

Joint Investigation by Senoko Power and PETRONAS Gas Berhad into the Gas Supply Disruption at Senoko Power Station on 21 December 2006

Summary of Incident

1. On 21 December 2006 at approximately 3.55pm, Senoko Power Station suffered an abrupt disruption of natural gas supply due to an unexpected closure of the main supply valve (identified as ML401) located at Senoko Pig Receiving Facility (SPRF).
2. At the time of the incident, two out of five gas-fired combined cycle plants (CCPs) at Senoko Power Station were connected to this gas supply source. The sudden plunge in gas pressure resulting from the abrupt disruption of gas supply and its occurrence being very close to the two CCPs meant there was insufficient time for on-load hot switching to take place in accordance with Senoko Power's standard operating procedure, even though an alternate source of gas supply or diesel was available.
3. The total loss in generation was 692MW. This represented approximately 14% of the system demand of 5,000MW. As a consequence of the loss of generation, load shedding was activated that resulted in the loss of power supply to seven areas in Singapore. The areas affected by the power failure were Bukit Batok, Choa Chu Kang New Town, Crawford, Jalan Eunos, Mandai, Pandan and SengKang areas. The power supply was restored fully at 4.40 pm.
4. The natural gas supply was restored within minutes by manually opening the isolating valve to the pig receiver which provided an alternative path for the gas to flow. After the restoration of gas supply and reset of the operating systems for the affected generating facilities, both the affected CCPs were re-synchronised to the Singapore electricity supply later on the same day.
5. Immediately following the incident, a joint investigation team was formed with PETRONAS Gas Berhad (PGB) to review the incident, establish the root cause of the unexpected closure of main supply valve, identify the lessons learnt and develop recommendations to assist in the avoidance of a repetition of the incident.
6. The Final Joint Investigation Report was forwarded to EMA.

Background

7. Petronas is one of the suppliers of natural gas to Senoko Power since the PUB days in early 1990s. PGB, a subsidiary of Petronas, operates and maintains 2,550 km of gas pipeline from Plentong Metering Station in Johor Bahru up to the international boundary between Malaysia and Singapore and administers the terms of the gas sales agreement between Petronas and Senoko Power.

8. The gas supply disruption incident occurred after a routine cleaning, known as “pigging”, of the natural gas pipeline from Plentong facility in Johor to the SPRF. The pig is a cylindrically constructed scrubber with a rubber liner to rub through the internal pipe surface as it travels through the gas pipeline. For the past 14 years, since the construction of the pipeline, PGB’s pipeline maintenance crew from Pasir Gudang Regional Operations has undertaken the entire pigging operation for this section of the pipeline successfully.

Investigation Report

9. The joint investigation included site tests and simulations conducted by the original equipment manufacturer. The investigation concluded that the cause of the gas supply disruption on 21 December 2006 was the unexpected automatic closure of ML401 that was activated by the self-closing mechanism.
10. The investigation reviewed all possible causes of the self-closing mechanism. The most important facet of the investigation was to eliminate any recurrence of this incident through the elimination of the only cause for the unexpected closure, the self-closing mechanism.

Other Findings

11. As a result of the incident, Senoko Power suffered a material commercial loss amounting to almost \$2 million from not having been able to meet its contractual sales commitments from its own generation capability and consequently having to buy from the wholesale electricity market, the pool, to supplement its physical output.

Follow up Actions

12. Senoko Power and PGB have proceeded, since the incident to strengthen the robustness of the gas supply system.
13. Following consultation with the original equipment manufacturer, the valve actuation system for ML401 will be modified and this new system has been ordered to replace the existing equipment.
14. Senoko Power has also taken the opportunity in the interest of continual improvement to review the work procedure and control arrangements for work at the Senoko Pig Receiving Facility.

Conclusion

15. The extensive joint investigation showed that the gas disruption was caused by the automatic closure of the main supply valve (identified as ML401) located at

- the Senoko Pig Receiving Facility. A self-closing mechanism had been activated, causing the automatic closure of ML401.
16. The investigation reviewed all the possible causes of the self-closing mechanism. Consequently, Senoko Power and PETRONAS Gas Berhad, the pipeline operator for PETRONAS, concentrated on the modification of the self-closing mechanism to remove this vulnerability. This was identified to be the root cause. Action has already been taken to ensure that this type of incident cannot recur.
 17. Both Senoko Power and PETRONAS Gas Berhad are confident that the measures they have taken will be sufficient to prevent a repetition of the incident.



Senoko Pig Receiving Facility (SPRF)



Valve ML401