

Preliminary Report: New South Wales market suspension on 17 March 2023

April 2023

A market event report for the
National Electricity Market –
information as at 28/3/2023





Important notice

Purpose

AEMO has prepared this preliminary report as part of its review of the 17 March 2023 New South Wales region market suspension, as a first step in reporting under clauses 3.14.3(c) and (d) and 3.14.4(g) of the National Electricity Rules.

If new information becomes available AEMO will prepare a supplementary report and the observations in this report will be updated as necessary.

Disclaimer

AEMO has been provided with data by Registered Participants as to the performance of some equipment leading up to, during and after the event in accordance with clause 3.14.3(f) of the National Electricity Rules. In addition, AEMO has collated information from its own systems. While AEMO has made reasonable efforts to ensure the quality of the information in this report, investigations may not be complete, and any findings expressed in it may change if further information becomes available and further analysis is conducted. Any views expressed in this report are those of AEMO unless otherwise stated and may be based on information given to AEMO by other persons.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

Copyright

© 2023 Australian Energy Market Operator Limited. The material in this publication may be used in accordance with the [copyright permissions on AEMO's website](#).

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
AGC	Automatic Generation Control
EMMS	Electricity Market Management System
FCAS	Frequency Control Ancillary Service
ICCP	Inter-Control Centre Communications Protocol
LOR	Lack of Reserve
MN	Market Notice
MW	megawatts
NEM	National Electricity Market
NEMDE	National Electricity Market Dispatch Engine
NER	National Electricity Rules
NSW	New South Wales
QNI	Queensland – New South Wales Interconnector
SCADA	Supervisory Control and Data Acquisition
TI	Trading Interval
TNSP	Transmission Network Service Provider
VNI	Victoria – New South Wales Interconnector



Contents

1	Overview	5
2	Pre-event conditions	5
3	Event	5
4	Market notices	12
5	Next steps	12

Tables

Table 1	Sequence of key events on 17 March 2023	5
Table 2	Adjusted spot prices of the first interval of the market suspension (TI 2015)	8
Table 3	Adjusted New South Wales FCAS prices of the first interval of the market suspension (TI 2015)	9
Table 4	Spot price outcomes during market suspension	9
Table 5	Summary of relevant market notices	12

Figures

Figure 1	QNI and VNI targets and flows (MW), New South Wales SCADA outage 17 March 2023	10
----------	--	----

1 Overview

This report relates to a market suspension in New South Wales on 17 March 2023. AEMO is required to report on this event in accordance with clauses 3.14.3(c) and (d) and 3.14.4(g) of the National Electricity Rules (NER).

At approximately 1930 hrs on 17 March 2023, the Inter-Control Centre Communications Protocol (ICCP) link between Transgrid¹ and AEMO failed. As a result, AEMO lost all Supervisory Control and Data Acquisition (SCADA) visibility from Transgrid, notably for all of New South Wales. AEMO subsequently suspended the spot market in New South Wales on 17 March 2023 from 2015 hrs to 2110 hrs.

Based on initial analysis, AEMO believes that the power system remained in a secure operating state throughout the SCADA outage and market suspension, and that no generation or load was lost associated with this incident. During the event New South Wales prices were set using market suspension schedule pricing.

This report provides a summary of the facts relating to the incident as known at 28 March 2023.

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

2 Pre-event conditions

Prior to this incident, Transgrid personnel were carrying out work activities involving interrogation of ICCP data on the Transgrid SCADA ICCP service as AEMO notified Transgrid that recently commissioned ICCP data points were not being received from Transgrid's system. The power system was in a secure operating state; although there had been an actual Lack of Reserve (LOR) level 1 condition earlier in the evening, no LOR conditions existed at the time, and no abnormal risks to the power system had been identified.

3 Event

Table 1 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 and information provided by Transgrid.

Table 1 Sequence of key events on 17 March 2023

Time	Event
1928 hrs	Transgrid personnel performed work involving ICCP data. During these works, one of the two ICCP links between Transgrid and AEMO failed. The Transgrid and AEMO control rooms were not aware of any planned work at this stage.
1930 hrs	Transgrid personnel performed further work involving ICCP data. As a result, the final working ICCP link between Transgrid and AEMO failed. The AEMO control room remained unaware of any planned work.
1933 hrs	AEMO became aware of total loss of SCADA in the New South Wales region and commenced investigations ² .
1937 hrs	AEMO informed all New South Wales generators regarding the New South Wales SCADA failure. New South Wales generators were requested to come to local control and follow 5-minute dispatch targets manually.
1940 hrs	Transgrid advised AEMO that it was not aware of any planned communication link work and had already contacted its SCADA contact to investigate.

¹ Transgrid is a Transmission Network Service Provider (TNSP) for New South Wales.

² This report focuses on the impact of loss of New South Wales SCADA, however there was also interruption of SCADA to Transgrid sites in Victoria (Deer Park substation, Kiamal Solar Farm and Berrybank Wind Farm).

Time	Event
1943 hrs	Transgrid informed AEMO it had no ICCP alarms, however the remote ICCP links were showing in a purple colour (normally green, and red when failed).
1947 hrs	AEMO issued Market Notice (MN) 106783 advising AEMO was experiencing a SCADA service interruption relating to all New South Wales SCADA.
1948 hrs	Transgrid advised AEMO it had dispatched extra personnel to the site.
2000 hrs	Transgrid confirmed to AEMO that it had visibility to certain areas in the New South Wales region. Transgrid also confirmed that the issue was unlikely to be resolved within 10 minutes.
2010 hrs	AEMO declared the electricity market suspended in New South Wales from 2015 hrs, with Market Suspension Schedule Pricing applied (refer NER 3.14.5(b)) from Trading Interval (TI) 2015 hrs on 17 March 2023 until further notice. AEMO issued MN 106784 noting the reason for the suspension was a failure of SCADA systems.
2016 hrs	Transgrid restored both ICCP links to AEMO.
2017 hrs	AEMO's visibility of New South Wales SCADA was restored.
2025 hrs	Transgrid informed AEMO that its SCADA technician performed a switchover to a standby server which restored the ICCP links.
2035 hrs	Transgrid confirmed to AEMO that the incident was unlikely to re-occur.
2042 hrs	AEMO issued MN 106785 declaring that the suspension of the spot market in New South Wales would end at 2110 hrs on 17 March 2023.
2107 hrs	AEMO informed all New South Wales generators that SCADA had been restored and that the New South Wales market would commence at 2110 hrs. AEMO requested all New South Wales generators to return to remote control.
2236 hrs	Transgrid advised AEMO that the issue was caused during ongoing work on the SCADA service and works had ceased, and that further investigations into the cause of the ICCP link failure would commence next day (18 March 2023).

ICCP failure and loss of AEMO SCADA visibility

Based on AEMO's initial investigation and information provided by Transgrid, AEMO understands that human error resulted in New South Wales SCADA failing during ICCP data querying activities conducted by Transgrid personnel on the Transgrid SCADA ICCP service. During the course of the tests, the changes had been intended to apply to the model page and therefore not affect the live system. However, the changes were applied on the runtime (online editor) page instead of the model page. As a result, the changes made during the course of the tests were applied across the live system.

Consequently, at approximately 1928 hrs, one of the two ICCP links between AEMO and Transgrid failed. Transgrid confirmed that no alarms were raised to indicate the ICCP link failure as changes in ICCP status are reported to operators as system events³. As such, Transgrid personnel remained unaware of the issue and continued to work on the runtime (online editor) page instead of the model page which ultimately caused the final working ICCP link to fail at Transgrid's end.

Initial investigations by AEMO and Transgrid have concluded:

- The SCADA system auto-failover behaved as per its design.
- Transgrid had full visibility and control of the New South Wales assets throughout the incident.

³ System events are normally lower priority than alarms and do not require immediate operator action.

- Prior to the event, neither Transgrid nor AEMO's control room personnel were aware of any work taking place on the ICCP service.

Declaration of market suspension

The market suspension was triggered by a loss of New South Wales SCADA visibility at AEMO. AEMO became aware of the SCADA failure at 1933 hrs on 17 March 2023, due to the failure of ICCP links between AEMO and Transgrid.

AEMO assessed that the ongoing lack of SCADA meant it was no longer possible to operate the spot market in New South Wales in accordance with NER 3.8 and 3.9. The Market Suspension and Systems Failure Procedures 3706 (Market Suspension Procedures 3706)⁴ state that if a large number of SCADA points have failed, AEMO will consider suspending the spot market where:

- At least 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.

AEMO issued Market Notice (MN) 106784 at 2010 hrs on 17 March 2023, declaring that:

- The spot market in New South Wales was suspended (refer NER 3.14.5(b)) from Trading Interval (TI) ending 2015 hrs on 17 March 2023 until further notice;
- Market suspension schedule pricing would apply;
- Dispatch prices in New South Wales for the first one or two dispatch intervals of this market suspension would be reviewed manually; and
- The cause of the suspension was a failure of SCADA systems.

MN 106784 complied with NER 3.14.4(a).

Market operation during the market suspension

During the market suspension, generators were able to receive and follow dispatch instructions using AEMO's Electricity Market Management System (EMMS). However, AEMO was unable to receive New South Wales generator SCADA data due to the ICCP failures. In accordance with Market Suspension Procedures 3706, when NEM Dispatch Engine (NEMDE) does not receive a SCADA value for the output of a generating unit at the start of a TI, it uses the dispatch target from the previous interval as the initial megawatts (MW) value for the current interval, thereby assuming all generators are perfectly following their dispatch targets.

During the AEMO SCADA outage, generators in New South Wales connected to the Transgrid SCADA were unable to receive Automatic Generation Control (AGC) signals for regulation Frequency Control Ancillary Service (FCAS) from AEMO via Transgrid. Consequently, regulation FCAS could only be enabled from units not connected to the Transgrid SCADA system.

⁴ 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.

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 market suspension pricing schedule published under NER 3.14.5(e).

As outlined in MN 106784, market suspension schedule pricing was used to set the New South Wales market prices during the market suspension. In accordance with AEMO's published Market Suspension Pricing Methodology⁵, this market suspension pricing schedule is based on a four-week rolling average of historic regional prices, separated into business and non-business days, with a half-hourly resolution⁶.

AEMO is also required to manually review prices for the first one (or in some cases two) intervals during a market suspension that uses market suspension schedule pricing in the suspended region. This is because a declaration of market suspension may be made partway through a TI but will apply from the start of that TI (when the prices for the TI were published). If market suspension schedule pricing is used, the 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 manually⁷.

Manual review also includes checking whether the prices in any other regions require scaling under NER 3.14.5(f). NER 3.14.5(f) applies only to suspended regions connected by one or more regulated interconnectors to a neighbouring region.

AEMO updated the revised New South Wales, Victoria and Queensland prices where manual scaling was required for TI ending 2015 hrs during the market suspension, using the market suspension pricing schedule published on 25 February 2023 and applying to the week beginning 13 March 2023, meeting the NER requirements. This triggered MN 106842 at 1145 hrs on 20 March 2022, advising the market of the revised prices in New South Wales, Queensland and Victoria.

Table 2 Adjusted spot prices of the first interval of the market suspension (TI 2015)

Region	Original price	Adjusted price
NSW	\$254.92	\$119.81
QLD	\$270.00	\$128.22
VIC	\$222.69	\$113.45

Manual adjustment has not only affected spot prices, but also FCAS prices. However, scaling was not applied to other regions, hence Victoria and Queensland FCAS prices remained the same, with no adjustment required.

⁵ See <https://aemo.com.au/-/media/files/electricity/nem/data/mms/estimated-price-methodology-suspension-ner-3-14-5.pdf?la=en&hash=1642CB140EE80C552C341D30443D33F1>.

⁶ See https://www.nemweb.com.au/REPORTS/CURRENT/MKTSUSP_PRICING/.

⁷ 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.

Table 3 Adjusted New South Wales FCAS prices of the first interval of the market suspension (TI 2015)

Market	Original price	Adjusted price
LOWER5MIN	\$0.39	\$0.50
LOWER60SEC	\$0.39	\$0.80
LOWER6SEC	\$0.19	\$0.38
LOWERREG	\$3.98	\$4.14
RAISE5MIN	\$0.69	\$0.62
RAISE60SEC	\$39.00	\$2.36
RAISE6SEC	\$127.88	\$4.90
RAISEREG	\$167.27	\$14.74

New South Wales spot price outcomes resulting from applying the market suspension schedule during the affected TIs were, on average, \$62.41 lower compared to what they would have been, had the market not been suspended. Queensland and Victoria prices were, as a result of the price scaling, \$54.53 and \$45.86 lower on average, respectively.

Table 4 Spot price outcomes during market suspension

Region	Average effective spot price	Average spot price without market suspension and scaling	Average price difference
NSW	\$117.35	\$179.76	\$62.41
QLD	\$134.60	\$189.13	\$54.53
VIC	\$110.75	\$156.62	\$45.86

Interconnector flows during the event

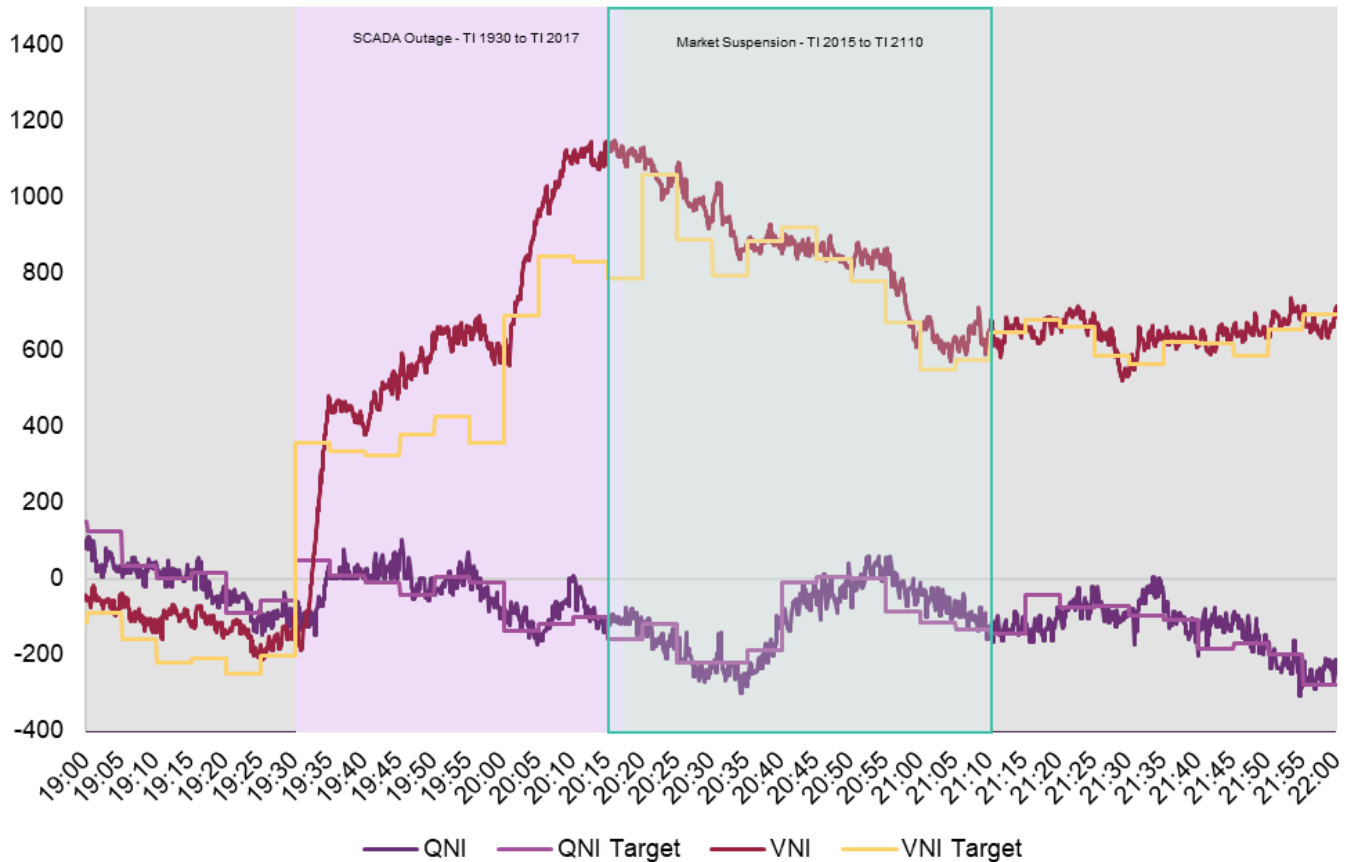
Through this report, AEMO has used data and information available at the time of writing this report. AEMO may conduct further analysis as necessary if and when new data becomes available.

New South Wales remained connected to the rest of the NEM during the event. Interconnectors in the direction of Queensland and Victoria were operating as normal. Deviation of flow on the Queensland – New South Wales Interconnector (QNI) during both the SCADA outage and the market suspension time periods was similar to deviation seen during normal system operations.

Deviations from target were seen on the Victoria – New South Wales Interconnector (VNI) between TI 1930 and TI 2020 as New South Wales was importing from Victoria⁸.

⁸ Behavior of generators in importing region has a greater impact on interconnector flow than generation in exporting region.

Figure 1 QNI and VNI targets and flows (MW), New South Wales SCADA outage 17 March 2023



Power system operation during the market suspension


Initial analysis from Transgrid indicates that the New South Wales power system remained in a secure operating state and the Frequency Operating Standard⁹ (FOS) was met throughout the SCADA outage and market suspension¹⁰. The system frequency monitored at Sydney West were maintained within 49.952-50.044 hertz (Hz) during the incident, consistent with frequency measurements from other mainland NEM locations outside New South Wales. No generation or load was shed or disconnected and there were no unplanned outages of transmission equipment during the New South Wales SCADA failure. Transgrid also confirmed that system voltages remained within acceptable limits.

The NEMDE remained operational, and all the generators in the NEM continued to receive their dispatch targets through EMMS. The failed ICCP links meant that units in New South Wales were unable to receive AGC signals from AEMO via Transgrid. As such, AEMO informed all New South Wales generators regarding the SCADA failure and requested them to come to local control and follow 5-minute targets manually.

As AEMO was unable to monitor system security during the incident, AEMO informed all Transmission Network Service Providers (TNSPs) in the NEM (ElectraNet, TasNetworks, Powerlink, and AusNet) of the SCADA issue in

⁹ See <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF>.

¹⁰ The VNI flow was above target during certain periods of the SCADA outage and Market suspension, and AEMO may conduct further analysis as necessary when new data becomes available.



New South Wales and requested them to monitor power system security and advise of any issues until AEMO could re-establish ICCP links.

AEMO considers the response from participants as adequate and confirms it did not need to take any other action to restore or maintain power system security during the incident.

Restoration of New South Wales SCADA visibility

At approximately 2017 hrs on 17 March 2023, AEMO became aware of the restoration of all New South Wales AEMO SCADA. At 2025 hrs on 17 March 2023, Transgrid confirmed that its SCADA personnel had switched over the server to a stand-by system which resulted in the restoration of Transgrid to AEMO ICCP links, restoring AEMO's SCADA. At approximately 2035 hrs on 17 March 2023, Transgrid confirmed that the New South Wales SCADA failure was unlikely to re-occur, and AEMO confirmed that there were no outstanding issues in the AEMO SCADA system.

Rectification

Following the incident, Transgrid suspended all test work on the SCADA system until the completion of Transgrid's initial review of the incident. In addition, Transgrid has identified several actions that will reduce the likelihood of a re-occurrence of this incident:

- Transgrid has implemented changes to the system which are designed to limit staff ability to navigate to the runtime (online editor) page when running model tests.
- Transgrid has added additional controls on access to the runtime (online editor) screens and additional displays to increase the operator's situational awareness of testing activities and possible ICCP failures.
- Transgrid plans to add functionality to alert SCADA operators of ICCP failures including:
 - A priority 1 alarm for Transgrid operators when ICCP link failure occurs.
 - An ICCP heartbeat display to continually monitor ICCP service status.
- Transgrid plans to review its SCADA auto-failover mechanism and consider whether a dual ICCP link failure should trigger an auto-failover.
- Transgrid is undertaking a broader review of the SCADA system operation and control to identify any additional system controls to be implemented to improve SCADA reliability/availability across the platform more broadly.

Awareness of planned/unplanned works that could affect in-service SCADA equipment can expediate the fault identification and rectification process. AEMO recommends Transgrid review its procedures for working on data communication services and ensure necessary controls are implemented to:

- Advise Transgrid and AEMO control rooms in advance of any work which could impact in-service SCADA systems, and
- Require permission to proceed from both Transgrid and AEMO control rooms before commencing work which could impact in-service SCADA systems.

AEMO recommends that all data communication providers review their SCADA systems and consider implementing suitable alarms and heartbeat displays to alert operators of ICCP link failures.

Resumption of the spot market

At 2038 hrs on 17 March 2023, AEMO confirmed with Transgrid that ICCP connectivity had been restored. In response, AEMO issued MN 106785 at 2042 hrs on 17 March 2023 declaring that the spot market in New South Wales would resume from 2110 hrs (TI ending 2115 hrs) on 17 March 2023. MN 106785 complied with NER 3.14.4(d).

The timing of the restoration of the market aligned with the recommended general principles of timing outlined in Section 10.2(b) of the Market Suspension Procedure 3706. The decision to resume the spot market also complied with Section 10.1 (c) of the same Market Suspension Procedure 3706 that requires AEMO to assess the likelihood of having to suspend the spot market within the next 24 hours due to the same cause. AEMO assessed this likelihood and upon receiving confirmation from Transgrid of ICCP connectivity restoration, deemed it to be minimal.

While AEMO became aware of SCADA restoration approximately two minutes after the market suspension took effect, further confirmation was required from Transgrid that the issue had been fully resolved and appropriate notice had to be given to market participants about the resumption of the spot market.

The practical effect of the timing of these events meant that only two trading intervals (TIs ending 2015 and 2020) were affected by both the SCADA failure and market suspension.

4 Market notices

Table 5 below outlines the relevant market notices AEMO issued for this market suspension.

Table 5 Summary of relevant market notices

MN	Summary of content
106783	AEMO advised of the service interruption relating to all New South Wales SCADA.
106784	AEMO declared the spot market in the New South Wales region suspended with market suspension schedule pricing from TI 2015 hrs on 17 March 2023 until further notice. AEMO noted the reason for the market suspension was the failure of SCADA systems in New South Wales.
106785	AEMO declared that the market suspension in New South Wales would end at 2110 hrs on 17 March 2023.
106842	AEMO confirmed the prices for TI 17 March 2023 2015 hrs.

5 Next steps

- Transgrid to implement the system controls it has identified to monitor the ICCP links and alert the SCADA operators of any ICCP link failure. These controls include:
 - An alarm indicating a priority 1 situation to the operator.
 - An ICCP heartbeat to continually monitor ICCP service state.
- Transgrid plans to review its SCADA auto-failover mechanism and consider whether a dual ICCP link failure should trigger an auto-failover.

- Transgrid is undertaking a broader review of the SCADA system operation and control to identify any additional system controls to be implemented to improve SCADA reliability/availability across the platform more broadly.
- Awareness of planned/unplanned works that could affect in-service SCADA equipment can expediate the fault identification and rectification process. AEMO recommends Transgrid review its procedures for working on data communication services and ensure necessary controls are implemented to:
 - Advise Transgrid and AEMO control rooms in advance of any work which could impact in-service SCADA systems, and
 - Require permission to proceed from both Transgrid and AEMO control rooms before commencing work which could impact in-service SCADA systems..
- When NSPs are carrying out work that could potentially impact the operation of the power system, AEMO recommends:
 - NSPs arrange the work at times where key personnel are available to respond quickly and rectify any issues, and
 - NSPs advise their control rooms and AEMO's control room in advance of this work and seek permission to proceed from the NSP and AEMO control rooms before commencing the work.
- AEMO recommends that data communication providers review their SCADA systems and consider implementing suitable alarms and heartbeat displays to alert operators of ICCP link failures.

AEMO is also required under NER 3.14.3(d) to report the payments made to each Market Suspension Compensation Claimant under the market suspension pricing schedule and on market suspension compensation payments and funding. These details are not expected to be finalised until October 2023, after completion of all routine settlement revisions. AEMO will publish a supplementary report when full and final details of these amounts are available.

If any issues relating to power system security are identified they will be reported on under NER 4.8.15 as necessary.