



Constraints Formulation Guidelines

Final Report – Standard consultation
for the National Electricity Market

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New South Wales | Queensland | South Australia | Victoria | Australian Capital Territory | Tasmania | Western Australia

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Executive summary

The publication of this final report concludes the standard consultation procedure conducted by AEMO to update the Constraints Formulation Guidelines (CFG) for the 1 second FCAS (the **proposal**) under the National Electricity Rules (**NER**).

AEMO thanks all stakeholders for their feedback on the proposal, which was undertaken as required by NER under clause 3.8.10(c), following the procedure in NER 8.9.2.

AEMO received one submission in the first stage of its consultation on the proposal, and another two submissions in the second stage with feedback on aspects of all issues noted in the consultation paper.

Based on the feedback received and further review:

- AEMO will update the Constraint Formulation Guidelines to include more information on the Constraint Automation system.
- When AEMO reviewed the CVPs, we assessed that the regulation services needed to a higher priority compared to the contingency services as regulation was being supplied at all times and not following a contingency.
- AEMO will review and update section 5.9 in the CFG so it provides better clarity on when AEMO will co-optimize FCAS constraint equations.
- AEMO will progress changing to three decimal places later in 2023 prioritizing the 9 constraint equations identified via the analysis as well as updating the Constraint Implementation Guidelines to match with this new policy.

After considering all submissions, AEMO's proposal is to make the Constraints Formulation Guidelines (CFG) in the form published with this report, with a proposed effective date of **22 June 2023**.

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1. Stakeholder consultation process

As required by National Electricity Rules (NER) under clause 3.8.10(c), AEMO is consulting on the Constraints Formulation Guidelines (CFG) for the 1 second FCAS (the proposal) in accordance with the standard rules consultation procedure in NER 8.9.2.

Note that this document uses terms defined in the NER, which are intended to have the same meanings. There is a glossary of additional terms and abbreviations in Appendix A.

AEMO's process and expected timeline for this consultation are outlined below. Future dates may be adjusted and additional steps may be included as needed, as the consultation progresses.

Table 1 Consultation process and timeline

Consultation steps	Dates
Consultation paper published	21 November 2022
Submissions due on consultation paper	20 December 2022
Stakeholder meetings	January/February 2023
Draft report published	13 March 2023
Stakeholder meetings (as required)	March/April 2023
Submissions due on draft report	12 April 2023
Final report published	22 June 2023

AEMO's consultation webpage for the proposal is at [AEMO | Constraints Formulation Guidelines and Schedule of Constraint Violation Penalty Factor](#), containing all previous published papers and reports, written submissions, and other consultation documents or reference material (other than material identified as confidential).

In response to its consultation paper on the proposal, AEMO received one written submission from CS Energy and two submissions in response to the draft report (from Grids and Snowy Hydro).

AEMO published a draft report of its review of the submission from CS Energy and an updated draft of the Constraints Formulation Guidelines.

AEMO thanks all stakeholders for their feedback on the proposal throughout this consultation, which has been considered in preparing this final report.

2. Background

2.1. Context for this consultation

AEMO needs to develop and consult on an updated version of the Constraints Formulation Guidelines (CFG) and an updated version of the Schedule of Constraint Violation Penalty Factors to align both with the 1 second FCAS which is due to be introduced in October 2023.

2.2. NER requirements

AEMO published the current interim Constraints Formulation Guidelines under NER 3.8.10(c) in accordance with the Rules consultation requirements detailed in clause 8.9 of the NER:

Clause 3.8.10 Network constraints

- (c) *AEMO* must, in accordance with the *Rules consultation procedures*, develop and *publish* by 1 June 2010, and, where necessary, amend *network constraint* formulation guidelines, to address, amongst other things, the following matters:
- (1) the circumstances in which *AEMO* will use *alternative network constraint formulations* in *dispatch*;
 - (2) the process by which *AEMO* will identify or be advised of a requirement to create or modify a *network constraint* equation, including in respect of:
 - (i) the methodology to be used by *AEMO* in determining *network constraint* equation terms and co-efficients; and
 - (ii) the means by which *AEMO* will obtain information from, and disseminate information to, *Scheduled Generators*, *Semi-Scheduled Generators* and *Market Participants*;
 - (3) the methodology to be used by *AEMO* in selecting the form of a *network constraint*, equation including in respect of the location of terms on each side of the equation;
 - (4) the process to be used by *AEMO* for applying, invoking and revoking *network constraint* equations in relation to different types of *network constraints*, including in respect of:
 - (i) the circumstances in which *AEMO* will use *alternative network constraint formulations* and *fully co-optimised network constraint formulations*; and
 - (ii) the dissemination of information to *Scheduled Generators*, *Semi-Scheduled Generators* and *Market Participants* in respect of this process; and
 - (5) *AEMO's* policy in respect of the management of negative *settlements residue*, by intervening in the *central dispatch* process under clause 3.8.1 through the use of *fully co-optimised network constraint formulations*,

including in respect of the process to be undertaken by *AEMO* to manage negative *settlements residue*.

2.3. The national electricity objective

Within the specific requirements of the NER applicable to this proposal, AEMO has sought to make a determination that is consistent with the national electricity objective (NEO) and, where relevant, to select the option best aligned with the NEO.

The NEO is expressed in section 7 of the National Electricity Law as:

to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:

- (a) price, quality, safety, reliability and security of supply of electricity; and
- (b) the reliability, safety and security of the national electricity system.

3. List of material issues

The key material issues arising from the proposal or raised in submissions or consultation meetings are listed in the following table:

Table 2 List of material issues

No.	Issue	Raised by
1.	FCAS regulation services have a higher priority than the FCAS contingency services	CS Energy
2.	Constraint Automation is briefly referred to in section 8.3 of the Guidelines	CS Energy
3.	AEMO should be reducing the size of large contingencies where it results in lower overall dispatch costs	Grids
4.	AEMO should undertake an investigation of rounding constraint coefficients in the energy market.	Snowy Hydro

Each of the material issues in Table 2 is discussed in Section 4.

4. Discussion of material issues

4.1. FCAS regulation services have a higher priority than the FCAS contingency services

4.1.1. Issue summary and submissions

Section 2.10.1 of the Guidelines refers to the CVP. CS Energy notes that items 35 to 42 in section 3 of the current version of the CVP indicate that the Frequency Control Ancillary Service (FCAS) regulation services have a higher priority than the FCAS contingency services, particularly the six (6) second services. This appears to be counter intuitive as arresting the frequency deviation should have a higher priority than a slower integral response such as the regulation services. CS Energy's recollection is that in previous versions of the CVP (not accessible on the AEMO website) the FCAS contingency services had a higher priority than the regulation services. There is no reference to the change in the CVP version release history. CS Energy is seeking to understand the rationale of the current CVP priority order regarding the FCAS regulation and contingency services.

4.1.2. AEMO's conclusion

When AEMO reviewed the CVPs we assessed that the regulation services needed to be a higher priority compared to the contingency services as regulation was being supplied at all times and not following a contingency.

4.2. Constraint Automation

4.2.1. Issue summary and submissions

Constraint Automation is briefly referred to in section 8.3 of the Guidelines. CS Energy proposes that reference be made to a detailed description of Constraint Automation in AEMO procedure, SO_OP3705 Dispatch, section 19.5 that will provide the required level of detail for the Guidelines.

4.2.2. AEMO's conclusion

AEMO will update the Constraint Formulation Guidelines to include more information on the Constraint Automation system.

4.3. Reducing the Size of Large Contingencies

4.3.1. Issue summary and submissions

Grids suggests that AEMO should co-optimize the size of the largest contingency for system not only for security purposes but also for economic benefits, i.e. reducing the size of large contingencies where it results in lower overall dispatch costs.

4.3.2. AEMO's conclusion

AEMO notes that Grids has also submitted a rule change request for this item to the AEMC, with an associated request to introduce runaway pricing for contingency FCAS cost recovery. Given that NER

changes could have implications for the CFG, it is most sensible to consider changes to the CFG once the rule change process has played out, avoiding potential duplication of effort.

Notably, however, AEMO will review and update section 5.9 in the CFG so that it provides clarity around the cases where AEMO currently co-optimises generator output with FCAS requirements. Some examples are described below. You will observe that these examples manage occasions where there is likely to be insufficient available FCAS reserves, and thus they have the effect of reducing the size of the contingency to ensure dispatch results in a secure operating state.

- when SA and Qld are islanded all the large generators are co-optimised (with the exception of Pelican Point as it is an aggregate). The amount of available FCAS when these regions are islanded cannot support the loss of the largest generator at its maximum output. These constraints have been very effective in managing the islanding scenarios.
- when a multiple generator trip is reclassified as a credible contingency and the combined MW is larger than the largest MW generator in the region
- where multiple generators are tripped due to the action of a control scheme following a credible contingency (such as north-west Victoria and in southern NSW) and the combined MW is larger than the largest MW generator in the region

Following this submission AEMO has also completed analysis of more recent events for loss of multiple Victorian generators on a 220kV line trip in north-west Victoria (this is called the generator fast tripping scheme or GFT). This generation maximum is in the range from 600-800 MW. In all these cases NEMDE only dispatched more FCAS and the generation output was not affected.

4.4. Rounding Constraint Coefficients

4.4.1. Issue summary and submissions

As part of the CFG consultation Snowy Hydro submits that AEMO should undertake an investigation of rounding constraint coefficients in the energy market. As part of the transmission access reform work undertaken by the Energy Security Board (ESB) there has been support for the investigation of the proposal to round constraint coefficients. The proposal has been deemed as valuable by the ESB and the rounding of constraint coefficients has been linked to the proposed Congestion Relief Market (CRM).

Snowy Hydro however believes that the proposal can be implemented as a stand-alone proposal and that AEMO should conduct some modelling to assess the potential impacts from rounding constraint coefficients on congestion and assess how much rounding would be required to deliver impactful results in the market.

4.4.2. AEMO's conclusion

The CFG does not include requirements on the number of decimal places used in constraint equations and AEMO does not support adding this into the CFG.

AEMO has conducted analysis on the impact of changing to 3, 2 and 1.5 decimal places and the impact on constraint equations that have bound in the last 18 months. Overall, there would only a small number of constraint equation changes where generator factors would increase to 1 or -1 (e.g. 0.9999, 0.975 and 0.95 would change to 1).

The main issue with changing to a smaller number of decimal places is the decrease in accuracy and impact on the limits. The operating margin is not in place to allow for a reduction in accuracy so a decrease to 2 or 1.5 decimal places would require a wholesale review of operating margins - and it is very likely they would increase. e.g. a 500 MW generator with a factor of 0.95 changing to 1 would mean a 25 MW difference – most operating margins are between 25 and 50.

However, there is a benefit to moving to three decimal places (particularly for several Qld thermal constraint equations). AEMO will progress changing to three decimal places later in 2023 prioritizing the 9 constraint equations identified via the analysis as well as updating the Constraint Implementation Guidelines to match with this new policy.

5. Final determination on proposal

Having considered the matters raised in submissions to the consultation paper, AEMO's final determination is to amend the Constraints Formulation Guidelines in the form published with this final report, in accordance with NER clause 3.8.10(c).

The published final Constraints Formulation Guidelines is marked up to show changes from the version issued with the consultation paper.

Appendix A. Glossary

Term or acronym	Meaning
CFG	Constraints Formulation Guidelines
CVP	Constraint Violation Penalty
FCAS	Frequency Control Ancillary Service
NER	National Electricity Rules
NEMDE	National Electricity Market Dispatch Engine