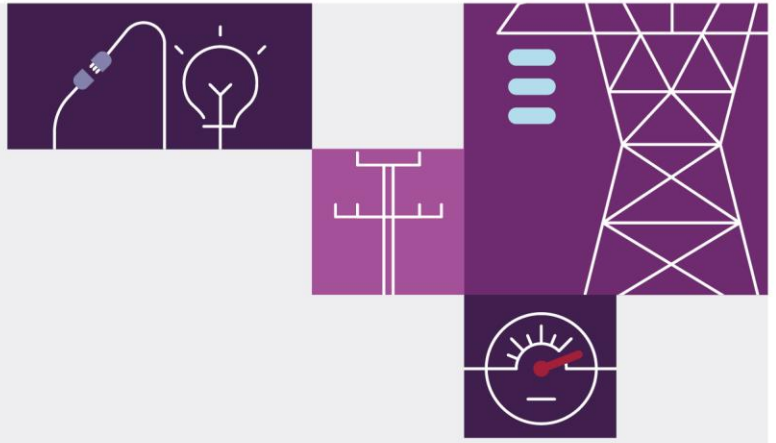


# Trip of South East No. 1 and No. 2 SVC on 12 October 2023

April 2024

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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## Contact

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
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
EMS	energy management system
HMI	human machine interface
kV	kilovolt/s
LV	low voltage
MCC	motor control centre
NEM	National Electricity Market
NER	National Electricity Rules
PVT	power voltage transformer
s	second/s
SSD	substation switching diagram
SVC	static volt-ampere reactive compensators
TF1	transformer 1
TF2	transformer 2
TF4	transformer 4
TF5	transformer 5
TNSP	Transmission Network Service Provider

# 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 12 October 2023 at 1524 hrs in South Australia. The incident involved simultaneous trip of the South East 275 kilovolt (kV) No. 1 and No. 2 static volt-ampere reactive compensators (SVCs).
<b>Incident classification</b>	Human error – SVC controller logic design errors leading to unexpected ‘supply fail latching’ on South East SVC’s 415 volt (V) auxiliary supply changeover system with procedural error being a secondary factor due to incomplete substation switching diagram (SSD) and ambiguous energy management system (EMS) alarms increasing the complexity of South East SVC switching and maintenance works.
<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>	There have been four previous non-credible contingencies at South East Substation which included South East 275 kV SVC No. 1 and No. 2 due to 415 V auxiliary supply interruptions: <ul style="list-style-type: none"> <li>• Two incidents occurred prior to 2020<sup>4,5</sup>. Following these events, a new 415 V auxiliary supply changeover system at South East Substation, including additional transformer supplies, was installed on site in 2020. As a result, no significant similarities were identified between the current incident and the incidents preceding the installation of new 415 V auxiliary supply changeover system.</li> <li>• Two incidents occurred after the installation of new 415 V auxiliary supply changeover system at South East Substation. Further detail regarding these two incidents is provided below: <ul style="list-style-type: none"> <li>– On 22 September 2021<sup>6</sup> South East 275 kV SVC No. 1 and No. 2 simultaneously tripped when ElectraNet were carrying out switching to isolate the South East 132 kV East busbar. At that time 415 V auxiliary supplies to both SVCs were being provided by transformer 1 (TF1). When TF1 was isolated, the auto changeover system was expected to automatically switch the SVC 415 V auxiliary supplies to South East Transformer 2’s (TF2’s) auxiliary supply. However, 5 seconds (s) after TF1 was isolated, the South East 275 kV SVC No. 1 and No. 2 cooling system protection operated, tripping both SVCs. Subsequent investigations by ElectraNet confirmed that several auto changeover relays had failed which meant both South East 275 kV SVC No. 1 and No. 2 auxiliary supplies were connected to TF1. These relay failures also meant that the 415 V auto changeover system was unable to switch SVC 415 V auxiliary supplies to TF2 when required to do so. 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, with one SVC 415 V auxiliary supply fed from TF1 and TF2, and the second SVC 415 V auxiliary supply fed from transformer 4 (TF4).</li> </ul> </li> </ul>

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

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

<sup>3</sup> See NER 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-no1andno2-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-no1andno2-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	
	<p>– On 23 March 2023<sup>7</sup>, South East 275 kV SVC No. 1 and No. 2 tripped as a result of AC changeover boards being left in an incorrect configuration during isolation of South East TF1 for planned maintenance. In isolating TF1, ElectraNet had assumed auxiliary supplies to the South East 275 kV SVC No. 1 and No. 2 cooling systems were being supplied from TF4 and transformer 5 (TF5), when in fact auxiliary supplies to the cooling systems were being supplied from TF1. Moreover, the auto changeover contactor on the power voltage transformer (PVT) changeover board was not able to close and transfer the auxiliary supply to another source as it was set to manual mode instead of auto mode. On 30 March 2023, ElectraNet conducted testing on the PVT changeover board and reconfigured the AC changeover boards, ensuring that SVC changeover control 1 is supplied by the intended auxiliary supply of TF4, and SVC changeover control 2 is supplied by the intended auxiliary supply of TF5. ElectraNet also checked and set all AC changeover control contactors to ‘auto’ mode. ElectraNet has confirmed that the configuration would ensure neither South East 275 kV SVC No. 1 or SVC No. 2 cooling is interrupted for a TF1 or TF2 outage.</p>
<b>Pre-incident conditions</b>	<p>On 12 October 2023, ElectraNet staff were carrying out planned testing of 415 V supply changeover system at South East Substation. South East 275 kV SVC No. 1 cooling pump No. 1 and SVC No. 2 cooling pump No. 1 were in operation with power supplied from the motor control centre (MCC)1 board. This test procedure included testing of PVT control 2 changeover and SVC control 2 changeover associated with MCC2 as shown in Figure 1.</p> <p>The final test was to confirm the correct automatic switching of the SVC 415 V auxiliary supply to TF4 when the TF5 supply becomes unavailable. As per the test plan, this was to be achieved by opening isolator F3 manually. The test plan required contactor F2011 to be in open state to ensure that isolator F3 operated without any load current. Testing affected 415 V supply to MCC2 only. Furthermore, as South East 275 kV SVC No. 1 cooling pump No. 2 and SVC No. 2 cooling pump No. 2 were not in service, ElectraNet was not expecting that making changes to the 415 V supply of MCC2 would interrupt the operation of the SVCs.</p>
<b>Incident key events</b>	<ol style="list-style-type: none"> <li>1. At 1524 hrs on 12 October 2023, South East 275 kV SVC No. 1 and No. 2 tripped.</li> <li>2. At 1607 hrs on 12 October 2023, South East 275 kV SVC No. 1 was returned to service.</li> <li>3. At 1609 hrs on 12 October 2023, South East 275 kV SVC No. 2 was returned to service.</li> </ol>
<b>Incident cause</b>	<p>ElectraNet’s post-incident investigation has confirmed that:</p> <ul style="list-style-type: none"> <li>• When contactor F2011 was opened, it caused MCC2 to be de-energised as expected. However, it also caused South East 275 kV SVC No. 1 and No. 2 ‘Cooling System Fail Trip’ protection to operate, opening circuit breaker (CB) 6610, CB 6606, CB 6607, and CB 6611 (see Figure 2). Therefore, at 1524 hrs on 12 October 2023, the 415 V auxiliary supplies to the South East SVC No. 1 and No. 2 cooling systems were interrupted and South East SVC No. 1 and No. 2 tripped after approximately 7 s. The cooling system protection operated in line with expected performance. Following the trip, all testing was abandoned, and the 415 V SVC auxiliary supply system was returned to its normal position with TF4 supplying MCC1 and TF5 supplying MCC2.</li> <li>• ElectraNet did not expect the SVC ‘Cooling System fail Trip’ to operate during the planned testing as ElectraNet was unaware of a ‘supply fail latching’ signal associated with the SVC 415 V MCC boards. During its investigation ElectraNet identified that a latching signal would become active in the SVC control system if the MCC board lost supply for more than 5 s. Furthermore, the latching signal would remain active even after the affected MCC 415 V supply was restored. ElectraNet also identified that once activated the latching signal associated with MCC remains active until it is reset from the SVC human machine interface (HMI). This signal is an input to an AND gate and if the other MCC fails then that will also send high latching signal through the AND gate, causing the ‘Cooling System Fail Trip’ protection to operate, irrespective of whether the SVC cooling system remains in service. ElectraNet has identified the root cause of the incident as a design error in the South East 275 kV SVC No. 1 and No. 2 controller, as the ‘supply fail latching’ signal is not required/desirable for the correct controller operation and could trip the SVC unnecessarily if the latched signal was not reset.</li> <li>• The onsite labelling of the South East 275 kV SVC No. 1 and No. 2 415 V auxiliary supply changeover system were ambiguous in relation to the site drawings. The equipment labels on the SSD were also incomplete and ElectraNet’s EMS alarm system did not display clear alarms for a South East SVC MCC1 or South East SVC MCC2 supply fail. ElectraNet has confirmed that this increased the complexity of the work being completed by the test team on 12 October 2023 and contributed to the incident.</li> </ul>
<b>Power system response (facilities and services)</b>	<p>There was no other material impact on the broader power system, load or generation.</p>

<sup>7</sup> [https://www.aemo.com.au/-/media/files/electricity/nem/market\\_notices\\_and\\_events/power\\_system\\_incident\\_reports/2023/trip-of-south-east-svc-no-1-and-2-on-23-march-2023.pdf?la=en](https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2023/trip-of-south-east-svc-no-1-and-2-on-23-march-2023.pdf?la=en).

Details	
<b>Rectification</b>	<ul style="list-style-type: none"> <li>To reduce the risk of a re-occurrence of this incident during future planned maintenance works, ElectraNet have updated their testing procedure to account for the 'supply fail latching' signal associated with the South East SVC 415 V MCC boards.</li> <li>ElectraNet have advised that this incident could re-occur if, following an MCC1 or MCC2 supply failure, and prior to the 'supply fail latching' signal being reset, the remaining in-service MCC supply fails. This risk will remain until the SVC control system is replaced. ElectraNet has confirmed that the SVC control system is due for replacement and regulatory investment test for transmission has been issued (although the replacement works have not yet been approved). To address this risk, ElectraNet plans to review all alarm signals associated with South East 275 kV SVC No. 1 and No. 2 auxiliary supplies to ensure that the alarm text displayed in their EMS matches the functionality. As part of this work ElectraNet will also update the relevant operating procedures. These EMS updates will allow ElectraNet to quickly identify that an MCC1 or MCC2 415 V supply failure has occurred and take appropriate action, reducing the risk that a subsequent MCC 415 V supply failure causes both South East SVCs to trip.</li> <li>ElectraNet has updated the signage on the South East 275 kV SVC No. 1 and No. 2 415 V auxiliary supply changeover system to improve clarity for on site staff.</li> <li>The operating time and the timer setting of all South East SVC 415 V auxiliary supply changeover circuits were tested and it was identified that the timer setting<sup>8</sup> of the SVC PVT control 2 changeover and SVC control 2 changeover were inconsistent, with overall supply fail time delays approaching 5 s. ElectraNet has confirmed that for correct operation, these fail times should be set to less than 2 s as the 'Cooling System Fail Trip' protection is set to operate if the SVC 415 V auxiliary supply is lost for more than 5 s. ElectraNet has corrected the timer setting of all changeover circuits of South East SVC 415 V auxiliary supply changeover system including PVT control 2 changeover and SVC control 2 changeover and has confirmed that the 415 V auxiliary supply changeover system operates after a maximum supply fail time of 1.5 s.</li> </ul>
<b>Power system security</b>	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard <sup>9</sup> was met for this incident.
<b>Reclassification</b>	<p>AEMO assessed whether to reclassify this incident as a credible contingency event<sup>10</sup>.</p> <p>On 12 October 2023, ElectraNet advised that the trip was caused inadvertently by staff working on site and was unlikely to re-occur in the present conditions. AEMO was able to obtain the appropriate level of assurance to determine that recurrence of the non-credible contingency event was not reasonably possible. Based on the information available to AEMO at the time, AEMO appropriately applied the reclassification criteria and determined the reclassification criteria were not met.</p> <p>On 13 October 2023, ElectraNet updated their advice to AEMO to clarify that the root cause of the incident had not been identified and had not been resolved. AEMO was unable to obtain the appropriate level of assurance to determine that a recurrence of the non-credible contingency event was not reasonably possible. AEMO appropriately applied the reclassification criteria and reclassified this incident as a credible contingency from 1620 hrs on 13 October 2023 until further notice.</p> <p>On 4 February 2024 ElectraNet confirmed that the root cause of this incident had been identified however, following an SVC MCC supply failure the 'supply fail latching' signal must be manually reset to prevent a re-occurrence of the incident. ElectraNet also confirmed that the existing alarm signals in the EMS and the SSD do not allow operators to easily identify an SVC MCC supply failure and take appropriate action. Therefore, this incident remains reclassified as a credible contingency until further notice.</p> <p>As noted in the rectification section, ElectraNet plans to update the alarm signals sent to the EMS and the SSD to provide system operators with more accurate information. Once these works are completed AEMO will consider whether there is a need to continue to reclassify this incident as a credible contingency.</p>
<b>Market information</b>	<p>For this incident, AEMO issued the following market notices:</p> <ul style="list-style-type: none"> <li>AEMO issued Market Notice 110232 at 1545 hrs on 12 October 2023 (approximately 21 minutes after the event) to advise the market of the non-credible contingency event.</li> <li>AEMO issued Market Notice 110234 at 1639 hrs on 12 October 2023 (approximately 75 minutes after the event) to advise the market that the cause of the non-credible contingency had been identified, AEMO was satisfied that another occurrence of this event is unlikely under the current circumstances and that AEMO had not reclassified this event as a credible contingency event.</li> </ul>

<sup>8</sup> This timer setting affects how quickly the South East SVC 415 V auxiliary supplies will changeover to an alternative supply if a 415 V auxiliary supply is lost.

<sup>9</sup> See <https://www.aemc.gov.au/sites/default/files/2023-04/FOS%20-%20CLEAN.pdf>.

<sup>10</sup> AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER 4.2.3A(c) – and to report how the reclassification criteria were applied – NER 4.8.15(ca).



Details	
	<ul style="list-style-type: none"> <li>AEMO issued Market Notice 110252 at 1620 hrs on 13 October 2023 to advise of the market that simultaneous trip of South East 275 kV SVC No. 1 and No. 2 had been reclassified as a credible contingency until further notice.</li> </ul> <p>AEMO invoked constraint set S-X_SE_SVC between 1535 hrs and 1620 hrs on 12 October 2023 to manage the outage of the South East 275 kV SVC No. 1 and No. 2. All constraints in this set have a term for the Heywood interconnector on the left-hand side. The Power System Security Guidelines (SO_OP_3715) indicate that AEMO should issue a market notice in these circumstances<sup>11</sup>, however, AEMO did not issue the relevant market notice during this incident. These constraints normally manage the Heywood interconnector flow to maintain its stability following the largest South Australia generation contingency or loss of a South East – Taillem Bend 275 kV line.</p> <p>AEMO has reinforced with its operators the requirement to publish market notices to advise the market of potential variance to interconnector transfer limits when invoking constraint sets for unplanned outages.</p>
<b>Recommendations</b>	<ul style="list-style-type: none"> <li>AEMO supports ElectraNet’s plan to review all alarm signals associated with South East 275 kV SVC No. 1 and No. 2 auxiliary supplies to ensure that the alarm text displayed in their EMS matches the functionality. ElectraNet intends to ensure that relevant alarm signals are provided to the ElectraNet control room in order for ElectraNet to meet their obligations under NER 4.8.1. Once this work is completed AEMO will consider whether there is a need to continue to reclassify this incident as a credible contingency. If the reclassification is revoked, on an ongoing basis, AEMO would assess circumstances where the event may need to be reclassified based upon advice from ElectraNet relating to any added risks, including following a failure of either MCC supply.</li> <li>AEMO to discuss the importance of testing new equipment to ensure that remote alarms provide clear information, labelling on the panels are clear as per the site drawings, and to share details of this event with the Power System Security Working Group (PSSWG) by Q2 2024.</li> <li>AEMO notes that ElectraNet plan to resolve the ‘supply fail latching’ signal reset issue when replacing the SVC control system, noting that a regulatory investment test<sup>12</sup> for transmission has been issued (although the replacement works have not yet been approved).</li> <li>AEMO supports ElectraNet’s plans to address the following recommendations from the 23 March 2023 incident<sup>13</sup>:             <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 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> </ul> </li> </ul>

<sup>11</sup> See Section 19 of the Power System Security Guidelines at [https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security\\_and\\_Reliability/Power\\_System\\_Ops/Procedures/SO\\_OP\\_3715%20Power-System-Security-Guidelines.pdf](https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3715%20Power-System-Security-Guidelines.pdf).

<sup>12</sup> See <https://aemo.com.au/consultations/current-and-closed-consultations/pacr--managing-the-risk-of-south-east-svc-control-system-failure>.

<sup>13</sup> See [https://www.aemo.com.au/-/media/files/electricity/nem/market\\_notices\\_and\\_events/power\\_system\\_incident\\_reports/2023/trip-of-south-east-svc-no-1-and-2-on-23-march-2023.pdf?la=en](https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2023/trip-of-south-east-svc-no-1-and-2-on-23-march-2023.pdf?la=en).

Figure 1 South East AC changeover system

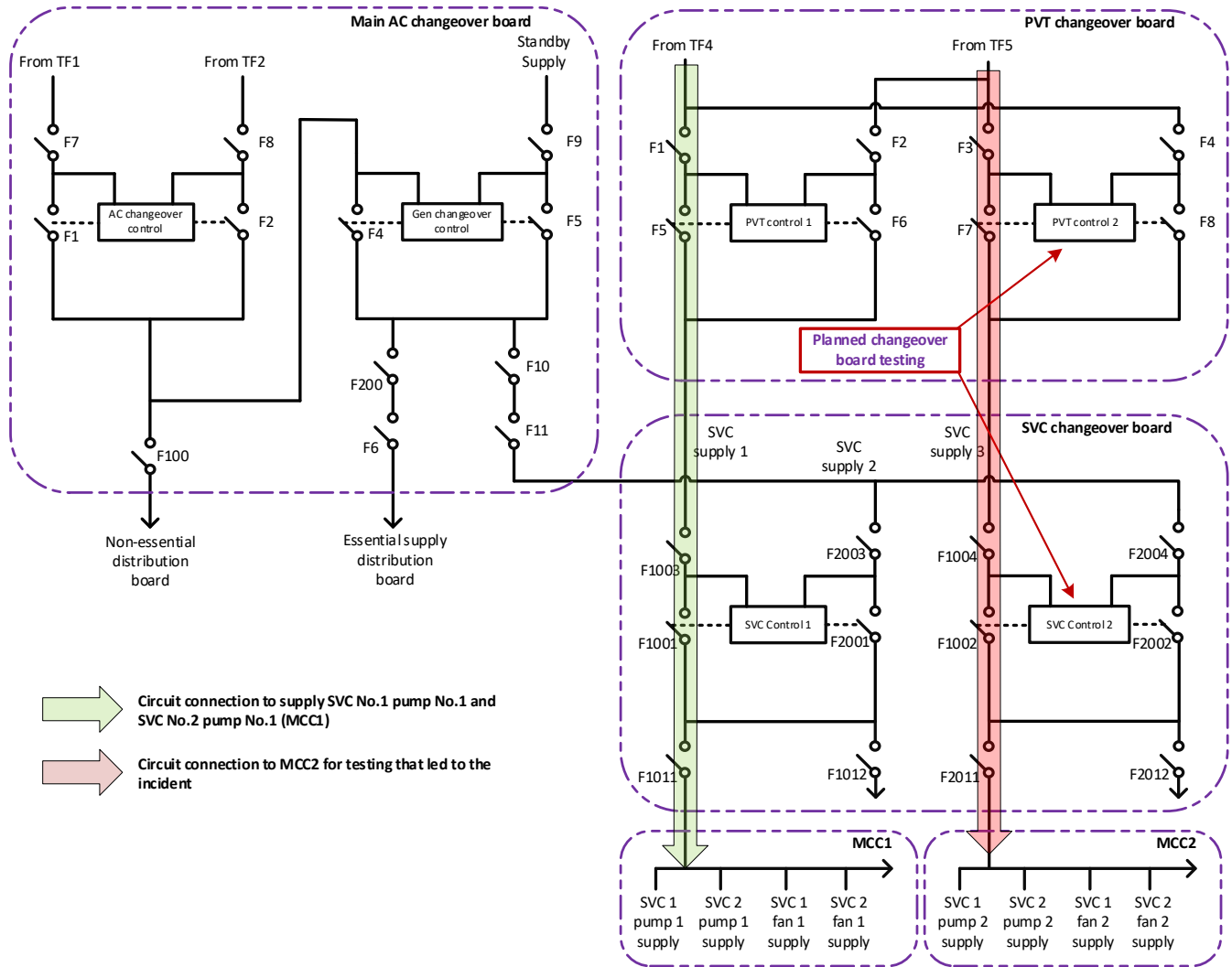




Figure 2 Incident diagram – Network representation immediately after the incident

