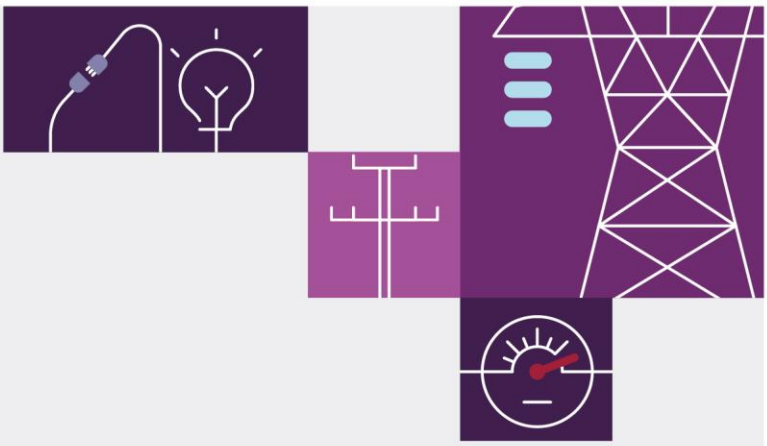
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Scheduling Error Report

November 2022

NEM Dispatch Constraint Calculation Error 6 April 2022

A report for the National Electricity Market



Important notice

Purpose

This report describes the circumstances surrounding a scheduling error identified by AEMO under clause 3.8.24(a)(2) of the National Electricity Rules. AEMO has prepared this report using information available as 4 November 2022, unless otherwise specified.

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Version control

Version	Release date	Changes
1	8/11/2022	Initial report

AEMO acknowledges the Traditional Owners of country throughout Australia and recognises their continuing connection to land, waters and culture. We pay respect to Elders past and present.

Abbreviations

Abbreviation	Term
FCAS	Frequency control ancillary service
L6, L60, L5	Fast (contingency 5 second), slow (contingency 60 second) and delayed (contingency 5 minute) FCAS lower services respectively
LREG, RREG	Lower and raise FCAS regulation services respectively
MII	Manifestly incorrect input
MNSP	Market Network Service Provider
MW	megawatt
MWh	megawatt hour
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NER	National Electricity Rules
OCD	Over-constrained dispatch
R6, R60, R5	Fast (contingency 5 second), slow (contingency 60 second) and delayed (contingency 5 minute) FCAS raise services respectively

Contents

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1 Summary

AEMO has determined that it failed to follow the central dispatch process set out in National Electricity Rules (NER) 3.8 from the trading interval ending at 1100 hrs to the trading interval ending at 1750 hrs on 6 April 2022, constituting a scheduling error under NER 3.8.24[1].

The error resulted in the National Electricity Market (NEM) dispatch engine (NEMDE) determining incorrect requirements for the delayed lower and regulating lower market ancillary services in Tasmania in the trading interval ending at 1640 hrs only. These artificial requirements significantly exceeded the available quantities of two frequency control ancillary services (FCAS), resulting in high prices for these two services in Tasmania.

AEMO identified that the issue occurred when a configuration file was changed for an unrelated issue. Although the error was in place for several hours, only one trading interval was affected by the error.

2 Description of the error

2.1 Configuration change

Two constraints to manage the loss or the largest load in Tasmania were affected by a configuration error inadvertently introduced at around 1100 hrs on 6 April 2022 in AEMO's dynamic FCAS calculator. This resulted in incorrect calculation of infeasibly high requirements for FCAS delayed lower service (L5[2]) and regulating lower service (LREG) in Tasmania.

Although the change was straightforward, a version control issue with the configuration file resulted in an out-of-date configuration being used for the change. The root cause of the incident was an error in the configuration file that was unrelated to the configuration change itself.

2.2 Error and initial impacts

The incorrect configuration file reduced Tasmanian load relief term in FCAS calculations from 0.1% to 0.05%, causing an occasional very large requirement to be calculated. A constraint that used this calculation would normally be 'swamped' for the power system conditions at the time. The swamping term reduces the requirement by 10,000 megawatts (MW), which is normally enough to ensure the constraint does not bind. Although the error had been in place for several hours, it only manifested in the 1640 trading interval.

The configuration file was fixed, tested and updated in the evening of 6 April 2022.

The principal impact of the error was to create a requirement for more than 50,000 MW of L5 service in Tasmania. NEMDE dispatched all available L5 service in Tasmania. The L5 and LREG services can be co-optimised so that

[1] AEMO, Scheduling error declaration, at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-events-and-reports/scheduling-error-reports.

[2] L5 refers to a 5-minute frequency lower contingency ancillary service. AEMO also dispatches 6-second (L6) and 60-second (L60) lower services, as well as frequency raise services.

LREG can also be used to provide L5 service, so NEMDE also dispatched all available LREG service in Tasmania.

To maximise the amount of L5 and LREG services in Tasmania that could be dispatched towards this artificial requirement, NEMDE's co-optimisation process also dispatched affected generation higher in the energy market. The actual dispatched volumes were 1056.7 MW of L5 and 129.3 MW of LREG.

AEMO has rerun trading interval 1640 to estimate the impact of the error on dispatch and pricing. Appendix A1 summarises the outcomes of this analysis. In summary, FCAS and energy prices for the 1640 trading interval were affected as follows:

- Co-optimisation of FCAS L5 and LREG services resulted in the same price in Tasmania for both services, changing from $0.50/megawatt hour (MWh) in trading interval 1635 hrs to $6,411.50/MWh in trading interval 1640 hrs. FCAS prices in other services and other regions were affected by the error by small amounts as shown in Table 1 in Appendix A.1.
- Co-optimisation of energy with FCAS resulted in the energy price in Tasmania changing from $232.96/MWh in trading interval 1635 hrs to $14.05/MWh in trading interval 1640 hrs. There was a similar change in energy prices in South Australia and Victoria.

3 Assessment of the error and response

3.1 Pricing and dispatch

Before the incident, power system conditions were unremarkable.

The dispatch outcomes resulting from the scheduling error did not trigger the automated procedures for determining trading intervals subject to price review (NER 3.9.2B), and AEMO did not determine at the time that the affected interval was likely to be subject to a manifestly incorrect input (MII).

The affected interval was over-constrained and prices were automatically resolved in accordance with AEMO's over-constrained dispatch (OCD) rerun process[3]. AEMO did not otherwise revise prices because of the incident.

3.2 Market notification

AEMO did not issue any specific market notices concerning the error. The result of the OCD dispatch rerun was automatically flagged in the dispatch output files.

AEMO declared a scheduling error on 8 April 2022. The declaration was published on AEMO's website[4] and notified through an AEMO Communication.

[3] AEMO, Over-Constrained Dispatch Rerun Process Document, at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Congestion-Information/2016/Over-Constrained-Dispatch-Rerun-Process.pdf.

[4] Scheduling error declarations available at https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-events-and-reports/scheduling-error-reports.

AEMO also provided information at an industry briefing on 7 April 2022 and to affected Tasmanian participants on 20 April 2022 to advise of the outcome and immediate actions.

3.3 Resettlement of FCAS market in Tasmania

The primary market impact of the incident was on dispatch of the L5 and LREG services, affecting Hydro Tasmania and market customers in Tasmania. AEMO reached a voluntary agreement with Hydro Tasmania to substitute a representative 'high' L5 volume for the quantity actually dispatched, reducing the total L5 cost for Tasmania by 90%. AEMO used the agreed lower L5 quantity in the preliminary settlement statements (with FCAS prices unchanged as shown in Table 1 in Appendix A.1).

Settlement of other services was not changed.

3.4 Manifestly incorrect inputs

NER 3.9.2B requires AEMO to develop and consult on procedures for the automatic identification of trading intervals subject to review where MII have resulted in material differences in pricing outcomes.

Although AEMO considers the trading interval 1640 on 6 April 2022 was affected by an incorrect input, the current automatic procedures only trigger on changes to energy prices and interconnector flows. Consequently, the automatic procedures did not trigger and prices were not revised.

Since that event, and following an unrelated scheduling error affecting FCAS prices in August 2022[5], AEMO is investigating a new price revision trigger based on suspect volumes of FCAS dispatched. The investigation is still underway, but AEMO expects to commence consultation by early 2023 on including the new trigger in the automated procedures.

4 Scheduling error compensation

Under the NER, a participant compensation fund has been established to fund compensation to scheduled and semi-scheduled generators and scheduled network service providers who incur spot market losses arising from specified dispatch outcomes resulting from scheduling errors. Compensation is limited to the specified participants and outcomes described in NER 3.16.2, and by the amount in the fund. Any compensation claims must be determined by a dispute resolution panel.

For this incident, no claims have been made for compensation from the participant compensation fund. Based on NER 3.16.2, AEMO has not identified any market participants eligible for compensation as a result of this scheduling error.

[5] AEMO, Scheduling Error Reports – NEM Dispatch Engine – Constraint Calculation Error – 10 August 2022, at https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-dispatch-engine-constraint-calculation-error-10-august-2022.pdf?la=en.

5 Recommendations

AEMO has identified the following process changes following a review of the incident:

- Implement peer review requirement for all changes to the FCAS configuration files, and a further peer review of the changes as implemented in the pre-production and production environments (complete).
- Undertake a review of version control of configuration files used for FCAS dynamic calculator (complete).
- Increase precision of load relief calculations in AEMO's displays to improve the ability to identify similar errors (complete).
- Review the FCAS dynamic calculator to identify alternative solutions or implement reasonability limits (in progress).
- Investigate a potential change to the automated procedures for identifying trading intervals subject to review. This investigation is underway with AEMO planning to commence consultation by early 2023 on potential triggers for FCAS input errors.

A1. Appendix – Dispatch rerun outcomes

Entries in red indicate a material difference between the original and rerun results.

A1.1 Prices

Table 1 Prices before rerun ($/MWh)

Region	Energy	R6	R60	R5	Rreg	L6	L60	L5	Lreg
NSW1	299.99	9.29	27.73	0.86	12.47	0.5	0.9	0.41	5.49
QLD1	311.86	9.29	27.73	0.86	12.47	0.5	0.9	0.41	5.49
SA1	14.05	9.29	27.73	0.86	12.47	0.5	0.9	0.41	5.49
TAS1	14.08	9.29	27.73	0.86	12.47	0.5	0.9	6411.5	6411.5
VIC1	14.68	9.29	27.73	0.86	12.47	0.5	0.9	0.41	5.49

Table 2 Prices after rerun ($/MWh)

Region	Energy	R6	R60	R5	Rreg	L6	L60	L5	Lreg
NSW1	299.99	4.98	2.95	0.86	12.47	0.5	0.9	0.5	5.49
QLD1	311.86	4.98	2.95	0.86	12.47	0.5	0.9	0.5	5.49
SA1	175.45	4.98	2.95	0.86	12.47	0.5	0.9	0.5	5.49
TAS1	177.4	4.98	2.95	0.86	12.47	0.18	0.9	0.44	5.43
VIC1	185.82	4.98	2.95	0.86	12.47	0.5	0.9	0.5	5.49

A1.2 Aggregated energy and FCAS targets

Table 3 Energy and FCAS aggregated dispatch targets before rerun (MW)

Region	Energy	R6	R60	R5	Rreg	L6	L60	L5	Lreg
NSW1	7295.23	83.1	92.65	85.65	35	71	84	25.38	61
QLD1	7665.55	100	142.73	28	36	0	0	0	0
SA1	1295.86	131	120	118	5	82.24	71	16	36
TAS1	1436.14	96.41	60.34	0	0	74.84	55.38	1056.7	129.31
VIC1	5595.81	194	188.79	229.81	144	62	151	55	63

Table 4 Energy and FCAS aggregate dispatch targets after rerun (MW)

Region	Energy	R6	R60	R5	Rreg	L6	L60	L5	Lreg
NSW1	7295.23	79.65	60.78	85.65	35	71	84	44	61
QLD1	7665.55	93	87	28	36	0	0	0	0
SA1	1345.83	122.43	99	118	0	82.01	70	68	39
TAS1	1325.72	115.43	197.74	0	20	75.07	56.38	56.07	19
VIC1	5648.6	194	160	229.81	129	62	151	60.25	91

A1.3 Inter-regional energy targets

Table 5 Inter-regional energy targets before rerun (MW)

Interconnector	Flow
N-Q-MNSP1	-104
NSW1-QLD1	-49
T-V-MNSP1	232
V-S-MNSP1	4
V-SA	-130
VIC1-NSW1	886

Table 6 inter-regional energy targets after rerun (MW)

Interconnector	Flow
N-Q-MNSP1	-104
NSW1-QLD1	-49
T-V-MNSP1	125
V-S-MNSP1	-9
V-SA	-170
VIC1-NSW1	886