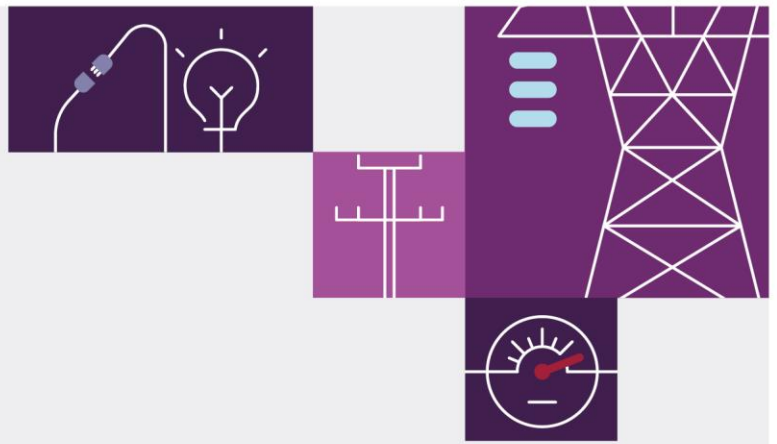


# Trip of South East No. 1 and No. 2 SVC on 23 March 2023

August 2023

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

To inform its review and the findings expressed in this report, AEMO has been provided with data by registered participants as to the status or response of some facilities before, during and after the reviewable incident, and has also collated information from its own observations, records and systems. 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. AEMO has made reasonable efforts 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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If you have any questions or comments in relation to this report, please contact AEMO at [system.incident@aemo.com.au](mailto: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
AC	alternating current
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CB	circuit breaker
kV	kilovolt/s
LV	low voltage
MSP	maintenance service provider
MN	market notice
NEM	National Electricity Market
NER	National Electricity Rules
PVT	power voltage transformer
SVC	static volt-ampere reactive compensator
TF1	transformer 1
TF2	transformer 2
TF4	transformer 4
TF5	transformer 5
TNSP	Transmission Network Service Provider
V	volt/s

# Incident review

This reviewable operating incident<sup>1</sup> 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<sup>2</sup> and from AEMO systems.

**Table 1 Summary of event**

Details	
<b>Reviewable operating incident type</b>	Non-credible contingency event impacting critical transmission elements.
<b>Incident details</b>	This report relates to a reviewable operating incident <sup>3</sup> that occurred on 23 March 2023 in South Australia. The incident involved the simultaneous trip of South East 275 kilovolt (kV) No. 1 and No. 2 static volt-ampere reactive compensators (SVCs) at 1113 hrs, and subsequent trip at 1949 hrs.
<b>Incident classification</b>	Procedural error/lack of procedure – Cooling system supply to South East 275 kV SVC No. 1 and No. 2 from low voltage (LV) 415 V (volts) changeover boards were left in incorrect configuration when it was last modified on 22 September 2021.
<b>Generation impact</b>	No generation was lost as a result of this incident.
<b>Customer load impact</b>	No load was lost as a result of this incident.
<b>Previous incidents</b>	<p>There have been three previous non-credible contingencies at South East Substation which included South East 275 kV SVC No. 1 and No. 2 trips due to auxiliary supply failures:</p> <ul style="list-style-type: none"> <li>Two events occurred prior to 2020<sup>4,5</sup>. A new 415 V supply changeover system at South East Substation, including additional transformer supplies, was installed on site after these events in 2020. Due to the change in SVCs auxiliary supplies, no significant similarities were identified between the current incident and these incidents.</li> <li>On 22 September 2021<sup>6</sup> South East 275 kV SVC No. 1 and No. 2 simultaneously tripped when ElectraNet was carrying out switching to isolate the South East 132 kV East busbar. At that time 415 V auxiliary supplies of to both SVCs were unexpectedly being provided by transformer 1 (TF1). After approximately 5 seconds when TF1 was isolated, South East 275 kV SVC No. 1 and No. 2 cooling system protection operated. Following the 22 September 2021 incident, investigations by ElectraNet confirmed that several auto changeovers relays had failed which caused both South East 275 kV SVC No. 1 and No. 2 to be supplied from TF1. Following this event and prior to full testing of the repaired changeover system, the changeover supplies were configured in a manner which ElectraNet believed was secure – one SVC auxiliary supply fed from TF1/transformer 2 (TF2) source, and the second SVC auxiliary supply fed from transformer 4 (TF4).</li> </ul>
<b>Pre-incident conditions</b>	<ul style="list-style-type: none"> <li>Prior to this event, ElectraNet's maintenance service provider (MSP) staff were onsite at South East substation carrying out planned switching to isolate South East TF1. Circuit breaker (CB) 6187 and CB 8030 had already been opened as part of this switching process, leaving TF1 connected to the power system via CB 6618.</li> <li>ElectraNet believed that the South East 275 kV SVC No. 1 and No. 2 supply 1 was supplied from auxiliary supply of TF4 and SVC No. 1 and No. 2 supply 2 was supplied from the main AC changeover board fed from auxiliary supply of TF1/TF2 (see blue arrow in Figure 3). However, at this time, South East 275 kV SVC No. 1 and No. 2 supply 1 and supply 2 were being sourced from the auxiliary supply of TF1. Unexpectedly, the TF4 415 V source was not supplying SVC No. 1 and No. 2 supply 1.</li> <li>Additionally, the South East – Mt Gambier 132 kV transmission line was out of service (see Figure 1).</li> </ul>

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

<sup>2</sup> ElectraNet Pty Limited is the Transmission Network Service Provider (TNSP) for South Australia.

<sup>3</sup> 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.

<sup>4</sup> 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](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).

<sup>5</sup> See [https://aemo.com.au/-/media/files/electricity/nem/market\\_notices\\_and\\_events/power\\_system\\_incident\\_reports/2017/simultaneous-trip-of-south-east-no1-and-no2-s75-kv-svcs.pdf?la=en](https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2017/simultaneous-trip-of-south-east-no1-and-no2-s75-kv-svcs.pdf?la=en).

<sup>6</sup> See [https://aemo.com.au/-/media/files/electricity/nem/market\\_notices\\_and\\_events/power\\_system\\_incident\\_reports/2021/trip-of-south-east-substation-no-1-and-no-2-static-var-compensators.pdf?la=en](https://aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2021/trip-of-south-east-substation-no-1-and-no-2-static-var-compensators.pdf?la=en).

Details	
<b>Incident key events</b>	<ul style="list-style-type: none"> <li>At 1112 hrs on 23 March 2023, planned switching began to isolate the South East 275/132 kV TF1.</li> <li>At 1113 hrs on 23 March 2023, CB 618 opened which deenergised the South East 275/132 kV TF1, and approximately 7 seconds later South East 275 kV SVC No. 1 and No. 2 tripped.</li> <li>At 1155 hrs on 23 March 2023, AEMO reclassified the simultaneous trip of South East 275 kV SVC No. 1 and No. 2 as a credible contingency event.</li> <li>At 1157 hrs on 23 March 2023, South East SVC No. 1 and No. 2 were returned to service.</li> <li>At 1950 hrs on 23 March 2023, during the preparation for re-energisation of TF1, South East 275 kV SVC No. 1 and No. 2 again tripped.</li> <li>At 2028 hrs on 23 March 2023, South East 275 kV SVC No. 1 and No. 2 were returned to service.</li> </ul>
<b>Incident cause</b>	<p><b>South East 275 kV SVC No. 1 and No. 2 trip at 1113 hrs on 23 March 2023</b></p> <p>At 1113 hrs on 23 March 2023, ElectraNet was isolating the South East TF1 for maintenance. ElectraNet believed that the AC changeover board was configured such that de-energising South East TF1 would not interrupt both South East 275 kV SVC No. 1 and No. 2 LV supplies (as shown by the blue arrow in Figure 3).</p> <p>Post incident investigation by ElectraNet identified that the AC changeover boards were last modified on 22 September 2021, and the configuration was as shown by red arrow in Figure 3. This configuration resulted in:</p> <ul style="list-style-type: none"> <li>South East 275 kV SVC No. 1 and No. 2 LV supplies being exclusively supplied from the auxiliary supply of TF1, and</li> <li>The automatic switching of contactor F5 in power voltage transformer (PVT) changeover board to be disabled (due to the switch being left in manual mode).</li> </ul> <p>On 16 September 2021, an alarm 'SVC No. 1 AC Supply 1 Fail' was generated when SVC No. 1 was restored following an outage. This alarm was intended to alert the operator that there was an issue with the configuration of the AC supply board. However, the operator cleared the alarm on 22 September 2021 and incorrectly reported that the SVC AC supplies had been restored to normal.</p> <p>On 23 March 2023, during the isolation of TF1, ElectraNet's switching procedure did not include a check of the AC changeover boards configuration, and consequently AC changeover boards were left with TF1 exclusively supplying South East SVC No. 1 and No. 2 LV supplies. Therefore, at 1113 hrs on 23 March 2023 when the operator opened CB 6618, the supply to the South East SVC No. 1 and No. 2 cooling systems was interrupted and South East SVC No. 1 and No. 2 tripped after approximately 7 seconds. The cooling system trip protection operated in line with expected performance. ElectraNet is planning to implement clear field signage and review the standard switching steps for operators to correctly configure the changeover boards including checking of the AC changeover board configuration when isolating South East transformers.</p> <p><b>South East 275 kV SVC No. 1 and No. 2 trip at 1950 hrs on 23 March 2023</b></p> <p>At 1157 hrs on 23 March 2023, South East 275 kV SVC No. 1 and No. 2 returned to service following reconfiguration of the SVC LV supplies by ElectraNet. South East 275 kV SVC No. 1 and No. 2 were being supplied by TF2 and the AC changeover control in the main AC changeover board was in automatic mode. As part of the TF1 re-energisation procedure, ElectraNet switched the AC changeover control in the main changeover board from automatic to manual mode to prevent the South East 275 kV SVC No. 1 and No. 2 LV supplies automatically changing over from TF2 to TF1. Before switching from automatic to manual mode, ElectraNet should have pre-set the AC changeover control to TF2 to avoid LV supply disconnection. This did not occur and when AC changeover control mode was switched to manual mode, it caused a loss in supply to the SVC cooling systems from TF2. The loss of supply to the SVC cooling systems caused South East 275 kV SVC No. 1 and No. 2 to trip again at 1950 hrs.</p>
<b>Power system response (facilities and services)</b>	<p>There was no other material impact on the broader power system, load or generation.</p>
<b>Rectification</b>	<ul style="list-style-type: none"> <li>ElectraNet attended the site to determine the actual state of the AC changeover boards after the incident and found it as shown in Figure 3 (red arrow), with South East 275 kV SVC No. 1 and No. 2 auxiliary supply (supply 1 and Supply 2) fed from TF1 through the main AC changeover board.</li> <li>On 30 March 2023, ElectraNet reattended site and conducted testing on the PVT changeover board and reconfigured the AC changeover boards, ensuring that SVC changeover control 1 is supplied by the intended supply of TF4, and SVC changeover control 2 is supplied by the intended supply of transformer 5 (TF5). ElectraNet also checked and set all AC changeover control contactors to 'auto' mode. ElectraNet has confirmed that the current configuration will ensure neither South East 275 kV SVC No. 1 or SVC No. 2 cooling is interrupted for a TF1 or TF2 outage. The updated configuration of South East SVC LV supplies is shown in Figure 3 (green arrow).</li> <li>ElectraNet has confirmed that the root cause of the incident was the absence of suitable checks in the standard switching steps and operating procedures. ElectraNet is planning to implement clear field signage and review the standard switching steps for operators to correctly configure the changeover boards including checking of the changeover boards configuration when isolating South East transformers.</li> <li>ElectraNet plans to review the 'SVC AC Supply Fail' alarms to make clear the intended meaning matches the functionality and update the relevant operating procedures.</li> </ul>

Details	
<b>Power system security</b>	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard <sup>7</sup> was met for this incident.
<b>Reclassification</b>	<p>AEMO assessed whether to reclassify this incident as a credible contingency event<sup>8</sup>.</p> <p>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 1155 hrs on 23 March 2023.</p> <p>ElectraNet advised AEMO that the root cause of the incident had been identified and that it was unlikely to reoccur in the present conditions. AEMO correctly cancelled the reclassification at 1207 hrs on 19 April 2023.</p>
<b>Market information</b>	<p>For this incident, AEMO issued the following market notices (all market notices for this incident were issued in accordance with NER requirements):</p> <ul style="list-style-type: none"> <li>• AEMO issued Market Notice (MN) 106896 at 1132 hrs on 23 March 2023 to advise the market of the non-credible contingency event involving the simultaneous trip of South East 275 kV SVC No. 1 and No. 2 at South East substation.</li> <li>• AEMO issued MN 106898 at 1133 hrs on 23 March 2023 to advise the market of the inter-regional transfer limit variation after simultaneous trip of South East 275 kV SVC No. 1 and No. 2 at South East substation. Two constraints were invoked due to the unplanned outage, one each for the Heywood interconnector and Murraylink DC interconnector term on the left hand side.</li> <li>• AEMO issued MN 106899 at 1203 hrs on 23 March 2023 to advise that this incident had been reclassified as a credible contingency from 1155 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 reoccur.</li> <li>• AEMO issued MN 106927 at 2001 hrs on 23 March 2023 to advise the market of the inter-regional transfer limit variation after unplanned outage of South East 275 kV SVC No. 1 and No. 2 at South East Substation at 1950 hrs. Two constraints were invoked due to the unplanned outage, one each for the Heywood interconnector and Murraylink DC interconnector term on the left hand side.</li> <li>• AEMO issued MN 107528 at 1207 hrs on 19 April 2023 to advise that the reclassification of this incident as a credible contingency had been cancelled from 1200 hrs on 19 April 2023.</li> </ul>
<b>Conclusions</b>	<p>AEMO has concluded that:</p> <ul style="list-style-type: none"> <li>• South East 275 kV SVC No. 1 and No. 2 tripped as a result of AC changeover boards being left in an incorrect configuration (see red arrow in Figure 3), resulting in supplies to the cooling system of South East 275 kV SVC No. 1 and No. 2 being derived from TF1. Auto changeover contactor F5 on PVT changeover board was not able to close as it was set to manual mode instead of auto mode. The cooling system trip protection operated in line with its settings and tripped the 275 kV CBs associated with the South East 275 kV SVC No 1 and No. 2.</li> <li>• ElectraNet has confirmed that the auto changeover contactors in changeover boards have been reconfigured (see green arrow in Figure 3) and has advised its control room of this arrangement. All auto changeover contactors in changeover boards have been checked and set to auto mode. The auto changeover contactors in changeover boards have been left in a configuration that will not be affected by TF1 or TF2 outages.</li> <li>• 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 reoccur. AEMO correctly cancelled the reclassification.</li> <li>• The power system remained in a secure operating state and the Frequency Operating Standard was met during the incident.</li> </ul>
<b>Recommendations</b>	<ul style="list-style-type: none"> <li>• ElectraNet to complete full testing of the SVC LV supplies system including a review of scheme alarms and ensure that scheme system instructions are available to site operators.</li> <li>• ElectraNet to implement clear field signage for operators to correctly configure the changeover boards including checking of the AC changeover board configuration when isolating South East transformers.</li> <li>• ElectraNet to update the standard switching instructions for transformers at South East to ensure the status of the SVC LV supplies is checked prior to any high voltage (HV) switching steps.</li> <li>• AEMO and ElectraNet to share findings of this event with the Power System Security Working Group (PSSWG) by Q4 2023.</li> </ul>

<sup>7</sup> See <https://www.aemc.gov.au/sites/default/files/2020-01/Frequency%20operating%20standard%20-%20effective%201%20January%202020%20-%20TYPO%20corrected%2019DEC2019.PDF>.

<sup>8</sup> 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

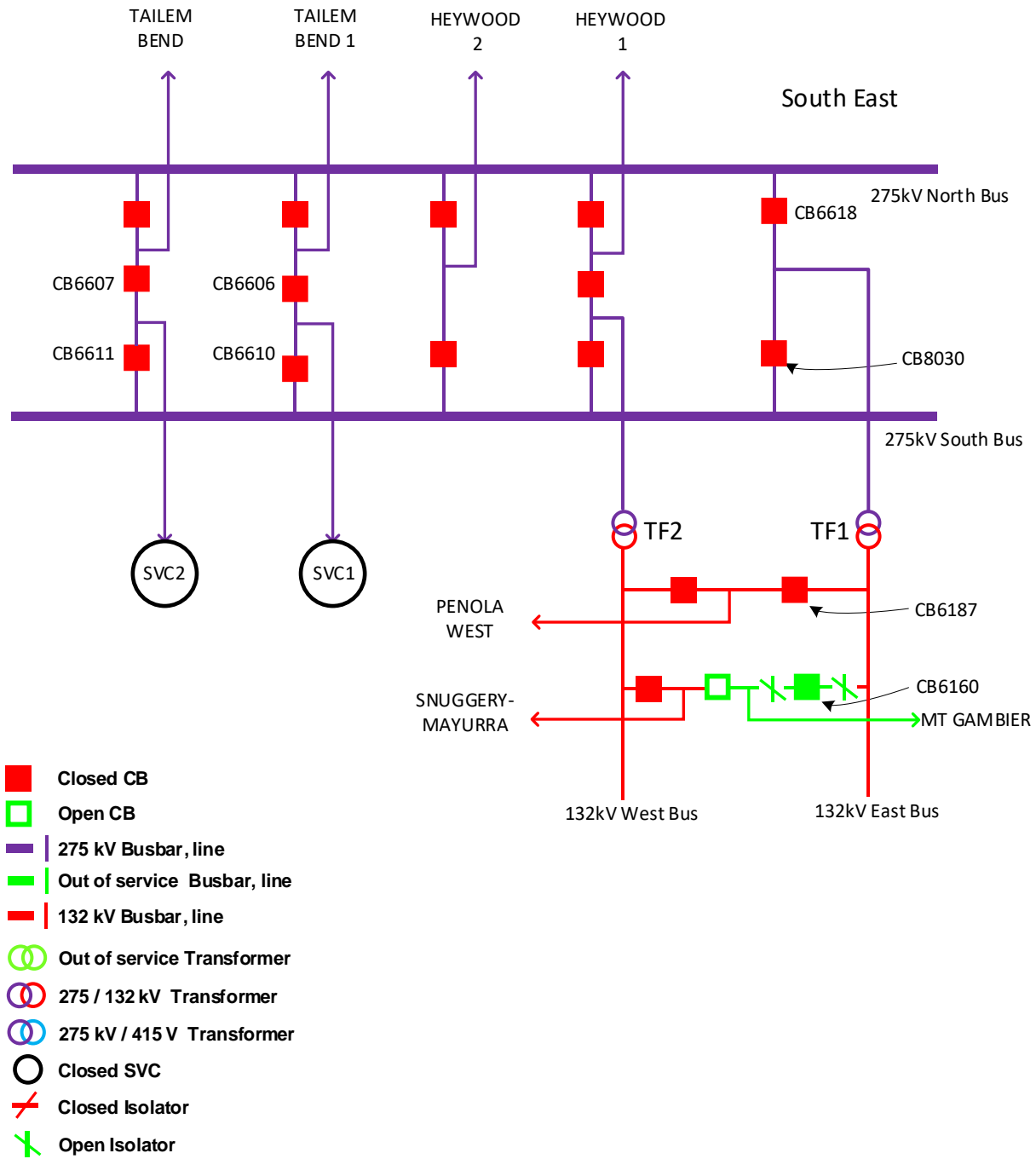


Figure 2 Incident diagram – Network representation immediately after the incident

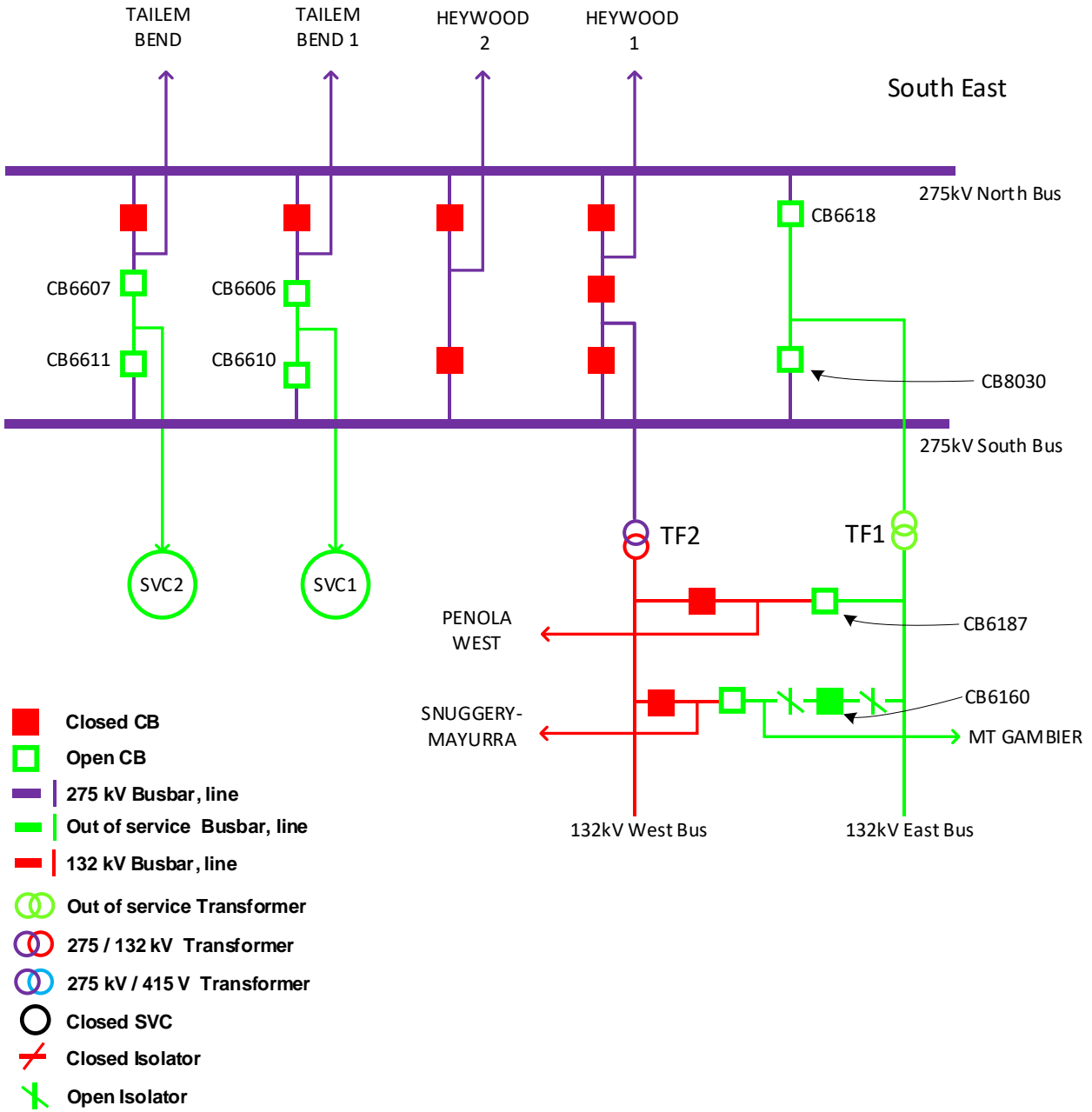




Figure 3 South East AC changeover system

