POWER SYSTEM OPERATING INCIDENT REPORT – TRIP OF 220 KV C BUSBAR AT GORDON POWER STATION ON 26 NOVEMBER 2011

PREPARED BY: Electricity System Operations Planning and Performance

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FINAL

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Abbreviations and Symbols

Abbreviation	Term
CB	Circuit Breaker
kV	Kilovolt
kW	Kilowatt
NET	Neutral Earthing Transformer

1 Introduction

At 1311 hrs on 26 November 2011, the 220 kV C busbar at Gordon underground hydro power station in Tasmania tripped on the operation of back up protection systems when a 22 kV busbar at Gordon experienced multiple faults during switching operations to restore the 22 kV busbar to service, which had tripped earlier in the day. The auxiliary supplies of Gordon and approximately 100 kW of customer load at Strathgordon were being supplied via this 22 kV busbar when the incident took place.

This report has been prepared under clause 4.8.15 (c) of the National Electricity Rules 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.

This report is largely based upon information provided by Hydro Tasmania. Data from AEMO's Energy Management System and Electricity Market Management System has also been used in analysing the incident.

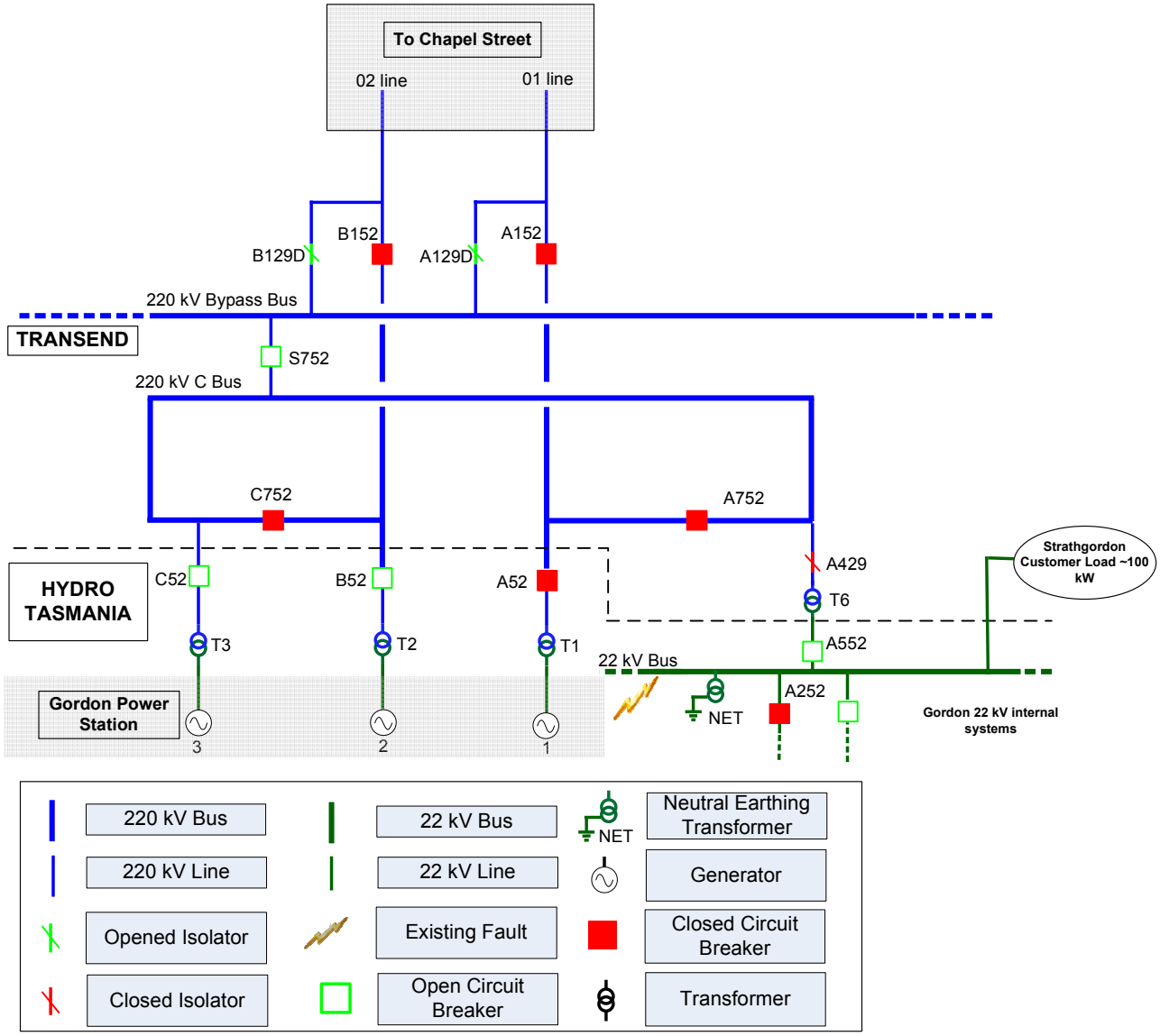
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Pre-Contingent System Conditions

Prior to the incident, Gordon 1 generating unit was generating 23 MW. Gordon 2 and 3 generating units were out of service.

The status of the power system prior to the incident is shown in Figure 1. For clarity, only equipment relevant to this incident has been included in the diagram.

Figure 1 - Status of the power system prior to the incident



3 Summary of Events

The key events that took place during this incident are summarised in Table 1.

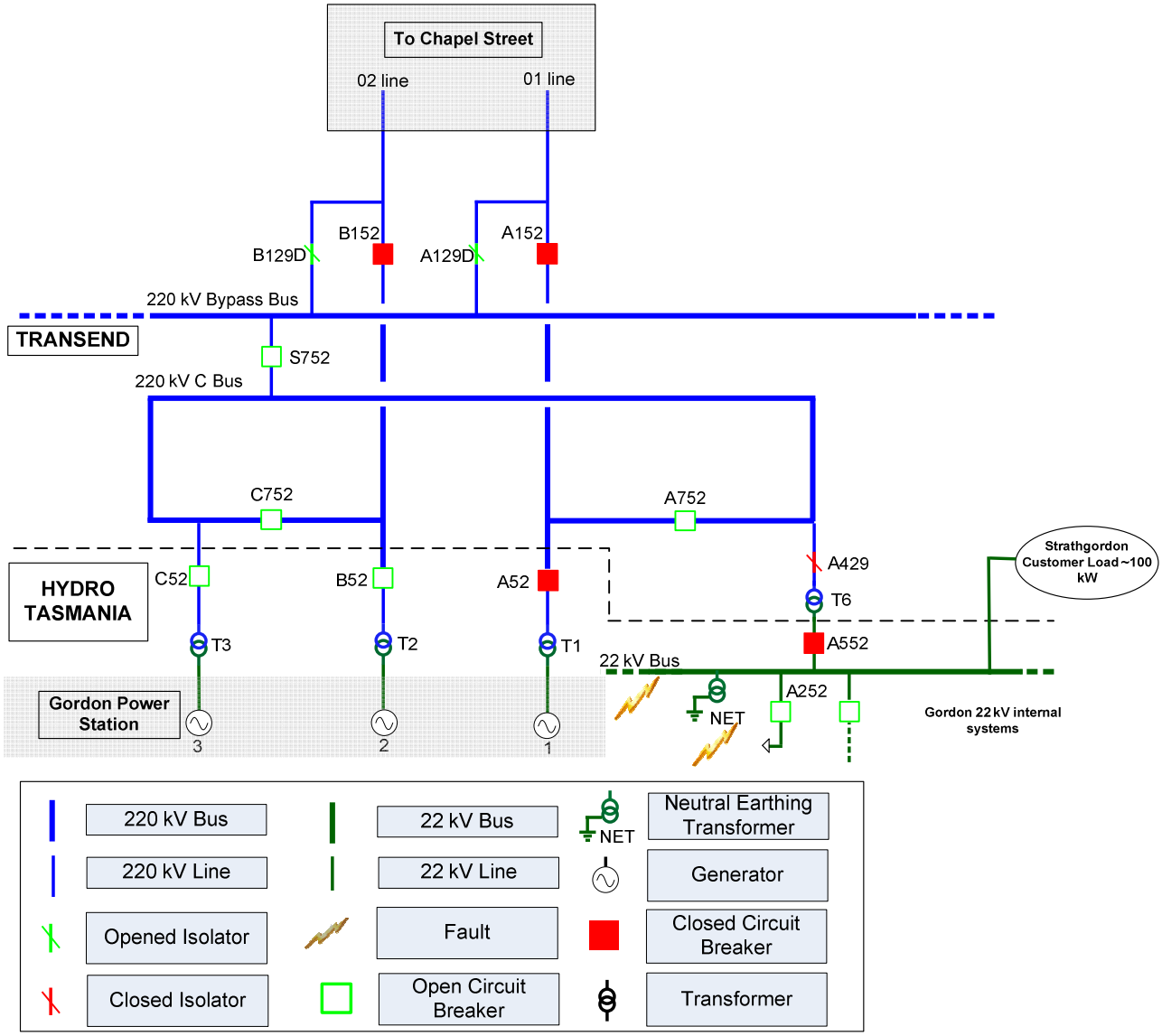
Table 1 Summary of events

Time	Operation	Comment
0900 hrs	22 kV busbar at Gordon tripped	Operation of earth fault protection tripped the busbar.
0903 hrs	Standby mini hydro generating unit started automatically but immediately tripped.	The standby generating unit tripped on the operation of over-current protection. Fault on the 22 kV busbar was still present.
0914 hrs	The operator at Gordon manually started standby generating unit and attempted to restore 22 kV busbar and it tripped again.	The standby generating unit tripped on the operation of over-current protection. Fault on the 22 kV busbar was still present.
0948 – 1026 hrs	On-call staff arrived at the power station and	Staff noted a burnt smell and damp area

	inspected the outdoor 22kV switch yard and found that the CB A252 had failed to open. The CB was then manually opened and isolated.	under the base of the CB. Staff believed that this was caused by the oil from the failed interrupter of CB A252.
1026 – 1308 hrs	The 22 kV busbar was prepared for energising.	The underground 415 V and 22 kV systems were tested and found to be satisfactory. Staff carried out visual inspection of the 22kV busbar again but did not observe damage or any other issues.
13:11:16	22kV busbar was energised by closing CB A552.	Transend closed CB A552 on the request of Hydro Tasmania.
13:11:26	A bus insulator and the neutral earthing transformer (NET) connected to the 22 kV busbar failed explosively. The CB A552 failed to open.	NET has a time limit of 5 seconds for withstanding fault currents. Hydro Tasmania investigation revealed that CB A552 had a burnt trip coil causing it to be inoperable.
13:11:27	220kV C bus at Gordon tripped.	Busbar protection of 220 kV C busbar operated tripping CBs A752 and C752 in 10 seconds. Gordon No.1 generating unit was unaffected and continued generating consistent with its dispatch target.
1453 hrs	220 kV C busbar was restored	Hydro Tasmania liaised with Transend to restore the busbar.

The status of the power system immediately after the incident is shown in Figure 2.

Figure 2 - Status of the power system after the incident



4 Immediate Actions Taken

At 1325 hrs, AEMO invoked the constraint set T-GO_BUS in market systems to reflect the outage of Gordon C busbar.

Hydro Tasmania restored the load at Strathgordon using standby diesel generating units.

At 1453 hrs, the C busbar was returned to service. AEMO revoked the constraint set T-GO_BUS at 1500 hrs.

In accordance with its operating procedure SO_OP 3715 Power System Security Guidelines[1], AEMO determined that it was not appropriate to declare the loss of 220 kV C busbar at Gordon as a credible contingency because the failed 22 kV busbar and the associated high voltage equipment remained out of service for repairs.

5 Follow-up Actions

Hydro Tasmania inspected the 22 kV switchyard and repaired all the failed equipment. After testing the high voltage equipment and the secondary systems, Hydro Tasmania restored the 22 kV switchyard at Gordon on 7 January 2012.

Hydro Tasmania conducted a complete investigation of this incident and made a number of recommendations to avoid similar failures in future. In particular, Hydro Tasmania noted that the most likely reason for the explosive failure of the NET was due to the 5 second short term rating of the NET whereas the backup protection was set to operate after 10 seconds.

6 Power System Security Assessment

The power system voltages, power flows and frequencies remained within the normal operating limits and the applicable frequency operating standards.

The provision and response of facilities and services of Hydro Tasmania were adequate to maintain power system security.

7 Conclusions

AEMO is satisfied that Hydro Tasmania has conducted a complete investigation of this incident and is pursuing the recommended corrective actions to minimise the risk of a similar incident occurring in the future.

AEMO noted that a more appropriate coordination of the time delay implemented for the back up protection systems of the 22 kV busbar, that was consistent with the rating of the NET could have prevented its failure.

AEMO correctly applied the criteria required by clause 4.2.3B of the NER and published in section 11 of its Power System Security Guidelines in assessing that the circumstances of this incident did not warrant reclassifying similar incidents as a credible contingency event.

8 Recommendations

Hydro Tasmania will liaise with Transend to review the time delay implemented for its back up protection systems of the 22 kV busbar, to better align with the rating of the NET. Hydro Tasmania will inform the progress of this action to AEMO by the end of July 2012.

[1] Clause 4.2.3B of the NER requires that AEMO establish criteria to use when considering whether a non-credible contingency event is reasonably possible. This is published in AEMO operating procedure SO_OP 3715 Power System Security Guidelines, which is available at: http://www.aemo.com.au/electricityops/3715.html