

**DETERMINATION OF THE MARKET SURVEILLANCE AND COMPLIANCE PANEL
MSCP/2013/D3**

Market Surveillance and Compliance Panel ("MSCP")

Mr Thean Lip Ping, Chair
Professor Lim Chin
Mr Lee Keh Sai
Mr TPB Menon
Mr Philip Chua

Date of Determination

26 September 2013

Party

Energy Market Company Pte Ltd ("EMC")

Subject

Energy Market Company's failure to determine, release and publish real-time schedules on 14 and 15 February 2013

BACKGROUND

1. There are three types of artificial lines in the Market Clearing Engine ("MCE"). Prior to 2007, these three types of artificial lines were modeled as lossless and the exclusion of these lines in the MCE would not have any implication on market clearing results.
2. On 9 February 2007, an urgent rule change was made to remodel the artificial line Type 2, one of the three types of artificial lines, to adopt the physical characteristics of the mapped step-up transformer for a generator. This rule change was to ensure that offline generation facilities stay connected to the grid through artificial line Type 2 and the nodal prices discovered at these generation facilities reflect the locational system marginal prices.
3. The modified artificial line Type 2 ceased to be lossless with the rule change. However, EMC did not realise that the loss calculation correction process, which had previously omitted the lossless lines, was not modified accordingly to take in consideration the change to artificial line Type 2 until the failure of the real-time dispatch runs on 14 and 15 February 2013.

FACTS AND CIRCUMSTANCES

4. EMC submitted a self-report on 22 March 2013 that it did not determine, release and publish real-time schedules for periods 6, 8, 9 and 10 on 14 February 2013 and period 4 on 15 February 2013.

5. At 2.27a.m., on 14 February 2013, EMC found that the real-time dispatch run for period 6 had failed.
6. Under the Singapore Electricity Market Rules (the "market rules"), in order for the market clearing results to be released and published, the non-physical loss (NPL) must be below the published threshold limit of 10MW. EMC found that the real-time dispatch run for period 6 (starting at 2.30a.m.) could not reduce the non-physical loss below the published threshold limit of 10MW after 20 iterations in the loss calculation correction process. The real-time dispatch runs for periods 8 to 10 on 14 February 2013 and period 4 on 15 February 2013 also failed due to the same reason.
7. On 14 and 15 February 2013, a number of generators were offline and artificial lines Type 2 were applied to connect them to the dispatch network model. However, the omission of artificial lines Type 2 in the loss calculation correction process resulted in the failure of the MCE to minimize NPL to below 10MW after 20 iterations for periods 6, 8, 9 and 10 on 14 February 2013 and period 4 on 15 February 2013. The real-time loss calculation correction processes during these periods were accordingly halted and the real-time schedules were not released.
8. On realising the root cause, EMC deployed the remodeled artificial line Type 2 in the User Acceptance Testing (UAT) server to monitor the market system's behaviour. The production scenario was also simulated to confirm that the fix was in order.
9. EMC completed the UAT at 4p.m. on 15 February 2013 and rolled out the MCE changes between 5.05pm to 5.45pm. Thereafter, the MCE ran without any further issue.
10. EMC performed price reruns for the affected real-time schedules and published the rerun results at 5.40pm (period 36) on 15 February 2013.
11. EMC reported that NPLs have always been below the published threshold limit of 10MW before the incident. Therefore, the past omission of artificial line Type 2 in the loss calculation process has had no impact on the market clearing results prior to the incidents on 14 February 2013.
12. EMC said that it would conduct a thorough analysis of any future formulation changes in the market rules against the MCE source codes and produce a report. A peer review by trained personnel will also be made to verify and strengthen the results.
13. EMC is building up internal capability to independently review MCE source codes in order to avoid recurrence of a similar incident.
14. On 19 August 2013, the MSCP issued a letter informing EMC that it considered that EMC had prima facie breached sections 9.2.1, 9.2.3 and 9.2.4 of Chapter 6 and sections D.22.3, D.22.4 and D.22.6 of Appendix 6D of the market rules and invited EMC to make written representations. EMC replied on 26 August 2013 that it would not be making written representations.

APPLICABLE MARKET RULES

15. Section 9.2.1 of Chapter 6 of the market rules provides that

The *EMC* shall, prior to the commencement of each *dispatch period* and in accordance with the *market operations timetable*, use the *market clearing engine* to determine for that *dispatch period*:

9.2.1.1 a *real-time dispatch schedule*, containing schedules of *energy, reserve and regulation* for *registered facilities*, to be released to the *PSO*, which in accordance with section 9.1.2 of Chapter 5 shall be deemed to constitute the *dispatch instructions* issued by the *PSO* to the applicable *dispatch coordinators* unless and until further *dispatch instructions* are issued by the *PSO* to a given *dispatch coordinator* pursuant to section 9.1.3 of Chapter 5; and

9.2.1.2 a *real-time pricing schedule* determined by the *market clearing engine* in accordance with section D.24 of Appendix 6D, including:

- a. *energy prices for each market network node*;
- b. *the uniform Singapore electricity price*;
- c. *reserve prices for each reserve class and for each reserve provider group*; and
- d. *regulation prices*.

16. Section 9.2.3 of Chapter 6 of the market rules provides that

The *EMC* shall, in accordance with the *market operations timetable*, release to the *dispatch coordinator* for each *registered facility* a *real-time dispatch schedule* comprising that portion of the *real-time dispatch schedule* referred to in section 9.2.1.1 that describes the quantities of *energy, reserve by reserve class and regulation* scheduled in respect of that *registered facility*.

Explanatory Note: Participants will be sent the specific schedule quantities that pertain to them under section 9.2.3 and will be provided with the associated prices under section 9.2.4.

17. Section 9.2.4 of Chapter 6 of the market rules provides that

The *EMC* shall, in accordance with the *market operations timetable*, *publish* the following information as it pertains to each *dispatch period*:

- 9.2.4.1 *total load*;
- 9.2.4.2 *total transmission losses*;
- 9.2.4.3 *total reserve requirements by reserve class*;
- 9.2.4.4 *total regulation requirements*;
- 9.2.4.5 *energy prices associated with each market network node at which a generation registered facility or generation settlement facility is located, determined in accordance with sections D.24.1 and D.24.5 of Appendix 6D*;
- 9.2.4.6 *the uniform Singapore energy price, determined in accordance with section D.24.6 of Appendix 6D*;
- 9.2.4.7 *reserve prices for each reserve class and reserve provider group, determined in accordance with sections D.24.3, D.24.5 and D.24.7 of Appendix 6D*;

- 9.2.4.8 *regulation prices*, determined in accordance with sections D.24.4 and D.24.5 of Appendix 6D;
- 9.2.4.9 any system *energy* shortfalls reported by the *market clearing engine*;
- 9.2.4.10 any system *reserve* shortfalls, by *reserve class*, reported by the *market clearing engine*;
- 9.2.4.11 any system *regulation* shortfalls reported by the *market clearing engine*; and
- 9.2.4.12 a list of *security constraints* and *generation fixing constraints* applied.

18. Section D.22.3 of Appendix 6D of the market rules provides that

D.22.3 Subject to section D.22.2, if the following condition:

$Weight_{k,j} = 0$ or $Weight_{k,i} = 0$

$\{k, j, i | j, i \in DISCRSUB, \text{ where } k \in LINES, i > j + 1\}$,

is false for any pair of non-adjacent line flow/line loss points i and j on any *dispatch network line* k , section D.22.4 shall apply. Otherwise, the *EMC* may accept the current solution of the linear program.

19. Section D.22.4 of Appendix 6D of the market rules provides that

Subject to section D.22.3, the total erroneous losses in the solution of the linear program, *SysError*, shall be calculated and checked as follows:

$$SysError = \sum_k CircuitError_k$$

where:

$$CircuitError_k = LineLoss_k - ActualLoss_k$$

$$ActualLoss_k = LineLossCnst_{k,i}$$

$$+ \frac{LineFlow_k - LineFlowCnst_{k,i}}{LineFlowCnst_{k,i+1} - LineFlowCnst_{k,i}}$$

$$\times (LineLossCnst_{k,i+1} - LineLossCnst_{k,i})$$

$$\left\{ \begin{array}{l} i, k | i \in DISCRSUB_k, \text{ where } k \in LINES, \\ i = \text{Max} \left(\begin{array}{l} j | j < N(DISCRSUB_k), \\ LineFlowCnst_{k,j} \leq LineFlow_k \end{array} \right) \end{array} \right\}$$

If *SysError* is less than the system loss error tolerance established by the *EMC* under section D.22.1.1, the *EMC* may accept the current solution of the linear program. Otherwise, section D.22.5 shall apply.

20. Section D.22.6 of Appendix 6D of the market rules provides that

Subject to section D22.5, for each *dispatch network line k*, the ordered set of line flow/line loss points in set DISCRSUB_k shall be adjusted according to sections D.22.6.1 and D.22.6.2.

D.22.6.1 Line flow/line loss point *i* shall be identified such that:

$$\{i | i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, i = \text{Max}(j | \text{LineFlowConst}_{k,j} < \text{LineFlow}_k + \text{SysError})\}$$

If there is no line flow/line loss point $j \in \text{DISCRSUB}_k$ where $j > i$, no adjustment shall be made.

Otherwise, all line flow/line loss points $j \in \text{DISCRSUB}_k$ where $j > i$ shall be discarded and a new line flow/line loss point with line loss and line flow given by $\text{LineLossConst}'_{k,i+1}$ and

$\text{LineFlowConst}'_{k,i+1}$ shall be defined:

$$\text{LineFlowConst}'_{k,i+1} = \text{LineFlow}_k + \text{SysError}$$

$$\begin{aligned} \text{LineLossConst}'_{k,i+1} &= \text{LineLossConst}_{k,i} \\ &+ \frac{(\text{LineFlow}_k + \text{SysError}) - \text{LineFlowConst}_{k,i}}{(\text{LineFlowConst}_{k,i+1} - \text{LineFlowConst}_{k,i})} \\ &\times (\text{LineLossConst}_{k,i+1} - \text{LineLossConst}_{k,i}) \end{aligned}$$

D.22.6.2 Line flow/line loss point *i* shall be identified such that:

$$\{i | i \in \text{DISCRSUB}_k, \text{ where } k \in \text{LINES}, i = \text{Min}(j | \text{LineFlowConst}_{k,j} > \text{LineFlow}_k - \text{SysError})\}$$

If there is no line flow/line loss point $j \in \text{DISCRSUB}_k$ where $j < i$, no adjustment shall be made. Otherwise, all line flow/line loss points $j \in \text{DISCRSUB}_k$ where $j < i$ shall be discarded and a new line flow/line loss point with line loss and line flow given by $\text{LineLossConst}'_{k,i-1}$ and $\text{LineFlowConst}'_{k,i-1}$ shall be defined:

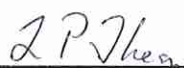



$$\text{LineFlowConst}'_{k,i-1} = \text{LineFlow}_k - \text{SysError}$$

$$\begin{aligned} \text{LineLossConst}'_{k,i-1} &= \text{LineLossConst}_{k,i} \\ &+ \frac{(\text{LineFlow}_k - \text{SysError}) - \text{LineFlowConst}_{k,i}}{(\text{LineFlowConst}_{k,i-1} - \text{LineFlowConst}_{k,i})} \\ &\times (\text{LineLossConst}_{k,i-1} - \text{LineLossConst}_{k,i}) \end{aligned}$$

ENFORCEMENT

21. Based on the evidence available, the MSCP determined that EMC breached sections 9.2.1, 9.2.3 and 9.2.4 of Chapter 6 and sections D.22.3, D.22.4 and D.22.6 of Appendix 6D of the market rules. Accordingly, the MSCP wrote to EMC on 5 September 2013 informing EMC of the breach, and invited EMC to make written representation before the MSCP decides on the quantum of financial penalty and costs.
22. EMC replied on 11 September 2013 that it would not be making written representations. However, EMC urged the MSCP to take into consideration EMC's diligence in resolving the matter expeditiously with negligible adverse impact on the market as well as EMC's commitment in ensuring the smooth and reliable operation of the NEMS system and maintaining the operational integrity of the market.

23. This incident was self-reported and did not have any significant impact on the wholesale electricity markets. EMC has also taken swift remedial actions to rectify the problem.
24. However, as the market operator, EMC has the duty to ensure that the MCE source codes are in accordance to the market rules at all times.
25. The MSCP determines that a financial penalty be imposed on EMC for breaching sections 9.2.1, 9.2.3 and 9.2.4 of Chapter 6 and sections D.22.3, D.22.4 and D.22.6 of Appendix 6D of the market rules on 14 and 15 February 2013. The MSCP assesses the penalty in the sum of \$2,000 after taking into account all the relevant circumstances. The MSCP hereby directs that EMC pays the sum of \$2,000 as financial penalty and costs of investigation fixed at \$1,500. The total sum of \$3,500 is to be paid forthwith.

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