

RAH Loss of Power Root Cause Analysis

Summary of Interim Findings



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1. INTRODUCTION

This technical note summarises the findings to date from the Root Cause Analysis (RCA) conducted by Frazer-Nash Consultancy into the loss of power that occurred at the Royal Adelaide Hospital (RAH) on 7th February 2018.

2. RCA INTERIM FINDINGS

This section provides a brief description of the generator system and presents our interim RCA findings:

2.1 DESCRIPTION OF THE GENERATOR SYSTEM

There are six diesel powered emergency generators at the RAH. Three are installed in the Generator Room on the western side of the RAH, while the remaining three are installed in a separate Generator Room on the eastern side. Each of the six emergency generators is provided with a 1000 litre “day tank”, which directly fuels their respective generators.

These smaller day tanks are refilled from underground bulk diesel storage tanks. There are two bulk diesel storage tanks on both the western and eastern side of the RAH, in proximity to the western and eastern generator rooms respectively. As the generators consume diesel, the day tanks are topped up by the “fuel transfer system”, which draws fuel from the bulk diesel storage tanks and pumps it to the required day tanks. With no faults present, the western bulk tanks will be used to top up the day tanks for the western generators, while the eastern bulk tanks will be used to top up the eastern generators. A basic sketch of the system arrangement is presented in Section 4.

The fuel transfer system can be operated in both “automatic” and “manual” modes. In automatic mode the generator day tanks will be topped up automatically by the fuel transfer system, which measures the remaining fuel within each day tank and transfers fuel accordingly. When in

manual mode, an operator can manually select which bulk tank to draw from and which day tank to transfer to. Use of manual mode also allows certain alarms and inhibits to be overridden.

The emergency generators and fuel transfer system are controlled by the “Master Generator and Load Control Panel” or MGLCP.

2.2 DESCRIPTION OF THE GENERATOR TEST

In accordance with Australian Standards (AS 3009-2008, B3.1) emergency generators at hospitals are required to be tested at least monthly. This helps to ensure that they will work if called upon during an actual loss of power from SA Power Networks (SAPN).

The emergency generators at the RAH are tested on a “live load”, meaning that they were used to power sections of the RAH. Not all six generators are tested at once – generally only two will be tested at a time to ensure that the remaining four are available in the event of an actual loss of SAPN power.

Spotless as Facility Manager for Hard FM, is accountable for ensuring the emergency generators are tested at least monthly.

2.3 INTERIM FINDINGS

The following facts are known:

- ▶ Generators 1 and 2, located in the western generator room, were being tested on 7th February;
- ▶ The fuel transfer system did not top up the days tanks, despite fuel being available in the western bulk tanks;
- ▶ Alarms sounded locally and at the BMS during the generator test to indicate low fuel levels in the day tanks;
- ▶ Generators 1 and 2 stopped when they ran out of diesel fuel, resulting in a loss of power to those systems forming the “live load” at 10:52 am on 7th February 2018;
- ▶ Spotless personnel manually intervened to restore power, which was achieved at 11:08 am on 7th February 2018.

The following contributing factors have been identified:

- ▶ Alarms had been present on both of the western bulk tanks for a number of days prior to the 7th of February and remained present at the commencement of the generator test;
- ▶ The presence of these alarms prevented the fuel transfer system from topping up the generator day tanks. The alarms on the western bulk tanks were subsequently shown to be “false” alarms;
- ▶ There is no evidence of similar alarms (false or otherwise) being present on the eastern bulk tanks, however the fuel transfer system did not automatically attempt to draw fuel from these tanks;
- ▶ Although alarms indicating low fuel levels in the day tanks sounded locally and at the BMS during the generator test, there was no attempt from personnel to fault find and rectify the fault, manually transfer fuel from available bulk tanks, or abort the test;
- ▶ Once the generators had stopped the MGLCP did not automatically revert to SAPN power, necessitating manual intervention.

The following potential Root Causes have been identified to date:

- ▶ Lack of maintenance response prior to the generator test. Alarms indicating faults within the fuel system had been present for a period and not rectified;
- ▶ Lack of preparedness at the commencement of the generator test. Alarms indicating faults within the fuel system were present when the decision to commence the generator test was made; and
- ▶ Failure of turret covers to prevent the ingress of water and failure to respond to previous maintenance reports indicating presence of water in the bulk tank turrets.

2.4 ONGOING INVESTIGATIONS

The following areas remain open to investigation:

- ▶ Review the appropriateness of the MGLCP logic with respect to enabling / inhibiting fuel transfer operations;
- ▶ Review the appropriateness of the MGLCP logic with respect to drawing from all available bulk tanks when in automatic mode;
- ▶ Review the appropriateness of the MGLCP logic with respect to automatically reverting to SAPN power on failure of a generator test;
- ▶ Review of MGLCP logic and alignment with Operations Information to assess whether there is appropriate alignment between the design and operations manuals;
- ▶ Review of BMS data to confirm which alarms were recorded at the BMS prior to the commencement of the generator test;
- ▶ Review of QfM records to determine which alarms recorded by the BMS were pass through to the Hard FM team; and
- ▶ Review of bulk tank turret covers to determine means of water ingress.

Note that these ongoing investigations may identify additional root causes or modify the potential root causes identified above.

3. LIMITATIONS AND DISCLAIMERS

This Technical Note has been prepared as an interim update on RCA activities for SA Health. It is based on information made available to Frazer-Nash Consultancy at the time of writing.

The RCA remains an ongoing activity and the root causes identified here may be added to or modified in light of new information.

4. GENERATOR AND FUEL SYSTEM SKETCH

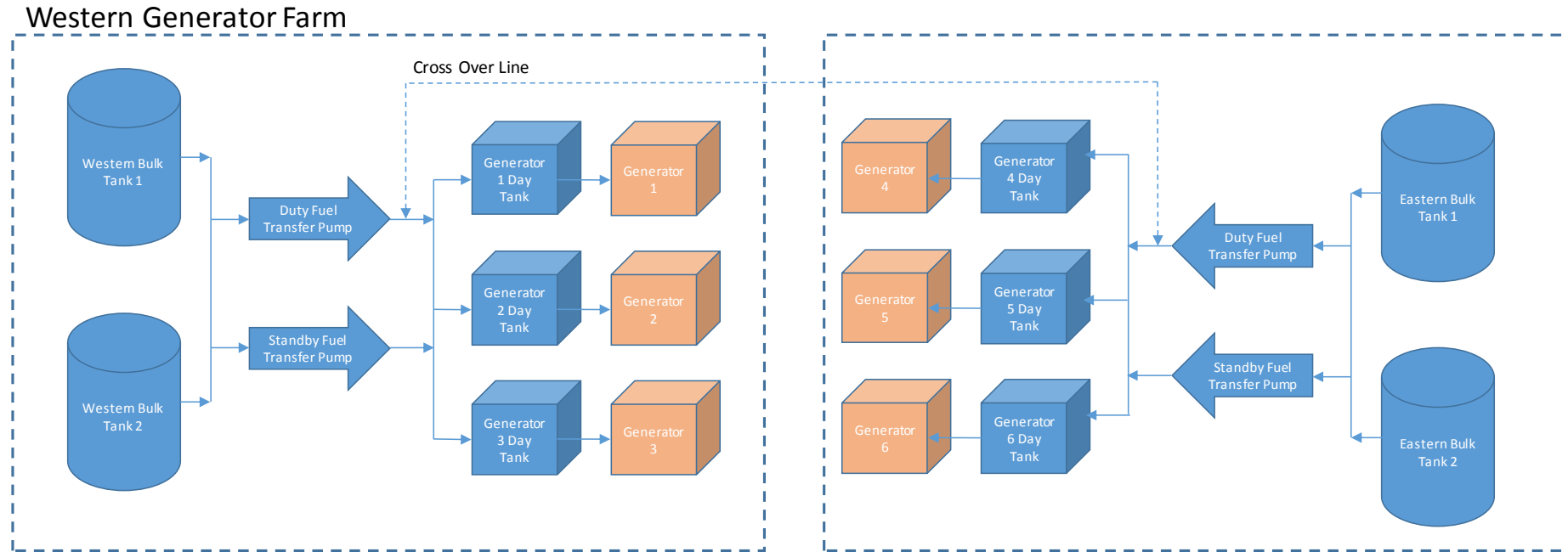


Figure 1 - Simplified Sketch of Generator Farms (reproduced from DWG: EC-09-010-K-517; Revision 10)