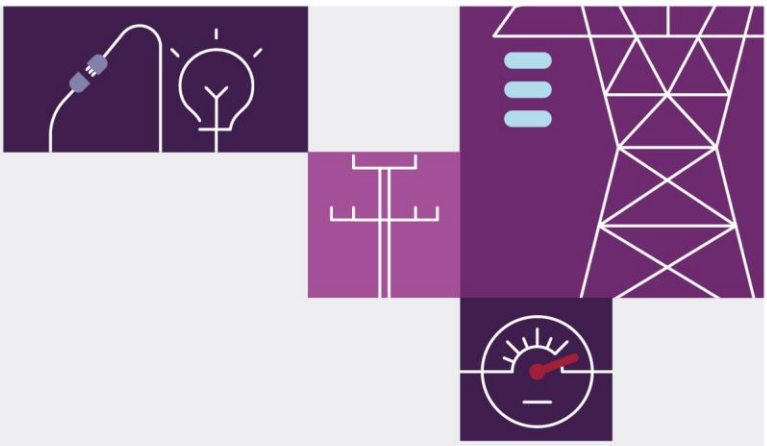
Trip of South East Substation No. 1 and No. 2 Static Var Compensators

March 2022

Reviewable Operating Incident Report under the National Electricity Rules



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.

Disclaimer

AEMO has made every reasonable effort to ensure the quality of the information in this report but cannot guarantee its accuracy or completeness. Any views expressed in this report may be based on information given to AEMO by other persons.

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Contact

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

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

Abbreviations

Abbreviation	Term
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	Circuit breaker
kV	Kilovolt
LV	Low voltage
NEM	National Electricity Market
NER	National Electricity Rules
SVS	Static Var Compensator
TNSP	Transmission Network Service Provider

Incident review

This reviewable operating incident[1] report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It has been prepared using information provided by ElectraNet[2] and from AEMO systems.

Table 1 Summary of event – Trip of South East 275 kilovolt (kV) No. 1 and No. 2 275 kV Static Var Compensators (SVCs)

	Details
Reviewable operating incident type	Non-credible contingency event impacting critical transmission elements.
Incident details	This report relates to a reviewable operating incident[3] that occurred on 22 September 2021 in South Australia. The incident involved the simultaneous trip of the South East 275 kV No. 1 and No. 2 SVCs.
Incident classification	Protection/Control system mal-operation
Generation impact	Nil
Customer load impact	Nil
Pre-incident conditions	Prior to the event, ElectraNet staff onsite at South East were carrying out switching in order to isolate South East Transformer 1 (TF1) to allow the South East 132 kV East Bus to be isolated. Circuit Breakers 6160, 6161, 6187 and 8030, had already been opened as part of this switching process leaving TF1 connected to the power system via Circuit Breaker 6618 (CB6618) alone. At this time, South East No.1 and No.2 SVC's 415 V supplies were being supplied from the TF1 auxiliary supply.
Incident key events	1. At 1133 hrs on 22 September 2021 the ElectraNet control room opened CB6618 remotely, disconnecting South East TF1 from the power system. 2. Approximately 5 seconds later, at 1134 hrs, the South East No.1 and No.2 SVCs tripped. 3. South East No.1 and No.2 SVCs were returned to service at 1218 hrs and 1230 hrs respectively.
Incident cause	ElectraNet was carrying out switching to isolate the South East 132 kV East busbar, to allow insulator cleaning of the South East 132 kV East busbar Voltage Transformer (VT). As part of this isolation process, ElectraNet de-energised the South East TF1 by opening CB6618. As 415 V supplies to both SVCs were being provided by TF1 at the time, the auto changeover system was expected to have automatically switched the 415 V supplies to South East Transformer 2's (TF2's) auxiliary supply. However, after approximately 5 seconds, the 415 V supplies had not switched supplies to the South East TF2. Subsequently, the No.1 and No. 2 SVCs' cooling system trip protection operated. This cooling system trip protection operated in line with its settings and tripped the 275 kV CBs associated with the South East No.1 and No.2 SVCs. Post incident investigation by ElectraNet has confirmed that prior to this incident, several auto changeovers relays had experienced failure which caused both South East SVCs to be supplied from TF1. These relay failures also meant that the 415 V auto changeover system was unable to switch supplies to TF2 when required to do so. ElectraNet was unaware of these relay failures prior to this incident.
Power system response (facilities and services)	There have been two previous non-credible contingencies at South East Substation which included South East SVC trips due to auxiliary supply failures[4]. These previous events occurred prior to 2020, when a new South East Substation 415 V supply changeover system, including additional transformer supplies, was installed on site. Due to the change in SVC auxiliary supplies, no significant similarities were identified between this incident and the previous events.

[1] Reviewable operating incidents are defined by NER clause 4.8.15(a) and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

[2] ElectraNet is a Transmission Network Service Provider (TNSP) for South East Substation.

[3] 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.

[4] See https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2016/trip-of-south-east-substation-no1-and-no2-275kv-svcs-on-23-april-2016.pdf and https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2017/simultaneous-trip-of-south-east-no1andno2-s75-kv-svcs.pdf?la=en&hash=8CC282943A7C4D38A68C7A843A2C7A73.

	Details
Rectification	To avoid a reoccurrence of this incident, ElectraNet has connected the AC supply for each South East SVC to separate transformer auxiliary supplies through re-configuration of the changeover boards. The changeover circuit breakers impacted have been left in manual mode (preventing any automatic changeovers). ElectraNet has confirmed that its control room has been advised of the affected AC changeover circuit breakers, ElectraNet has also reconfigured SVC power supply so the SVCs will remain in service following transformer trip. During its investigation, ElectraNet was made aware of a manufacturer equipment recall on several low voltage (LV) circuit breakers installed in the AC changeover boards at South East substation involved in this incident. This recall highlighted that one failure mode causes the affected circuit breakers not to operate when required. ElectraNet is planning to replace the affected LV circuit breakers at South East 275 kV substation but has not determined a timeframe for completion of this work at this stage. ElectraNet have confirmed that the affected circuit breakers are not present on transmission equipment/equipment LV supplies elsewhere in their network.
Power system security	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard[5] was met for this incident.
Reclassification	AEMO assessed whether to reclassify this incident as a credible contingency event[6]. At the time of the incident ElectraNet could not determine the cause of the incident, therefore AEMO correctly reclassified this incident as a credible contingency from 1229 hrs on 22 September 2021. This reclassification was cancelled at 1935 hrs on 22 September 2021 as ElectraNet had identified the cause of the incident and determined that it was unlikely to re-occur.
Market information	For this incident, AEMO issued the following market notices (all market notices for this incident were issued in accordance with NER requirements): • AEMO issued Market Notice MN90950 at 1201 hrs on 22 September 2021 to advise the market of the non-credible contingency event involving the simultaneous trip of No. 1 and No. 2 275 kV SVCs at South East Substation. • AEMO issued Market Notice MN90965 at 1306 hrs on 22 September 2021 to advise that this incident had been reclassified as a credible contingency from 1229 hrs until further notice. The cause of the incident was unknown and AEMO was not satisfied that the non-credible contingency event was unlikely to re-occur. • AEMO issued Market Notice MN90951 at 1946 hrs on 22 September 2021 to advise that the reclassification of this incident as a credible contingency had been cancelled from 1935 hrs on 22 September 2021.
Conclusions	AEMO has concluded that: 1. The No. 1 and No. 2 275 kV South East SVCs were simultaneously tripped due to defects in the South East automatic changeover system which resulted in an unexpected loss of 415 V AC supply. 2. The rectification of the incident involved the separation of the AC supply for the SVCs through re-configuration of the changeover boards and the affected AC changeover CBs being left in the manual mode. ElectraNet has confirmed that the LV CBs in changeover boards have been re-configured such that this incident will not re-occur and has advised its control room of this arrangement. In addition, ElectraNet has confirmed that the affected circuit breakers are not present on transmission equipment/equipment LV supplies elsewhere in its network. 3. AEMO correctly identified the need to reclassify this incident as a credible contingency, as at the time of the incident the cause was unknown. Subsequently ElectraNet identified the incident cause and determined the incident was unlikely to re-occur. AEMO subsequently cancelled the reclassification. 4. The power system remained in a secure operating state and the Frequency Operating Standard was met during the incident.
Recommendations	1. ElectraNet to replace LV circuit breakers affected by manufacturers recall at South East substation. 2. ElectraNet to share details of the manufacturers LV circuit breaker recall with the Power System Security Working Group.

[5] Please see https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF.

[6] AEMO is required to assess whether or not 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).

Figure 1 Incident diagram – Network representation immediately prior to the incident

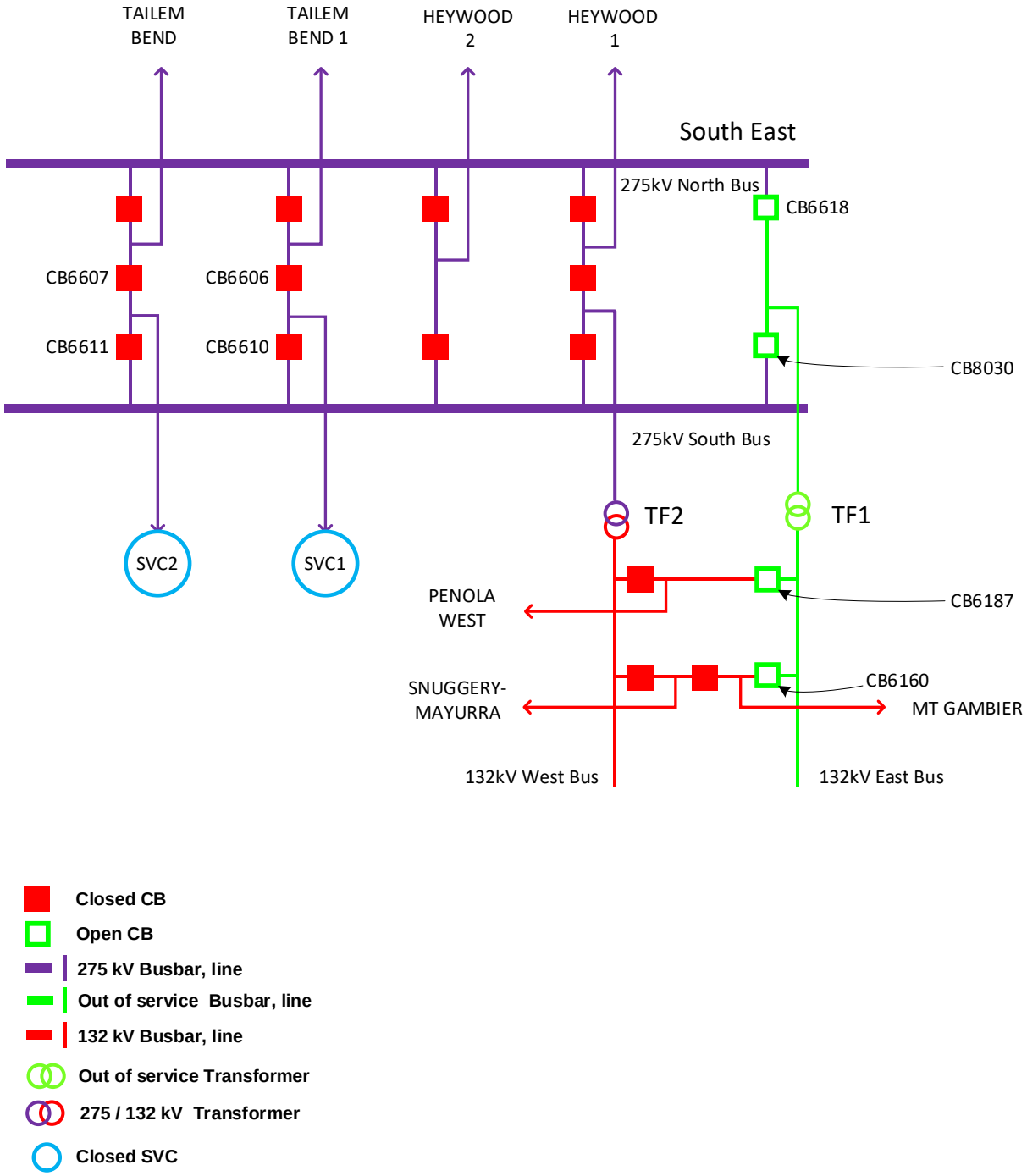

Figure 2 Incident diagram - Network representation immediately following the incident