
Trip of the No. 1 Transformer and
No. 2 Static Var Compensator at
South East substation on
20 June 2019

November 2019

Reviewable Operating Incident Report under the
National Electricity Rules

INCIDENT CLASSIFICATIONS

Classification	Detail
Time and date of incident	0747 hrs on 20 June 2019
Region of incident	South Australia
Affected regions	South Australia
Event type	Control system failure
Generation impact	No generation was disconnected as a result of this incident
Customer load impact	No customer load was disconnected as a result of this incident
Associated reports	AEMO, <i>Simultaneous Trip of South East No. 1 And No. 2 275 kV SVCs on 31 July 2017</i> , published September 2017; and AEMO, <i>Trip of South East Substation No. 1 And No. 2 275 kV SVCs on 23 April 2016</i> , published July 2016, at https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notice-and-events/Power-System-Operating-Incident-Reports .

ABBREVIATIONS

Abbreviation	Term
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	Circuit Breaker
HV	High voltage
kV	Kilovolt
NEM	National Electricity Market
NER	National Electricity Rules
SVC	Static Var Compensator
TNSP	Transmission Network Service Provider

Important notice

PURPOSE

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

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1. Overview

This report relates to a reviewable operating incident¹ that occurred on 20 June 2019 in South Australia. The incident involved the near simultaneous trip of the No. 1 275/132 kilovolt (kV) Transformer (Transformer 1) and No. 2 Static Var Compensator (SVC 2) at the South East substation.

There was no loss of generation or customer load as a result of this incident.

As this was a reviewable operating incident, 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 security².

AEMO has concluded that:

1. The trip of Transformer 1 was due to low oil levels resulting from the low ambient temperature in the area. All protection operated as expected.
2. The trip of SVC 2 was due to the loss of the 415 V supply to the SVC cooling system resulting from the failure of the 415 volt (V) supply auto-changeover system after the loss of Transformer 1.
3. ElectraNet has not yet identified the cause of the failure of the auto-changeover system for SVC 2, and consequently has disabled the auto-changeover switch (C/O switch 4) pending further investigation/maintenance.
4. In response to this and similar recent incidents, ElectraNet has commenced a project to modify the 415 V supply to the SVCs to reduce the likelihood of future events of this kind. This work is expected to be completed by mid-2020.
5. The power system remained in a secure operating state over the course of this incident.

This report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It is based on information provided by ElectraNet³ and AEMO.

National Electricity Market (NEM) time (Australian Eastern Standard Time [AEST]) is used in this report. At the time of this incident, the local time in South Australia was AEST minus 30 minutes.

2. The incident

2.1 The incident

At 0747 hrs on 20 June 2019, Transformer 1 and SVC 2 tripped near simultaneously. There was no high voltage fault on the power system.

The SVC 2 and the Transformer 1 were returned to service at 0851 hrs and 1336 hrs respectively on 20 June 2019.

¹ See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² See NER clause 4.8.15(b).

³ElectraNet is a Transmission Network Service Provider (TNSP) in South Australia.

2.2 ElectraNet investigation

The following is based on information provided by ElectraNet.

At 0703 hrs on 20 June 2019, a Transformer 1 Buchholz alarm was received at the ElectraNet control room and staff were dispatched to the South East substation to investigate. At 07:47:29 hrs, approximately four minutes after staff arrived at South East, Transformer 1 tripped. Investigations showed the trip was due to operation of the Buchholz protection due to low oil level in the transformer. Operation of the Buchholz protection is an expected outcome for low oil levels. The low oil level resulted from low temperatures in the area⁴.

Transformer 1 was returned to service at 1336 hrs on 20 June 2019 after additional oil had been added to the transformer.

At 07:47:34 hrs on 20 June 2019, SVC 2 tripped due to loss of the 415 V supply to the cooling system for SVC 2. Continuous 415 V supply to the SVC cooling system is critical to SVC operation. An interruption to the 415 V supply for longer than approximately six seconds will result in the trip of the SVC.

The 415 V supply to the SVCs is described in Appendix A. In this instance, the primary 415 V supply was from the Transformer 1 tertiary winding. On the loss of Transformer 1, the 415 V supply for SVC 1 successfully switched over to the Standby Supply, but the auto-changeover switch (C/O switch 4) for SVC 2 failed to correctly switch back to the Essential bus, resulting in a loss of 415 V supply to SVC 2 and subsequent tripping of SVC 2 due to loss of cooling.

SVC 2 was returned to service at 0850 hrs on 20 June 2019 after supply was restored to the cooling system. ElectraNet has not yet established the reason for the failure of the change-over process for SVC 2.

Consequently, ElectraNet has advised it has disabled the auto-changeover for SVC 2 (C/O switch 4) so it will remain permanently connected to the Essential bus. This configuration will remain until maintenance can restore the normal functionality of the auto-changeover scheme.

AEMO notes that similar incidents occurred in July 2017 and April 2016, where SVCs at South East tripped due to a failure of the 415 V supply change-over process⁵.

ElectraNet has advised there is a project underway to modify the 415 V supply to the South East SVCs. When the project is complete, the 415 V supply to the South East SVCs will be derived from auxiliary transformers connected to the South East North and South 275 kV busbars. This will fundamentally change the risk of losing the normal supply to the SVCs. Supply loss that results in operation of the voltage changeover to select an alternative source will then only occur for busbar faults or busbar outages, which will be less likely to occur than a transformer outage. In addition, each SVC will have its main supply selected to a different busbar transformer, such that loss of a bus will affect one SVC only, and the other SVC will remain supplied via its "normal" connection from the unaffected busbar. This project is due to be complete by mid-2020.

⁴ The minimum temperature at the Mount Gambier airport on 20/6/19 was -1.0 degrees. This was the lowest morning temperature to date for the current winter. (Sourced from Bureau of Meteorology)

⁵ See AEMO, *Simultaneous Trip of South East No. 1 And No. 2 275 kV SVCs on 31 July 2017*, published September 2017; and AEMO, *Trip of South East Substation No. 1 And No. 2 275 kV SVCs on 23 April 2016*, published July 2016, at <https://aemo.com.au/Electricity/National-Electricity-Market-NEM/Market-notice-and-events/Power-System-Operating-Incident-Reports>

3. Power system security

AEMO is responsible for power system security in the NEM. This means AEMO is required to operate the power system in a secure operating state to the extent practicable and take all reasonable actions to return the power system to a secure state following a contingency event in accordance with the NER⁶.

The power system was in a secure operating state prior to this incident and remained in a secure operating state for the duration of the incident.

AEMO was not required to take any actions in relation to power system security for this incident, apart from invoking constraint sets S-SE_VC1⁷ and S-SE_TX-1⁸ at 0755 hrs on 20 June 2019. The constraint sets were revoked at 0900 hrs and 1340 hrs respectively on 20 June 2019 when the relevant plant had been returned to service.

3.1 Reclassification

AEMO assessed whether to reclassify this incident as a credible contingency event⁹.

ElectraNet procedures require that during the outage of either of the 275/132 kV transformers at South East, the trip of the remaining transformer and both SVCs should be reclassified as a credible contingency event. This is because the loss of the second transformer may also result in the loss of the standby supply feeder to the SVC 415 V supply boards, resulting in a loss of supply to the SVC cooling system and subsequent loss of the SVCs.

At 0826 hrs on 20 June 2019, AEMO reclassified the simultaneous loss of Transformer 2 and SVC 1 at South East as a credible contingency. At 0909 hrs on 20 June 2019, this reclassification was updated to include SVC 2. The reclassification was cancelled at 1412 hrs on 20 June 2019, after Transformer 1 was returned to service.

As ElectraNet had not yet established and resolved the cause of the failure of the 415 V supply change-over process, AEMO reclassified the loss of either one of the transformers and either one of the SVCs at South East as a credible contingency at 1419 hrs on 20 June 2019. This reclassification will remain in place until AEMO is confident the issue has been resolved. No constraint sets are required to be invoked as a result of this reclassification.

4. Market information

AEMO is required by the NER and operating procedures to inform the market about incidents as they progress. This section assesses how AEMO informed the market¹⁰ over the course of this incident.

For this incident, AEMO informed the market on the following matters:

⁶ Refer to AEMO's functions in section 49 of the National Electricity Law and the power system security principles in clause 4.2.6 of the NER.

⁷ Out = either one of the SVC at South East

⁸ Out = either one of the 275/132kV transformers at South East

⁹ AEMO is required to assess whether to reclassify a non-credible contingency event as a credible contingency event – NER clause 4.2.3A(c) – and to report how the reclassification criteria were applied – NER clause 4.8.15(ca).

¹⁰ AEMO generally informs the market about operating incidents as the progress by issuing Market Notices – see <https://www.aemo.com.au/Market-Notices>.

1. A non-credible contingency event – notify within two hours of the event¹¹.
 - AEMO issued Market Notice 68802 at 0808 hrs on 20 June 2019, 21 minutes after the event, to advise of the non-credible contingency event.
2. Reclassification, details, and cancellation of a non-credible contingency – notify as soon as practical¹².
 - AEMO issued Market Notice 68804 at 0826 hrs on 20 June 2019 to advise that AEMO had reclassified the loss of the 275/132 kV Transformer 2 and the SVC 1 at South East as a credible contingency.
 - AEMO issued Market Notice 68805 at 0909 hrs on 20 June 2019 to advise that AEMO had reclassified the loss of the 275/132kV Transformer 2 and both SVCs at South East as a credible contingency.
 - AEMO issued Market Notice 68808 at 1412 hrs on 20 June 2019 cancelling the reclassification at South East.
 - AEMO issued Market Notice 68810 at 1419 hrs on 20 July to advise that AEMO had reclassified the loss of either of the two 275/132 kV transformers and either of the two SVCs at South East as a credible contingency.
3. Inter-regional transfer limit variations¹³.
 - AEMO issued Market Notice 68803 at 0816 hrs on 20 July to advise that constraint set S-SE_VC1 had been invoked.

5. Conclusions

AEMO has assessed this incident in accordance with clause 4.8.15(b) of the NER. In particular, AEMO has assessed the adequacy of the provision and response of facilities or services, and the appropriateness of actions taken to restore or maintain power system security.

AEMO has concluded that:

1. The trip of Transformer 1 was due to low oil levels resulting from the low ambient temperature in the area. All protection operated as expected.
2. The trip of SVC 2 was due to the loss of the 415 V supply to the SVC cooling system resulting from the failure of the 415 V supply auto-changeover system after the loss of Transformer 1.
3. ElectraNet has not yet identified the cause of the failure of the auto-changeover system for SVC 2 and consequently has disabled the auto-changeover switch (C/O switch 4) pending further investigation/maintenance.
4. In response to this and similar recent incidents, ElectraNet has commenced a project to modify the 415 V supply to the SVCs to reduce the likelihood of future events of this kind. This work is expected to be completed by mid-2020.
5. The power system remained in a secure operating state over the course of this incident.

¹¹ AEMO is required to notify the Market of a non-credible contingency event within two hours of the event – AEMO, Power System Security Guidelines, Section 10.3, available at [SO_OP3715 Power System Security Guidelines](#).

¹² AEMO is required to notify the market of a reclassification – NER clause 4.2.3(g), details of the reclassification – 4.2.3(c), and when AEMO cancels the reclassification – 4.2.3(h).

¹³ Refer Section 22 of the AEMO Power System Security Guidelines: [SO_OP3715 Power System Security Guidelines](#).

APPENDIX A. SVC 415 V AUXILIARY SUPPLIES

South East substation SVCs 1 and 2 require a 415 V supply to maintain water cooling to the thyristor valves. If the 415 V supply to the cooling system pumps is interrupted for greater than six seconds, the SVCs are tripped.

The essential and non-essential boards are normally fed from No. 1 Transformer. Manual changeover to No. 2 Transformer is available via switch 89AC.

On loss of supply from No. 1 Transformer, the essential and non-essential boards auto-changeover (C/O switch 1) to the standby supply fed from the local 11 kV distribution network. This takes approximately two seconds.

During this changeover period, SVCs 1 and 2 auto-changeover from the essential to the non-essential board via C/O switches 3 and 4.

On restoration of supply via the standby supply, the SVCs then auto-changeover back to the essential board.

If normal and standby supplies fail, a standby generator is started automatically, and this will restore essential 415 V supplies to site, via changeover switch C/O 2. The diesel generator normally takes longer than six seconds to start, and cannot be relied on to maintain supply to the SVC cooling systems.

Figure 1 South East Substation 415 V supply

