheduled load*, which is the required *active power* consumption.

(e) The bid *available capacity* (in MW) of a *wholesale demand response unit* is its total consumption reduction capacity available for *dispatch*.

2.6. Aggregate Systems

(a) Under NER clause 4.9.2C, a *generating system* or *integrated resource system* that comprises two or more *scheduled resources* for which AEMO issues separate *dispatch instructions*, may be permitted to conform in aggregate to *dispatch instructions* for those *scheduled resources* (referred to in this Procedure as aggregated dispatch conformance), excluding any *scheduled resources* for which AEMO has required resource level compliance in the *dispatch instruction* (referred to in this Procedure as individual dispatch conformance), and excluding any *wholesale demand response* or *scheduled network services*.

(b) A *Market Participant* can apply to AEMO to register all or some of the *scheduled resources* in its *generating system* or *integrated resource system* for aggregated dispatch conformance (the registered *scheduled resources* being an **Aggregate System**, or **Aggregate**).

(c) AEMO determines whether the Aggregate is a Cap Aggregate, a Mixed Aggregate or a Target Aggregate, in accordance with sections 2.6.1(a), 2.6.2(a) or 2.6.3(a) respectively.

(d) In accordance with section 2.8, all *scheduled resources* in an Aggregate must be capable of linear ramping, in aggregate and individually, if individual dispatch conformance is required.

2.6.1. Aggregated Dispatch Conformance – Cap Aggregate

(a) A Cap Aggregate is an Aggregate that only comprises *semi-scheduled generating units* (for example, a *generating system* comprising a wind and solar *semi-scheduled generating unit*).

(b) All *semi-scheduled generating units* in a Cap Aggregate use the conformance mode in their *dispatch instructions* and ignore the semi-dispatch cap flag.

(c) The *semi-scheduled generating units* in a Cap Aggregate with conformance mode = 0 in their *dispatch instruction* are not required to cap their *active power* either in aggregate or individually. The conformance mode for all *semi-scheduled generating units* is set = 0 if no units have their semi-dispatch cap flag set.

(d) The *semi-scheduled generating units* in a Cap Aggregate with conformance mode = 1 in their *dispatch instruction* are required to conform to their *dispatch instructions* by capping their Aggregate Active Power at their Aggregate Dispatch Target (aka Aggregate Dispatch Cap).

(e) The conformance mode for a *semi-scheduled generating unit* in a Cap Aggregate is set = 1 in its *dispatch instruction* if the semi-dispatch cap flag is set for any *semi-scheduled generating unit* in the Cap Aggregate unless individual dispatch conformance is required on that *semi-scheduled generating unit* (conformance mode = 2).

Figure 1 below shows the dispatch conformance logic for a Cap Aggregate.

2.6.2. Aggregated Dispatch Conformance – Mixed Aggregate

(a) A Mixed Aggregate is an Aggregate that comprises *scheduled generating units* or *scheduled bidirectional units* and which may also include *semi-scheduled generating units* or *scheduled loads* (but excluding a *scheduled generating unit* and *scheduled load* pair for a single physical plant, which is a Target Aggregate).

(b) All *scheduled resources* in a Mixed Aggregate use the conformance mode in their *dispatch instructions*.

(c) The conformance mode for a *scheduled resource* in a Mixed Aggregate is set = 1 in its *dispatch instruction* unless individual dispatch conformance is required on the resource (conformance mode = 2).

(d) If any *scheduled resource* in a Mixed Aggregate with conformance mode = 1 is not conforming to its individual Dispatch Target for a *trading interval*, then all resources in the Mixed Aggregate are deemed to be participating in aggregated dispatch conformance for that *trading interval*.

(e) *A semi-scheduled generating unit* in a Mixed Aggregate uses the semi-dispatch cap flag in its *dispatch instruction* to determine whether to cap its *active power* to its individual Dispatch Target or (if its conformance mode = 1) to participate in aggregated dispatch conformance.

(f) The *scheduled resources* in a Mixed Aggregate that are participating in aggregated dispatch conformance are required to conform to their *dispatch instructions* as follows:

  (i) their Aggregate Active Power cannot be greater than their Aggregate Dispatch Target; and

  (ii) their Aggregate Active Power cannot be less than their Aggregate Dispatch Target, if the Net Scheduled Active Power is less than the Net Scheduled Dispatch Target.

Figure 2 below shows the dispatch conformance logic for a Mixed Aggregate.

2.6.3. Aggregated Dispatch Conformance – Target Aggregate

(a) A Target Aggregate is an Aggregate that comprises a *scheduled generating unit* and *scheduled load* pair, pertaining to a single physical plant.

(b) The conformance mode for all *scheduled resources* in a Target Aggregate is set = 1 in its *dispatch instruction*.

(c) The *scheduled resources* in a Target Aggregate are required to conform to their *dispatch instructions* by controlling their Aggregate Active Power to meet their Aggregate Dispatch Target.

Figure 3 below shows the dispatch conformance logic for a Target Aggregate.

Figure 1 Dispatch conformance logic for a Cap Aggregate

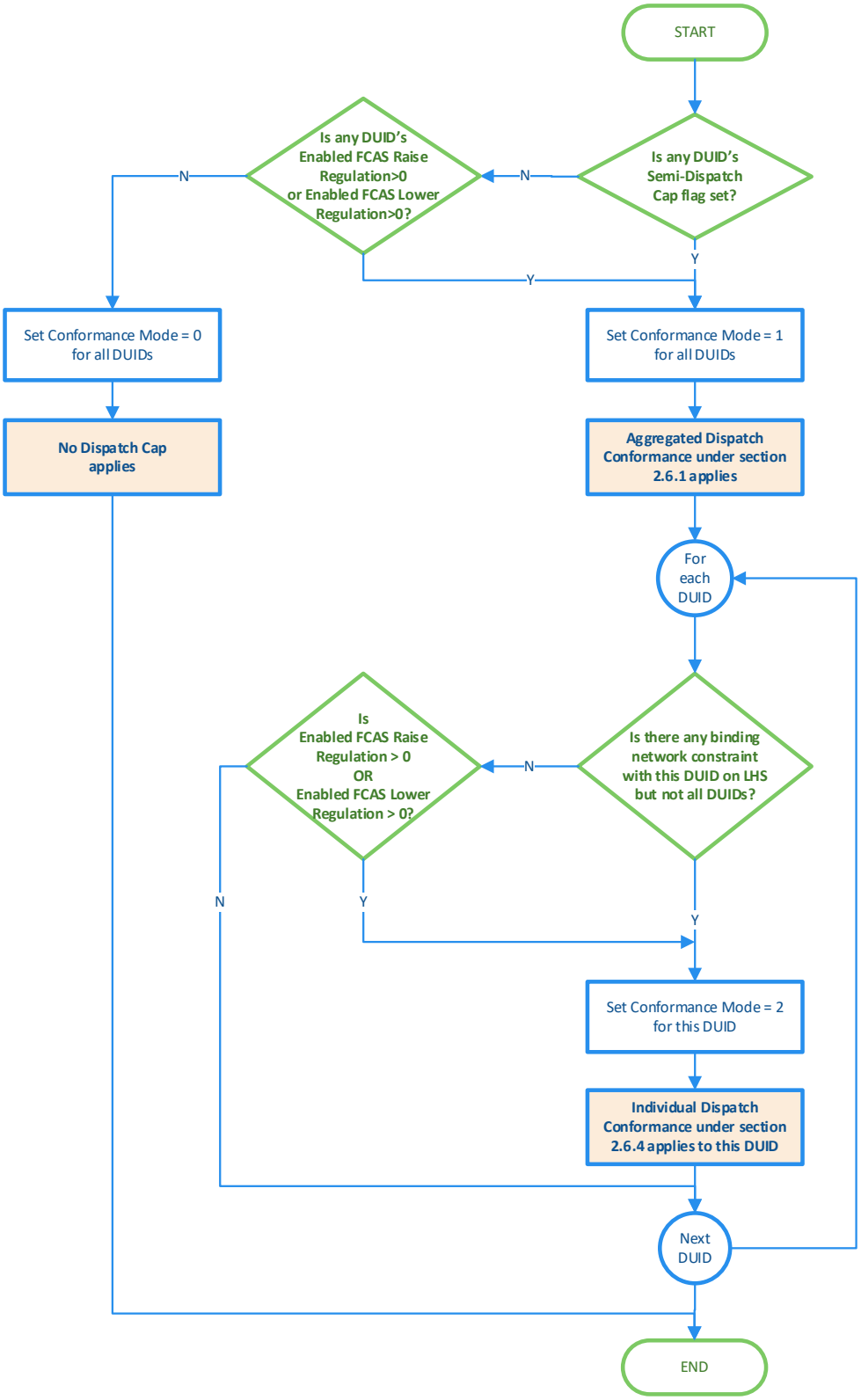


Figure 2 Dispatch conformance logic for a Mixed Aggregate

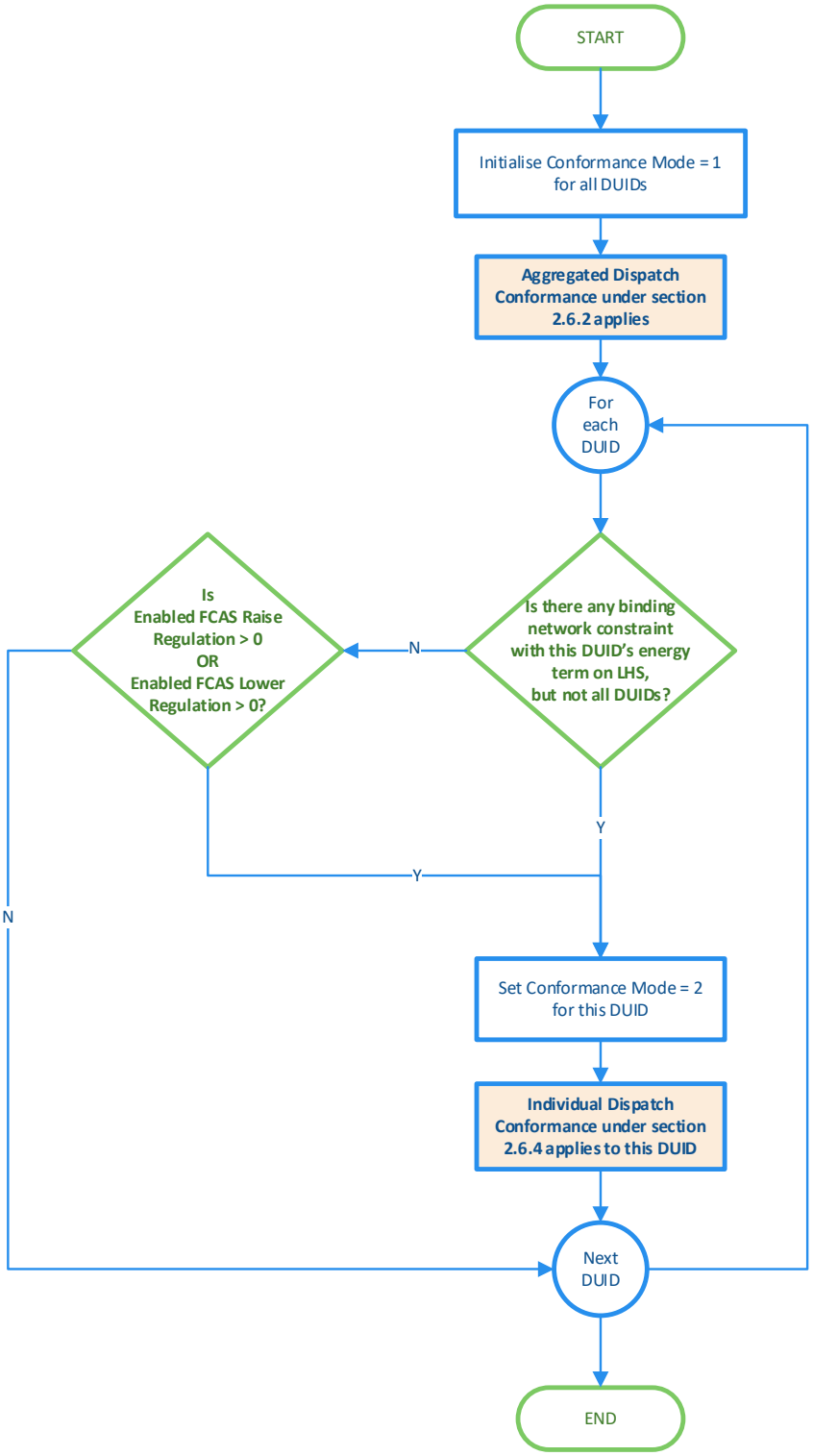
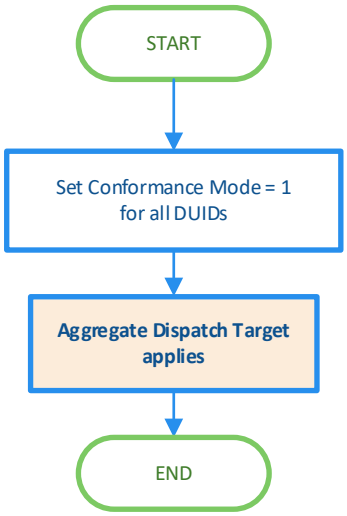


Figure 3 Dispatch conformance logic for a Target Aggregate



2.6.4. Individual Dispatch Conformance

(a) The aggregated dispatch conformance requirements are subject to, and overridden by, any individual dispatch conformance requirement on a *scheduled resource* or the provision of any service required from that *scheduled resource* under the NER.

(b) AEMO may specify in a *dispatch instruction* for a *scheduled resource* in an Aggregate that the relevant *scheduled resource* is required to operate in accordance with that *dispatch instruction* where a *network constraint* would be violated if the *scheduled resource* were to operate other than in accordance with the *dispatch instruction*, due to technical characteristics of the *scheduled resource*.

(c) Table 3 shows the technical characteristics that might require individual dispatch conformance for a *scheduled resource* in an Aggregate, for example to facilitate the maintenance of stability or the delivery of services required for *power system security*.

(d) If individual dispatch conformance is required for a *scheduled resource* in an Aggregate, this is indicated by conformance mode = 2 in that resource's *dispatch instruction*.

(e) For a *semi-scheduled generating unit*, individual dispatch conformance requires that their *active power* is capped at their Dispatch Target (that is, Dispatch Cap) and may only deviate from its Dispatch Target due to energy source availability, physical capability (as defined in section 2.8(b)(vii) and (viii)) or when providing any FCAS or other service required under the NER.

(f) For a *scheduled generating unit, a scheduled bidirectional unit*, or a *scheduled load*, individual dispatch conformance requires that its *active power* meets its Dispatch Target and may only deviate from that Dispatch Target due to physical capability (as defined in section 2.8(b)(vii) and (viii)) or when providing any FCAS or other service required under the NER.

Table 3 Technical characteristics that might require individual dispatch conformance

Characteristics	Description
Network Thermal Limit	Power system security could be violated if additional firming were to occur beyond its full delivery of enabled FCAS regulation based on AEMO's AGC set-point
Network Support	Constraint to ensure delivery of a *network support* and *control ancillary service* under a *network support agreement*
Quality of Supply	Limits to manage voltage unbalance, negative sequence voltage, harmonics, flicker or voltage step changes
System Strength	System strength limit
Transient Stability	Transient stability limit for a fault on a network element
Voltage Stability	Steady state voltage collapse or voltage stability limit

2.6.5. FCAS and Aggregated Dispatch Conformance

(a) Each *scheduled resource* in an Aggregate that is registered for regulation FCAS (or if the *Market Participant* otherwise requests to receive *dispatch instructions* via AGC) will receive a separate AEMO AGC set-point. The exception to this is described in paragraph (b) below.

(b) For a two-DUID scheduled battery (*scheduled generating unit/scheduled load* pair) that is a Target Aggregate and is registered for regulation FCAS (or if the *Market Participant* otherwise requests to receive *dispatch instructions* via AGC for such an Aggregate that is not registered for regulation FCAS), then AEMO will set up its AGC system to issue a single *dispatch instruction* covering all *scheduled resources* in the Aggregate (**aggregate**

set-point). The *Market Participant* must set up a complying AGC system to receive this aggregate set-point and control the *scheduled resources*.

(c) When a *scheduled resource* in an Aggregate is enabled for any regulation FCAS then the resource is not permitted to firm or offset its *active power* against other resources in the Aggregate (that is, cannot participate in aggregated dispatch conformance). AEMO will require individual dispatch conformance for that *scheduled resource* (conformance mode = 2 in its *dispatch instruction*).

(d) At other times, including when a *scheduled resource* in an Aggregate is enabled for any contingency FCAS only, that *scheduled resource* is permitted to firm or offset its *active power* against that of other *scheduled resources* to the Aggregate Dispatch Target, subject to there being no impact on any *scheduled resource's* ability to provide its *enabled* contingency FCAS response.

(e) A *scheduled resource* in an Aggregate must not offset the delivery of FCAS response or other service required under the NER from other *scheduled resources* in the Aggregate.

(f) To achieve the objectives in paragraphs (c), (d) and (e), a *scheduled resource* in an Aggregate must:

- maintain its *enabled* FCAS reserve (headroom for FCAS raise, footroom for FCAS lower) for each FCAS, and cannot transfer any enabled FCAS to other *scheduled resources* in the Aggregate, and
- operate within the effective FCAS lower and upper breakpoints relevant to the amount of FCAS *enabled* for each FCAS (**operating limits**), to ensure that the *enabled* FCAS can be delivered.

The *Market Participant* will need to determine these operating limits for each *trading interval* based on the FCAS bid trapezium and the enabled quantity for each type of FCAS.

Figures 4 and 5 below provide a generalised example of the operating limits that a *scheduled resource* providing FCAS must operate within to ensure its enabled FCAS reserves are maintained while allowing room for aggregated dispatch conformance with other *scheduled resources* in the Aggregate.

Figure 4 Operating Limits for managing Contingency FCAS and Aggregated Dispatch in a Mixed Aggregate

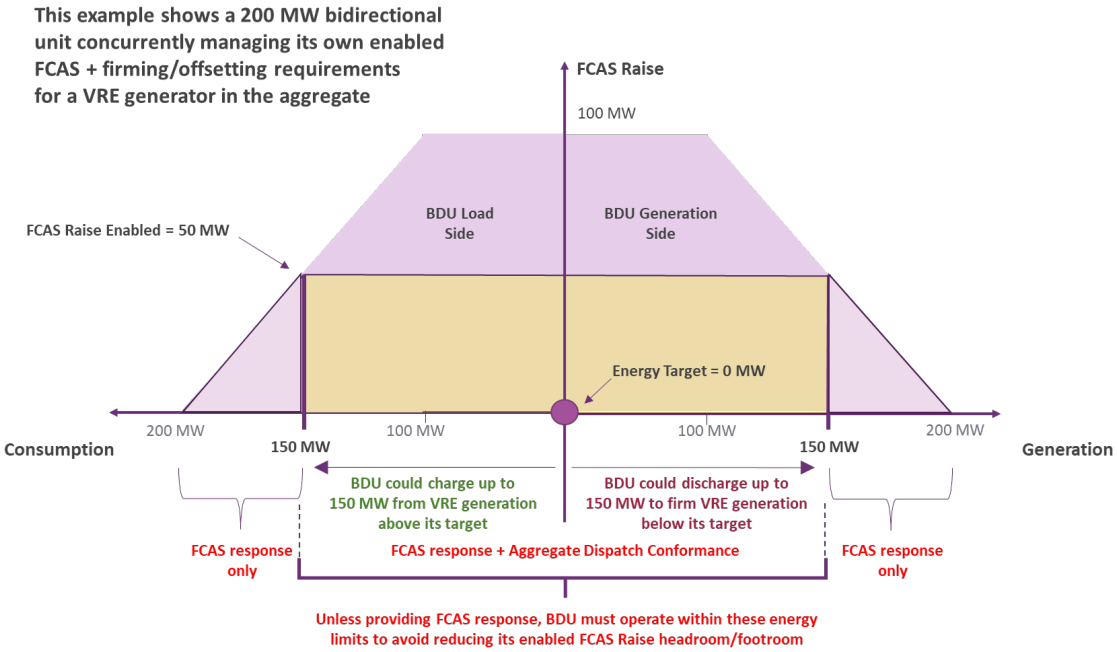
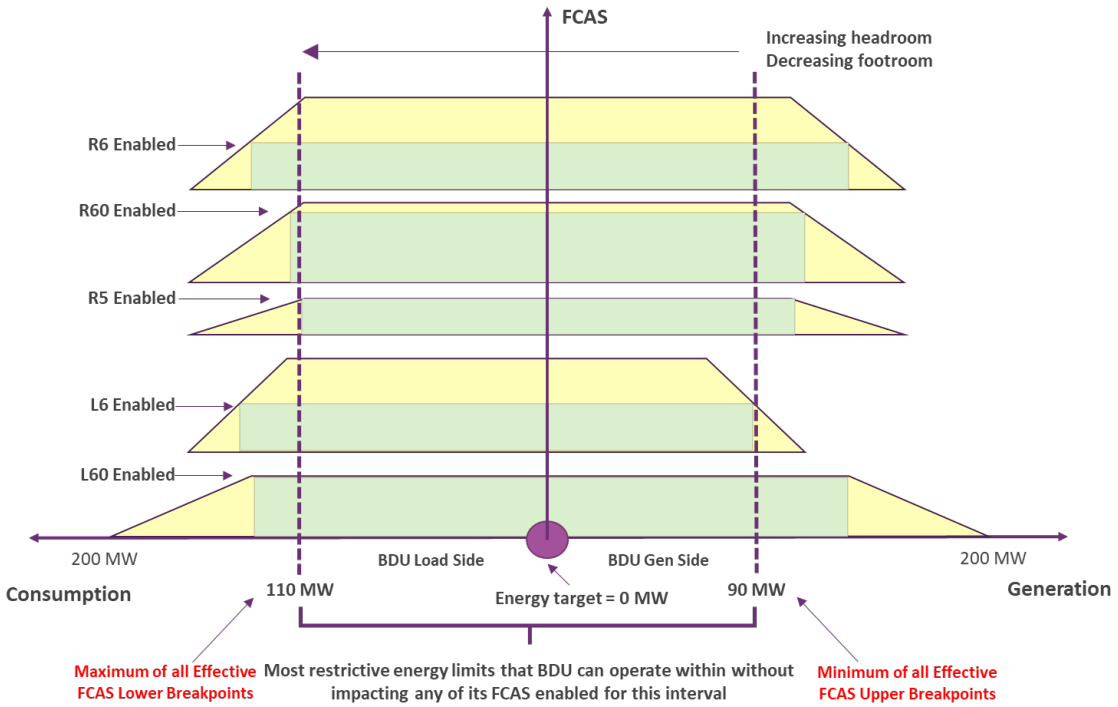


Figure 5 Operating Limits based on the most restrictive Contingency FCAS breakpoints



2.7. Dispatch of Non-Market Ancillary Services

Refer to SO_OP_3708 Non-Market Ancillary Services.

2.8. Ramp rates in energy dispatch instructions

(a) As part of a *dispatch instruction* for energy, NER clauses 4.9.5(a)(3) and 4.9.5(a2)(3) require AEMO to specify a *ramp rate* or a specific target time for a *generating unit* or a *wholesale demand response* unit to reach an applicable outcome (being Dispatch Target) specified in the *dispatch instruction*. This section makes provision for this requirement, which extends to *scheduled loads* subject to capability. Note that NEMDE already accounts for the maximum and minimum *ramp rate* requirements (described in section 9) when it produces a Dispatch Target.

(b) Absent a *ramp rate* provided directly in a *dispatch instruction*:

(i) *scheduled generating units*;

(ii) *scheduled loads*;

(iii) *scheduled bidirectional units*;

(iv) *wholesale demand response units*;

(v) *semi-scheduled generating units* not in an Aggregate, during *semi-dispatch intervals* or when constrained by a Local Limit; and

(vi) *scheduled resources* in an Aggregate

must linearly ramp (either individually [if not in an Aggregate, or in an Aggregate but individual dispatch conformance is required] or in aggregate with other *scheduled resources* in an Aggregate [if individual dispatch conformance is not required]) their *active power* across the *trading interval* in a uniform way, from their initial *active power* at the time of receiving the *dispatch instruction* to the Dispatch Target at the end of the *trading interval*, subject to:

A. energy source availability (for *semi-scheduled generating units*);

B. physical limitations of the *facility*;

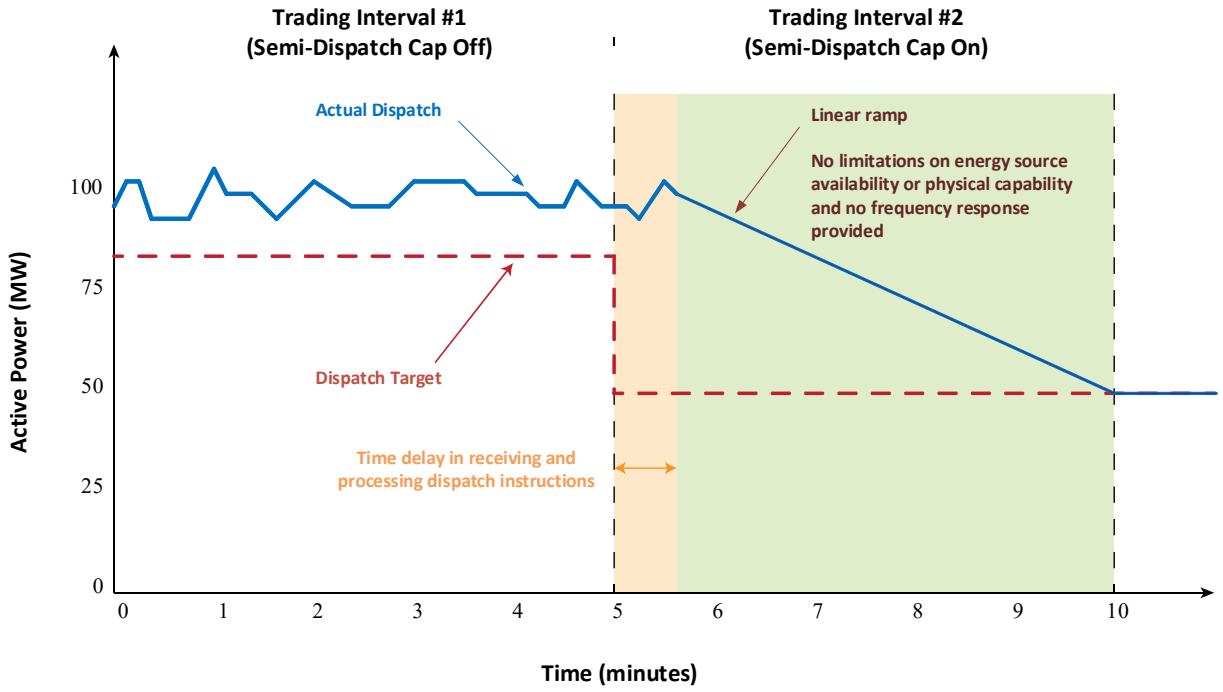
C. technical capabilities of the *facility*, which must, as a minimum, be consistent with its applicable *performance standards*; and

D. provision of any service required under the NER.

(c) Outside of *semi-dispatch intervals,* intervals where neither aggregated nor individual dispatch conformance is required for a Cap Aggregate, or intervals where they are constrained by a Local Limit, *semi-scheduled generating units* must either linearly ramp to their Dispatch Target or generate in accordance with their energy source availability (subject to paragraphs (b)(B)-(D) above).

Figure 6 below shows the expected *dispatch* for a *semi-scheduled generating unit* assuming no limiting factors.

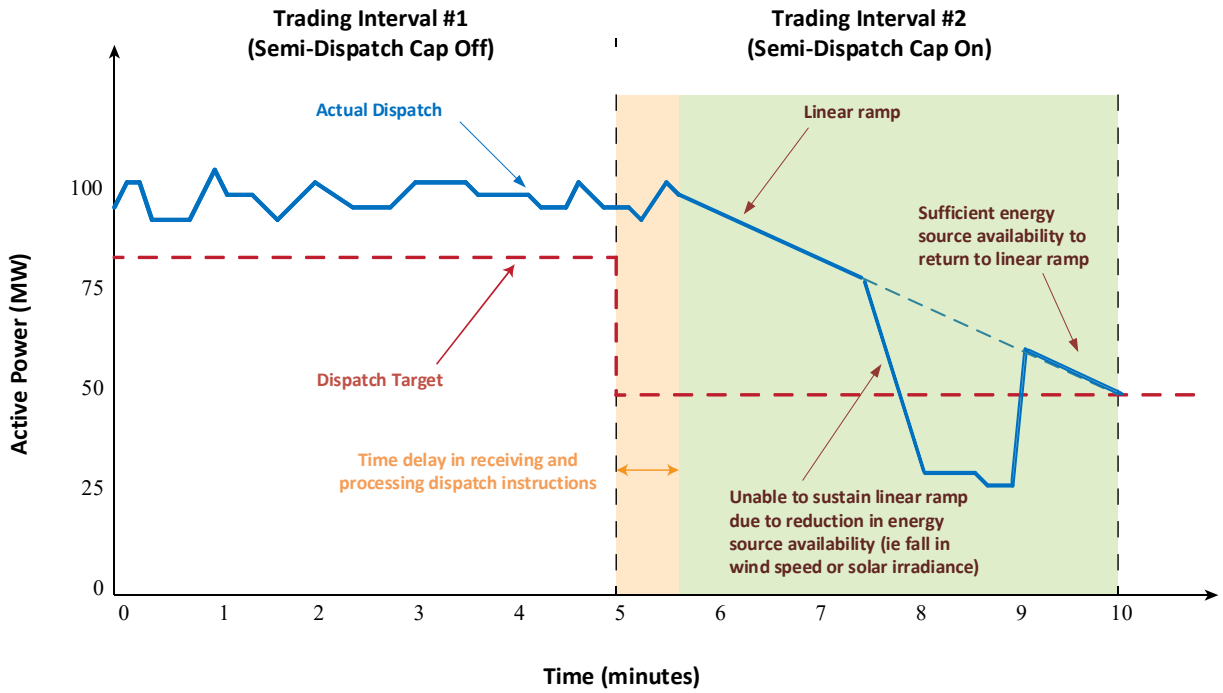
Figure 6 Semi-scheduled generating unit linear ramping with no limiting factors



Note that for "Trading Interval #1", the *semi-scheduled generating unit* is deviating from the red dashed "Dispatch Target" line (being a straight line between two successive Dispatch Targets) due to variations in its available energy source (shown as "Actual Dispatch").

Figure 7 shows the expected *dispatch* for a *semi-scheduled generating unit* that cannot sustain its linear ramp due to a reduction in energy available.

Figure 7 Semi-scheduled generating unit cannot sustain linear ramp due to reduction in energy available



3. Non-conformance with dispatch targets

3.1. Principles of Conformance Monitoring

Conformance Monitoring is a process that AEMO applies to *scheduled generating units*, *semi-scheduled generating units*, *scheduled bidirectional units*, *scheduled loads* and Aggregate Systems using the AEMO Conformance Module. The aim of the process is to identify and implement corrective measures if a *Market Participant* fails to follow a *dispatch instruction*.

The AEMO Conformance Module automatically flags non-responsive *scheduled generating units*, *semi-scheduled generating units*, *scheduled bidirectional units*, *scheduled loads* and Aggregate Systems based on the SCADA quantities used by the *central dispatch* process. Non-conformance action then follows in a Manual or Automated manner.

Two trigger mechanisms are utilised to identify the severity of non-conformance. These are the Small Error Trigger and the Large Error Trigger. Corrective measures are then taken depending on the severity and duration of the non-conformance event. The corrective measures are a logical defined sequence of actions aimed at resolving the mismatch between actual and total dispatched generation in the NEM.

In addition to the communication steps set out in this section, participants should contact the AEMO control room when clarification of conformance status is necessary.

The Non-conformance Calculations and Process Overview, including worked examples, are detailed in Appendix A of this document.

AEMO does not apply the Conformance Monitoring process to *wholesale demand response units* and *scheduled network services*. For *wholesale demand response units* there is a separate post-event dispatch non-compliance analysis performed. For *scheduled network services,* AEMO monitors dispatch conformance using an offline process.

3.1.1. FCAS Conformance

If an Ancillary Service Provider is enabled to provide a service and fails to respond in the manner expected by the market ancillary service specification (as determined in AEMO's reasonable opinion), then the NER provide for AEMO to take certain actions, including:

(a) The FCAS generating unit or load is to be declared and identified as non-conforming

(b) AEMO must advise the *Market Participant* that the FCAS generating unit or load is identified as non-conforming and request a reason for the non-conformance. The *Market Participant* must promptly provide a reason.

(c) AEMO may set a fixed constraint for the relevant FCAS and the *Market Participant* must ensure that the FCAS generating unit or load complies with the fixed constraint.

AEMO may also require Ancillary Service Providers to periodically report on their FCAS conformance and their management of enabled FCAS headroom and footroom.

3.2. Scheduled Resources and Aggregate Systems

The dispatch conformance of *scheduled generating units*, *scheduled bidirectional units*, *semi-scheduled generating units*, *scheduled loads* or Aggregate Systemsmay be processed by AEMO in a Manual or Automated manner. The Conformance Data Report indicates the mode of operation at any time. Manual and Automated processing are described in this section.

3.2.1. Manual Processing

If the AEMO Conformance Module is operating in Manual mode for a *region* and a non-conformance exists for a *scheduled generating unit*, *scheduled bidirectional unit, semi-scheduled generating unit*, *scheduled load* or Aggregate System in that *region* but it does not cause *power system security* violations, the following actions are to be taken:

(a) Identify non-responsive *scheduled generating unit, scheduled bidirectional unit*, *semi-scheduled generating unit*, *scheduled load* or Aggregate System using the AEMO Conformance Module.

(b) Contact the *Market Participant* and request a reason for the non-conformance. Log the reason given. Note that the Conformance Data Report is available to the participant each *trading interval*, so any non-response issue should have already been observed. The Conformance Status at this point will be Not-Responding. Note that in Manual operating mode, the Conformance Status as reported by the AEMO Conformance Module will not advance beyond Not-Responding. All subsequent actions are manually applied and involve telephone communication between AEMO and the *Market Participant*.

(c) If modification to the bid is necessary to achieve a realistic real-time dispatch, request the *Market Participant* to submit a *rebid* to reflect the current performance of the plant.

(d) If the *Market Participant* fails to follow the Dispatch Targets or to submit a *rebid* within two *trading intervals*, the relevant *scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or Aggregate System is to be declared non-conforming. If required, AEMO will set the unit at an output determined by AEMO so that a physically realisable dispatch is achieved. This will be achieved by AEMO applying a non-conformance constraint. The constraint violation penalty factor for this constraint will be set at 1160 x MPC.

(e) The *Market Participant* will be advised that the *scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or Aggregate System has been declared non-conforming and that a non-conformance constraint has been applied. Note that because the non-conformance constraint action will result in the error being reduced, this may result in the reported Conformance Status returning to Normal. This is to be expected as the error has been corrected and the Non-Conforming declaration is being processed manually.

(f) The *scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or Aggregate System is to remain at the loading determined by the non-conformance constraint until AEMO is advised by the *Market Participant* that it is now capable of following *dispatch instructions*.

3.2.2. Automated Processing

If the AEMO Conformance Module is operating in Automatic mode (normal mode) and a non-conformance exists but does not cause *power system security* violations, the following actions are to be taken:

(a) Observe non-responsive *scheduled generating unit, semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or Aggregate System using the AEMO Conformance Module. The participant will be in an informed position as the Conformance Data Report is published each *trading interval*.

(b) The Conformance Status change observed in the AEMO Conformance Module is identical to the Conformance Data Report content. The *Market Participant* also receives a message corresponding to the Conformance Status in each Report. The sequence of Conformance Status change and message content is as follows:

(i) Off-Target

Participant Message: Please move to dispatch target or rebid

(ii) Not-Responding

Participant Message: Please move to dispatch target or rebid

(iii) NC-Pending

Participant Message: Unit not responding to dispatch target. Non-conformance action pending

(iv) Non-Conforming

Participant Message: Unit declared Non-conforming (NC). NC constraint is invoked. AEMO is requesting a reason for the NC

For an Aggregate System where aggregated dispatch conformance applies, the sequence of Conformance Status change and message content is as follows:

(i) Off-Target

Participant Message: Please move to aggregate dispatch target or rebid

(ii) Not-Responding

Participant Message: Please move to aggregate dispatch target or rebid

(iii) NC-Pending

Participant Message: Unit(s) not responding to aggregate dispatch target. Non-conformance action pending

(iv) Non-Conforming

Participant Message: ADG declared non-conforming (NC). ADG NC constraint invoked. AEMO is requesting a reason for the NC.

(c) Note that the non-conformance constraint application mentioned in this automated process is the same as that applied for the manual process.

(d) If the *Market Participant* has not contacted AEMO in a reasonable time following the Non-Conformance Declaration then AEMO will contact the *Market Participant* and request a reason for the non-conformance to the *dispatch instruction*. AEMO will log the reason given.

(e) The *scheduled generating unit*, *semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or Aggregate System is to remain at the loading determined by the non-conformance constraint until AEMO is advised by the *Market Participant* that it is now capable of following *dispatch instructions*. For an Aggregate System, this will be the aggregate loading level determined by the aggregate non-conformance constraint.

3.3. [This section is deleted]

3.4. Conditions to apply to registered Fast Start generating units

(a) Registered Fast Start *generating units* may immediately be declared non-conforming if:

(i) a unit has synchronised and increased its generation level greater than 0 MW without having received a *dispatch instruction* from AEMO; or

(ii) a unit has received a *dispatch instruction* to reduce to 0 MW and fails to meet that *dispatch instruction*.

(b) The above also applies to *scheduled resources* in an Aggregate when aggregated dispatch conformance applies. The declaration of non-conformance will remain in place until AEMO is satisfied that the relevant *scheduled resource* will accurately respond to future *dispatch instructions*. The Non-Conformance Declaration may be implemented in an Automated or Manual manner by AEMO depending on the current operating mode of the AEMO Conformance Module. In either case AEMO will initiate communication with the *Market Participant* for any accelerated Non-Conformance Declaration.

(c) Appropriate participant staff should contact AEMO to confirm when the unit is able to follow Dispatch Targets.

3.5. Non-Conformance constraints

(a) When a *scheduled resource* is declared as non-conforming, AEMO may apply a constraint. In most cases this will be a dynamic constraint where the Right Hand Side equals the telemetered generation, consumption or transfer. For an Aggregate, the Right Hand Side of the aggregate non-conformance constraint will equal the sum of the telemetered *generation* or consumption for all *scheduled resources* in the Aggregate System.

(b) However, in some cases this dynamic constraint is not appropriate (e.g., it may cause or not remove a security violation), AEMO may apply a different constraint formulation or may determine not to apply a specific non-conformance constraint.

3.6. Market Reporting of Non-Conformance

If a declaration of non-conformance is made then this will be advised to all *Market Participants* before the end of next day. The notice should include the following details:

(a) identity of the *scheduled generating unit, semi-scheduled generating unit*, *scheduled bidirectional unit*, *scheduled load* or *scheduled network service*;

(b) *trading intervals* affected; and

(c) magnitude of non-conformance (the difference between the actual generation and the Dispatch Target).

In the case of a non-conforming Aggregate System, the notice will refer to the Aggregate System, all *scheduled resources* in the Aggregate System, and to the aggregate magnitude of non-conformance.

3.7. Accelerated non-conformance process

It is to be noted that at any stage of pursuing the non-conformance, if the *Market Participant* in respect of the *scheduled generating unit*, *semi-scheduled generating unit, scheduled*

bidirectional unit, *scheduled load, scheduled network service* or Aggregate System clearly indicates that the plant will not be conforming to *dispatch instructions*, the details of the discussion / communication will be logged and the *scheduled generating unit*, *semi-scheduled generating unit, scheduled load, scheduled bidirectional unit*, *scheduled network service* or Aggregate System may be declared immediately as non-conforming. Then the listed actions above for non-conformance will be taken as appropriate.

4. Commitment and de-commitment of scheduled generating units

4.1. Self-Commitment

(a) A *scheduled generating unit* is self-committing if it has a *self-dispatch level* of greater than 0 MW, where the *self-dispatch level* equals the sum of all energy bid in offloading (that is, negatively priced) price bands in its *dispatch bid*.

(b) Clauses 4.9.6(a)(1) and 4.9.7(a) of the NER require a *Scheduled Generator* to confirm with AEMO the expected *synchronising* time and *de-synchronising* time at least 1 hour before, and update this advice 5 minutes before *synchronising* or *de-synchronising*.

(c) *Scheduled generating units* that are self-committing are not required to further inform AEMO of their expected *synchronising* or *de-synchronising* times providing the relevant bid has been received by AEMO at least 1 hour prior to the expected *synchronising* or *de-synchronising* time, unless specifically requested by AEMO.

4.2. Fast-Start Generators that choose not to Self-Commit

(a) Fast-start *generating units* that choose not to *self-commit*, are subject to the same obligations as all other *Generators* in relation to *PASA* (NER clause 3.7.2 and 3.7.3). They are not, however, subject to the requirement in NER clause 4.9.6(a) to confirm expected *synchronisation* times with AEMO. Those *generating units* are subject to *dispatch instructions* from AEMO under NER clause 4.9.6(b). Those instructions must include a *synchronisation* time nominated by AEMO. This will be via the normal *dispatch* process.

(b) Clause 4.9.6(b)(3) of the NER requires a *Generator* that receives such a *dispatch instruction* to advise AEMO promptly if it cannot meet the nominated *synchronisation* time set out in that instruction.

(c) However, if a fast-start generator chooses to *self-commit* then that *generating unit* is subject to the same requirements in relation to advice to AEMO regarding *synchronising* or *de-synchronising* times as other self-committing *generating units*.

5. Dispatch re-runs

There are a number of conditions that could trigger an automatic re-run of the dispatch solution. The automatic re-run solution is completed and published within the original *trading interval*.

5.1. Over Constrained Dispatch (OCD) Re-Runs

(a) The automation of this process detects, adjusts, re-runs and reports an adjusted energy price for a high percentage of over-constrained *trading intervals* thereby allowing the automatic publishing of correct *spot prices* in real time.

(b) *The OCD re-run process is initiated when an* interconnector*,* intra-regional network constraint or ancillary service constraint is violated, and one or more of the following applies:

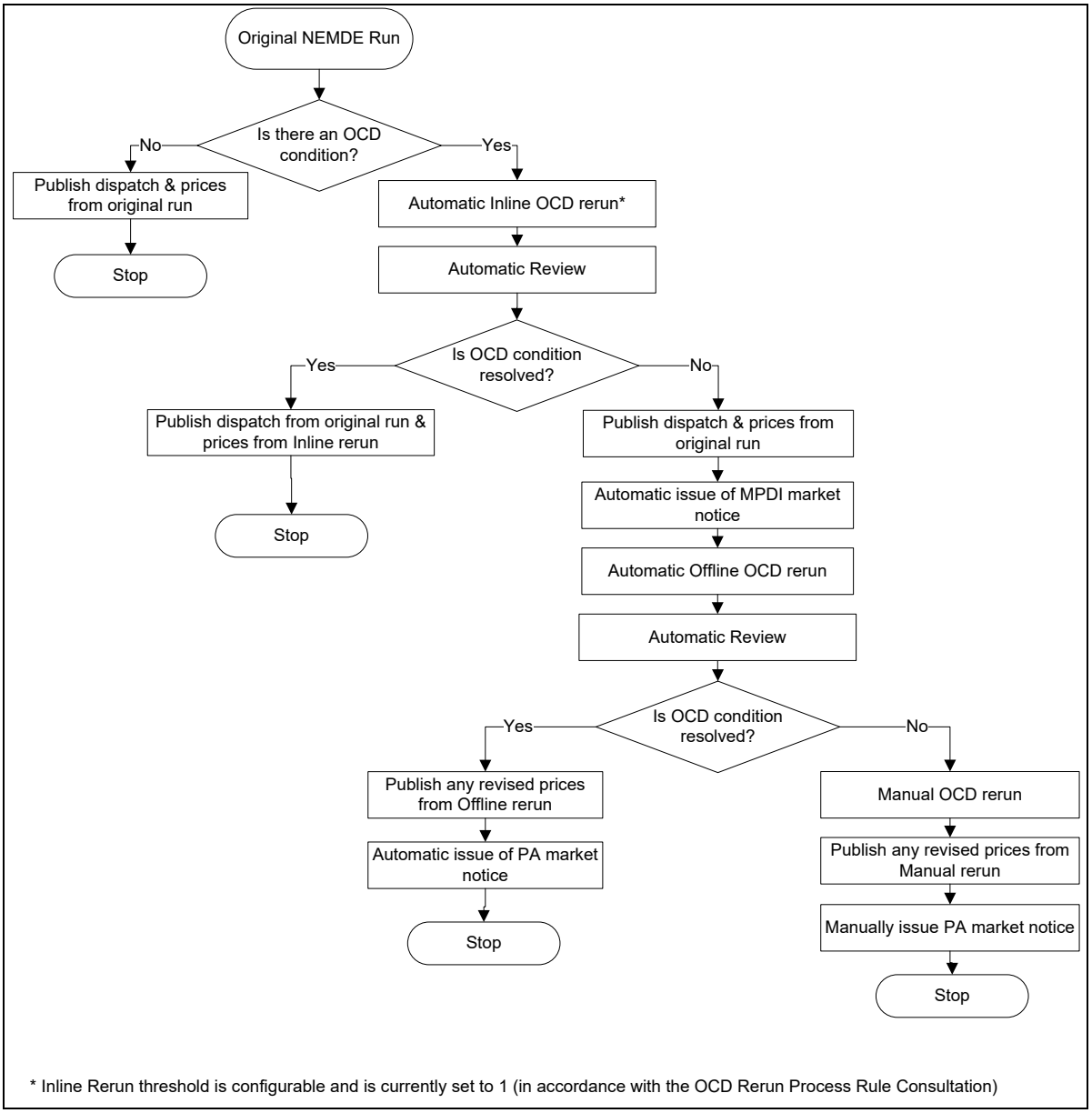
(i) An *energy spot price* is greater than or equal to MPC or;

(ii) An *energy spot price* is less than or equal to the *Market Floor Price* or

(iii) Any *ancillary service price* is greater than or equal to MPC.

Refer to the flowchart below for further clarification of the OCD process. Section 1 also includes a reference to the AEMO website.

Figure 8 Over Constrained Dispatch Re-Run Flow Diagram



(c) The OCD re-run process is run with relaxed violated constraint inputs to determine adjusted *spot and ancillary service prices*. In such cases all regional energy and *market ancillary service* prices are revised from the OCD re-run.

(d) *Commitment* of fast start plant is determined on the basis of the unit *commitment* undertaken prior to the initial unrelaxed pricing run.

(e) If the OCD is resolved after the Automatic Inline review, then no market notice will be issued.

(f) If an automatic OCD re-run occurs, then the original run prices (greater than MPC or less than the *Market Floor Price*) are not published.

5.2. NEMDE second run for Basslink dispatch

(a) There are two important characteristics of Basslink that can cause NEMDE to be unable to find the optimal solution in a significant number of *trading intervals*:

(i) No-go Zone - NEMDE is a linear program and will attempt to produce Dispatch Targets anywhere in the no-go zone if demanded by the market conditions.

(ii) FCAS Transfer Capability - When operating at levels greater than 50 MW in either direction, Basslink has the capability to transfer FCAS from one *region* to another. This allows, for example, the FCAS requirement for the Tasmanian *region* to be met in part by scheduling additional FCAS on the mainland, if it is economical to do so.

(b) NEMDE performs two runs for every *trading interval*. The first run uses the SCADA indication for the status of the Basslink frequency controller, and for the additional NEMDE run the input status of the Basslink frequency controller is assumed to be switched off. i.e., if the Basslink frequency controller is turned off, the two runs are identical.

(c) The final solution and the associated NEMDE input status of the Basslink frequency controller is decided by selecting the run with the least cost objective function. This allows:

(i) NEMDE to increase the set of allowable dispatch outcomes that satisfy the complex model of Basslink available to NEMDE so that it can maximise the value of spot market trade, as required under clause 3.8.1(a) of the NER.

(ii) A reduction in unnecessary counter price flows across the Basslink HVDC interconnector.

6. Aggregate dispatch error

6.1. Background

(a) Aggregate Dispatch Error is an adjustment to the Dispatch regional demand forecast. This adjustment is based on the following calculation for each *scheduled generating unit* or *scheduled bidirectional unit* not performing regulation duty:

ADE = Target value – Actual Value

(b) ADE will be positive when *scheduled generating units* or *scheduled bidirectional units* are operating below targets and negative when the units are operating above targets. The ADE for each unit in a *region* is summed to produce an ADE for that *region*.

(c) The resulting ADE value for each *region* is then added to the respective *region* demand forecast in the next *trading interval*.

6.2. ADE calculation

(a) Using a 30-minute time weighted average for the *region* ADE provides a more accurate predictor of the level of sustained dispatch error that should apply as a forecast demand adjustment in the next *trading interval*.

(b) The following calculation of each *region* ADE is performed. The calculation is based on 6 data samples at 5 minute intervals with the most recent sample being given a weight of 6 and the oldest a weight of 1.

Time Weighted Average ADE = ((Sample 1 * Weight1) + (Sample2 * Weight2) +… + (Sample6 * Weight6)) / (Weight1 + Weight2 + . … + Weight6)

(c) This calculation will be performed on a *regional* basis rather than on an individual *scheduled generating unit* or *scheduled bidirectional unit* basis.

6.3. Frequency element in ADE

(a) To ensure that any frequency deviation is not caused by or exacerbated by the ADE a frequency element is introduced into the ADE calculation. This ensures that if a frequency deviation occurs only ADE in a direction that would help to restore frequency is passed to the market systems.

IF Frequency > high dead band value AND ADE > 0 THEN

ADE = 0

ELSE ADE = ADE

Conversely

If Frequency < low dead band value AND ADE < 0 THEN

ADE = 0

ELSE ADE = ADE

(b) To ensure short duration frequency excursions are not passed to the ADE calculation the frequency input is a 60 second time weighted average.

(c) The calculation is based on 6 data samples at 10 second intervals with the most recent sample being given a weight of 6 and the oldest a weight of 1.

Time Weighted Average Hz = ((Sample 1 * Weight1) + (Sample2 * Weight2) +…(Sample6 * Weight6)) / (Weight1 + Weight2 +. …Weight6)

(d) A separate calculation is performed for each NEM *region*. The frequency dead bands are:

(i) Tasmania ±0.05Hz

(ii) Other regions ±0.025Hz

6.4. ADE cap values

To ensure excessive ADE values do not compromise *power system security* the ADE for each *region* is capped to the following values:

(a) Queensland, New South Wales and Victoria = ±50 MW

(b) South Australia ±25 MW

(c) Tasmania ±25 MW.

7. Directions and intervention pricing

(a) Where, during an *intervention trading interval*, AEMO is required to set a price at a value which AEMO considers would have applied had an *AEMO intervention event* not occurred, NEMDE will be run twice:

(i) First, the dispatch or outturn run, which includes *reserve contracts* or *direction* constraints to determine Dispatch Targets.

(ii) Second, the intervention price run, to determine *spot* and *ancillary service prices* and does not contain *reserve contracts* or *direction* constraints.

For more information regarding *directions* and intervention pricing refer to AEMO's SO_OP_3707 (Intervention, Direction and Clause 4.8.9 Instructions) and Intervention Pricing Methodology.

8. Review of constraints

(a) Constraint equations that are overly conservative or not functioning correctly can unnecessarily constrain the market. If such constraint equations are identified, they can be removed from *dispatch* and *pre-dispatch* by either blocking the constraint equation or removing it from the constraint set. Only constraints associated with thermal limits and not transient or voltage stability constraints will be removed.

(b) Until the constraints are revised, the *power system* will be managed by Contingency Analysis, Constraint Automation and/or discretionary constraints.

9. Ramp rate requirements

A *Market Participant* with a *scheduled resource* must provide up and down *ramp rates* in their bids. These *ramp rates* represent the highest rate at which the *scheduled resource* can move from one production or consumption point to another. In the case of *scheduled bidirectional units*, which can bid different *ramp rates* for the *generation* and consumption sides of the unit, a composite *ramp rate* may be used. This is explained in greater detail in Appendix C.

The bid *ramp rates* cannot be greater than the *maximum ramp rates* provided under NER 3.13.3(b) and cannot be less than the *minimum ramp rate requirements* defined in the Rules, except in the circumstances outlined below.

9.1. Minimum Ramp Rate Requirements

(a) For aggregated *scheduled resources*[2], the *minimum ramp rate requirement* is the sum of *the minimum ramp rate requirement* for each individual *scheduled resource*.

(b) For non-aggregated *scheduled resources* (except *wholesale demand response units*) the *minimum ramp rate requirement*:

(i) For *scheduled network services* is 3 MW/minute

[2] Aggregation of *scheduled resources* refers to any more than one resource within a DUID. Aggregation for *semi-scheduled generating units* is based on NER 3.8.3 (i), i.e., *semi-scheduled generating units* registered as a single unit under NER 2.2.7 are treated as non-aggregated for *ramp rate* purposes.

(ii) For *generating units* is Minimum (3 MW/minute, 3% of maximum *generation*)

(iii) For *scheduled loads* is Minimum (3 MW/minute, 3% of maximum consumption)

(iv) For *bidirectional units*:

(A) in respect of *generation* is Minimum (3 MW/minute, 3% of maximum *generation*)

(B) in respect of consumption is Minimum (3 MW/minute, 3% of maximum consumption)

rounded down to the nearest whole number greater than or equal to 1 MW/minute.

9.2. For *wholesale demand response units* there are no *minimum ramp rate requirements*. However, bidding system limitations require *Demand Response Service Providers* to use the 'reason' field in the bid if the *ramp rate* is less than 3 MW/min.Bid Ramp Rate Less than Minimum Requirements

A *ramp rate* less than the minimum requirements specified in section 9.1 may be provided in a bid if an event physically prevents or makes it unsafe for the relevant plant to operate. In this case:

(a) The r*amp rate* provided must be the maximum the plant can safely attain at that time.

(b) The participant must simultaneously provide a brief, verifiable and specific reason why the *ramp rate* is below the requirements. This is to be included in the 'reason' field in the bid.

9.3. Maximum Ramp Rate Less than Minimum Requirements

A *maximum ramp rate* less than the minimum requirements specified above may be provided under NER 3.13.3(b). In this case:

(a) The *maximum ramp rate* must be the maximum the relevant plant can safely attain.

(b) The participant must provide a brief, verifiable and specific reason why the *maximum ramp rate* is below the *minimum ramp rate* requirements.

(c) The participant does not need to provide a reason for the bid *ramp rate* unless the bid *ramp rate* is below the *maximum ramp rate* of the *scheduled resource*.[3]

9.4. Minimum Safe Operating Level

(a) As *generating units* approach the lowest output they can sustain without becoming unstable, a *rebid* may need to be submitted to ensure that the unit does not receive an even lower Dispatch Target. This is required to ensure safe operation of the plant.

(b) For clarity, the minimum safe operating level is assumed to be the level below which the *generating unit* would become unstable, after other technical responses have been

[3] For example, if the *minimum ramp rate requirement* for a *scheduled generating unit* is 3 MW/min, but the *maximum ramp rate* provided under NER 3.13.3(b) is 2 MW/min, then any bids with a 2 MW/min *ramp rate* will not need to be accompanied by a reason to be accepted. However, any bids with a *ramp rate* less than 2 MW/min will need to include a reason.

exhausted (for example, auxiliary firing). The minimum safe operating level does not reflect commercial issues, only technical and plant safety issues. Plant availability reflecting commercial considerations should still be managed through the normal price-band bidding dispatch process.

(c) In instances where a *scheduled generating unit* or *semi-scheduled generating unit* has reached its minimum safe operating level and cannot safely follow a *dispatch instruction* to vary its output downwards, it is appropriate for a zero down *ramp rate* to be provided to AEMO, as long as the zero *ramp rate* can be justified on the basis of a technical limitation. This approach should be used in preference to submitting an inflexible bid, as it provides greater flexibility to ensure the market remains in a *secure operating state*.

(d) As soon as the output of the *generating unit* moves materially above the minimum safe operating level, a *rebid* must be submitted to provide a *ramp rate* compliant with clause 3.8.3A of the NER.

(e) The complete “Rebidding and Technical Parameters Guideline” can be found on the AER website.

(i)

10. Dispatch of generation under network support agreements

NER clause 5.3A.12(b) provides that where a NSP decides to use generation to provide a network support function, the NSP must advise AEMO of any *network support agreements* entered into. To ensure that a *generating unit* that is the subject of a *network support agreement* is *dispatched* at the agreed level AEMO will constrain the *generating unit* on and as such the *generating unit* will not be eligible to set *spot prices* when *constrained on* in accordance with clause 3.9.7 of the NER. The constraint will normally take the form:

- GenID >=X MW (where X is the megawatt amount subject to the network support agreement) and will have a constraint violation penalty (CVP) of 30.

11. Outages and work on market related SCADA

11.1. Impact on Market Processes

Failed, suspect or incorrect SCADA has the potential to adversely affect Dispatch Targets, constraint outcomes and AEMO’s *power system security* monitoring applications. *Market Participants* and NSPs must advise AEMO in advance of any work that has the potential to affect market processes via SCADA values supplied to AEMO. This may include, but is not limited to SCADA equipment, RTU outages or injection testing. *Market Participants* and NSPs must report any SCADA failures to AEMO as a matter of urgency. When AEMO becomes aware of suspect or failed SCADA, AEMO will take appropriate action to ensure the integrity of the market processes and its security monitoring applications. This may involve using alternate data sources or replacing failed or suspect values with estimated or hand dressed values.

12. [Deleted]

[Formerly Mandatory Restrictions]

13. Scheduling error and process review

(a) A *scheduling error* is one of the circumstances described in clause 3.8.24 of the NER, which include a declaration by AEMO that it failed to follow the *central dispatch* process as set out in clause 3.8 of the NER.

(b) Where AEMO or a Participant identified a potential scheduling error, AEMO will investigate and determine whether it has failed to follow the central dispatch instruction.

(c) If as a result of the process review AEMO identifies that it has failed to follow the *central dispatch* process set out in NER clause 3.8, AEMO will declare that a *scheduling error* has occurred and publish a summary of the error on AEMO's website.

(d) A *dispute resolution panel* may also determine a *scheduling error* as set out in clause 3.8.24 of the NER.

14. Setting MPC Override

14.1. Load shed under instructions from AEMO

If AEMO reasonably believes that the *central dispatch* process would determine that there would be insufficient supply options to meet all the demand in a *region*, and issues an instruction to load shed in that *region*, then from the time that the AEMO instruction is to apply AEMO will set the *spot price* to MPC for that *region*.

Note 1 If the *dispatch algorithm* has already set the *spot price* then that price must remain.

14.2. Resetting of MPC Override

The MPC override *spot price* for a *region* must be removed when clearance is given to restore the final block of shed load in that *region*.

15. Administered price periods

An *administered price period* is determined to apply separately for each *region*.

15.1. Triggers for an Administered Price Period

Under clause 3.14.2(c) of the NER, an *administered price period* for a *region* is triggered if:

(a) The sum of the uncapped *spot prices* or *ancillary service prices* for that *region* over the previous 2016 *trading intervals* (7 days) exceeds the *cumulative price threshold*; or

(b) Refer to 15.2.

15.2. Current Trading Day

Once an *administered price period* is declared for a *region*, the remaining trading intervals for that trading day will also be administered price periods.

15.3. Dispatch during Administered Price Period

During *administered price periods* AEMO will continue dispatching generation and loads in accordance with the *central dispatch* process

15.4. Administered Price Cap & Cumulative Price Threshold

The *administered price cap* (APC) sets the maximum price, and the *administered floor price* (AFP) sets the minimum price that can apply while an *administered price period* is in place.

Note 2	The AFP does not apply to ancillary service prices because those prices are limited by the $0/MWh floor on FCAS bids.

The latest *cumulative price threshold* can be found on the AEMC website.

15.5. Pricing during Administered Price Periods

15.5.1. Triggered by Spot Prices exceeding CPT

If the sum of the uncapped *spot prices* in a *region* has triggered an *administered price period*, then from the next *trading interval*:

(a) If the *spot price* exceeds the APC, then AEMO must set the *spot price* to the APC.

(b) If the *spot price* is less than the *administered floor price*, AEMO must set the *spot price* to the *administered floor price*.

(c) If an *ancillary service price* for any *market ancillary services* in that *region* exceeds the APC, AEMO will set that *ancillary service price* to the APC.

15.5.2. Triggered by Ancillary Service Prices exceeding CPT

If the sum of the uncapped ancillary service prices for *a market ancillary service* in a *region* has triggered an *administered price period*, then from the next *trading interval:*

(a) If an *ancillary service price* for any *market ancillary service* in that *region* exceeds the APC, AEMO will set that *ancillary service price* to the APC.

16. Manifestly Incorrect Inputs (MII) and price review

16.1. Heading 2 Trading intervals that are subject to review (clause 3.9.2B (b), (c))

(a) AEMO has developed an automated method of monitoring and identifying *trading intervals* that are subject to review. Refer to Appendix B for the details of this method and the trigger thresholds used. The dispatch outputs associated with all the *regions* are independently monitored for this purpose.

(b) A Price Status flag of *"Not Firm"* is published to indicate *trading intervals* for which all the prices associated with those *trading intervals* are subject to review, pending the identification of manifestly incorrect inputs. A Price_Status flag of *"Firm"* is published for all other *trading intervals*. (Note that the Price_Status flag may not be set to *"Not Firm"* for *trading intervals* affected by MII/s where there are violated prices (MPC) that were not resolved by the automatic over-constrained dispatch (OCD) process.)

16.2. Manifestly Incorrect Inputs and revision of prices

(a) Whenever a *trading interval* is identified as subject to review, AEMO control room staff will check whether the inputs used in that *trading interval* contained a MII. The inputs to dispatch mean any value used by NEMDE including:

(i) SCADA measurements of power system

(ii) Five-minute demand forecast values

(iii) Constraint equations entered by AEMO

(iv) Software setup

(b) If AEMO determines that the *trading interval* in question was affected by a MII, all the published prices for the "affected" *trading interval*s will be rejected (energy and all FCAS prices, for all *regions*) and will be replaced using the corresponding prices of the last correct *trading interval*. The last correct *trading interval* is the previous *trading interval* that was not affected by a MII (that is, preceding the "affected" *trading interval*).

(c) After the original publication of prices for a *trading interval* identified as subject to review, there is a time limit of 30 minutes within which AEMO can subsequently reject those prices and automatically replace them with the corresponding set of prices from the last correct *trading interval*.

(d) Once AEMO has followed the price revision process for the *trading interval* identified as subject to review the Price_Status flag for that *trading interval* will change to "Firm". If 30 minutes has expired since the publication of prices for the *trading interval* identified as subject to review and AEMO have not taken any action to either reject or accept prices for that *trading interval*, then the prices for that and all subsequent *trading interval*s will automatically be accepted and their Price_Status flags will change to "Firm".

16.3. Trading intervals following a trading interval identified as subject to review

(a) Whenever a *trading interval* is identified as subject to review, the *trading interval* immediately following that interval may also be identified as being subject to review if

AEMO considers that it is likely to be subject to that same MII (clause 3.9.2B(c) of the NER).

(b) AEMO's automatic "subject to review" monitoring system is such that whenever a *trading interval* is identified as subject to review, the Price Status of the following *trading interval*(s) will continue to be automatically flagged internally to AEMO as either subject to review or indeterminate (externally, these are flagged as "Not Firm") until AEMO rejects and/or accepts all the preceding subject to review or indeterminate ("Not Firm") *trading interval*s. Since there is a time limit of 30 minutes for the price revision of the first interval identified as subject to review, potentially there could be up to five *trading interval*s with Price_Status flag "Not Firm" following the first *trading interval* until AEMO completes the price review process.

16.4. Trading intervals identified as subject to review that had a successful Over-constrained Dispatch (OCD) re-run

Whenever a trading interval is identified as subject to review, the trading interval immediately following that interval may also be identified as being subject to review if AEMO considers that it is likely to be subject to that same MII (clause 3.9.2B(c) of the NER). Where an automatic OCD re-run has occurred for a trading interval identified as "subject to review", AEMO will review that trading interval for the presence of a MII and, if found, the prices will be rejected and then automatically replaced using the corresponding prices from the last correct trading interval.

16.5. Trading intervals identified as subject to review following a trading interval that had an unsuccessful Over-constrained Dispatch (OCD) re-run

If an MII is found, AEMO will reject and automatically replace prices of the *trading interval* identified as subject to review with the prices from the last correct interval. The last correct *trading interval* could be an interval that had an unsuccessful OCD re-run (refer to section 5.1). The prices of the original interval with an unsuccessful OCD re-run, as well as the following rejected *trading interval* (which inherits the prices from the previous interval) would now both be subject to manual review. Market Notices would be issued covering both *trading intervals* and the price revision process will be followed as shown in section 5.1.

17. Negative settlements residues

17.1. General Approach

(a) If the accumulation of negative *settlements residues* over the period of counter-price flows is forecast to reach the threshold value of $100 000 then AEMO would use reasonable endeavours to apply constraints to the affected *directional interconnector* to prevent the accumulation exceeding the threshold, provided system security can be maintained.

(b) These constraints would remain in place until, in AEMO's reasonable opinion, the constraints could be revoked without creating counter-price flows.

(c) AEMO will treat each occurrence individually and the *billing period* accumulation will not be used to offset the trigger. (i.e., will not use the amount of positive residue accumulated during the *billing period* to offset the trigger).

(d) If negative *settlements residues* began to occur due to a binding fully co-optimised constraint in dispatch at a material rate but had not been forecast in *pre-dispatch* then AEMO would take action to halt the further accumulation of negative *settlements residues* when the total negative *settlements residues* was estimated to have accumulated to $100,000. In order to ensure a response within a *30-minute period* such estimates of negative *settlements residues* accumulation will be made on the basis of *trading interval* quantities.

17.2. Constraints in Dispatch

To halt further accumulation of negative *settlements residues* AEMO will constrain the d*irectional interconnector* flow ("interconnector capping") at a rate no greater than that which applies for a planned outage. This would cease at the point at which counter price flows were halted. From that point on periodic adjustment of the level of the constraint might be necessary due to changing market conditions by:

(a) Increasing the level of constraint if counter-price flows re-emerged OR

(b) Relaxing the level of constraint if significant positive inter-regional settlements accumulations indicated that current level of constraint was excessive.

18. Requests for clarification of market reports or for additional information

(a) AEMO will ensure that *confidential information* is not inadvertently provided to *Market Participants* and that any information designated as public information is equitably provided to all *Market Participants* at the same time. To achieve this, the following policy is adopted:

  (i) All requests for further information about specific market notices should be to the AEMO Information and Support Hub.

  (ii) At times when the Information and Support Hub is not staffed then all enquiries from energy traders will be handled by the control centres.

(b) The response will depend on the nature of the enquiry as follows:

  (i) If the enquiry involves a confidential matter for that energy trader then the question will be directly answered.

  (ii) If the enquiry involves a request for additional public information then the enquiry will not be directly answered instead a response may be sent out in the form of an AEMO Communication or market notice so that the information is available to all *Market Participants* at the same time.

  (iii) If the enquiry involves *confidential information* to which that energy trader is not entitled, then a response will not be provided.

19. Generic constraint application options in MMS

There are a number of options available to AEMO control room staff when generic constraints are to be invoked in the MMS. The options include the use of:

(a) Predefined constraint sets prepared for system normal conditions

(b) Predefined constraint sets prepared for routine *transmission network* outages

(c) Blocking constraint equations

(d) Predefined discretionary constraint sets

(e) Quick constraints

(f) Constraint sets and/or equations built by control room staff as a need arises

(g) Constraint Automation created constraint sets and equations prepared for any network condition

Depending on the circumstances at the time, one or a number of these types of generic constraint will be invoked in the MMS. These are briefly described in this section.

19.1. System Normal and Network Outage Constraints

(a) A system security issue may arise at any time under system normal conditions, *network outage* conditions or following the occurrence of a *contingency event*. Generally, if predefined generic constraints are available for a system normal or network outage condition then they will be invoked in the MMS.

(b) In the case of a *contingency event*, one of the many tasks undertaken would be to determine if *network* equipment was going to be returned to service in a very short time. If not then depending on requirements, a *network outage constraint* set may be invoked provided an appropriate associated generic constraint is available. Generic constraints of this nature are prepared on the basis of accommodating a *network outage* while maintaining the network in a *secure operating state*.

19.2. Blocking Constraint Equations

If a constraint equation, which is part of an invoked constraint set, is malfunctioning, AEMO can 'block' that constraint equation without removing it from the constraint set. 'Blocking' a constraint equation removes it from dispatch, *pre-dispatch* and 5 min pre-dispatch calculations. Blocking is linked to the constraint equation name, not the constraint set. So, if any other constraint set containing the blocked equation is invoked, the equation will remain blocked. Blocking will also remain in place if a constraint equation is reviewed and the constraint equation name does not change. AEMO may replace the blocked constraint equation with a discretionary or quick constraint. AEMO can 'Unblock' the constraint equation when it considers appropriate. Refer to section 8 for more details about when AEMO may block a constraint equation.

19.3. Discretionary and Quick Constraints

(a) There is a predefined series of constraints referred to as discretionary constraints. These are generally simple format constraints with either a *generating unit* or *bidirectional unit*, a collection of *generating units* or *bidirectional units*, or an *interconnector* term on the LHS. There are no dynamic RHS components, only a static RHS. These are for use at the discretion of AEMO control room staff to meet any requirement that results in the need to limit power flow on major network components. Discretionary constraints may be used with routine planned network outages where a constant limit on power flow is required. They may also be used as a post-contingent response to reduce or limit network power

flow or at any time that a system security issue arises and control of power flow on a single network element is required.

(b) The AEMO MMS has constraint type labelled as a quick constraint. The quick constraint is simply a constraint which acts on a selected LHS with a user defined RHS value. The selected LHS may be:

(i) A single *generating unit*, *bidirectional unit*, or *interconnector*.

(ii) Multiple *generating units*, *bidirectional units*, or *interconnectors*.

(iii) FCAS for any combination of selected *regions* or for a single *ancillary service* unit.

(c) The label "quick constraint" is a reflection of the method of application. A quick constraint may be invoked in a short time compared to other constraints that may take a number of minutes to search for, verify and apply.

Note 3 All quick constraints are prefixed with a # symbol for ease of identification.

19.4. Generic Constraints Built as Required by Control Room Staff

The case may arise where *power system security* is an issue and there is not a suitable network outage constraint, discretionary constraint or quick constraint available. In such circumstances control room staff may develop constraint equations or constraint sets as required to maintain system security.

Note 4 The ID of all constraint equations and constraint sets built by control room staff are prefixed with an @ symbol for ease of identification.

19.5. Constraint Automation

Constraint Automation is an EMS based application that allows AEMO staff to generate thermal constraints based on an EMS study case. This system is used to create constraints for system conditions where constraints don't already exist, or existing constraints are not operating correctly. Constraint Automation generates constraints based on violations in the EMS Contingency Analysis; these are then packaged together into a single constraint set and loaded into the MMS where they can be invoked like any other constraint set. Constraints generated by this system are uniquely identified. Constraint Sets have IDs which start with CA_xxx_ and are followed by a unique identifier. Constraint Equations use the same ID suffixed by a number for each constraint in the series (01, 02 etc.)

e.g., Constraint Set: CA_MQS_36661FF1

Constraint Equation: CA_MQS_36661FF1_01

19.6. Network Constraint Ramping

(a) The Network Constraint Ramping Tool (part of the SOMMS application) allows the creation of ramping constraints for any planned outage constraint irrespective of whether the LHS of the constraint includes *interconnectors* and/or generators. This ramping system includes the following features:

(i) The process will source the data for an outage from 30 minute Pre-dispatch forecasts and ramp the RHS of all constraint equations associated with the outage gradually to values forecast to apply when the outage commences.

(ii) The process will utilise two forms of ramping for each constraint in the outage set thus creating double the number of constraints than in the outage set:

(A) Soft ramping towards the final outage level, to minimise transient dispatch pricing disturbances that would otherwise occur without ramping. The soft constraint will complete ramping two *trading interval*s prior to the completion of hard constraint ramping.

(B) Hard ramping at slower rate than soft ramping, to ensure that the outage is ready to proceed within a certain maximum time regardless of dispatch pricing outcomes.

(b) The soft constraint and hard constraint will have the same constraint equation formulation, but the soft constraint will ramp faster than the hard constraint because the soft constraint has fewer *trading interval*s to ramp than the hard constraints. Consequently, the soft constraint has a small value of generic constraint weight which is typically less than MPC. The constraint violation penalty (CVP) of the soft constraint will be determined by the marginal value of its outage constraint equation in pre-dispatch, while the CVP for hard constraints will be set as the same as a normal network constraint.

(c) The timing in which the ramping process should be invoked and revoked is determined by the number of *trading interval*s required for the ramp, plus an allowance for a safety margin. During the ramping constraint set creation and invocation process, the final outage level will be obtained from the *pre-dispatch* forecast for the outage constraint equations' RHS.

Note 5 If an outage constraint equation was not binding in pre-dispatch, the ramping constraint equation will still use the RHS value for its formulation. Consequently, all the constraint equations in the outage constraint set will be ramped in dispatch even though not all of them were binding during pre-dispatch.

(d) The ramping process can be applied to any constraint sets related to the planned network outage, especially fully co-optimised constraints which contain a mixture of *interconnector* and generator terms on the LHS. The ramping process should be used for all planned outage constraints where ramping is required, irrespective of whether an *interconnector* is involved or not.

(e) The ramping process would not apply to FCAS constraint sets or any network outage constraint sets that have FCAS terms in their LHS.

(f) The process is required to ramp all the constraints that are included in the invoked outage constraint set regardless of whether all the constraints were binding in *Pre-dispatch*.

Note 6 If there is not at least one Pre-dispatch interval in which the network outage constraint has been invoked, the process will be prevented from being enabled.

(g) The ramping constraint sets, and constraints will be named as follows

(i) Constraint Set: #R<RAMP_SEQ>_RAMP

(ii) Soft Constraint: #R<RAMP_SEQ>_nnn_RAMP_V

(iii) Hard Constraint: #R<RAMP_SEQ>_nnn_RAMP_F

(iv) Where the <RAMP_SEQ> is a six digit unique number.

(h) Constraint ramping will not be used for situations where AEMO reclassifies a non-credible contingency *event* as a *credible contingency event*.

20. AEMO constraint equation performance

Binding constraint equations are simply a result of the network being operated at or near a design limit. These are generally a normal market outcome. However, there is always the possibility of a constraint equation not performing as expected. This may result in either limits falling short of system security requirements or in limits being more restrictive or conservative. The latter can result in the market being constrained with available generation capacity being restricted unnecessarily.

The process for reviewing non-performing constraint equations is progressed as soon as possible and in any case within 30 mins of the problem occurring. In general, participants should contact AEMO immediately if they suspect that a constraint equation is not performing as expected. This action should assist the participant by providing an understanding of the situation at that time.

This section outlines the steps that may be taken in response to a non-performing constraint equation.

20.1. AEMO Action for Under Conservative Constraint Equations

This is the situation where a constraint equation should be binding but is failing to set appropriate power system limits. Actions taken by AEMO under such conditions may include:

(a) Confirm *power system security* violations evident from network analysis tools.

(b) Assess alternative network configuration to remove the security violation.

(c) Use the Constraint Automation tool to create a new constraint for the system condition. Note: Thermal constraints only.

(d) Invoke appropriate network generic constraints to restore the power system to a *secure operating state*.

(e) Request constraint builders to tune or replace the inadequate constraint equation.

20.2. AEMO Action for Over Conservative Constraint Equations

- Establish that a constraint equation is binding by observing a non-zero marginal value for the equation.
- Determine the purpose of the constraint equation and ensure it is required at that time.
- Based on network study results, estimate the constraint equation result that should be reasonably expected at that time.
- Compare the expected result to the binding constraint equation result.
- Depending on the significance of any discrepancy, appropriate actions may be :
  - Minor discrepancies: Continue to monitor.
  - Block the constraint equation or remove it from the set or revoke the constraint set from MMS.

- Apply discretionary network constraints to manage power system security. If a thermal constraint, replace using the constraint automation tool.
- During business hours: Arrange for tuning or replacement of the binding constraint equation.

Until the constraints have been revised, the *power system* will be managed by Constraint Automation and/or discretionary constraints as appropriate.

In situations where an over conservative constraint problem exists control room staff will **not revoke** constraints associated with **Transient stability, Steady State Stability or Voltage Stability**. The control room does not have sufficient analysis facilities to establish acceptable levels to extend these types of limits.

20.3. AEMO Action for Binding Constraints

(a) Under clause 3.8.1(a) of the NER, in operating the *central dispatch* process AEMO is to use its reasonable endeavours to maintain *power system security* in accordance with Chapter 4 and to maximise the value of *spot market* trading on the basis of *dispatch bids*.

(b) When a *constraint* binds in dispatch, AEMO will, to the extent that is reasonably possible, review the *constraint* to assess the validity and accuracy of the constraint outcome and use reasonable endeavours to determine if there are actions AEMO can initiate to relieve the network congestion.

(c) These actions may include utilising the full extent of the thermal ratings of transmission elements as specified by the Network Service Provider (NSP) in accordance with the Rules, clause 4.6.4.

Appendix A. Non-conformance calculations and process overview

A.1 Overview

AEMO operates Conformance Monitoring software (Compmon[4]) to assist with the management of the non-conformance process. Compmon operates continuously in AEMO control rooms. Conformance calculations are initiated immediately following each dispatch calculation. Each conformance calculation is relevant to the previous *trading interval* but calculated at a time when both the Dispatch Targets for that *trading interval* and the final actual megawatt values for that *trading interval* are known.

The conformance calculation covers the following[5]:

- *Scheduled generating units*
- *Semi-scheduled generating units*
- *Scheduled bidirectional units*
- *Scheduled loads*
- Aggregates

The table below lists the abbreviations used in this Appendix and their corresponding naming convention in the Conformance Data Report:

Table 4 List of abbreviations used in Appendix A

Abbreviation	Definition	Name in Conformance Data Report
MW	Actual Generation/Consumption	ACTUALMW
MWB	Dispatch Target (also referred to as *dispatch level* for *semi-scheduled generating units*.	TOTALCLEARED
MWO	Bid Unit Availability. For a *semi-scheduled generating unit* = Minimum of (Bid Max Availability, UIGF). For a *scheduled bidirectional* unit = Bid Max Availability for Gen direction	AVAILABILITY
ROC	Rate of Change or Ramp Rate	ROC
FCR	FCAS Raise Regulation enabled	RAISEREG
FCL	FCAS Lower Regulation enabled	LOWERREG

[4] Also referred to in this procedure as the AEMO Conformance Module

[5] Under some circumstances, some *scheduled resources* or classes of *scheduled resources* may be suspended from non-conformance monitoring.

A.2 Conformance Calculations

Detection of non-conformance is based on two error thresholds. The Small Error Trigger[6] and the Large Error Trigger[7] are calculated in Compmon.

For a *scheduled resource*, either not in an Aggregate or in an Aggregate and with individual dispatch conformance required, the individual Small and Large Error Trigger thresholds are calculated as follows:

Small Error Trigger threshold:

Trigger level (MW) is: MAX (6, MIN [3% MWO, 2*ROC])

Large Error Trigger threshold:

Trigger level (MW) is: MAX (6, MIN [5% MWO, 4*ROC])

ROC calculation[8]:

If Dispatch Target > Actual MW then:

ROC = min (SCADA Ramp Up rate, bid Ramp Up rate)

Else if Dispatch Target < Actual MW then:

ROC = min (SCADA Ramp Down rate, bid Ramp Down rate)

Else (Dispatch Target = Actual MW)

ROC = Min [min (SCADA Ramp Up rate, bid Ramp Up rate),
min (SCADA Ramp Down rate, bid Ramp Down rate)]

If the *scheduled resource* is a *bidirectional unit* moving from *generation* to consumption or *vice versa* during a *trading interval*, then the bid Ramp Up rates and bid Ramp Down rates used in the formulas above will be the composite *ramp rates* described in Appendix C.

For an Aggregate, dispatch conformance is monitored:

- in aggregate across all *scheduled resources*, against an aggregate Small Error Trigger and aggregate Large Error Trigger (see calculations below), but only if aggregated dispatch conformance is required on any of the *scheduled resources* in the Aggregate (conformance mode > 0 in their *dispatch instructions*); and
- for an individual *scheduled resource* against its individual Small Error Trigger and individual Large Error Trigger (see calculations above), but only if individual dispatch conformance is required on the *scheduled resource* (conformance mode = 2 in its *dispatch instruction*)

For an Aggregate, the aggregate Small and Large Error Trigger thresholds are calculated as follows:

[6] STRIGLM in the Conformance Data Report

[7] LTRIGLM in the Conformance Data Report

[8] Note that the ROC calculation uses the Dispatch Target from the latest *trading interval.* Actual MW is at the start of that *trading interval.*

Aggregate Small Error Trigger threshold (MW):

MAX (6,

{ MIN [3% MAX (Sum of all Generating Unit and BDU MWO, Sum of all Load MWO),

2 * MAX (Sum of all Generating Unit and BDU ROC, Sum of all Load ROC)]

})

Aggregate Large Error Trigger threshold (MW):

MAX (6,

{ MIN [5% MAX (Sum of all Generating Unit and BDU MWO, Sum of all Load MWO),

4 * MAX (Sum of all Generating Unit and BDU ROC, Sum of all Load ROC)]

})

ROC calculation for Aggregate Error Trigger threshold[9]:

If Aggregate Dispatch Target > Aggregate Actual MW then:

Generating Unit ROC = min (SCADA Ramp Up rate, bid Ramp Up rate)

BDU ROC = min (SCADA Ramp Up rate, bid Ramp Up rate)

Load ROC = min (SCADA Ramp Down rate, bid Ramp Down rate)

Else if Aggregate Dispatch Target < Aggregate Actual MW then:

Generating Unit ROC = min (SCADA Ramp Down rate, bid Ramp Down rate)

BDU ROC = min (SCADA Ramp Down rate, bid Ramp Down rate)

Load ROC = min (SCADA Ramp Up rate, bid Ramp Up rate)

Else (Aggregate Dispatch Target = Aggregate Actual MW)

Generating Unit/BDU ROC/Load ROC =

Min [min (SCADA Ramp Up rate, bid Ramp Up rate),

min (SCADA Ramp Down rate, bid Ramp Down rate)]

The BDU bid Ramp Up rates and bid Ramp Down rates used in the formulas above are those described in Appendix C. If a BDU is moving from *generation* to consumption or *vice versa* during a *trading interval*, then they will be the composite *ramp rates* described in that Appendix.

[9] Note that the ROC calculation uses the Aggregate Dispatch Target from the latest *trading interval*. Aggregate Actual MW is at the start of that *trading interval.*

Note that 6 MW is the minimum Small Error Trigger threshold and 6 MW is the minimum Large Error Trigger threshold.

After every dispatch run, the Compmon application compares the difference between the MWB of the previous *trading interval* and the MW of the current *trading interval* with the error trigger thresholds. In addition to MWB, a compensation for FCAS is included to allow for regulating plant movement.

The Small and Large Error Triggers (including the aggregate Small and Large Error Triggers for an Aggregate) each have an associated counter[10]. For an Aggregate, the aggregate error count and any individual *scheduled resource* error counts are independent of each other. The counters each increment on detection of error and are used to trigger applicable non-conformance action.

For an individual *scheduled generating unit*, *scheduled bidirectional unit*, or *scheduled load*[11]

For error detection above MWB:

- If a Generating Unit or BDU and [MW - (MWB + FCR)] > Small Error Trigger Threshold
  or
  If a Load and [MW - (MWB + FCL)] > Small Error Trigger Threshold
  - Then increment the Small Error Counter
- If a Generating Unit or BDU and [MW – (MWB + FCR)] > Large Error Trigger Threshold
  or
  If a Load and [MW – (MWB + FCL)] > Large Error Trigger Threshold
  - Then increment the Large Error Counter

For error detection below MWB:

- If a Generating Unit or BDU and [(MWB – FCL) – MW] > Small Error Trigger Threshold
  or
  If a Load and [(MWB – FCR) – MW] > Small Error Trigger Threshold
  - Then increment the Small Error Counter
- If a Generating Unit or BDU and [(MWB – FCL) – MW] > Large Error Trigger Threshold
  or
  If a Load and [(MWB – FCR) – MW] > Large Error Trigger Threshold
  - Then increment the Large Error Counter

[10] Small Error Count and Large Error Count are called SECOUNT and LECOUNT in the Conformance Data Report

[11] Including any *scheduled resource* in an Aggregate subject to individual dispatch conformance (conformance mode = 2)

For an individual *semi-scheduled generating unit*[12]

For error detection above MWB:

- If semi-dispatch cap flag = 'TRUE'
  Then
  - If [MW - (MWB + FCR)] > Small Error Trigger Threshold
    - Then increment the Small Error Counter
    - Else reset the Small Error Counter to zero
  - If [MW – (MWB + FCR)] > Large Error Trigger Threshold
    - Then increment the Large Error Counter
    - Else reset the Large Error Counter to zero
- Else (semi-dispatch cap flag = 'FALSE') reset the Small and Large Error Counters to zero

For an Aggregate that is a Cap Aggregate

Aggregate Dispatch Target = $SUM_{\text{all Generating units}}$ (MWB)

Aggregate Actual MW = $SUM_{\text{all Generating units}}$ (MW)

For error detection above the aggregate dispatch target:

- If conformance mode > 0 for any *scheduled resource* in the Aggregate
  Then
  - If Aggregate Actual MW - Aggregate Dispatch Target - $SUM_{\text{all Generating units}}$ (FCR)
    > Aggregate Small Error Trigger Threshold
    - Then increment the Small Error Counter
    - Else reset the Small Error Counter to zero
  - If Aggregate Actual MW - Aggregate Dispatch Target - $SUM_{\text{all Generating units}}$ (FCR)
    > Aggregate Large Error Trigger Threshold
    - Then increment the Large Error Counter
    - Else reset the Large Error Counter to zero
- Else (conformance mode = 0 for all *scheduled resources*) reset the Small and Large Error Counters to zero

[12] Including any *scheduled resource* in an Aggregate subject to individual dispatch conformance (conformance mode = 2)

For an Aggregate that is a Mixed Aggregate[13]

Aggregate Dispatch Target = $SUM_{\text{Generating units}}$ (MWB) + SUM_{BDU} (MWB) - SUM_{Loads} (MWB)

Aggregate Actual MW = $SUM_{\text{Generating units}}$ (MW) + SUM_{BDU} (MW) - SUM_{Loads} (MW)

Net Scheduled Dispatch Target = $SUM_{\text{all Scheduled Generating units}}$ (MWB) + SUM_{BDU} (MWB) – SUM_{Loads} (MWB)

Net Scheduled Actual MW = $SUM_{\text{all Scheduled Generating units}}$ (MW) + SUM_{BDU} (MW) – SUM_{Loads} (MW)

Net Scheduled Small/Large Error Trigger Thresholds: calculated using the Aggregate Small/Large Error Trigger Thresholds formula above, but with *semi-scheduled generating units* ignored.

Aggregate Error Logic

IF
ANY *scheduled resource* in the Mixed Aggregate with conformance mode = 1 is not conforming to its individual dispatch target (based on the relevant individual resource's small error logic described above)

THEN
ALL *scheduled resources* in the Mixed Aggregate are deemed to be participating in aggregated dispatch conformance, and the following aggregate error logic applies:

For error detection above the aggregate dispatch target:

- If Aggregate Actual MW - Aggregate Dispatch Target
  - $SUM_{\text{all Generating units}}$ (FCR) - SUM_{BDU} (FCR) - SUM_{Loads} (FCR)
  > Aggregate Small Error Trigger Threshold
  - Then increment the Small Error Counter
- If Aggregate Actual MW - Aggregate Dispatch Target
  - $SUM_{\text{all Generating units}}$ (FCR) - SUM_{BDU} (FCR) - SUM_{Loads} (FCR)
  > Aggregate Large Error Trigger Threshold
  - Then increment the Large Error Counter

For error detection below the aggregate dispatch target:

If Net Scheduled Dispatch Target - Net Scheduled Actual MW
- $SUM_{\text{all Scheduled Generating units}}$ (FCL) - SUM_{BDU} (FCL) - SUM_{Loads} (FCL)
> Net Scheduled Small Error Trigger Threshold

Then

- If Aggregate Dispatch Target - Aggregate Actual MW
  - $SUM_{\text{all Generating units}}$ (FCL) - SUM_{BDU} (FCL) - SUM_{Loads} (FCL)
  > Aggregate Small Error Trigger Threshold
  - Then increment the Small Error Counter

[13] In below formulas the subscript 'Generating units' includes all *generation* from *scheduled generating units* and *semi-scheduled generating units* that are included in the Mixed Aggregate. The subscript 'Loads' only includes consumption from *scheduled loads* (not *scheduled bidirectional units)*.

If Net Scheduled Dispatch Target - Net Scheduled Actual MW
- $SUM_{\text{all Scheduled Generating units}}$ (FCL) - SUM_{BDU} (FCL) – SUM_{Loads} (FCL)
> Net Scheduled Large Error Trigger Threshold

Then

- If Aggregate Dispatch Target – Aggregate Actual MW
- $SUM_{\text{all Generating units}}$ (FCL) - SUM_{BDU} (FCL) – SUM_{Loads} (FCL)
> Aggregate Large Error Trigger Threshold
  - Then increment the Large Error Counter

For an Aggregate that is a Target Aggregate

Aggregate Dispatch Target = $SUM_{\text{all Generating units}}$ (MWB) - $SUM_{\text{all Loads}}$ (MWB)

Aggregate Actual MW = $SUM_{\text{all Generating units}}$ (MW) - $SUM_{\text{all Loads}}$ (MW)

For error detection above the aggregate dispatch target:

- If Aggregate Actual MW - Aggregate Dispatch Target
- $SUM_{\text{all Generating units}}$ (FCR) - $SUM_{\text{all Loads}}$ (FCR) > Aggregate Small Error Trigger Threshold
  - Then increment the Small Error Counter
- If Aggregate Actual MW - Aggregate Dispatch Target
- $SUM_{\text{all Generating units}}$ (FCR) - $SUM_{\text{all Loads}}$ (FCR) > Aggregate Large Error Trigger Threshold
  - Then increment the Large Error Counter

For error detection below the aggregate dispatch target:

- If Aggregate Dispatch Target – Aggregate Actual MW
- $SUM_{\text{all Generating units}}$ (FCL) – $SUM_{\text{all Loads}}$ (FCL) > Aggregate Small Error Trigger Threshold
  - Then increment the Small Error Counter
- If Aggregate Dispatch Target – Aggregate Actual MW
- $SUM_{\text{all Generating units}}$ (FCL) – $SUM_{\text{all Loads}}$ (FCL) > Aggregate Large Error Trigger Threshold
  - Then increment the Large Error Counter

The individual and aggregate Small Error Triggers are measured over 6 consecutive *trading intervals* and the individual and aggregate Large Error Triggers are measured over 3 consecutive *trading intervals*. These error counter values will progress the non-conformance action.

For individual *scheduled generating units*, *scheduled bidirectional units* and *scheduled loads*[14], or for a Mixed or Target Aggregate, the relevant individual or aggregate error counters are reset to 'zero' if no error is apparent or reset to 'one' if the direction of error reverses.

A.3 Conformance Status

Following the conformance calculation, each item of plant (DUID and, if part of an Aggregate, the ADG_ID) is allocated a Conformance Status. An item of plant can only have one conformance Status allocated to it in a *trading interval*.

[14] Including any *scheduled resource* in an Aggregate subject to individual dispatch conformance (conformance mode = 2)

Possible Conformance Status states and explanations of each are:

- **Normal:** Plant is following Target within Error thresholds.
- **Off-Target:** Plant is not following Target. MW Error exceeds detection thresholds.
- **Not-Responding:** A number of *trading intervals* have passed and plant is still not following target. (The number of *trading intervals* depends on the severity of error)
- **NC-Pending:** The non-response has reached a stage where the plant will be declared Non-Conforming.
- **Non-Conforming:** The plant is declared Non-Conforming and a Non-Conformance constraint is applied.
- **Suspended:** The plant is not included in the Conformance Process.

Conformance Status change for an item of plant may be achieved by:

- An automated process based on the error counters.
- An AEMO user-initiated action.

Additionally, two operating modes exist for Compmon, these are:

- Auto, where all Conformance Status changes through to Non-Conforming are based on error counters. Once plant has been declared Non-Conforming a phone communication is required from the participant advising AEMO of the reason for the non-conformance. The participant must advise AEMO when they are capable of following Dispatch Targets, then the non-conformance declaration can be lifted. There is an optional "Verify Non-Conformance Declaration" function available to the AEMO user when operating in this mode. This will hold the process at the NC-Pending Conformance Status until the AEMO user confirms the Non-Conformance Declaration. This option may be applied or not at the AEMO users' discretion.
- Manual, where Conformance Status changes up to the Not-Responding stage only are determined on an automated basis. Any further action to declare plant Non-Conforming is based on AEMO user actions. These actions include initiating phone calls to plant operations staff, Non-Conformance and Conformance Declarations, Constraint application, manual logging and Market Notice publication. In Manual mode, Compmon is used only as an alarm mechanism for AEMO operations staff to take manual action.

Possible status changes in Manual and Auto operating modes are illustrated below. Note that the solid lines (arrows) represent a Conformance Status change based on error counters with no AEMO user input. **The dotted lines (arrows) represent possible AEMO user-initiated Conformance Status change.**

Figure 9 Status Transition in Manual Mode

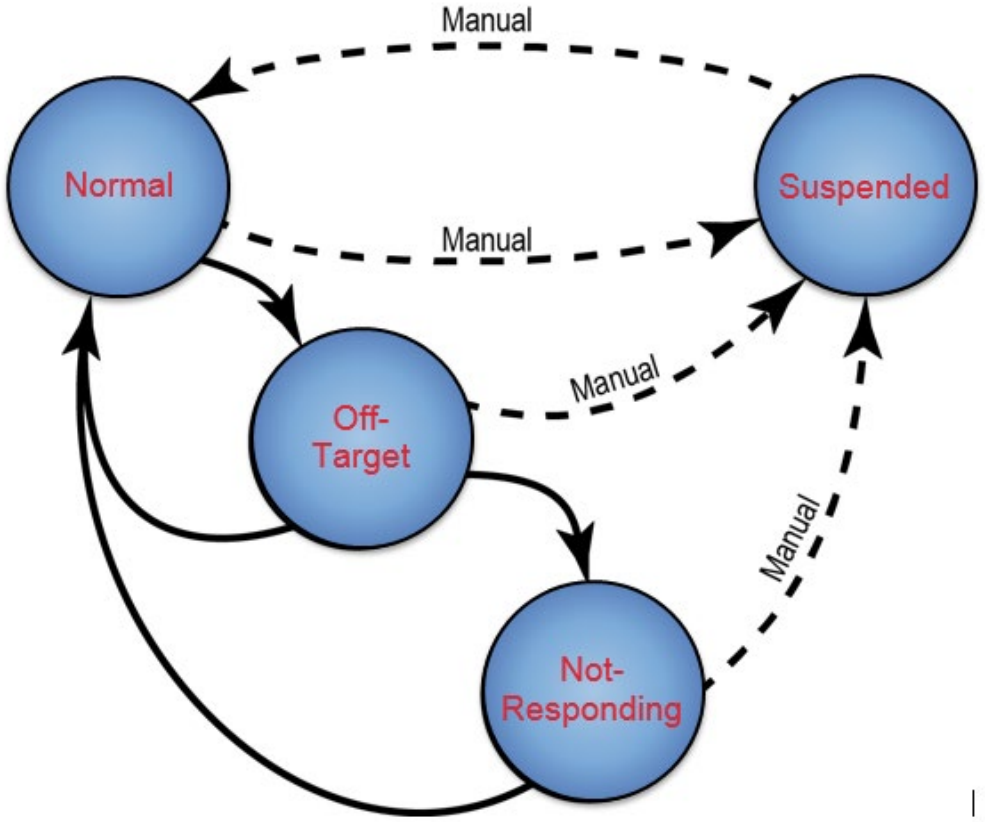
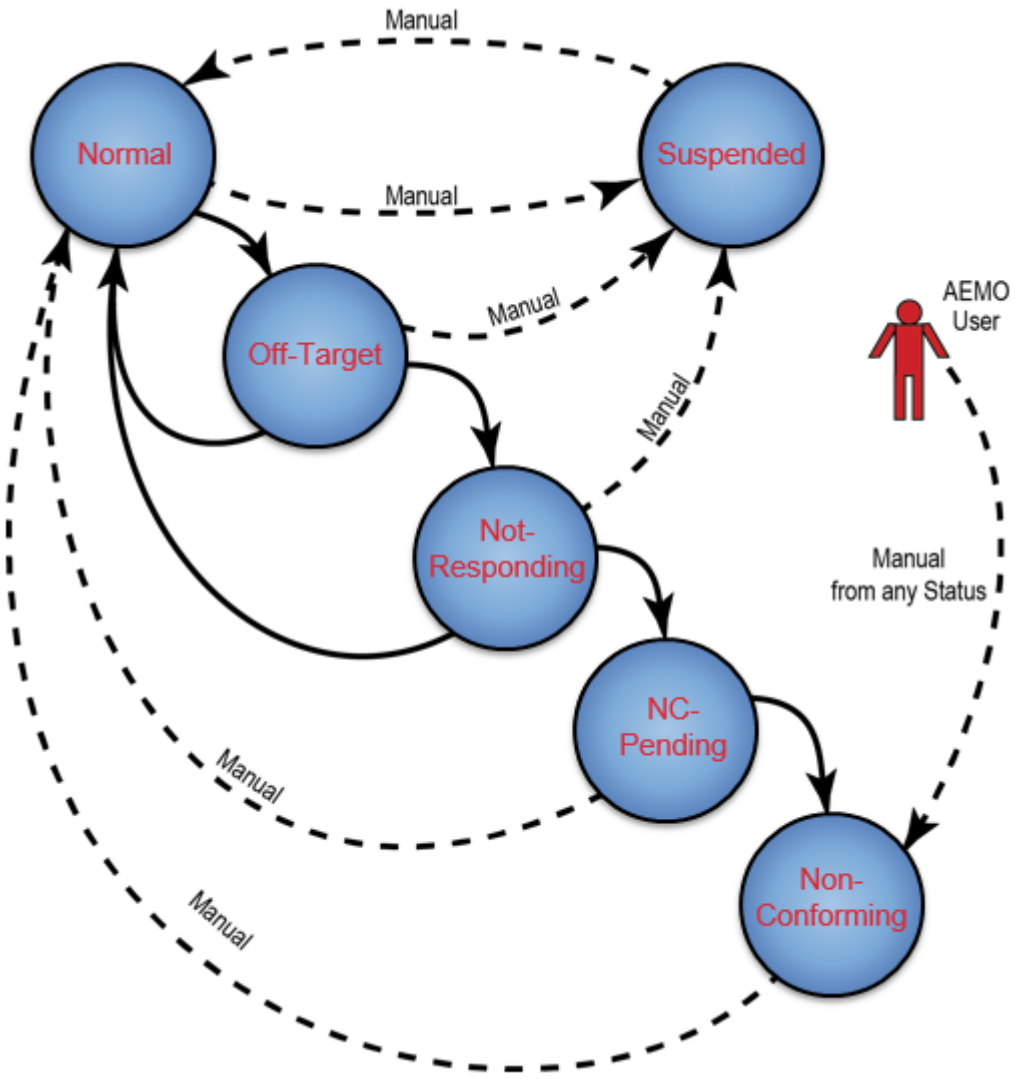


Figure 10 Status Transition in Auto Mode



As can be seen from the illustrations above and the previous descriptions of Conformance Status, plant following target within the error thresholds will have a Conformance Status of Normal.

In Manual mode, this will change to Off-Target then to Not-Responding based on error counters. Non-Conformance Declaration by AEMO will then be a manual AEMO user action in this mode. This includes constraint application, logging, market notice issue, and phone conversations with plant control staff regarding the declaration of Non-Conformance. The severity of the Conformance Status indicated by the AEMO Conformance Module will be limited to Not-Responding while the manual action takes place. Note that if plant is manually declared Non-Conforming and a non-conformance constraint is applied then it is likely that the reported Conformance Status will revert to Normal as a result of the constraint action.

In Auto mode, the Conformance Status will change to Off-Target, Not-Responding, NC-Pending and Non-Conforming based on error counters.

In either mode, the AEMO user may accelerate the process and declare Non-Conformance at any time or Suspend a DUID or ADG_ID from taking part in the Conformance process.

The criteria for Conformance Status change in Manual and Auto operating modes is presented in the following two tables. In addition to this information, the AEMO user-initiated changes illustrated in the diagrams above are available at the user's discretion in line with current policy.

Table 5 Conformance Status Change in Manual or Auto Modes

Previous Status	Criteria for Conformance Status Change	Resulting Status Change
Normal	Large Error Count ≥ 1	Off-Target
Normal	Small Error Count ≥ 1	Off-Target
Off-Target	Large Error Count ≥ 3	Not-Responding
Off-Target	Small Error Count ≥ 6	Not-Responding
Off-Target or Not-Responding	Large Error Count = 0 and Small Error Count = 0	Normal

Table 6 Conformance Status Change in Auto Mode

Previous Status	Criteria for Conformance Status Change	Resulting Status Change
Not-Responding	Large Error Count ≥ 5	NC-Pending
Not-Responding	Small Error Count ≥ 8	NC-Pending
NC-Pending	The Status in the next trading interval will be Non-Conforming.	Non-Conforming

A.4 Information to Participants

A Conformance Data Report will be published to participants for their applicable plant following each Conformance Module calculation, once per trading interval. As well as the relevant time information, the report will contain the following information for each DUID and (if the DUID is part of an Aggregate) at the ADG_ID level (where DUID = ADG_ID).

Status

The status of the particular DUID and (if applicable) ADG_ID following the last conformance module calculation. That is, Normal, Suspended, Off-Target, Not-Responding, NC-Pending, Non-Conforming.

Participant Status Action Messages for a DUID

An action message is included on the report corresponding to each status as follows:

- **Normal:** No action required. Unit is following dispatch target
- **Suspended:** No action required. Unit is excluded from the conformance process at this time
- **Off-Target:** Please move to dispatch target or rebid
- **Not-Responding:** Please move to dispatch target or rebid
- **NC-Pending** (Possible in Auto mode only): Unit not responding to dispatch target. Non-conformance action pending
- **Non-Conforming** (Possible in Auto mode only): Unit declared non-conforming (NC). NC constraint is *invoked.* **AEMO is requesting a reason for the NC**

Participant Status Action Messages for an ADG_ID[15]

An action message is included on the report corresponding to each status as follows:

- **Normal:** No action required
- **Suspended:** No action required at the aggregate level. Units excluded from aggregate conformance monitoring
- **Off-Target:** Please move to aggregate dispatch target or rebid
- **Not-Responding:** Please move to aggregate dispatch target or rebid
- **NC-Pending** (Possible in Auto mode only): Unit(s) not responding to aggregate dispatch target. Non-conformance action pending
- **Non-Conforming** (Possible in Auto mode only): ADG declared non-conforming (NC). ADG NC constraint invoked. AEMO is requesting a reason for the NC

Energy values relevant to the specific conformance calculation

- MWB[16]: NEMDE Dispatch Target or Dispatch Level for the *trading interval*.
- MW[17]: Actual plant MW at the end of the *trading interval*.
- MW Error: Difference between MWB and MW values with allowance for FCR and FCL.
- Max MW Error: Max MW Error (positive or negative) over the period since the Status was last "Normal" or "Suspended" and the small error count was zero.

Operating Mode

- "Manual" (AEMO is currently operating in Manual mode)
- "Auto" (AEMO is currently operating in Auto mode)

This Conformance Data Report is expected to be used by plant operating staff during normal operation.

Note 7	If **AEMO's** Compmon is operating in Manual mode for a particular region, the Conformance Status of NC-Pending and Non-Conforming does not exist for DUIDs and ADG_IDs in that region. As previously discussed, the Declaration of Non-Conformance and Conformance is carried out via phone communication initiated by **AEMO**.

A.5 Worked Examples

Individual unit – Large Error Example

A hypothetical generating unit A has a bid unit availability of 200 MW and a *ramp rate* of 2 MW/min. Dispatch Target > Actual MW, hence *ramp rate* = min (SCADA *ramp up rate* , bid *ramp up rate*).

The large error trigger is determined as follows:

- The term representing 5% of the bid unit availability is 5/100 x 200 = 10 MW.
- The term representing 4 x [*ramp rate*] is 4 x 2 = 8 MW.

[15] In the Conformance Data Report, aggregated dispatch conformance data appears in records where the DUID = ADG_ID

[16] TOTALCLEARED in the Conformance Data Report

[17] ACTUALMW in the Conformance Data Report

- The minimum of these two terms (10 MW and 8 MW) is 8 MW.
- The minimum allowable error is 6 MW.
- The maximum of these two terms (6 MW and 8 MW) is 8 MW.
- Therefore, the large error trigger is 8 MW.

This means that if the generation or load of the plant differs from its Dispatch Target by more than 8 MW then the Conformance Status will be Off-Target. If this occurs for 3 consecutive *trading intervals,* then the Conformance Status will be Not-Responding. If this occurs for five consecutive *trading intervals* then the Conformance Status will be NC-Pending (only if in Auto mode). The result for the following *trading interval* will be Non-Conforming (only if in Auto mode).

Individual unit – Small Error Example

The small error trigger is determined as follows:

- The term representing 3% of the bid unit availability is 3/100 x 200 = 6 MW.
- The term representing 2 x [*ramp rate*] is 2 x 2 = 4 MW.
- The minimum of these two terms (6 MW and 4 MW) is 4 MW.
- The minimum allowable error is 6 MW.
- The maximum of these two terms (6 MW and 4 MW) is 6 MW.
- Therefore, the small error trigger is 6 MW.

This means that if the generation or load of the plant differs from its Dispatch Target by more than 6 MW then the Conformance Status will be Off-Target. If this occurs for 6 consecutive *trading intervals* then the Conformance Status will be Not-Responding. If this occurs for 8 consecutive *trading intervals* then the Conformance Status will be NC-Pending (only if in Auto mode). The result for the following *trading interval* will be Non-Conforming (only if in Auto mode).

Cap Aggregate - Large Error Example

A hypothetical Cap Aggregate comprising:

- Unit A: wind *semi-scheduled generating unit*
  - availability of 100 MW
  - *ramp up rate* of 2 MW/min
  - *ramp down rate* of 1 MW/min
  - semi-dispatch cap flag is set (TRUE)
- Unit B: solar *semi-scheduled generating unit*
  - availability of 200 MW
  - *ramp up rate* of 3 MW/min
  - *ramp down rate* of 2 MW/min
  - semi-dispatch cap flag is reset (FALSE)

For this *trading interval* assume:

- Aggregate Dispatch Target < Aggregate Actual MW
  - ROC: use *ramp down rate* for *generating units*

Because at least one of the *semi-scheduled generating units* has its semi-dispatch cap flag set then all *semi-scheduled generating units* will have their aggregated dispatch conformance flag set (conformance mode = 1 in their dispatch instruction)

The aggregate large error trigger is determined as follows:

Unit A + Unit B:

- 5% availability = 0.05 x (100+200) = 15 MW
- 4 x SUM[*ramp down rate*] = 4 x (1+2) = 4 x 3 = 12 MW
- Unit A + Unit B aggregate trigger term = minimum of above terms (15 MW and 12 MW) = 12 MW

Aggregate large error trigger:
= MAX(minimum large allowable error, Unit A + Unit B aggregate trigger term)

= MAX(6 MW, 12 MW) = 12 MW

This means that if the aggregate generation of the Cap Aggregate exceeds its Aggregate Dispatch Target by more than 12 MW, then the Conformance Status for the ADG_ID will be Off-Target. If this occurs for three consecutive *trading intervals,* then the Conformance Status will be Not-Responding.

If this occurs for five consecutive *trading intervals,* then the Conformance Status will be NC-Pending (only if in Auto mode). The Conformance Status for the following *trading interval* will be Non-Conforming (only if in Auto mode).

Mixed Aggregate – Large Error Example

A hypothetical Mixed Aggregate comprising:

- Unit A: solar *semi-scheduled generating unit*
    - availability of 100 MW
    - *ramp up rate* of 1 MW/min
    - *ramp down rate* of 2 MW/min
    - semi-dispatch cap flag is set (TRUE)
- Unit B: *scheduled bidirectional unit*
    - BDU Generation bid availability of 200 MW
    - BDU Load bid availability of 250 MW
    - BDU composite *ramp up rate* of 3 MW/min
    - BDU composite *ramp down rate* of 2 MW/min

For this *trading interval* assume:

- Aggregate Dispatch Target > Aggregate Actual MW
    - ROC for Mixed Aggregate: use *ramp up rate* for generation (including composite *ramp up rate* for BDU) and *ramp down rate* for loads

- Both units have their aggregated dispatch conformance flag set (conformance mode = 1 in their *dispatch instruction*)
- Participant is opting into aggregated dispatch conformance because the *semi-scheduled generating unit* active power is exceeding its dispatch target by more than its small error trigger threshold

Net Scheduled Large Error Trigger Threshold (MW) =

MAX (6, { MIN [5% MAX (Sum of {Scheduled Generating Unit MWO, BDU Generation MWO}, Sum of Scheduled Load MWO),
4 * MAX (Sum of {Scheduled Generating Unit ROC Up, BDU Composite ROC Up}, Sum of Scheduled Load ROC Down)] })
= MAX (6, { MIN [5% of 300 MW, 4 * 4 MW/min] }) = 15 MW

The aggregate large error trigger (MW) =

MAX (6, { MIN [5% MAX (Sum of {Generating Unit MWO, BDU Generation MWO}, Sum of Scheduled Load MWO),
4 * MAX (Sum of {Generating Unit ROC Up, BDU Composite ROC Up}, Sum of Scheduled Load ROC Down] })

The aggregate large error trigger is determined as follows:

1) Sum of all Generating Unit + BDU Generation MWO = (100 + 200) = 300 MW
2) Sum of all Scheduled Load MWO = 0 MW
3) Sum of all Generating Unit ROC Up + BDU Composite ROC Up = (1 + 3) = 4 MW/min
4) Sum of all Scheduled Load ROC Down = 0 MW/min
5) 5% MAX(Eq 1, Eq 2) = 0.05 x MAX(300, 0) = 0.05 x 300 = 15 MW
6) 4 x MAX(Eq 3, Eq 4) = 4 x MAX(4,0) = 4 x 4 = 16 MW
7) MAX(6, MIN(Eq 5,Eq 6)) = MAX(6, MIN(15,16)) = MAX(6,15) = 15 MW

The aggregate large error trigger (Eq 7) = 15 MW

This means that if the:

- Aggregate Actual MW exceeds its Aggregate Dispatch Target by more than 15 MW, or
- Aggregate Actual MW is below its Aggregate Dispatch Target by more than 15 MW (only if BDU Actual MW is below BDU Dispatch Target by more than 15 MW)

then the Conformance Status for the Aggregate will be Off-Target. If this occurs for three consecutive *trading intervals,* then the Conformance Status will be Not-Responding.

If this occurs for five consecutive *trading intervals,* then the Conformance Status will be NC-Pending (only if in Auto mode). The Conformance Status for the following *trading interval* will be Non-Conforming (only if in Auto mode).

Mixed Aggregate – Large Error Example – with individual and aggregated dispatch conformance

A hypothetical Mixed Aggregate comprising the same units as in the previous example (i.e. Mixed Aggregate – Large Error Example).

For this *trading interval* assume:

- Aggregate Dispatch Target > Aggregate Actual MW
    - ROC for Mixed Aggregate: use *ramp up rate* for generation (including composite ramp up rate for BDU) and *ramp down rate* for load
- Unit A has the individual dispatch conformance flag set (conformance mode = 2 in its *dispatch instruction*) and unit B has the aggregated dispatch conformance flag set (conformance mode = 1 in their *dispatch instructions*)
- Unit A Dispatch Target < Unit A Actual MW
    - ROC: use *ramp down rate* for *generating unit*

For the Aggregate, dispatch conformance is monitored across all *scheduled resources* in the Aggregate. Hence the aggregate large error trigger calculation remains the same as the previous example.

- The aggregate large error trigger = 15 MW

In addition, Unit A is monitored and assessed for its individual dispatch conformance against its individual unit error trigger of 5 MW, calculated as follows:

- 5% availability = 0.05 x 100 = 5 MW
- 4 x *ramp down rate* = 4 x 2 = 8 MW
- Minimum of above terms (5 MW and 8 MW) = 5 MW
- Minimum allowable error is 6 MW
- The maximum of these two terms (6 MW and 5 MW) is 6 MW.

Target Aggregate – Large Error Example

A hypothetical Target Aggregate comprising:

- Unit A: *scheduled generating unit*
    - bid availability of 200 MW
    - *ramp up rate* of 2 MW/min
    - *ramp down rate* of 3 MW/min
- Unit B: *scheduled load*
    - bid availability of 200 MW
    - *ramp up rate* of 2 MW/min
    - *ramp down rate* of 4 MW/min

For this *trading interval* assume:

- Aggregate Dispatch Target > Aggregate Actual MW
    - ROC: use *ramp up rate* for *generating units* and *ramp down rate* for loads
- Unit A has 10 MW of FCAS Lower Regulation enabled (FCL)

By default:

- All units have their aggregated dispatch conformance flag set (conformance mode = 1 in their *dispatch instruction*)
- Aggregated dispatch conformance is applied – no individual dispatch conformance

Aggregate Large Error Trigger Threshold (MW) =

MAX (6, { MIN [5% MAX (Generating Unit MWO, Load MWO),
4 * MAX (Generating Unit ROC Up, Load ROC Down)] })
= MAX (6, { MIN [5% of 200 MW, 4 * 4 MW/min] }) = 10 MW

Aggregate Large Over-Target Error Threshold =
Aggregate Large Error Trigger Threshold + $SUM_{\text{all Generating units}}$ (FCR) + $SUM_{\text{all Loads}}$ (FCR)

= 10 + 0 + 0 = 10 MW

Aggregate Large Under-Target Error Threshold =
Aggregate Large Error Trigger Threshold + $SUM_{\text{all Generating units}}$ (FCL) + $SUM_{\text{all Loads}}$ (FCL)

= 10 + 10 + 0 = 20 MW

This means that if the Aggregate Actual MW of the aggregate is less than its Aggregate Dispatch Target by more than 20 MW, then the Conformance Status for the Aggregate will be Off-Target. If this occurs for three consecutive *trading intervals,* then the Conformance Status will be Not-Responding.

If this occurs for five consecutive *trading intervals,* then the Conformance Status will be NC-Pending (only if in Auto mode). The Conformance Status for the following *trading interval* will be Non-Conforming (only if in Auto mode).

Appendix B.Logic used in identifying trading intervals as subject to review and the trigger thresholds

B.1 Logic for identifying trading intervals as subject to review

Trigger logic used to identify *trading intervals* as subject to review (S):

For each Region

IF ({Unusual change in Region Energy Price} AND {Unusual change in any connected Interconnector Cleared Flow}) OR {Unusual quantity of dispatched FCAS}

THEN

Set *trading interval* Price Status flag = 'SUBJECT TO REVIEW' (S)

ELSE

IF Previous *trading interval* Price Status is either 'SUBJECT TO REVIEW' (S)

OR

'INDETERMINATE' (I)

THEN

Set Current *trading interval* Price Status to 'INDETERMINATE' (I)

B.2 AEMO's internal and external flags

Note 8 The following table explains the **AEMO** internal and external flagging of *trading intervals* identified as subject to review with the progress of price revision process.

Table 7 Flags used with Trading Intervals Subject to Review

***AEMO* internal flagging**	**External flagging**
'SUBJECT TO REVIEW' and AEMO action pending (up to 30 minutes from the publication of the prices for the trading interval)	NOT FIRM
'INDETERMINATE' and AEMO action pending	NOT FIRM
'SUBJECT TO REVIEW' was flagged and AEMO has 'Rejected" the published prices due to the presence of MII	FIRM
'SUBJECT TO REVIEW' was flagged and AEMO has 'Accepted" the published prices since AEMO determined that the trading interval was not affected by a MII	FIRM

B.3 Types of triggers and corresponding thresholds

B.3.1 Energy Price trigger

Trigger for unusual change in the Energy Price of a *region*:

IF EITHER

- The lesser of the absolute values of both the current *spot price* and the previous *spot price* of *region* 'R' is greater than threshold $\$X_R$

  AND

  The absolute difference between the current and previous *spot prices* of *Region* 'R' expressed as an absolute percentage change over the lesser of the current & previous *spot prices*, is greater than percentage threshold Y_R

  OR

- The lesser of the absolute values of both the current *spot price* and the previous *spot price* of *region* 'R' is less than or equal to threshold $\$X_R$

  AND

  The absolute difference between the current & previous *spot prices* of *region* 'R' is greater than threshold $\$X_R$ multiplied by percentage threshold $Y_R/100$

THEN

An unusual change in *Region* ''R' Energy Price has occurred.

B.3.2 Interconnector flow trigger

Trigger for Unusual change in the Cleared Flow of any *interconnector* associated with the *region*:

IF EITHER

For any *interconnector* 'I' connected to *region* 'R'

- The absolute difference between the current & previous *trading interval* Cleared Flow is greater than threshold $Z_{(R,I)}$

OR

For all *interconnectors* 'I' connected to the *Region* 'R'

- Cleared Flow = zero MW for both the current & previous *trading intervals*.

THEN

An unusual change in connected *interconnector* Cleared Flow has occurred.

B.3.3 Dispatched FCAS trigger

Trigger for Unusual quantity of dispatched FCAS the *region*:

IF

Dispatched FCAS in any FCAS market is greater than the threshold $Q_{(R)}$

THEN

An unusual quantity of FCAS in the *region* has been dispatched.

B.3.4 Trigger Thresholds

Table 8 Region Energy Price Trigger Thresholds

Region Energy Price Change Triggers	Default values	
	$X_R ($/MWh)	$Y_R (%)
QLD1	20	300
NSW1	20	300
VIC1	20	300
SA1	20	300
TAS1	20	400

Table 9 Region-Interconnector Flow Change Trigger Thresholds

Region-Interconnector Flow Change Trigger $Z_{R,I}$ (MW)	QNI	Terranora	Vic-NSW	Heywood	Murraylink	Basslink
QLD1	240	100				
NSW1	450	100	500			
VIC1			500	300	100	190
SA1				300	100	
TAS1						190

Table 10 Dispatched FCAS Trigger Thresholds

FCAS Market	FCAS threshold value Q_R (MW)
Raise 1 sec (R1)	500
Raise 6 sec (R6)	500
Raise 60 sec (R60)	500
Raise 5 min (R5)	500
Raise regulation (RREG)	500
Lower 1 sec (L1)	500
Lower 6 sec (L6)	500
Lower 60 sec (L60)	500
Lower 5 min (L5)	500
Lower regulation (LREG)	500

Appendix C. Composite ramp rates for scheduled bidirectional units

Scheduled bidirectional units can submit different *ramp rates* for the *generation* and consumption sides of the unit. Because of the possibility of the unit moving from *generation* to consumption, or *vice versa*, during a *trading interval*, NEMDE uses a composite *ramp rate* for the unit, comparing it to the relevant SCADA *ramp rate* when the SCADA *ramp rate* is available, to determine optimum dispatch. The composite *ramp rates* in NEMDE are calculated as follows:

Composite up ramp rate

If Initial MW ≥ 0

then Gen Bid Ramp Up Rate

else if Load Bid Ramp Down Rate = 0

then 0

else if ABS [Initial MW / Load Bid Ramp Down Rate] ≥ Dispatch Period

then Load Bid Ramp Down Rate

else {(Dispatch Period – ABS [Initial MW / Load Bid Ramp Down Rate]) * Gen Bid Ramp Up Rate – Initial MW} / Dispatch Period

Composite down ramp rate

If Initial MW ≤ 0

then Load Bid Ramp Up Rate

else if Gen Bid Ramp Down Rate = 0

then 0

else if ABS [Initial MW / Gen Bid Ramp Down Rate] ≥ Dispatch Period

then Gen Bid Ramp Down Rate

else {(Dispatch Period – ABS [Initial MW / Gen Bid Ramp Down Rate]) * Load Bid Ramp Up Rate + Initial MW} / Dispatch Period

This may be easier to understand diagrammatically. Consider the following example in dispatch, with a *scheduled bidirectional unit* moving from consumption to *generation*, which has bid a down *ramp rate* for the load side of 5 MW/min, and an up *ramp rate* for the generation side of 3 MW/min:

- Initial MW ≤ 0; and
- Load Bid Ramp Down Rate ≠ 0; and
- ABS [Initial MW / Load Bid Ramp Down Rate] = ABS [-10 / 5] = 2 which is not greater than or equal to the Dispatch Period = 5

therefore the composite up *ramp rate* is given by the formula

{(Dispatch Period – ABS [Initial MW / Load Bid Ramp Down Rate]) * Gen Bid Ramp Up Rate – Initial MW} / Dispatch Period

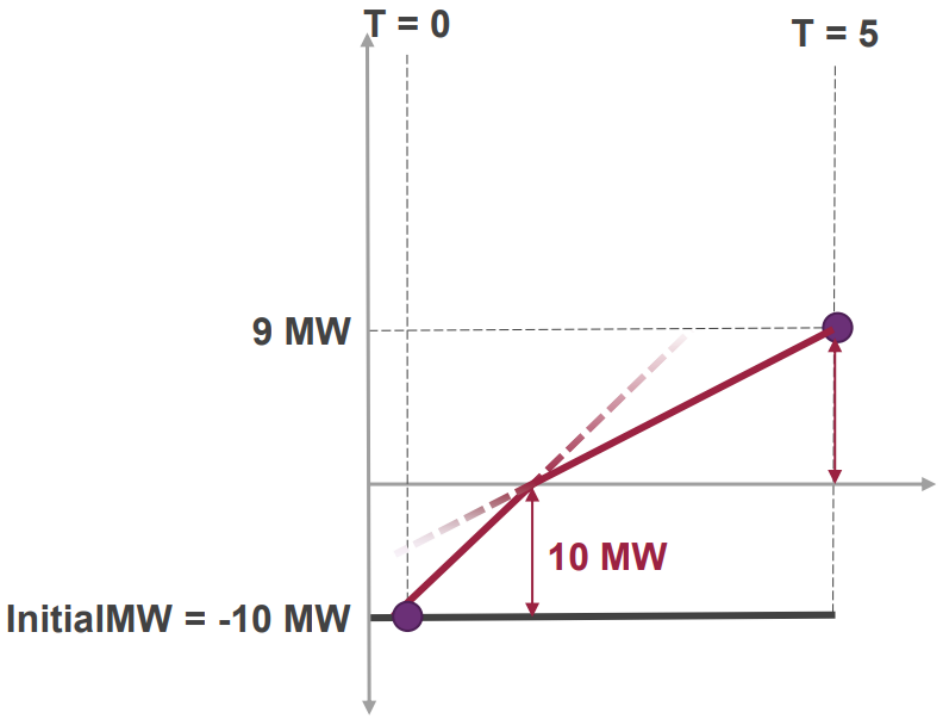
= {(5 – ABS[-10 / 5]) * 3 – (-10)} / 5

= {(3 * 3) + 10} / 5

= 3.8 MW / min

allowing the unit to move from -10 MW to 9 MW in the five-minute dispatch period at a ramp rate of 3.8 MW / min.

Figure 1: Composite ramp rate example



Appendix D. History of version release details

Version	Effective Date	Summary of Changes
93.0	06 December 2023	Transferred content to new template. Added explanatory footnotes to non-conformance calculations in Appendix A. Updates to the logic used in identifying trading intervals as subject to review to include dispatched FCAS quantities as triggers. The update affected Appendix B. Further, Appendix B has been structured to include sub-sections.
92.0	9 August 2023	Updates to implement aggregated dispatch conformance for scheduled resources in an aggregate system, in accordance with NER clause 11.145.16 of the National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021 No. 13. Updates to reflect and clarify the existing dispatch conformance process, including removal of manual conformance monitoring process for scheduled loads under section 3.3.
91.0	7 August 2023	Inclusion of bid energy Max Avail for semi-scheduled generating units, minor drafting updates.
90.0	01 December 2022	Update to remove values of administered price cap and administered floor price.
89.0	01 July 2022	Updates for interconnector flow change trigger thresholds of Heywood and Terranora in Appendix B, following amendment of the Automated Procedures for determining a Manifestly Incorrect Input (final determination 15 December 2021).
88.0	24 October 2021	Updates for the wholesale demand response mechanism rule change. Updates for the five-minute settlement rule change. Removed the ability for AEMO to submit a default bid on behalf of a non-conforming scheduled load.
87.0	31 March 2021	Updates to reflect semi-scheduled generator dispatch obligations rule change. Conversion to new template and general drafting review. Minor updates: • Replace “compliance” with “conformance” when referring to AEMO’s process • Use consistent terminology for dispatch target, semi-dispatch cap and semi-dispatch cap flag • Updates for rule changes on intervention pricing and mandatory restrictions • Remove Appendix C, merge into section 2.4 • Updates to section 2.2 to clarify the issue of dispatch instructions via AGC
86.0	11 February 2019	Section 8.3 removed. Non-Physical Loss (NPL) obsolete with NEMDE V3.3.8 upgrade using Special Order Set 2 (SOS2). There is an option to use or not use SOS2.
85.0	26 July 2018	Added requirement for linear ramping for semi-scheduled generating units in section 2.2. Obsolete references removed. NER-defined terms italicized
84.0	14 August 2017	Updated the procedure to match automated processing messages sent to participants. Added clause on linear ramping in section 2.
83.0	14 November 2016	Periodic review
82.0	24 June 2016	Updated Section 9 to reflect rule change for minimum ramp rate requirements
81.0	11 December 2015	Reduce change history to only 1 page (most recent). Remove 'Next Review' box for online documents. Update the automated processing message sent to participants in section 3.2.2.
80.0	23 October 2014	Removed section 3 and Appendix D
79.0	16 May 2014	Update section 2 Remote AGC selection Added Section 3 and appendix D Clarified phone communication requirements for non –conformance Appendix A.3

Version	Effective Date	Summary of Changes
		Changes made to incorporate addition of solar generation forecasts (ASEFS) to market systems processes.
78.0	20 August 2013	Applied changes to reflect new CVP factors in constraints. Update interconnector flow change trigger thresholds of Heywood and Murraylink
77.0	07 May 2013	Transferred content to new template. Added SO_OP_3709 Section 12-13 into Section 22-23.
76.0	03 January 2013	Section 18.2 clarified due to negative settlement residues automation project.
75.0	19 September 2012	Section 12.1 clarified participants must advise AEMO of any work that may impact SCADA values
74.0	01 July 2012	Reference to CPT updated in section 16.4.
73.0	01 May 2012	Section 3.3 revised.