POWER SYSTEM OPERATING INCIDENT REPORT
SIMULTANEOUS TRIP OF BOTH GENERATING UNITS AT MORTLAKE POWER STATION ON 4 SEPTEMBER 2012

PREPARED BY: Systems Performance and Commercial

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FINAL

Disclaimer

Purpose

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Abbreviations and Symbols

Abbreviation	Term
ºC	Degree Celsius
MPa	Mega Pascal
PRMS	Pressure Reduction Metering Station

1 Introduction

At 0111 hrs on Tuesday 4 September 2012, both units at Mortlake Power Station tripped simultaneously from a combined output of 315 MW.

This report has been prepared under clause 4.8.15 (c) of the National Electricity Rules (NER) 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 Origin Energy. Data from AEMO's Energy Management System (EMS) and Electricity Market Management System (EMMS) has also been used in analysing the incident.

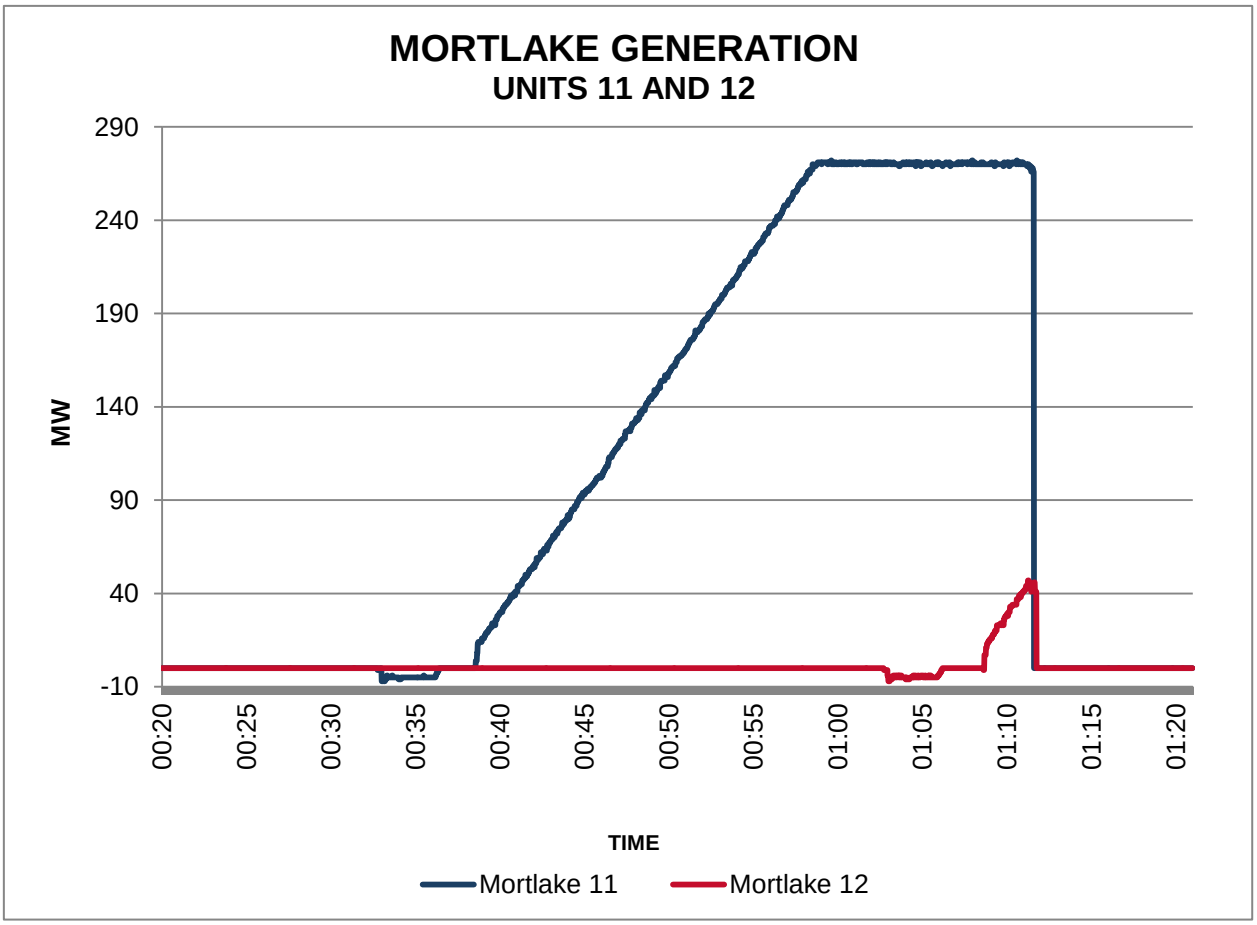
All references to time in this report are to National Electricity Market time (Australian Eastern Standard Time).

2 Summary of Events

At approximately 0111 hrs on Tuesday 4 September 2012 both units at Mortlake Power Station tripped simultaneously.

Prior to the event unit 11 was generating 270 MW and unit 12 was generating 45 MW as indicated in Figure 1.

Figure 1 – Mortlake Generation



Origin Energy has indicated that the cause of the trip was a gas supply interruption to the units during start-up of unit 12. This interruption was due to a low temperature protection shutdown of the Fuel Gas Supply to the Fuel Gas Heaters in the Mortlake Pressure Reduction Metering Station (PRMS) located adjacent to the Mortlake Power Station.

AEMO issued Market Notice No.39653 at 0121 hrs advising the market of the non-credible contingency.

There was no violation of power system security due to this event.

The key events that took place during the incident are summarised in Table 1 below:

Table 1: Summary of events

Time	Events
04/09/2012 00:31 hrs	Mortlake unit 11 in service.
01:01 hrs	Mortlake unit 12 in service.
01:11 hrs	Mortlake units 11 and 12 trip
01:21 hrs	Market Notice 39653 issued
03:07 hrs	Mortlake unit 12 returned to service
03:36 hrs	Mortlake unit 11 returned to service

2.1 Gas System

The Mortlake gas pipeline is a dedicated 84 km pipeline from Otway to the PRMS at Mortlake Power Station.

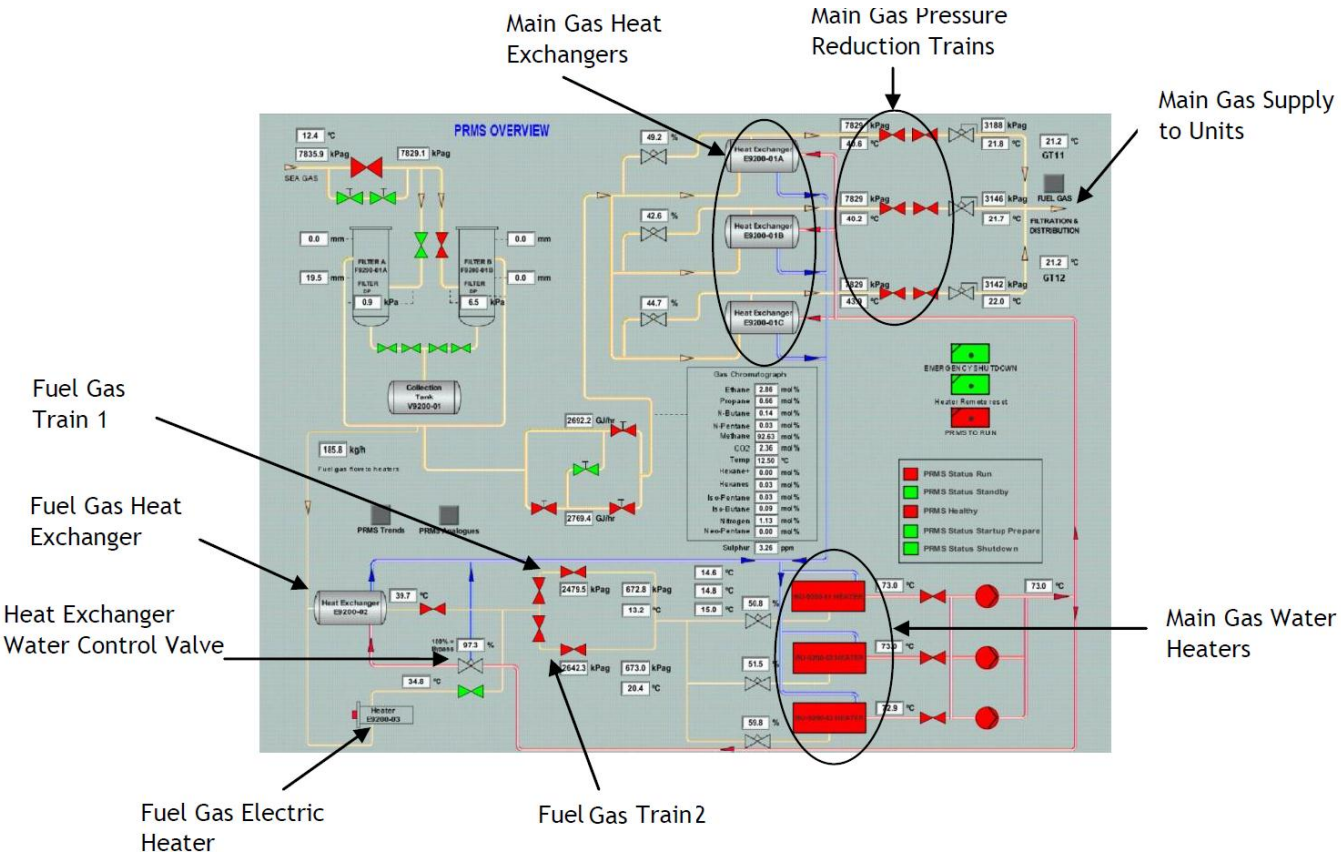
The cause of the simultaneous trip was the main gas outlet temperature of each pressure reduction train[1] at the PRMS falling below the allowable limits, and each train consequently ceasing supply of gas to the units.

To ensure correct main gas outlet temperature, the pressure reduction trains are supplied with hot water from the main gas water heaters. The gas supply for the main gas heaters is via two redundant fuel gas supply trains. The gas supply for the fuel gas heaters is preheated via a dedicated water bath heater and an electric gas heater.

Figure 2 provides an overview of the PRMS.

[1] The term **train** refers to each one of the parallel paths followed by the gas in different areas of the PRMS (i.e. fuel gas regulator trains, pressure reduction trains, etc.)

Figure 2 – PRMS Overview



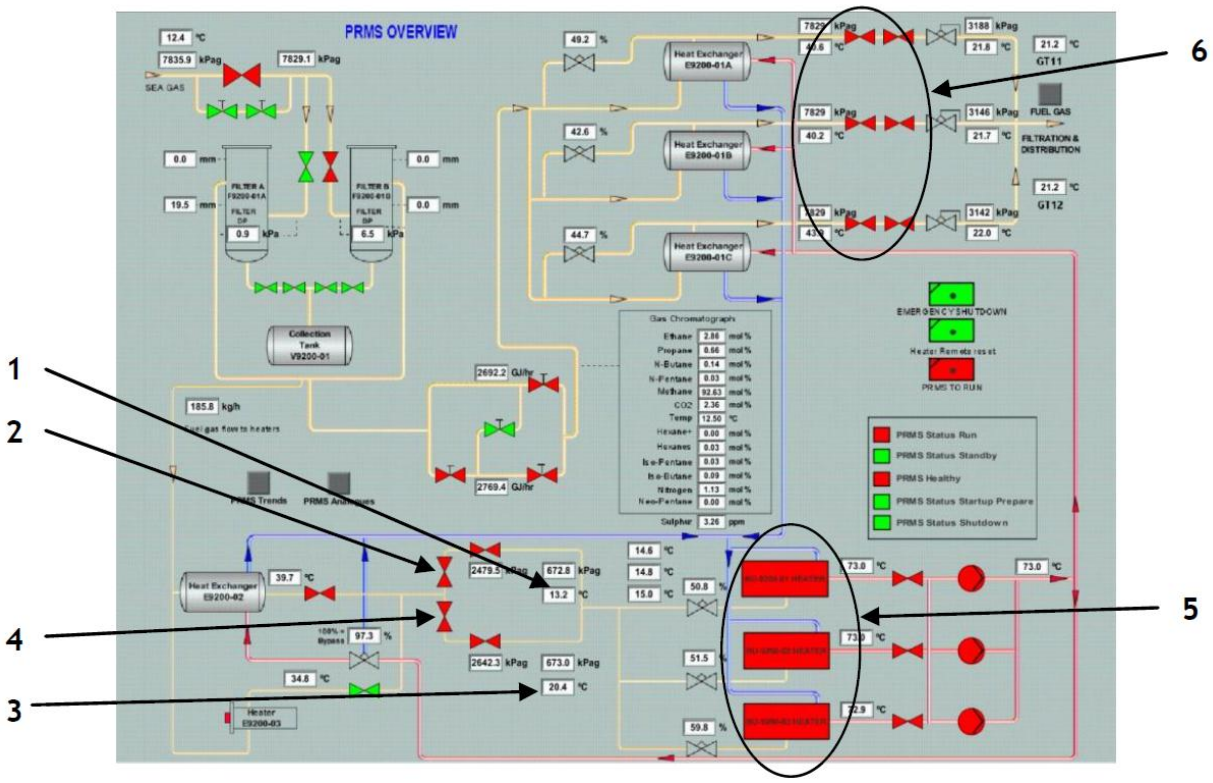
The following is the sequence of events for the PRMS trip:

1. Fuel gas regulator train 1 (lead train) outlet temp below set point – (Joules-Thomson Effect[2]).
2. Fuel gas regulator train 1 Safety Valve closes due to outlet temp low temperature trip.
3. Fuel gas regulator train 2 (lag train) outlet temp below set point – (Joules-Thomson Effect).
4. Fuel gas regulator train 2 Safety Valve closes due to outlet temp low temperature trip.
5. Main gas water heater shutdown due to loss of fuel gas supply.
6. Pressure reduction trains safety valve close due to low gas temp at outlet of PRMS – Loss of hot water for main gas heat exchangers.

[2] Joules Thomson Effect: In thermodynamics, the **Joule–Thomson effect** or **Joule–Kelvin effect** or **Kelvin–Joule effect** or **Joule–Thomson expansion** describes the temperature change of a gas or liquid when it is forced through a valve or porous plug while kept insulated so that no heat is exchanged with the environment.

Figure 3 below provides a graphical indication of the sequence of events described above.

Figure 3 – PRMS Trip Sequence



The failure of the Fuel Gas Heating systems was due to several factors:

- Joules-Thomson effect of higher than normal gas inlet pressures across the regulators.
- Commissioned configuration of the Fuel Gas Heating System was not ideal to accommodate pressures above 12 MPa, specifically the
    - Heat exchanger control valve logic control
    - PRMS cold start-up process
- Cold ambient temperature impacting heater effectiveness.
- PRMS in standby mode for more than 1 hour, and the system being in a cold state.

Due to these factors, Origin Energy believes the Fuel Gas Heating systems did not provide sufficient heating for the inlet gas as experienced on 4 September 2012. This resulted in the trip of the redundant fuel gas supply trains, and the consequent trip of both Mortlake Power Station units. Origin Energy notes however, that the PRMS fuel gas heating system was able to regulate the heating of the fuel gas and main gas effectively once the system had stabilised.

3 Immediate Actions Taken

This event resulted in a loss of 315 MW of generation. There were no violations of power system security during the event.

Immediately after the event Origin Energy's on-call operators were dispatched to the Mortlake Power Station to investigate and restore the units to operational status, and operational procedures were put in place to prevent recurrence of the incident. The procedures included

interim protocols to manage incoming gas pressures to ensure reliable start-up of the units and manual start-up operation of the gas system at higher inlet pressures.

During the start-up of the Mortlake Power Station units later in the morning of 4 September 2012, manual operator intervention was required to prevent subsequent trips of the fuel gas regulator trains due to low gas temperature at the outlet of the regulator trains. Prior to 4 September 2012, the inlet gas pressure to the PRMS has typically been below 12 MPa.

Based on the information provided by Origin Energy, AEMO made the decision not to reclassify the simultaneous loss of Mortlake generating units 11 and 12 as a credible contingency.

No further actions were required by AEMO.

4 Follow-up Actions

The following actions were undertaken by Origin Energy in response to the incident:

- Amendments to start-up protocols when the other unit is offline (cold start up process)
    - PRMS pre-start process for pressures above 12 MPa
    - Stagger of unit starts for pressures above 12 MPa
- Retuning of the fuel gas heating system by the original equipment manufacturer to accommodate PRMS inlet pressures above 12 MPa was completed on 11 September 2012.
- Modifications were made by the original equipment manufacturer to the fuel gas heating control logic on 11 September 2012.

The actions undertaken above have resulted in reliable operation of the Mortlake Power Station and the associated PRMS. Additionally, Origin Energy has advised that inlet gas pressures at the PRMS above 12 MPa would be an uncommon occurrence due to the configuration of the Mortlake Pipeline and associated gas network at the pipeline gas network connection.

5 Power System Security Assessment

The power system security was not compromised during the event.

AEMO's decision of not reclassifying the loss of Mortlake generating units 11 and 12 as a credible contingency based on information provided by Origin Energy was appropriate.

6 Conclusions

The simultaneous trip was due to shut down of gas supply to the units as a result of lower than allowable temperature at the main gas outlet of each PRMS pressure reduction train.

7 Recommendations

The following actions are being undertaken by Origin Energy in relation to this incident:

- Ongoing monitoring of the inlet pressures and system temperatures, with further tuning as required.

- Origin Energy is in the process of reviewing the Fuel Gas Heating design to identify potential improvements. This work is currently estimated to be completed in quarter 3 of the 2012/13 financial year.