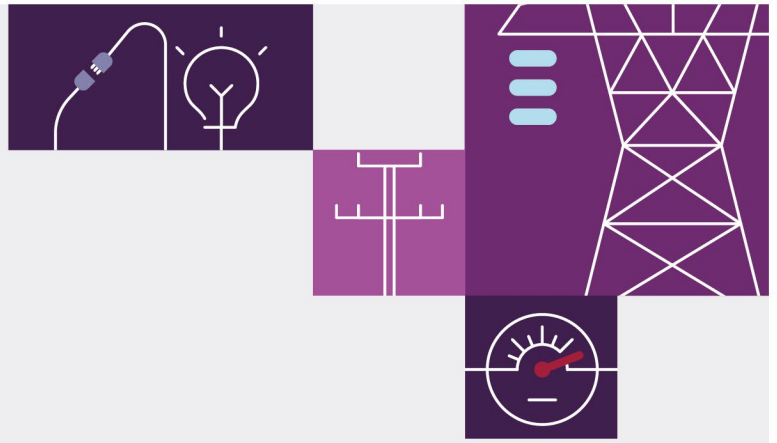


Final Report: South Australia market suspension on 18 February 2022

July 2023

A market event report for the
National Electricity Market





Important notice

Purpose

AEMO has prepared this final market event report in accordance with clauses 3.14.3(c)-(d) and 3.14.4(f)-(g) of the National Electricity Rules, using information available as at the date of publication unless otherwise specified.

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Contact

If you have any questions or comments in relation to this report, please contact AEMO at nemintervention@aemo.com.au.

Abbreviations

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
EMS	Energy Management System
FCAS	Frequency Control Ancillary Service
MN	Market Notice
MSPS	Market Suspension Pricing Schedule
NEM	National Electricity Market
NER	National Electricity Rules
RTU	Remote Terminal Unit
SA	South Australia
SCADA	Supervisory Control and Data Acquisition
TI	Trading Interval
TNSP	Transmission Network Service Provider



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1 Overview

This is the final report relating to AEMO's suspension of the spot market in South Australia on 18 February 2022. It consolidates and updates AEMO's preliminary report on the market suspension published in March 2022¹ and is based on information available to AEMO on 17 July 2023.

From 1339 hrs² on 18 February 2022, ElectraNet's Supervisory Control and Data Acquisition (SCADA) system in South Australia failed, with ElectraNet having only approximately 20% system visibility³. In response to this South Australia SCADA failure, AEMO suspended the spot market in South Australia from 1420 hrs to 1610 hrs. The power system remained in a secure operating state throughout the market suspension, and no generation or load was lost because of the incident. During the suspension period, South Australian prices were set using market suspension schedule pricing.

As required by National Electricity Rules (NER) 3.14.3(c) and 3.14.4(f), AEMO has conducted a review of the market suspension. This final report includes the matters required by NER 3.14.3(c) and (d) and 3.14.4(g), namely:

- The reason for the suspension and its effect on the operation of the spot market, which is unchanged from the preliminary report and is covered in Section 2. Information and analysis of system responses and actions is unchanged from the preliminary report and is also summarised in Section 2.
- AEMO's assessment of the adequacy of the provision and response of facilities and services, and actions taken to maintain power system security, which is in Section 3.
- Details of the payments and compensation made to each Market Suspension Compensation Claimant and the share of compensation costs recovered from each Market Customer in South Australia. These details were not available at the time of the preliminary report and are provided in section 4.

This report also includes, in Section 5, an update on the progress of actions or recommendations set out in the preliminary report.

2 Event summary

Table 1 below outlines the timeline of key events which formed part of this market suspension. The information in Table 1 is based on AEMO's operational logs.

This sequence of events does not differ from the timeline of events set out in the preliminary report.

¹ AEMO, Preliminary report: South Australia market suspension on 18 February 2022. Available at https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/preliminary-report-sa-market-suspension.pdf?la=en.

² National Electricity Market time (Australian Eastern Standard Time [AEST]) is used in this report.

³ ElectraNet is the transmission network service provider (TNSP) in South Australia.

Table 1 Sequence of key events on 18 February 2022

Time	Event
1339 hrs	AEMO became aware of a SCADA failure in the South Australia region through AEMO's Energy Management System (EMS) and the PI ProcessBook Grid Monitoring display.
1339 hrs	AEMO started to investigate the source of the issue, and confirmed that all Inter-control Centre Communications Protocol and Border Gateway Protocol Network links were in service.
1403 hrs	ElectraNet informed AEMO that ElectraNet had only approximately 20% SCADA visibility in the South Australia region.
1421 hrs	AEMO declared the spot market suspended in South Australia with the Market Suspension Pricing Schedule (MSPS) applying from trading interval (TI) 1425 hrs onwards. Market Notice 94690 issued.
1531 hrs	AEMO issued Market Notice 94693 confirming that the spot market suspension in the South Australia region was due to a SCADA service interruption.
1531 hrs	ElectraNet confirmed with AEMO that essential SCADA in the South Australia region had been restored.
1538 hrs	AEMO declared that the suspension of the spot market in South Australia would end from 1610 hrs on 18 February 2022. Market Notice 94694 issued.
1824 hrs	ElectraNet informed AEMO that full SCADA redundancy had been restored to all ElectraNet control and data centres.
19/02/2022 1039 hrs	Prices for TI 14:25, the first trading interval of the suspension, were adjusted to the market suspension pricing schedule. Market Notice 94707 issued.

2.1 SCADA failure

ElectraNet's initial investigation has identified that an ElectraNet contractor mistakenly disconnected live cables from a decommissioned plant that supported the redundant communication between the main and backup South Australia SCADA systems. This left some backup Remote Terminal Units⁴ (RTUs) connected to main systems and some to backup systems. The SCADA system is unable to function correctly when in this arrangement.

2.2 Declaration of market suspension

The market suspension was triggered by a SCADA failure in South Australia. AEMO became aware of the South Australia SCADA failure at 1339 hrs on 18 February 2022 through AEMO's Energy Management System (EMS) and the PI ProcessBook Grid Monitoring display.

AEMO conducted its own initial tests to identify the problem and contacted ElectraNet to better understand the situation. After this initial testing AEMO assessed that the ongoing lack of SCADA meant it was no longer possible to operate the spot market in accordance with NER 3.8 and 3.9.


AEMO issued Market Notice (MN) 94690 at 1421 hrs on 18 February 2022, declaring that:

- the spot market in South Australia was suspended from Trading Interval (TI) 1425 18 February 2022 until further notice, and
- prices in South Australia would be set using the Market Suspension Pricing Schedule (MSPS).

MN 94690 complied with NER 3.14.4(a).

The time between first detecting the SCADA failure in South Australia and suspension of the spot market in that region was approximately 40 minutes. This aligns with the recommended timing in SO_OP_3706 Market

⁴ A Remote Terminal Unit monitors digital and analogue parameters from the system and transmits this information to the SCADA system.



Suspension and Systems Failure⁵. SO_OP_3706 provides guidelines on the steps that should be taken if the spot market needs to be suspended. The guidelines state that if a large number of SCADA points have failed, AEMO will consider suspending the spot market if:

- 30 minutes have elapsed since AEMO became aware of the SCADA failure, and
- the SCADA system is not expected to be restored within a further 10 minutes.

2.3 Pricing during the market suspension

During a spot market suspension, prices may be determined in accordance with NER 3.9, or in accordance with the MSPS published under NER 3.14.5(e).

As outlined in MN 94690, the MSPS was used to set the South Australian market price during the market suspension. In accordance with AEMO's published Market Suspension Pricing Methodology⁶, this MSPS was based on a four-week rolling average of historic regional prices, separated into business and non-business days, with a half-hourly resolution⁷.

2.4 Power system operation during the market suspension

Investigation by AEMO has concluded that the power system remained in a secure operating state and the Frequency Operating Standard⁸ was met throughout the market suspension. No generation or load was shed or disconnected and there were no unplanned outages of transmission equipment during the South Australia SCADA failure.

Additionally, the National Electricity Market Dispatch Engine (NEMDE) remained operating, and generators in South Australia followed their dispatch targets from the Market Management System portal.

During the market suspension, SA Power Networks monitored network voltages and tap positions as a proxy for transmission voltages. No actions were required to maintain transmission voltages.

Finally, the flow on the Heywood interconnector remained within 50 megawatts (MW) of its dispatch target and no operational actions were needed to control its flow.

2.5 Market operation during the market suspension

The use of the MSPS during the South Australia market suspension created counter-price flows on the Heywood and Murraylink interconnectors.


Net interconnector flow was consistently from South Australia to Victoria before, during, and after the market suspension. South Australian spot prices were also consistently lower than Victorian spot prices before and after the market suspension. However, during the market suspension, the market suspension pricing schedule raised

⁵ See Section 8.2 of https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3706%20Failure-of-Market-or-Market-Systems.pdf.

⁶ See <https://aemo.com.au/-/media/files/electricity/nem/data/mms/estimated-price-methodology-suspension-ner-3-14-5.pdf?la=en>.

⁷ See https://www.nemweb.com.au/REPORTS/CURRENT/MKTSUSP_PRICING/.

⁸ See <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF>.



South Australian spot prices above Victorian spot prices for 21 of the 22 TIs, meaning there were counter-price flows from South Australia to Victoria during most of the market suspension.

The use of market suspension schedule pricing during the South Australia market suspension also caused a small amount of frequency control ancillary services (FCAS) recovery costs which would not have otherwise existed. During the market suspension there were three TIs where mainland lower 5-minute FCAS prices would have been zero except for the use of the market suspension pricing schedule. The market suspension pricing schedule created non-zero prices for lower 5-minute FCAS in those TIs in South Australia, which meant there were FCAS costs to be recovered for those TIs that would not otherwise have existed.

2.6 Further information during the market suspension

AEMO issued MN 94693 at 1531 hrs on 18 February 2022, stating that the cause of the market suspension was a SCADA service interruption in South Australia, and at that stage there was no impact to supply in any of the other National Electricity Market (NEM) regions.

2.7 Restoration of South Australia SCADA

Once ElectraNet identified the SCADA failure, it took the following actions:

- Identified priority severed cables for repair to reinstate South Australia SCADA as quickly as possible. This information was passed to the ElectraNet contractor on site. Cables required to maintain SCADA system redundancy were then repaired, and ElectraNet informed AEMO that full SCADA system redundancy had been restored at 1824 hrs on 18 February 2022.
- Dispatched an engineer to the backup SCADA system site to investigate why RTUs had failed to automatically connect to the backup system. This engineer identified a firewall rule issue which was preventing RTUs connecting the backup system correctly. Discussions on how to rectify this firewall issue were ongoing when essential South Australia SCADA services were returned to service. ElectraNet has confirmed that a rectification to the firewall issue was completed on 28 February 2022.
- At approximately 1531 hrs on 18 February 2022, essential SCADA in the South Australia region was restored. Further details on the actions undertaken by ElectraNet to restore SA SCADA are outlined in Section 5 of this report.

2.8 Resumption of the spot market

At 1531 hrs on 18 February 2022, ElectraNet confirmed to AEMO that SCADA in the South Australia region had been restored. In response, AEMO issued MN 94694 at 1538 hrs on 18 February 2022 declaring that the spot market in South Australia would resume from 1610 hrs 18 February 2022. MN 94694 complied with NER 3.14.4(d).

The time between declaring the resumption of the spot market in South Australia and the spot market resuming was about 30 minutes. This aligns with the recommended timing in Section 10.2(b)(ii) of SO_OP_3706.

AEMO suspended the spot market in South Australia from 1420 hrs to 1610 hrs on Friday 18 February 2022. The spot market in South Australia was suspended for one hour and 50 minutes.



2.9 Power system operation after the market suspension

At 1824 hrs on 18 February 2022, ElectraNet informed AEMO that full SCADA redundancy had been restored to all ElectraNet control centres and its data centre.

2.10 Market operation after the market suspension

AEMO's central dispatch system automatically applies MSPS prices to a region when required, as well as performing any further price scaling, capping or flooring required by the NER. However, prices in the first one (or possibly two) intervals during a market suspension usually require manual review. The reason for this is outlined below.

A declaration of market suspension happens partway through a TI, but applies from the start of that TI (when the prices for the TI were published). If MSPS is used, prices published at the start of the TI need to be overwritten. AEMO's central dispatch system does not allow this retrospective action to be performed automatically. The prices must therefore be reviewed by AEMO manually⁹.

Manual review also includes checking whether the prices in any other regions require scaling under NER 3.14.5(f). In TI 1425 on 18 February 2022, the net interconnector flow was away from South Australia, and no price scaling in other regions was required.

Under NER 3.14.5(h), AEMO was required to review the prices for the first TI of the market suspension by the end of Monday 21 February 2022. On Saturday 19 February 2022, AEMO uploaded the revised South Australia prices for TI 1425, using the MSPS published on 29 January 2022 and applying to the week beginning 14 February 2022, meeting the NER requirements. This triggered MN 94707 at 1039 hrs that day, advising the market of the revised prices in South Australia.

3 Adequacy of actions taken

Under NER 3.14.3(c), AEMO has reviewed the adequacy of the provision and response of facilities and services during the market suspension, and the appropriateness of actions taken to restore or maintain power system security, and has concluded all responses and actions were adequate in the circumstances.

4 Payments and compensation

4.1 Market suspension pricing schedule payments and compensation payments

Table 2 shows the MSPS energy and FCAS payments and compensation payments for energy and FCAS made to each Market Suspension Compensation Claimant, as required by NER 3.14.3(d)(1)(i) and (ii). During the

⁹ If the declaration of market suspension happens sufficiently far through a TI that the pricing run for the next TI has been triggered, the prices for the second TI also require manual review. This did not happen during this event.

market suspension period there were five Market Suspension Compensation Claimants, being the scheduled generators and ancillary service providers who supplied energy or provided FCAS in an affected region.

The compensation payments shown in the table represent formula-based payments made under NER 3.14.5A, using the schedule of benchmark values published by AEMO and current for the period when the suspension occurred. These payments compensate a Market Suspension Compensation Claimant for any additional amount of costs it is deemed to have incurred based on its plant type, in excess of the payments received under the MSPS for energy and FCAS.

No additional compensation claims were made by any Market Suspension Compensation Claimant under NER 3.14.5B or 3.15.7B.

Values in Table 2 and Table 3 are rounded to the nearest whole dollar value.

Table 2 MSPS payments and compensation payments

Participant name	MSPS payment (energy)	MSPS payment (FCAS)	Compensation payment (energy and FCAS)
Accel Energy Retail Pty Ltd*	\$1	\$229	\$0
AGL SA Generation Pty Limited	\$6,509	\$0	\$11,695
Hornsedale Power Reserve Pty Ltd	\$97	\$321	\$0
Lake Bonney Wind Power Pty Ltd	\$13	\$186	\$0
Pelican Point Power Limited	\$1,278	\$0	\$3,357
Total	\$7,897	\$737	\$15,052

* On 6 October 2022, Accel Energy Retail Pty Limited's name changed to AGL Dalrymple Pty Limited.

4.2 Compensation costs payable

Table 3 overleaf shows the share of compensation costs payable by each Market Customer to AEMO as required by NER 3.14.3(d)(1)(iii). The total of these amounts is equal to the total compensation payment from AEMO to the Market Suspension Compensation Claimants in Table 2.

All compensation costs were recoverable from Market Customers in the suspended region, South Australia, as the only region determined to benefit from the payment of compensation in accordance with NER 3.15.8A.

Table 3 Compensation costs payable

Participant name	Compensation cost payable
Alinta Energy Retail Sales Pty Ltd	\$170
Blue NRG Pty Ltd	\$42
Covau Pty Ltd	\$24
Delta Electricity	\$28
Diamond Energy Pty Ltd	\$20
EnergyAustralia Yallourn Pty Ltd	\$1,198
GloBird Energy Pty Ltd	\$6
Hanwha Energy Retail Australia Pty Ltd	\$2
Iberdrola Australia Energy Markets Pty Ltd	\$1,614
Liberty Greenpower Pty Ltd	\$874
Momentum Energy Pty Ltd	\$284
Next Business Energy Pty Ltd	\$48
Origin Energy Electricity Ltd	\$6,731
OVO Energy Pty Ltd	\$2
Power Club Ltd	\$1
Progressive Green Pty Ltd	\$497
QEnergy Ltd	\$25
ReAmped Energy Pty Ltd	\$5
Shell Energy Retail Pty Ltd	\$929
SmartestEnergy Australia Pty Ltd	\$42
South Australian Water Corporation	\$382
Synergen Power Pty Ltd	\$12
Tango Energy Pty Ltd	\$79
Zen Energy Retail Pty Ltd	\$2,034
Total	\$15,051

Note that the total compensation cost payable is equal to the total compensation payments for energy and FCAS, at \$15,052.

Participants that had a compensation cost payable of less than \$0.50 were excluded from Table 3, making up the discrepancy between Table 2 and Table 3. These participants were:

- CSR Building Products Ltd.
- Electricity In A Box Pty Ltd.
- Mojo Power East Pty Ltd.
- MTA Energy Pty Limited.
- Sanctuary Energy Pty Ltd.
- Telstra Energy Pty Ltd.

5 Actions taken since preliminary report

This section provides an update on progress of the actions or recommendations identified in the Next Steps section (Section 5) of the preliminary report.

5.1 Improved market notices

5.1.1 Preliminary report

AEMO recommended improvements to market notices declaring market suspension, so that the initial notice will:

- include the reason for the market suspension
- refer only to trading intervals (not dispatch intervals), and
- be more easily readable.

5.1.2 Final report

AEMO has modified the form of its suspension Market Notices to include the reason for the market suspension, to refer only to trading intervals, and for improved readability. This form has been used for all subsequent market suspensions.

5.2 Re-routing of communication cables

5.2.1 Preliminary report

ElectraNet advised that in-service redundant communication cables would be re-routed away from decommissioned plant to ensure main and backup SCADA systems have different physical paths/cable trays to prevent a similar incident reoccurring.

5.2.2 Final report

ElectraNet has confirmed that in-service redundant communication cables have been re-routed away from decommissioned plant and cables between main and backup SCADA systems have different physical paths/cable trays. This system will remain operable even if cut in the same way as during the market suspension.

Additional actions have been taken to prevent a similar incident occurring. These include:

- Full labelling of communication equipment, including labelling the cabinets, and where cabinets have mixed ownership, labelling individual componentry within cabinets.
- A new change advisory board (CAB) was set up within 2 weeks of the event occurring. Every change is documented by the CAB in regular meetings.
- Cables have been rerouted to ensure upgraded redundant fibres do not share a common path.



5.3 Further investigation of RTU backup system connection failure

5.3.1 Preliminary report

At the time of the preliminary report, ElectraNet had advised that it was investigating why some field RTUs failed to connect to the backup system when both systems were operating as masters, and whether this resulted in suspect data being sent to AEMO.

5.3.2 Final report

ElectraNet advised that field RTUs failed to connect to the backup system when both systems were operating as masters as it is an inherent part of their design. In addition, a firewall issue prevented the RTUs connecting to the backup system. The failure of the RTUs to connect to the backup system resulted in suspect data being sent to AEMO. Further:

- Firewall rules have been updated such that if one communication system is disabled on either path, the redundant communication system can connect.
- The changes to the firewall rules have been formally tested by ElectraNet, in a site shutdown.

5.4 Recommended SCADA system review by all NEM TNSPs

5.4.1 Preliminary report

AEMO recommended that all other TNSPs also review their SCADA systems to ensure that, wherever possible:

- Communication cables between main and backup SCADA systems have different physical paths/cable trays.
- In-service SCADA communication cables are routed away from decommissioned plants.

5.4.2 Final report

AEMO has made this recommendation to TNSPs at a power system security working group meeting following the market suspension. In addition, tools and processes to handle the loss of SCADA and related systems were reviewed in May 2022.