AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Preliminary Report – Total loss of SCADA systems on 24 January 2021

February 2021

A preliminary operating incident report for the National Electricity Market – information as at 15 February 2021

Important notice

PURPOSE

AEMO has prepared this preliminary report as part of its review of the reviewable operating incident associated with failure of AEMO's SCADA system on 24 January 2021, as a first step in reporting under clause 4.8.15(c) of the National Electricity Rules.

The observations in this report will be updated in AEMO's final operating incident report, where new information becomes available.

DISCLAIMER

AEMO has been provided with preliminary data by Registered Participants as to the performance of some equipment leading up to, during, and after the incident in accordance with clause 4.8.15 of the National Electricity Rules. In addition, AEMO has collated preliminary information from its own systems. Any analysis and conclusions expressed in this document are also preliminary in nature.

While AEMO has made every reasonable effort to ensure the quality of the information in this report, its investigations are incomplete, and the findings expressed in it may change as 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.

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1. Overview

This is a preliminary report on a reviewable operating incident[1] that occurred on 24 January 2021 and impacted all National Electricity Market (NEM) regions. This review is undertaken consistent with clause 6(f) of the Reliability Panel guidelines[2], given the significance of the event.

From approximately 1546 hrs on 24 January, AEMO's internal Supervisory Control and Data Acquisition (SCADA) service failed. AEMO uses the SCADA system to monitor and operate the NEM; SCADA feeds into both the Energy Management Systems (EMS) used to monitor the power system and the Electricity Market Management Systems (EMMS) used to dispatch generating units. See Appendix A1 for more information about these systems.

In accordance with AEMO's internal procedures, transmission network service providers (TNSPs) were requested to monitor the power system and advise AEMO of any issues. Additionally, generating units normally controlled via the Automatic Generation Control (AGC) system were instructed to turn off the AGC and follow the targets provided by the market systems.

Normal operation of SCADA was restored by 1656 hrs on 24 January 2021, and the relevant generating units were returned to normal AGC operation.

Under the NER, AEMO is required to assess the adequacy of the provision and response of facilities and services and the appropriateness of actions taken to restore or maintain power system security following this reviewable operating incident[3].

The NEM operates on Australian Eastern Standard Time (AEST). All times in this report are AEST.

2. Pre-event conditions

Prior to the loss of SCADA, the power system was in a secure operating state, no reserve conditions existed, and no abnormal risks to the power system had been identified.

3. SCADA failure

Preliminary investigations by AEMO have determined the SCADA failure related to a vendor system software bug that initially impacted the standby SCADA servers. This software bug affected the replication process on the active servers to the point where it caused outages with internal SCADA communications processes. This impacted the SCADA servers at both the Brisbane and Sydney control rooms. AEMO initiated discussion with relevant NSPs and Emergency Coordination Teams to effectively respond to the event.

[1] See NER clause 4.8.15(a)(1)(i).

[2] See https://www.aemc.gov.au/sites/default/files/2018-02/Final-revised-guidelines.pdf.

[3] See NER clause 4.8.15(b).

In response to the incident, a software vendor-issued patch has been applied at both sites. AEMO will continue to review the causes of the SCADA failure and methods to prevent a recurrence of this type of event and will provide more information in a subsequent report.

4. Power system impact

Although the failure of SCADA is an uncommon event, AEMO has procedures to manage the situation.

The strategy adopted by AEMO during this SCADA failure was to continue to dispatch generating units via dispatch targets from the National Electricity Market Dispatch Engine (NEMDE). Power system parameters including interconnector transfers, frequency and voltage levels were monitored via consultation with TNSPs[4] to establish if any significant errors existed between dispatch and actual power system conditions.

Errors outside of acceptable margins may have resulted in a requirement to suspend the operation of the market, under AEMO's Failure of Market or Market Systems procedure[5]. However, errors as assessed at the time were not outside the required margins and market suspension was not warranted.

Observations during the incident and initial post event analysis shows that the system remained in a secure operating state.

Frequency in the Mainland NEM remained within the normal operating frequency band (NOFB) for the majority of the duration of the SCADA failure. There were minor short term deviations above 50.15 hertz (Hz) towards the end of the SCADA outage.

The Tasmanian frequency briefly fell below the lower limit of the normal operating band (49.85 Hz) on two occasions and briefly rose above the upper limit (50.15 Hz) on two occasions[6].

These frequency deviations did not create any significant issues.

Initial analysis indicates maintenance of frequency within the NOFB was assisted by the primary frequency control provided by governors whose settings have been recently modified as part of the Primary Frequency Response (PFR) project. Further analysis will be undertaken to confirm the impact of the PFR enabled generators on power system frequency.

The only major power system incident that occurred during the SCADA outage occurred at 1643 hrs on 24 January 2021, just prior to the restoration of the SCADA. This involved the trip of two 275 kilovolt (kV) lines and a 132 kV line in South Australia[7]. At the time, ElectraNet[8] was monitoring the power system and conducting regular contingency analysis. If this event had resulted in the need for AEMO to issue directions to generating units to manage power flows, this would have resulted in suspension of the market. This event will be the subject of a separate incident event report.

[4] The TNSPs' SCADA systems were operational, however peripheral SCADA they receive from AEMO was impacted.

[5] SO_OP_3706 available on AEMO's website, at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures.

[6] The maximum frequency in Tasmania during this period was 50.2 Hz and the minimum frequency was 49.15 Hz.

[7] AEMO issued Market Notice 82348 at 1829 hrs on 24 January to advise the market of this non-credible contingency event.

[8] ElectraNet is the TNSP for South Australia.

5. Market impact

The central dispatch process including NEMDE operated throughout the interruption of SCADA data. As a general rule, NEMDE will use either the last good value received from the SCADA system or targets from the previous dispatch interval as the initial active power setpoint for the next interval.

However, initial post-event analysis suggests that, at times during the event, some inputs to NEMDE from the EMS database appear to have been updated.

As a result of the SCADA failure, AEMO's AGC system was not sending controls to generators, and all AGC-enabled generating units were requested to come off AGC and follow market targets manually. As no generating units were enabled for AGC, no regulation raise and lower frequency control ancillary service (FCAS) was dispatched for the duration of the SCADA outage. During the SCADA outage in a subset of intervals some generators appeared to be available on AGC, the reason for this will be investigated. Contingency FCAS continued to be enabled.

Initial review indicates that the central dispatch process used demand forecast data throughout the incident, based on historic demand profiles used in 5-minute pre-dispatch process and the initial region supply from the previous dispatch interval.

The notable pricing and dispatch issues identified during the incident were:

- A price spike in Queensland to $2,173 and $15,000 per megawatt hour (MWh) for Dispatch Intervals ending 16:35 hrs and 16:40 hrs respectively. This was associated with the violation of a network constraint in Central Queensland which appears to have been affected by the failure of the SCADA data.
- Significant rises in prices for lower and raise regulation in the period 16:15 hrs to 16:50 hrs.

The performance of AEMO's 5-minute forecasts for renewable generation was impacted as actual megawatt (MW) data was only available intermittently. The other SCADA inputs (for example, wind speed and irradiance) were also flagged as suspect quality intermittently during the event, but the impact of this to the dispatch forecasts appears to have been minimal.

Initial review indicates that 5-minute semi-scheduled generation forecasting provided by participants under the self-forecasting arrangements was not impacted.

There appears to have been minimal impact on pre-dispatch and short-term projected assessment of system adequacy (ST PASA) forecasts.

6. Advice to the market

Two Market Notices were issued regarding this event:

- Market Notice 82330 was issued at 1633 hrs on 24 January to advise the market of the SCADA issues.
- Market Notice 82340 was issued at 1708 hrs on 24 January to advise the market the SCADA issue had been resolved.

AEMO will further consider and report in the final report if the above information was sufficiently accurate and timely.

7. Conclusions and next steps

Following the SCADA failure, AEMO has applied a software patch at both the Brisbane and Sydney control room sites, and has configured additional monitoring and automated alerts to help mitigate the potential for re-occurrence.

AEMO will continue its investigation into how each relevant component of the NEM market and operational systems responded throughout this event.

AEMO intends to further investigate and report on:

- The cause of the SCADA failure and the immediate actions taken to resolve the issue.
- Any further changes that may be required to prevent software bugs impacting AEMO's SCADA systems.
- The impact on the power system and whether the power system remained in a secure operating state.
- The impact on the market, including a review of pricing outcomes, the impact on the demand forecast process, the impact on constraint equations, and the performance of the 5-minute forecasts for renewable generation.
- The impact of primary frequency response on power system frequency performance.
- The provision of information to the market.
- The application of procedures associated with market suspension.

AEMO will include any additional findings in its final report on this event.

A1. SCADA, EMS, and EMMS Systems

A1.1 Summary of SCADA/EMS Environment

SCADA control system architectures are widely used to manage process and operational systems. In the context of the NEM, SCADA information is sourced from field devices and updated approximately every four seconds and input into operational systems and displays for use by operational staff. AEMO does not source SCADA information directly from the field devices, but rather from the asset owners, such as NSPs. The asset owners' SCADA systems were not impacted by the failure of AEMO's SCADA systems.

The AEMO SCADA/EMS environment consists of eight servers located over two sites. At any one time, two of these servers are active, with the remainder available on standby. The standby servers are kept in synchronism with the active servers via an automated copying process. This environment and copying process facilitates backup and redundancy across the separate sites and servers.

A1.2 Energy Management System (EMS)

The EMS displays the status of the power system – including line flows, system voltages and frequency and equipment status – and provides real-time analysis tools for AEMO control room staff, to monitor and asses the status of the power system. The SCADA is also used in a number of power system analysis tools used to assist in ensuring the power system remains in a secure operating state. The EMS requires SCADA to update in a timely fashion with the correct information, otherwise the information it displays may not accurately represent the status of the power system.

A1.3 Electricity Market Management System (EMMS)

The EMMS calculates the dispatch level of generators and interconnectors, and regional energy and FCAS prices on a 5-minute dispatch interval basis. The EMMS also provides pre-dispatch (or forecast dispatch outcomes) and reserve levels for up to the next 24 hours. SCADA information is one of the major inputs to these processes.