

Singapore Electricity Market Rules

Chapter 6 Market Operation

Energy Market Authority

1 January 2010

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1 INTRODUCTION

1.1 INTRODUCTION AND INTERPRETATION

- 1.1.1 This Chapter sets forth the obligations and responsibilities of the *EMC*, the *PSO* and *market participants* relative to the establishment, operation and suspension of the *real-time markets* and the *procurement markets*, including:
- 1.1.1.1 the submission of *standing offers* and *offer variations* by *market participants*;
 - 1.1.1.2 the operation of the *market clearing engine*;
 - 1.1.1.3 the development of *market outlook scenarios*, *pre-dispatch schedule scenarios* and *short-term schedules* and the associated pricing schedules;
 - 1.1.1.4 the development of *real-time dispatch schedules* and *real-time pricing schedules*;
 - 1.1.1.5 the issuance of *advisory notices*; and
 - 1.1.1.6 the description of data to be provided to the settlement process.
- 1.1.2 Until such time as the *EMC publishes* a notice referred to in section 5.1.2.2 of Chapter 2 to the effect that *load facilities* may be registered as *registered facilities* for the purpose of providing *reserve*, this Chapter shall be construed and applied without regard to any references to *load registered facilities*.

1.2 MARKET SUSPENSION

- 1.2.1 The *Authority* may, on its own initiative or at the request of the *EMC*, declare the suspension of and suspend the operation of the *real-time markets* and the *procurement markets* if:
- 1.2.1.1 the Government of Singapore has declared or has announced that it anticipates that it will declare a state of emergency;
 - 1.2.1.2 there is a declaration or outbreak of war in or involving Singapore;

- 1.2.1.3 there is a significant and continuing degradation of the *power system* as the result of a natural or man made disaster;
- 1.2.1.4 the *Authority* receives notification from the *EMC* that circumstances have arisen, other than the inability of the *EMC* to meet its financial obligations under the *market rules*, which mean that it is no longer possible or practical for the *EMC* to comply with its non-financial functions and duties or meet its non-financial obligations under the *market rules*; or
- 1.2.1.5 following receipt of a request by the *EMC* made under section 1.2.2 if the *Authority* is satisfied that the condition set forth in that section has been met,

and the *Authority* determines, in its sole discretion, that the ability of the *EMC* to operate the *real-time markets* and the *procurement markets* has, as a result, been materially detrimentally affected thereby.

- 1.2.2 The *EMC* may request that the *Authority* suspend the operation of the *real-time markets* and the *procurement markets* if an emergency situation has required or will imminently require the *EMC*, the *PSO* or both to evacuate their respective principal control centres and move into their respective back-up control centres.
- 1.2.3 A suspension of the operation of the *real-time markets* and the *procurement markets* shall take effect:
 - 1.2.3.1 immediately upon a declaration to that effect being made by the *Authority* pursuant to section 1.2.1; or
 - 1.2.3.2 at such later time as the *Authority* may specify in such declaration.

No suspension of the operation of the *real-time markets* and the *procurement markets* shall have effect retroactively to a time prior to such declaration.

- 1.2.4 The *Authority* shall, if it suspends the operation of the *real-time markets* and the *procurement markets* pursuant to section 1.2.1:
 - 1.2.4.1 notify all *electricity licensees* of the suspension as soon as practicable and by such means as the *Authority* considers appropriate and notify all *electricity licensees* of:
 - a. the cause of the suspension;

- b. the expected duration of the suspension if such duration is known or can reasonably be estimated; and
 - c. description of the manner in which facilities will be *dispatched* and *market participants* and *market support services licensees* will be *settled* under section 1.2.5;
 - 1.2.4.2 continuously monitor the circumstances which gave rise to the suspension;
 - 1.2.4.3 in conjunction with the *EMC*, take such measures or direct that such measures be taken as may mitigate the events or circumstances which gave rise to the suspension or mitigate the effects of such events or circumstances on the operation of the *real-time markets* and the *procurement markets* for the purpose and with the intent of permitting the resumption of the operation of the *real-time markets* and the *procurement markets* at the earliest opportunity;
 - 1.2.4.4 make every endeavour to restore or to have restored the operation of the *real-time markets* and the *procurement markets* as soon as possible after the events or circumstances which gave rise to the suspension have abated sufficiently or may be expected to cease to have a materially detrimental effect on the operation of the *real-time markets* and the *procurement markets*; and
 - 1.2.4.5 notify *electricity licensees* of the *dispatch period* in which the operation of the *real-time markets* and the *procurement markets* will be resumed as long in advance of such resumption as practicable but in any event no less than one hour prior to such resumption.
- 1.2.5 While a suspension of the operation of the *real-time markets* and the *procurement markets* is in effect:
 - 1.2.5.1 facilities shall be *dispatched*;
 - 1.2.5.2 *market participants* shall be *settled* for *physical services* injected onto the *transmission system*; and
 - 1.2.5.3 *market participants* and *market support services licensees* shall be *settled* for *physical services* withdrawn from the *transmission system*,

in accordance with the manner and on the basis of prices determined by the *Authority* in consultation with the *EMC* and the *PSO*. Such prices may be determined by means of the fixing of their amounts or by reference to a formula or method of calculation *published* in accordance with Section 1.2.5A.

1.2.5A On the day that this section shall come into force, the *Authority* shall provide to the *EMC* for *publication*, the formula or method of calculation for determining prices when the operation of the *real-time markets* and/or the *procurement markets* are suspended. This formula or method of calculation may be revised from time to time and any such revisions shall be provided by the *Authority* to the *EMC* for *publication*.

1.2.6 Each *market participant* and *market support services licensee* shall promptly provide the *Authority*, the *EMC* or the *PSO*, as the case may be, with such information that each may request immediately prior to, during or following the suspension of the operation of the *real-time markets* or the *procurement markets* in order to assist in or facilitate:

1.2.6.1 the *dispatch* of facilities while a suspension of the operation of the *real-time markets* and the *procurement markets* is in effect;

1.2.6.2 *settlement* in respect of any *physical services* injected onto or withdrawn from the *transmission system* while a suspension of the operation of the *real-time markets* and the *procurement markets* is in effect;

1.2.6.3 the resumption of operation of the *real-time markets* and the *procurement markets*; and

1.2.6.4 the preparation of the report referred to in section 1.2.9.

- 1.2.7 Each *market participant* and *market support services licensee* shall comply with any and all directions issued to it by the *Authority*, the *EMC* or the *PSO* while a suspension of the operation of the *real-time markets* and the *procurement markets* is in effect.
- 1.2.8 Where the *Authority* determines, on its own initiative or upon receipt of information from the *EMC* or the *PSO*, that one or more corrective measures are required by the *EMC*, *market participants* or *market support services licensees* to avoid the recurrence of a suspension of the operation of the *real-time markets* and the *procurement markets*, the *Authority* may direct the *EMC* or the affected *market participants* or *market support services licensees* to implement the corrective measures and the *EMC* or the affected *market participants* or *market support services licensees* shall implement the corrective measures as soon as practicable.
- 1.2.9 The *Authority* shall, as soon as reasonably practicable following the resumption of operation of the *real-time markets* and the *procurement markets* prepare, in consultation with the *EMC* and the *PSO*, and *publish* a report describing:
- 1.2.9.1 the reason for the suspension of the operation of the *real-time markets* and the *procurement markets*;
 - 1.2.9.2 the steps taken by the *Authority*, the *EMC* and the *PSO* during the period of suspension of the operation of the *real-time markets* and the *procurement markets* to ensure the *reliable* operation of the *power system* and to remedy the causes or effects on the *real-time markets* and the *procurement markets* of the suspension;
 - 1.2.9.3 the actions of *market participants* and *market support services licensees* during the suspension of the operation of the *real-time markets* and the *procurement markets*; and
 - 1.2.9.4 any conclusions or recommendations for avoiding similar suspension of the operation of the *real-time markets* and the *procurement markets* in the future.

2 SYSTEM REPRESENTATION

2.1 DISPATCH NETWORK DATA

Explanatory Note: The dispatch network is the representation of the Singaporean network used for dispatch purposes. It comprises dispatch network nodes and dispatch network lines. Most dispatch network nodes will not have market transactions occurring at them because there will be no generators or consumers at those dispatch network nodes. A separate set of nodes, called market network nodes, is described below. The market network nodes correspond to nodes at which market transactions occur. A market network node could be defined to be a dispatch network node, or there could be several market network nodes (representing different facilities offering into the market) at a single dispatch network node. While the Market Clearing Engine explicitly represents dispatch network nodes when determining power flows etc, the market network node prices are derived as part of a post-processing exercise. These rules allow the flexibility to define market network nodes in many different ways.

The dispatch network will be based on EMS data, but the rules and systems do allow (but do not require) simplifications in this representation if this is considered desirable (e.g. to make the software run faster).

2.1.1 The *EMC* shall establish, prior to the *market commencement date* and in consultation with the *PSO*, and shall thereafter maintain and, in consultation with the *PSO*, update as required, requirements for *dispatch network data*, which requirements shall be consistent with the equations describing the *dispatch network* in Appendix 6D, and shall communicate such requirements and updated requirements to the *PSO*.

2.1.2 The *PSO* shall establish, prior to the *market commencement date* and in consultation with the *EMC*, and shall thereafter maintain and, in consultation with the *EMC*, update as required *dispatch network data* consistent with the requirements for *dispatch network data* specified by the *EMC* pursuant to section 2.1.1. Such *dispatch network data* shall comprise a representation of all *dispatch network lines*, *dispatch network nodes* and facilities forming part of or connected to the *PSO controlled system* which:

2.1.2.1 the *PSO* considers may be *connected* in such a manner as to materially affect the *dispatch* of facilities pursuant to this Chapter; or

2.1.2.2 the *EMC* requires to be included for purposes of the operation of the *real-time markets*.

2.1.3 *Dispatch network lines* and *dispatch network nodes* need not correspond exactly to physical *electricity lines* or *nodes*. In establishing or updating the requirements for *dispatch network data* the *EMC* may, in consultation with the *PSO*, simplify or expand the representation of the physical network in ways that do not materially affect scheduling, pricing or *settlement*, but that simplify the scheduling, pricing or *settlement* processes.

Explanatory Note: The dispatch network is used to determine the schedules used by the PSO and determines the prices which the EMC applies, possibly with transformations, to market network nodes. For this reason, both the EMC and the PSO must have input to the dispatch network representation.

2.1.4 The *PSO* shall specify and *publish*, prior to the *market commencement date*, and shall thereafter maintain, update and re-*publish* as required, any *generic constraints* that are likely to arise, which *generic constraints* shall be consistent with the *generic constraint* equations in Appendix 6D.

2.1.5 The *PSO* shall, prior to the *market commencement date*:

2.1.5.1 establish the minimum total requirements for each *reserve class* in accordance with section 4.5.3 of Chapter 5;

2.1.5.2 establish the total requirements for *regulation* in accordance with section 4.4.4 of Chapter 5;

2.1.5.3 establish *reserve provider groups*, each of which is associated with a single *reserve class*, and the criteria by which prospective *reserve providers* will be assigned to such *reserve provider groups* in accordance with section 4.6.1 of Chapter 5; and

2.1.5.4 establish parameters describing the effectiveness of each *reserve provider group* in meeting the *reserve* requirements for its *reserve class* in accordance with section 4.6.3 of Chapter 5,

and shall thereafter maintain and update as required the elements described in this section 2.1.5.

- 2.1.6 The *PSO* shall update all data and elements described in sections 2.1.2 to 2.1.5:
- 2.1.6.1 in the manner and at the times required by this Chapter; and
- 2.1.6.2 in any event, in a timely fashion as may otherwise be required to reflect temporary or permanent changes in the structure, capacity and operation of the *PSO controlled system*.
- 2.1.7 The *PSO* shall, prior to the *market commencement date*, establish such systems and procedures, and train such staff, as may be necessary to allow the *PSO* to provide to the *EMC*, on a continuous basis as required by sections 6.1 and 8.1, the data referred to in those sections so as to enable the *EMC* to determine forecasts and schedules in accordance with this Chapter.

2.2 IMPORT AND EXPORT LIMITS

- 2.2.1 The *Authority* shall, prior to the *market commencement date*, establish an *import limit* for Singapore, which shall be a limit on the total net *energy* flows into Singapore across all *connections*, including *interties*, from facilities outside of Singapore. The *import limit* shall be communicated by the *Authority* to the *EMC* and the *EMC* shall *publish* the *import limit*.
- 2.2.2 The *Authority* may, from time to time revise the *import limit* in consultation with *market participants*. Such revised *import limits* shall be communicated by the *Authority* to the *EMC* and the *EMC* shall *publish* the revised *import limit*.
- 2.2.3 The *Authority* shall, prior to the *market commencement date*, establish an *export limit* for Singapore, which shall be a limit on the total net *energy* flows out of Singapore across all *connections*, including *interties*, from facilities outside of Singapore. The *export limit* shall be communicated by the *Authority* to the *EMC* and the *EMC* shall *publish* the *export limit*.
- 2.2.4 The *Authority* may, from time to time revise the *export limit* in consultation with *market participants*. Such revised *export limits* shall be communicated by the *Authority* to the *EMC* and the *EMC* shall *publish* the revised *export limit*.

2.3 CONSTRAINT VIOLATIONS

- 2.3.1 The *PSO* shall, prior to the *market commencement date* and in consultation with the *EMC* and the *rules change panel*, establish any *constraint violation costs*, except those specified in Appendix 6J, as the *EMC* determines may be required to ensure that the *market clearing engine* can always determine a solution.
- 2.3.2 The *PSO* shall, in consultation with the *rules change panel*, from time to time review the *constraint violation costs* referred to in section 2.3.1 and may, after any such review, alter their values.
- 2.3.3 A *constraint violation cost* established or altered by the *PSO* pursuant to section 2.3.1 or 2.3.2 may comprise a range of values to be applied in different circumstances in that their application may vary depending on the extent of the violation of a given constraint.
- 2.3.4 The *PSO* shall communicate the *constraint violation costs* established pursuant to section 2.3.1 and any alteration to their values made pursuant to section 2.3.2 to the *EMC*, and the *EMC* shall *publish* the values.

3 EMC RESPONSIBILITIES COMMENCING PRIOR TO MARKET COMMENCEMENT

3.1 MARKET NETWORK NODES

Explanatory Note: The Market Network Nodes (MNNs) represent those nodes at which market transactions take place. Thus a dispatch network node (DNN) with no load or generation will not be represented as a MNN. A MNN will be associated with each different schedulable resource to be settled. Thus if there are 5 different meters corresponding to different facilities at a dispatch network node then there will need to be 5 MNNs associated with that dispatch network node. While this feature has been defined to allow maximum generality, the fact that loads are settled at a single location (the SHUB) will mean that the distinction between MNNs and DNNs will be most relevant for generators.

- 3.1.1 The *EMC* shall define, prior to the *market commencement date*, and shall thereafter maintain and update as required, a set of *market network nodes* or *MNN* having the following characteristics:
- 3.1.1.1 at each *market network node* there shall be either a single *revenue quality meter* measuring all relevant flows into or out of that *market network node*, or a process by which the flows measured by one or more *revenue quality meters* can be transformed to determine the *deemed flow* at that *market network node*; and
 - 3.1.1.2 each *market network node* shall be associated with only one *market participant*.
- 3.1.2 Only one *market participant* shall, for *settlement* purposes, be assigned to and responsible for making or receiving *settlement amounts* in respect of the metered flow or the *deemed flow* at a given *MNN*.
- 3.1.3 The *EMC* shall, prior to the *market commencement date*:
- 3.1.3.1 establish the necessary parameters for relating *dispatch network nodes* and *market network nodes* to all *generation registered facilities* and *generation settlement facilities* in accordance with section D.7 of Appendix 6D;

- 3.1.3.2 develop software and procedures to perform the price transformations described in sections D.7 and D.24 of Appendix 6D; and
 - 3.1.3.3 *publish* the names of the *market network nodes*, the identity of the *revenue quality meter* assigned to each *market network node*;
- 3.1.4 and shall thereafter maintain and update as required the elements described in this section 3.1.3, including *publishing* changes to any information *published* pursuant to section 3.1.3.3.

3.2 FORECASTING SYSTEMS

- 3.2.1 The *EMC* shall, prior to the *market commencement date*, establish such systems and procedures, and train such staff, as may be necessary to allow the *EMC* to transform, on a regular basis as required by sections 7.2.1 and 9.1.1, *load* forecasts for Singapore received from the *PSO* for each *dispatch period* into *nodal load forecasts* for the same *dispatch period*.

3.3 MARKET CLEARING ENGINE

- 3.3.1 The *EMC* shall, prior to the *market commencement date*, develop, test, and implement the *market clearing engine*, which shall:
- 3.3.1.1 employ linear programming to maximise the net gains from trade between *market participants*, as defined by their *offers*, given the conditions and requirements assumed for any *dispatch period*;
 - 3.3.1.2 implement the formulation specified in Appendix 6D, employing such approximations as may be necessary to provide a sufficient approximation of physical reality for scheduling purposes within a linear programming framework;
 - 3.3.1.3 be capable of always producing a solution within a timeframe that allows the *EMC* and the *PSO* to perform their respective obligations under these *market rules* in a timely manner;

- 3.3.1.4 accept as input the data referred to in Appendix 6B;
- 3.3.1.5 produce *dispatch schedules* for each *dispatch period* containing the data referred to in section C.2 of Appendix 6C;
- 3.3.1.6 produce *price schedules* for each *dispatch period* containing the data referred to in sections C.3.1 of Appendix 6C; and
- 3.3.1.7 produce additional reports containing the data referred to in section C.4 of Appendix 6C.

3.4 DATA SUBMISSION PROCESS

- 3.4.1 The *EMC* shall, prior to the *market commencement date*, establish, *publish* in the applicable *market manual* and implement a process for the submission and validation of the following data:
 - 3.4.1.1 *standing offers* for *energy*, *reserve* and *regulation*;
 - 3.4.1.2 *offer variations* for *energy*, *reserve* and *regulation*; and
 - 3.4.1.3 *standing capability data*.

Explanatory Note: Standing offers and offer variations will be submitted and validated via computer without human intervention. Modifications to standing capability data will be quite infrequent and the data in question must be certified by the PSO, so this information will be entered manually by the EMC.

- 3.4.2 Validation by the *EMC* of *standing offers*, *offer variations* and *standing capability data* shall be limited to determining whether:
 - 3.4.2.1 they are in the form and contain the information required by the *market rules* and any applicable *market manual*;
 - 3.4.2.2 they are submitted in the manner and within the time prescribed by the *market rules* and any applicable *market manual*;
 - 3.4.2.3 in the case of *standing capability data*, it has been approved by the *PSO* in accordance with section 4.2; and
 - 3.4.2.4 in the case of *standing offers* and *offer variations*, they are in accordance with the corresponding *standing capability data* to the extent described in sections 5.2 to 5.4;

and the applicable *dispatch coordinator* shall be responsible for ensuring that such *standing offers*, *offer variations* and *standing capability data* comply with the *market rules* and all applicable *market manuals*.

3.5 ELECTRONIC COMMUNICATION SYSTEM

- 3.5.1 The *EMC* shall have an *electronic communications system* that allows for:
- 3.5.1.1 the submission of *standing offers* and *offer variations* by *dispatch coordinators*;
 - 3.5.1.2 the communication by the *EMC* to each *dispatch coordinator* of the acceptance or rejection of *standing offers* and *offer variations*;
 - 3.5.1.3 the issuance by the *EMC* of *market outlook scenarios*, *pre-dispatch schedule scenarios*, *short-term schedules* and *real-time dispatch schedules* and the associated pricing schedules,
- on a timely basis and in a manner consistent with these *market rules*.
- 3.5.2 The *EMC* shall *publish* in the applicable *market manual*:
- 3.5.2.1 the protocols and procedures for the use of the *electronic communications system*; and
 - 3.5.2.2 the method by which exchanges of the data referred to in section 3.5.1 shall be communicated in the event of a failure of the *electronic communications system*.

3A TIMETABLE

3A.1 TIMETABLE

- 3A.1.1 The *EMC*, the *PSO* and each *market participant* shall comply with the *market operations timetable* set out in Appendix 6A, unless the *market rules* allow otherwise.

4 STANDING CAPABILITY DATA

4.1 SUBMISSION

- 4.1.1 When a *market participant* applies to register a facility under section 5 of Chapter 2, it shall at the same time submit that facility's initial *standing capability data* to the *PSO* for approval.
- 4.1.2 If there is a change in the physical capability of a *registered facility*, its *dispatch coordinator* shall submit revised *standing capability data* as necessary to reflect the change, to the *PSO* for approval.
- 4.1.3 *Standing capability data* shall:
- 4.1.3.1 comply with the requirements of Appendix 6E;
 - 4.1.3.2 be submitted to the *PSO* in the form specified by the *system operation manual*; and
 - 4.1.3.3 in the case of revised *standing capability data*, be submitted to the *PSO* within the time specified by the *system operation manual*.
- 4.1.4 If the *PSO* requires a *dispatch coordinator* to provide revised *standing capability data* under section 9.6.5 of Chapter 5, it shall do so within the time specified by the *PSO*.

4.2 APPROVAL OR REJECTION

- 4.2.1 If any initial *standing capability data* submitted by a *market participant* or revised *standing capability data* submitted by a *dispatch coordinator* is:
- 4.2.1.1 approved by the *PSO*, the *PSO* shall forward the relevant *standing capability data* to the *EMC*; or
 - 4.2.1.2 rejected by the *PSO*, the *PSO* shall notify the *market participant* or the *dispatch coordinator* (as the case may be) of the rejection, with the reasons for the rejection.

4.3 RECEIPT

- 4.3.1 When the *EMC* receives approved *standing capability data* from the *PSO* under section 4.2.1.1, the *EMC* shall:
- 4.3.1.1 confirm receipt to the *PSO* and the *market participant* or *dispatch coordinator* who submitted the *standing capability data* (as the case may be) in the manner and within the time specified in the applicable *market manual*; and
 - 4.3.1.2 create or update, as applicable, its records of that relevant *standing capability data* to be used by the *market clearing engine* in accordance with the applicable *market manual*.
- 4.3.2 If a *market participant* or *dispatch coordinator* (as the case may be) does not receive confirmation of receipt of *standing capability data* under section 4.3.1.1, it must immediately notify the *EMC* in accordance with the applicable *market manual*.

4.4 HOW STANDING CAPABILITY DATA IS USED

- 4.4.1 The *EMC* shall use the *standing capability data* held in its records to produce *market schedules*.
- 4.4.2 For a given *dispatch period*, if a *registered facility*'s revised *standing capability data*:
- 4.4.2.1 is not communicated by the *PSO* to the *EMC* in time to allow the *EMC* to revise its records in accordance with section 4.3.1.2; or
 - 4.4.2.2 is rejected by the *PSO*,
- the *EMC* shall use that *registered facility*'s last approved *standing capability data* held in the *EMC*'s records to produce *market schedules* for that *dispatch period*.

5 ENERGY, RESERVE AND REGULATION OFFERS

5.1 OBLIGATION TO HAVE OFFERS

5.1.1 Each *generation registered facility* shall at all times have a valid *standing offer for energy* for each *dispatch period* of each day of the week.

5.1.2 If a *generation registered facility* is *registered* to provide:

5.1.2.1 *reserve* of a *reserve class*, it shall at all times have a valid *standing offer for reserve* of that *reserve class*; and

5.1.2.2 *regulation*, it shall at all times have a valid *standing offer for regulation*,

for each *dispatch period* of each day of the week.

5.1.3 If a *load registered facility* is *registered* to provide *reserve* of a *reserve class*, it shall at all times have a valid *standing offer for reserve* of that *reserve class* for each *dispatch period* of each day of the week.

5.1.4 A *dispatch coordinator* may revise a *standing offer* at any time.

Explanatory Note: The gate closure requirement in section 10.4 shall apply to the revision under section 5.1.4.
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5.1.5 For any *dispatch period* in the current *market outlook horizon*, if the quantity currently *offered* in a valid *offer* for a *registered facility* exceeds the relevant quantity that its *dispatch coordinator* reasonably expects to be available from the *registered facility* by more than:

5.1.5.1 10 MW; or

5.1.5.2 5 percent of the quantity currently *offered*,

whichever is greater, then that *dispatch coordinator* shall immediately submit an *offer variation* for that *registered facility* to the *EMC*.

5.1.6 For each *dispatch period* that a *registered facility* is not *synchronised* and until the earliest *dispatch period* in which it would be possible for that *registered facility* to be *synchronised*, its *dispatch coordinator* shall:

5.1.6.1 submit *offer variations* where there are existing *offer variations*; or

5.1.6.2 submit revised *standing offers* where there are no *offer variations*,

so that all the *offered* quantities are zero.

5.1.7 The *dispatch coordinator* of a *registered facility* shall, to the extent necessary for consistency with any *standing capability data* that is revised and approved under section 4, submit revised *standing offers* and *offer variations* that apply from the time that revised *standing capability data* takes effect.

5.2 FORM OF ENERGY OFFERS

5.2.1 Each *energy offer* is an *offer* to provide *energy* to the relevant *real-time market* by a *generation registered facility* at its *market network node* in a *dispatch period*.

5.2.2 Each *energy offer* shall state:

5.2.2.1 the identity of the *generation registered facility* that the *energy offer* is for;

5.2.2.2 if it is a *standing offer* or an *offer variation*;

5.2.2.3 the *dispatch period* that the *energy offer* is for;

5.2.2.4 between 1 to 10 *price-quantity pairs*. These shall be stated in increasing order of price;

5.2.2.5 the maximum combined capacity of the *generation registered facility* for *energy*, *reserve* and *regulation* for the *dispatch period*; and

Explanatory Note: Under normal circumstances, the maximum combined capacity under section 5.2.2.5 could be stated as at least equal to the highest maximum combined generation capacity and reserve capacity for any reserve class, indicated in that generation facility's standing capability data under section E.1.1.6 of Appendix 6E. (In such situations, the limits in the standing capability data will apply through sections D.9A.7.1 and D.9A.8.1 of Appendix 6D.)

If the market participant wishes to temporarily de-rate its generation facility for maintenance or other purposes, the maximum combined capacity under section 5.2.2.5 could be stated at a lower level. (In such situations, the stated maximum combined capacity will apply through sections D.9A.7.2 and D.9A.8.2 of Appendix 6D.)

- 5.2.2.6 the *energy* ramp-up rate and the *energy* ramp-down rate, which respectively imply the allowable increase and decrease in the output of the *generation registered facility* during the *dispatch period*.
- 5.2.3 The *generation registered facility* that the *energy offer* is for must be *registered* to provide *energy*.
- 5.2.4 The price in each *price-quantity pair* of an *energy offer* shall:
- 5.2.4.1 be expressed in \$/MWh to two decimal places;
- 5.2.4.2 not exceed the upper price limit specified in Appendix 6J; and
- 5.2.4.3 not be less than the lower price limit specified in Appendix 6J.
- 5.2.5 The quantity in each *price-quantity pair* of an *energy offer* shall be expressed in MW to one decimal place and shall not be less than 0.0 MW.
- 5.2.6 If the quantity in a *price-quantity pair* of an *energy offer* is 0.0 MW, the corresponding price shall be \$0.00/MWh.
- 5.2.7 The total of the quantities in all the *price-quantity pairs* of an *energy offer* for a *dispatch period* shall not exceed:
- 5.2.7.1 the maximum *generation capacity*, indicated in the relevant *generation registered facility's standing capability data* for that *dispatch period*;
- 5.2.7.2 the maximum quantity of *energy* that can be supplied in that *dispatch period* by that *generation registered facility*, as reasonably estimated by its *dispatch coordinator*; or
- 5.2.7.3 the maximum combined capacity of that *generation registered facility* for *energy, reserve and regulation* stated in the *energy offer* under section 5.2.2.5.

- 5.2.8 The maximum combined capacity of the *generation registered facility* for *energy*, *reserve* and *regulation* stated in an *energy offer* under section 5.2.2.5 shall be expressed in MW to one decimal place and not be less than 0.0 MW.
- 5.2.9 The *energy ramp-up rate* and the *energy ramp-down rate* stated in an *energy offer* shall each:
- 5.2.9.1 be expressed in MW/minute to one decimal place;
 - 5.2.9.2 not be less than 0.0 MW/minute; and
 - 5.2.9.3 not exceed respectively the maximum ramp-up rate and maximum ramp-down rate indicated in the relevant *generation registered facility's standing capability data*.

5.3 FORM OF RESERVE OFFERS

- 5.3.1 Each *reserve offer*:
- 5.3.1.1 is an *offer* to provide *reserve* to the relevant *real-time market* by a *generation registered facility* or a *load registered facility* in a *dispatch period*;
 - 5.3.1.2 applies only to one *reserve class*; and
 - 5.3.1.3 constitutes an *offer* to provide *reserve* within the *reserve provider group* to which the *generation registered facility* or the *load registered facility* (as the case may be) has been assigned by the *PSO* for that *reserve class*.
- 5.3.2 Each *reserve offer* shall state:
- 5.3.2.1 the identity of the *generation registered facility* or *load registered facility* that the *reserve offer* is for;
 - 5.3.2.2 if it is a *standing offer* or an *offer variation*;
 - 5.3.2.3 the *reserve class* that the *reserve offer* relates to;
 - 5.3.2.4 the *dispatch period* that the *reserve offer* is for;
 - 5.3.2.5 between 1 to 5 *price-quantity pairs*. These shall be stated in increasing order of price; and
 - 5.3.2.6 if the *reserve offer* is for a *generation registered facility*, a *reserve proportion*, which constrains the maximum *reserve*

that may be scheduled from that *generation registered facility* to a specified ratio of its *energy* scheduled.

- 5.3.3 The *generation registered facility* or *load registered facility* must be registered to provide *reserve* for the *reserve class* that its *reserve offer* is for.
- 5.3.4 The price in each *price-quantity pair* of a *reserve offer* shall:
- 5.3.4.1 be expressed in \$/MWh to two decimal places;
 - 5.3.4.2 not exceed the upper price limit for the applicable *reserve class* specified in Appendix 6J; and
 - 5.3.4.3 not be less than \$0.00/MWh.
- 5.3.5 The quantity in each *price-quantity pair* of a *reserve offer* shall be expressed in MW to one decimal place and must not be less than 0.0 MW.
- 5.3.6 If the quantity in a *price-quantity pair* of a *reserve offer* is 0.0 MW, the corresponding price shall be \$0.00/MWh.
- 5.3.7 The total of the quantities in all the *price-quantity pairs* of a *reserve offer* of a *dispatch period* shall not exceed:
- 5.3.7.1 the maximum *reserve capacity* for that *reserve class*, indicated in the relevant *generation registered facility* or *load registered facility*'s *standing capability data* for that *dispatch period*; or
 - 5.3.7.2 the maximum quantity of *reserve* that can be supplied for that *reserve class* in that *dispatch period* by that *generation registered facility* or *load registered facility*, as reasonably estimated by its *dispatch coordinator*.
- 5.3.8 The *dispatch coordinator* shall state in a *reserve offer* the *reserve proportion* that minimises the likelihood of the *generation registered facility* being scheduled to provide more *reserve* than it can reliably provide at any given level of scheduled *energy*.
- 5.3.9 The *reserve proportion* stated in a *reserve offer* shall:
- 5.3.9.1 not be less than zero; and
 - 5.3.9.2 not exceed the *reserve proportion* indicated in the relevant *generation registered facility*'s *standing capability data*.

5.4 FORM OF REGULATION OFFERS

- 5.4.1 Each *regulation offer* is an *offer* to provide *regulation* to the relevant *real-time market* by a *generation registered facility* in a *dispatch period*.
- 5.4.2 The *EMC* shall use a *regulation offer* of a *generation registered facility* to produce *market schedules* only if it is *synchronised* and its forecast generation level at the beginning of that *dispatch period* indicates that it is able to provide *regulation*.
- 5.4.3 Each *regulation offer* shall state:
- 5.4.3.1 the identity of the *generation registered facility* that the *regulation offer* is for;
 - 5.4.3.2 if it is a *standing offer* or an *offer variation*;
 - 5.4.3.3 the *dispatch period* that the *regulation offer* is for; and
 - 5.4.3.4 between 1 to 5 *price-quantity pairs*. These shall be stated in increasing order of price.
- 5.4.4 The *generation registered facility* that the *regulation offer* is for must be *registered* to provide *regulation*.
- 5.4.5 The price in each *price-quantity pair* of a *regulation offer* shall:
- 5.4.5.1 be expressed in \$/MWh to two decimal places;
 - 5.4.5.2 not exceed the upper price limit specified in Appendix 6J; and
 - 5.4.5.3 not be less than \$0.00/MWh.
- 5.4.6 The quantity in each *price-quantity pair* of a *regulation offer* shall be expressed in MW to one decimal place and shall not be less than 0.0 MW.
- 5.4.7 If the quantity in a *price-quantity pair* of a *regulation offer* is 0.0 MW, the corresponding price shall be \$0.00/MWh.
- 5.4.8 The total of the quantities in all the *price-quantity pairs* of a *regulation offer* shall represent both the maximum increase and the maximum decrease in *energy* output that the relevant *generation registered facility* can achieve for the purpose of providing *regulation*. The total of the

quantities in all the *price-quantity pairs* of a *regulation offer* of a *dispatch period* shall not exceed:

- 5.4.8.1 the maximum *regulation capacity*, indicated in that *generation registered facility's standing capability data* for that *dispatch period*; or
- 5.4.8.2 the maximum quantity of *regulation* that can be supplied in that *dispatch period* by that *generation registered facility*, as reasonably estimated by its *dispatch coordinator*.

5.5 COMMUNICATION OF OFFERS

- 5.5.1 Each *offer* shall:
 - 5.5.1.1 be submitted using the forms, procedures and data formats prescribed in the applicable *market manual*; and
 - 5.5.1.2 comply with the requirements in section 5.2, 5.3 or 5.4; and
 - 5.5.1.3 be submitted to the *EMC* by the applicable *dispatch coordinator* via the *electronic communications system* or in accordance with section 3.5.2.2.

5.6 RECEIPT OF OFFERS

- 5.6.1 When the *EMC* receives any *offer*, it shall:
 - 5.6.1.1 stamp the *offer* with the time that it was received;
 - 5.6.1.2 within five minutes, confirm receipt of the *offer*; and
 - 5.6.1.3 within five minutes, validate the *offer* in accordance with section 5.7.1 and release information indicating that the *offer* has been:
 - a. accepted as valid; or
 - b. rejected, with reasons for the rejection.

- 5.6.2 If a *dispatch coordinator* does not receive confirmation of receipt or information of the acceptance or rejection of an *offer* from the *EMC* in accordance with section 5.6.1, it shall immediately inform the *EMC*. If the problem lies with the *EMC*'s communications systems, the *EMC* shall take steps to rectify the problem as soon as possible.
- 5.6.3 For a given *registered facility*, if any revised *standing offer* or *offer variation*:
- 5.6.3.1 is not communicated to the *EMC*, or
- 5.6.3.2 is rejected by the *EMC*,
- the last accepted valid *standing offer* for the relevant *dispatch period* shall apply. However, if that *registered facility* has a last accepted valid *offer variation* for that *dispatch period*, that *offer variation* shall apply instead.

5.7 VALIDATION OF OFFERS

- 5.7.1 The *EMC* shall determine if each *offer*:
- 5.7.1.1 complies with the *market manual* referred to in section 3.4.1; and
- 5.7.1.2 complies with the requirements in section 5.2, 5.3 or 5.4.

If an *offer* satisfies both conditions, the *EMC* shall accept the *offer* as valid. If not, the *EMC* shall reject the *offer*.

5.8 HOW OFFERS ARE USED

- 5.8.1 All *offers* shall, if accepted as valid by the *EMC*, be stored by the *EMC*.
- 5.8.2 Subject to sections 5.8.3 and 5.8.4, the *EMC* shall use the last accepted valid *standing offer*, except that, if there is a last accepted valid *offer variation*, the *EMC* shall use that *offer variation* instead, to produce *market schedules* for the applicable *dispatch period*.
- 5.8.3 If an *offer* for a *dispatch period* was accepted as valid less than five minutes before the production of a *market schedule* containing that *dispatch period*, that *offer* is not guaranteed to be used by the *EMC* in the production of that *market schedule*.
- 5.8.4 If an *offer variation* for a *dispatch period* was submitted after that *dispatch period* had begun, the *EMC* shall not use that *offer variation* in the production of any *market schedule* containing that *dispatch period*.

6 PSO RESPONSIBILITIES WITHIN THE MARKET OUTLOOK HORIZON

6.1 MARKET OUTLOOK HORIZON DATA

6.1.1 The *PSO* shall, on each *dispatch day* and in accordance with the *market operations timetable*:

6.1.1.1 conduct such studies as may be necessary to determine the appropriate parameters to be used as inputs to the *market clearing engine* for each *dispatch period* in the current *market outlook horizon*;

6.1.1.2 determine or update, as the case may be, the *dispatch related data* referred to in Appendix 6G for each *dispatch period* in the *market outlook horizon*; and

6.1.1.3 communicate the *dispatch related data* referred to in section 6.1.1.2 to the *EMC*.

7 EMC RESPONSIBILITIES WITHIN THE MARKET OUTLOOK HORIZON

7.1 TERMINOLOGY AND PURPOSE

- 7.1.1 The *market outlook horizon* is, at any given point in time, the period running continuously from that point in time to the end of the sixth *dispatch day* thereafter.
- 7.1.2 The *pre-dispatch horizon* shall:
- 7.1.2.1 at any given time before 12:00 hours on a given *dispatch day*, cover all *dispatch periods* commencing at the end of the current *dispatch period* and ending following the end of the last *dispatch period* of the current *dispatch day*; and
 - 7.1.2.2 at any given time at or after 12:00 hours on a given *dispatch day*, cover all *dispatch periods* commencing at the end of the current *dispatch period* and ending following the end of the last *dispatch period* of the *dispatch day* following the current *dispatch day*.
- 7.1.2A The *short-term horizon* shall, at any given point in time, cover twelve consecutive *dispatch periods* commencing immediately after the end of the current *dispatch period*.
- 7.1.3 The *EMC* shall determine *market outlook scenarios*, *pre-dispatch schedule scenarios* and *short-term schedules* in order to provide itself, the *PSO* and *market participants* with advance information and projections necessary to plan the physical operation of the *PSO controlled system* and *registered facilities* and to manage *load* over the *market outlook horizon*.

7.2 LOAD FORECASTING

- 7.2.1 The *EMC* shall prepare and update, on the basis of the data received from the *PSO* pursuant to section 6.1.1.3 and in accordance with section 7.2.2, the following three *nodal load forecasts* covering the remainder of the current *market outlook horizon*:
- 7.2.1.1 a normal *load forecast*, being based on the expected system *load forecast* provided by the *PSO* pursuant to section 6.1.1.3;

- 7.2.1.2 a low forecast, being based on the expected system *load* forecast referred to in section 7.2.1.1 less the load sensitivity factor; and
- 7.2.1.3 a high forecast, being based on the expected system *load* forecast referred to in section 7.2.1.1 plus the load sensitivity factor;

where the load sensitivity factor shall be a fixed MW quantity determined and *published* by the *EMC* from time to time.

Explanatory Note: If the demand forecast was for 5000 MW and the load sensitivity factor was 600 MW then we would have load scenarios for 4400 MW, 5000 MW, 5600 MW. The MCE will be solved with the 4400 MW, 5000 MW and 5600 MW loads for market outlook scenarios and pre-dispatch schedule scenarios. The results of these scenarios give participants some idea as to how the schedules will differ if the load differs from the expected value. However, for the short-term schedules, the MCE will only solve with the 5000MW demand forecast (i.e. the normal load forecast).

- 7.2.2 The *nodal load forecasts* described in section 7.2.1, comprising a forecast of *load* for each *dispatch network node* for the relevant *dispatch period*, shall be prepared by applying the *load* participation factors to the forecast of *non-dispatchable load* provided by the *PSO* in accordance with section G.2.1 of Appendix 6G. The *load* participation factor for a given *dispatch period* shall be determined by the *EMC* using *load* disposition for similar days and similar *dispatch periods*. *Load* disposition shall be determined by the *EMC* using the data provided by the *PSO* pursuant to section G.2.3 of Appendix 6G or historical *metering data*, as the *EMC* deems appropriate. The *load* participation factors for all *dispatch network nodes* for a given *dispatch period* shall sum to one. The methodology, including revisions thereof, for determining the *load* participation factors shall be *published* by the *EMC*.

Explanatory Note: The phrase “load disposition for similar days and similar dispatch periods” is explained in the aforesaid published methodology.

- 7.2.3 In the event that the *PSO* forecasts a shortfall of *energy* in accordance with section G.2.2 of Appendix 6G for any *dispatch period* within the first two hours of the *market outlook horizon*, the *EMC* shall immediately adjust the *nodal load forecasts* described in section 7.2.1 for the corresponding *dispatch periods* to reflect the shortfall quantities and locations specified by the *PSO*.
- 7.2.4 Notwithstanding section 13 of Chapter 1, no *market participant* shall be entitled to compensation from the *EMC* or the *PSO* for any financial loss sustained by the *market participant* due to the *market participant* having

been *dispatched* on the basis of *load* as forecasted pursuant to this section 7 rather than on the basis of actual *load*.

7.3 DETERMINING MARKET OUTLOOK SCENARIOS

- 7.3.1 The *EMC* shall, in accordance with section 7.6 and Appendix 6A, determine three *market outlook scenarios* corresponding to the *nodal load forecasts* described in sections 7.2.1, adjusted where applicable under section 7.2.3.
- 7.3.2 Each *market outlook scenario* shall include all *dispatch periods* between the end of the *pre-dispatch horizon* current at the time when the *market outlook scenario* is due to be released and the end of the *market outlook horizon* current at the time when the *market outlook scenario* is due to be released in accordance with section 7.7.1.

7.4 DETERMINING PRE-DISPATCH SCHEDULE SCENARIOS

- 7.4.1 The *EMC* shall, in accordance with section 7.6 and Appendix 6A, determine three *pre-dispatch schedule scenarios* corresponding to the *nodal load forecast* described in sections 7.2.1, adjusted where applicable under section 7.2.3.
- 7.4.2 Each *pre-dispatch schedule scenario* shall include all *dispatch periods* in the *pre-dispatch horizon* current at the time when the *pre-dispatch schedule scenario* is due to be released in accordance with section 7.7.2.

Explanatory Note: This means that the pre-dispatch schedule will always cover at least 12 hours and not more than 36 hours of time. Before noon it will cover the period up to the end of the current dispatch day, and after noon will cover the period up to the end of the next dispatch day. The market outlook scenario will cover the remaining 6 days to the end of the market outlook horizon.

7.4A DETERMINING SHORT-TERM SCHEDULE

- 7.4A.1 The *EMC* shall, in accordance with section 7.6 and Appendix 6A, determine a *short-term schedule* corresponding to the *nodal load forecast* described in section 7.2.1.1.
- 7.4A.2 The *short-term schedule* shall include all *dispatch periods* in the *short-term horizon* current at the time when the *short-term schedule* is due to be released in accordance with section 7.7.2A.

Explanatory Note: The short-term schedule will always cover 12 consecutive dispatch periods.

7.5 INFORMATION USED IN EACH SCENARIO OR SCHEDULE

- 7.5.1 The *EMC* shall use the following information to determine and revise each of the scenarios referred to in sections 7.3, 7.4 and 7.4A using the most current valid information:
- 7.5.1.1 *offers* for the relevant *dispatch period* held by the *EMC*;
 - 7.5.1.2 *standing capability data* as applicable to each *dispatch period* represented within the *short-term horizon*, *pre-dispatch horizon* and the *market outlook horizon*, as the case may be, held by the *EMC*;
 - 7.5.1.3 the applicable *nodal load forecasts* referred to in section 7.3.1, 7.4.1 or 7.4A.1, as the case may be;
 - 7.5.1.4 the *dispatch related data* referred to in section 6.1.1.3 received from the *PSO*;
 - 7.5.1.5 the initial loading of each *generation facility*, determined:
 - a. in the case of each *market outlook scenario*, on the basis of the end of the last *dispatch period* represented in the most recently *published pre-dispatch schedule* which was determined using the same *nodal load forecast* and that contains the applicable *dispatch period*; and
 - b. in the case of each *pre-dispatch schedule scenario*, on the basis of the later of the *real-time dispatch schedule* for the period after the current *dispatch period* (if available) and the *real-time dispatch schedule* for the current *dispatch period*;
 - 7.5.1.6 the *import limit* and *export limit*;
 - 7.5.1.7 the applicable price limits from Appendix 6J; and
 - 7.5.1.8 such other parameters or data as may be required to enable the *market clearing engine* to determine the required outputs.

7.6 SOLVING EACH SCENARIO OR SCHEDULE

7.6.1 The EMC shall determine and revise as required each *market outlook scenario*, *pre-dispatch schedule scenario* and *short-term schedule* by sequentially running the *market clearing engine* for each *dispatch period* specified in section 7.3.2, 7.4.2 or 7.4A.2, as the case may be, using the information described in section 7.5.

7.6.1A When preparing each *pre-dispatch schedule scenario*, the *market clearing engine* shall be run for each *dispatch period* from the end of the relevant *dispatch period* for which the *real-time dispatch schedule* used in Section 7.5.1.5(b) applies, until the end of the *pre-dispatch horizon* to which such *pre-dispatch schedule scenario* relates.

Explanatory note: This means that for pre-dispatch schedules, the market clearing engine is always run from the best current estimates of data. However, when reporting the actual schedule, only the dispatch periods in the schedule are reported – the initial periods that are run in order to get to the start of the pre-dispatch horizon are not reported.

7.6.1B When preparing each *short-term schedule*, the *market clearing engine* shall be run for each *dispatch period* from the end of the current *dispatch period*, until the end of the *short-term horizon* to which such *short-term schedule* relates.

Explanatory note: This means that for the short-term schedule, the market clearing engine is always run from the best current estimates of data. However, when reporting the actual schedule, only the dispatch periods in the short-term horizon are reported – the initial period that is run in order to get to the start of the short-term horizon is not reported.

7.6.2 In determining the *scenarios* referred to in section 7.6.1, each *dispatch period* shall be assumed to be independent of the others except that:

7.6.2.1 subject to section 7.6.2.2, the initial loading of each *generation facility* for each *dispatch period* shall be set equal to the value determined for the end of the preceding *dispatch period* for the relevant *nodal load forecast*; and

7.6.2.2 the initial loading of each *generation facility* for the first *dispatch period* shall be set in accordance with section 7.5.1.5 for the relevant *nodal load forecast*.

7.7 RELEASE OF SCENARIO INFORMATION

- 7.7.1 By 9:00 hours of each *dispatch day* the *EMC* shall, for each *dispatch period* covered by each of the three *market outlook scenarios* referred to in section 7.3.1:
- 7.7.1.1 release to the *dispatch coordinator* for each *registered facility* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for that *registered facility*;
 - 7.7.1.2 *publish* the information described in section 7.7.3; and
 - 7.7.1.3 communicate to the *PSO* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for each *registered facility*, together with the information described in section 7.7.3, in accordance with the *system operation manual* and any applicable *market manual*.
- 7.7.2 Not later than 15 minutes prior to the commencement of the first *dispatch period* of each of the three *pre-dispatch schedule scenarios* referred to in section 7.4.1, the *EMC* shall, for each *dispatch period* included in each of those three *pre-dispatch schedule scenarios*:
- 7.7.2.1 release to the *dispatch coordinator* for each *registered facility* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for that *registered facility*;
 - 7.7.2.2 *publish* the information described in section 7.7.3; and
 - 7.7.2.3 communicate to the *PSO* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for each *registered facility*, together with the information described in section 7.7.3, in accordance with the *system operation manual* and any applicable *market manual*.
- 7.7.2A Not later than 25 minutes prior to the commencement of the first *dispatch period* of the *short-term schedule* referred to in section 7.4A, the *EMC* shall, for each *dispatch period* included in the *short-term schedule*:
- 7.7.2A.1 release to the *dispatch coordinator* for each *registered facility* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for that *registered facility*;
 - 7.7.2A.2 *publish* the information described in section 7.7.3; and
 - 7.7.2A.3 communicate to the *PSO* the projected schedules for *energy, regulation* and *reserve*, by *reserve class*, for each

registered facility, together with the information described in section 7.7.3, in accordance with the *system operation manual* and any applicable *market manual*.

- 7.7.3 In accordance with sections 7.7.1, 7.7.2 and 7.7.2A, the *EMC* shall *publish* the following information for each *dispatch period* and for each *market outlook scenario*, *pre-dispatch schedule scenario* and *short-term schedule*:
- 7.7.3.1 the projected total *load*;
 - 7.7.3.2 the projected total transmission losses;
 - 7.7.3.3 total *reserve* requirements by *reserve class*;
 - 7.7.3.4 total *regulation* requirements;
 - 7.7.3.5 projected *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;
 - 7.7.3.6 the projected *uniform Singapore energy price*, determined in accordance with section D.24.6 of Appendix 6D;
 - 7.7.3.7 projected *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;
 - 7.7.3.8 projected *regulation prices*, determined in accordance with sections D.24.4 and D.24.5 of Appendix 6D;
 - 7.7.3.9 any predicted system *energy* shortfalls;
 - 7.7.3.10 any predicted system *reserve* shortfalls, by *reserve class*;
 - 7.7.3.11 any predicted system *regulation* shortfalls; and
 - 7.7.3.12 a list of *security constraints* and *generation fixing constraints* applied.
- 7.7.4 The *market outlook scenarios*, *pre-dispatch schedule scenarios* and *short-term schedules* reflect indicative forecasts which are released for information purposes only and are not binding on the *EMC*, the *PSO* or any *market participant*.

8 PSO RESPONSIBILITIES IN REAL TIME

8.1 PREPARATION FOR REAL-TIME DISPATCH

8.1.1 The *PSO* shall, prior to each *dispatch period* and in accordance with the *market operations timetable*, take the following actions so as to keep *dispatch related data* current and available for the *EMC*:

8.1.1.1 conduct such studies as may be necessary to determine the appropriate parameters to be used as inputs to the *market clearing engine* for the upcoming *dispatch period*;

8.1.1.2 determine or update, as the case may be, the *dispatch related data* referred to in Appendix 6G for the *dispatch period*; and

8.1.1.3 communicate the *dispatch related data* referred to in section 8.1.1.2 to the *EMC*.

8.1.2 In accordance with section 9.1.2 of Chapter 5, any *real-time dispatch schedule* received from the *EMC* 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.

9 EMC RESPONSIBILITIES IN REAL TIME

9.1 PREPARATION FOR REAL-TIME DISPATCH

- 9.1.1 The *EMC* shall for each *dispatch period* and in accordance with the *market operations timetable*:
- 9.1.1.1 revise as required the most current *nodal load forecast* referred to in section 7.2.1.1 on the basis of information received from the *PSO* pursuant to section 8.1.1.3; and
 - 9.1.1.2 determine and communicate *real-time dispatch schedules* in accordance with section 9.2.
- 9.1.2 In the event that the *PSO* forecasts a shortfall of *energy* in accordance with section G.2.2 of Appendix 6G for any *dispatch period* within the first two hours of the market outlook horizon, the *EMC* shall immediately adjust the *nodal load forecasts* described in section 7.2.1.1 for the corresponding *dispatch periods* to reflect the shortfall quantities and locations specified by the *PSO*.
- 9.1.3 Notwithstanding section 13 of Chapter 1, no *market participant* shall be entitled to compensation from the *EMC* or the *PSO* for any financial loss sustained by the *market participant* due to the *market participant* having been *dispatched* on the basis of *load* as forecasted pursuant to this section 9 rather than on the basis of actual *load*.

9.2 THE REAL-TIME SCHEDULING PROCESS

- 9.2.1 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*.
- 9.2.2 The *EMC* shall use the following information to determine the *real-time dispatch schedule* and *real-time pricing schedule* described in section 9.2.1 using the most current valid information:
- 9.2.2.1 *offers* for the relevant *dispatch period* held by the *EMC*;
- 9.2.2.2 *standing capability data* for the relevant *dispatch period* held by the *EMC*;
- 9.2.2.3 the *nodal load forecast* referred to in section 9.1.1.1, adjusted where applicable under section 9.1.2;
- 9.2.2.4 the *dispatch related data* referred to in section 8.1.1.3 received from the *PSO*;
- 9.2.2.5 the *import* and *export limits*;
- 9.2.2.6 the applicable price limits from Appendix 6J; and
- 9.2.2.7 such other parameters or data as may be required to enable the *market clearing engine* to determine the required outputs.
- 9.2.3 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.

- 9.2.4 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.
- 9.2.5 The quantities specified in a *real-time dispatch schedule* shall be considered firm in the sense that:
- 9.2.5.1 they are deemed to be the *dispatch instructions* for each *registered facility* unless and until further *dispatch instructions* are issued by the *PSO* to the *dispatch coordinator* for a given *registered facility* pursuant to section 9.1.3 of Chapter 5;
 - 9.2.5.2 *market participants* shall comply with the *dispatch instructions* referred to in section 9.2.5.1 unless forced to deviate from those *dispatch instructions* under the

conditions referred to in and to the extent permitted by section 9.6 of Chapter 5.

- 9.2.6 In the event the *market clearing engine* fails to produce any *real-time pricing schedule* for a particular *dispatch period* for any reason other than due to the suspension of *real time market*, then the *EMC* shall issue a price revision *advisory notice* in accordance with 9.3.2B as if for provisional prices confirmed to be subject to revision. In such circumstances, the prices for the affected *dispatch period* for which no *real-time pricing schedule* was produced shall be determined in accordance with the provisions of section 10.2.

9.3 MARKET ADVISORIES

- 9.3.1 The *EMC* shall issue, as soon as practicable and in such manner as will provide adequate notice, using electronic means or in the case where electronic means are not available, by any other means it considers suitable, *advisory notices* pertaining to the incidence and extent of any of the following events for any *dispatch period* included in the current *market outlook horizon* in respect of which such event is indicated by the *market outlook scenarios*, *pre-dispatch schedule scenarios* and *short-term schedule* described in sections 7.3, 7.4 and 7.4A respectively, and containing the applicable information described in Appendix 6H:
- 9.3.1.1 any *energy* surplus;
 - 9.3.1.2 any *energy* shortfalls;
 - 9.3.1.3 any *reserve* shortfalls, by *reserve class*; and
 - 9.3.1.4 any *regulation* shortfalls.
- 9.3.2 The *EMC* shall issue, as soon as practicable and in such manner as will provide adequate notice, using electronic means, or in the case where electronic means are not available, by any other means it considers suitable, and containing the applicable information described in Appendix 6H:
- 9.3.2.1 system status *advisory notices* for the current *dispatch period*, any *dispatch period* of the current *short-term horizon* or any *dispatch period* of the current *pre-dispatch horizon* in respect of which it has been informed by the *PSO* that a major equipment *outage*, *load shedding* or other abnormal condition on the *PSO controlled system* that the *PSO* considers material is occurring or is likely to occur;

- 9.3.2.2 communications warning *advisory notices* for the current *dispatch period*, any *dispatch period* of the current *short-term horizon* or any *dispatch period* of the current *pre-dispatch horizon* in respect of which *market participants* are experiencing, or the *EMC* considers that there is a significant probability that *market participants* will experience, difficulties in delivering communications to, or receiving communications from, the *EMC*, or that the *EMC* will experience, difficulties in delivering communications to, or receiving communications from, the *PSO*; and
- 9.3.2.3 price warning *advisory notices* for the current *dispatch period*, any *dispatch period* of the current *short-term horizon*, any *dispatch period* of the *pre-dispatch horizon* or any *dispatch period* of the *market outlook horizon* for which the prices calculated or released to *market participants* may be subject to revision.
- 9.3.2A The *EMC* shall provide confirmation by 12.00 noon each day, in such manner as will provide adequate notice, using electronic means, or in the case where electronic means are not available, by any other means it considers suitable, as to whether prices determined for the previous *dispatch day* are final or provisional. Provisional prices may be subject to revision.
- 9.3.2B For provisional prices which are confirmed to be subject to revision, and where section 9.3.2C does not apply, the *EMC* shall issue, as soon as possible but no later than 2 *business days* prior to the time at which the *preliminary settlement statements* for the relevant *dispatch day* must be issued in accordance with section 5.2.1 of Chapter 7, price revision *advisory notices* for the relevant *dispatch day* in such manner as will provide adequate notice, using electronic means, or in the case where electronic means are not available, by any other means it considers suitable, and containing the applicable information in Appendix 6H. Provisional prices in respect of which no such price revision advisory notices are issued by the deadline stipulated above shall be deemed final.
- 9.3.2C Where *constraint violation costs* have been applied by the *market clearing engine* in accordance with section D.16 of Appendix 6D in respect of any *dispatch period*, the *EMC* shall declare the prices for that *dispatch period* to be provisional in accordance with section 9.3.2A.
- 9.3.2D Where prices in respect of any *dispatch period* have been declared to be provisional pursuant to section 9.3.2C, the *EMC* shall request that the *PSO* confirm whether or not *load shedding* had occurred during that *dispatch period* and provide to the *EMC* the maximum actual line flow values of such lines as identified by the *EMC* for that *dispatch period*.

- 9.3.2E If the *PSO* confirms that *load shedding* had not occurred in the *dispatch period* referred to in section 9.3.2D, the *EMC* shall issue a price revision *advisory notice* for that *dispatch period* no later than 2 *business days* prior to the time at which the *preliminary settlement statements* for the relevant *dispatch day* must be issued in accordance with section 5.2.1 of Chapter 7, in such manner as will provide adequate notice, using electronic means, or in the case where electronic means are not available, by any other means it considers suitable, and containing the applicable information in Appendix 6H. Provisional prices in respect of which no such price revision *advisory notices* are issued by the deadline stipulated above shall be deemed final.
- 9.3.3 The *EMC* shall, as soon as practicable, withdraw any of the *advisory notices* referred to in sections 9.3.1 and 9.3.2.1 to 9.3.2.3 and issued in respect of a *dispatch period* to the extent that the conditions referred to in such *advisory notices* are no longer or are expected to no longer be applicable to such *dispatch period*.
- 9.3.4 [Deleted and Intentionally Left Blank]
- 9.3.5 [Deleted and Intentionally Left Blank]
- 9.3.6 Where the *EMC* issues a communications warning *advisory notice* pursuant to section 9.3.2.3, it shall use all reasonable endeavours to promptly restore communications, establish alternative means of communication or avoid the communications problem anticipated in the *advisory notice*, as the case may be.

10 EMC RESPONSIBILITIES AFTER EACH DISPATCH PERIOD

10.1 FINALISING SETTLEMENT DATA

10.1.1 The *EMC* shall, in accordance with section 10.2 and the *market operations timetable*, determine final prices and quantities for *energy*, *reserve* and *regulation* that are to be used for *settlement* purposes in accordance with Chapter 7.

10.2 DETERMINING SETTLEMENT PRICE DATA

10.2.1 The *EMC* shall, for *settlement* purposes, use the following price data, determined in accordance with section D.24 of Appendix 6D and, where applicable, sections 10.2.2 and 10.2.3:

10.2.1.1 the *market energy price* or *MEP* for each *market network node*;

10.2.1.2 the *uniform Singapore energy price*;

10.2.1.3 the *market reserve price* or *MRP* for each *reserve provider group*; and

10.2.1.4 the *market regulation price* or *MFP*.

10.2.2 If a price revision *advisory notice* for a *dispatch period* is not in effect at beginning of the *dispatch period*, the *EMC* shall use prices taken from the *real-time pricing schedule* described in section 9.2.1.2 for that *dispatch period*, whether or not produced in accordance with the *market operations timetable*, as and for the *settlement* data described in section 10.2.1 for that *dispatch period*, unless and until a price revision *advisory notice* is later issued by the *EMC* for that *dispatch period* under section 9.3.2B or section 9.3.2E, in which case the *settlement* data described in section 10.2.1 shall be determined in accordance with section 10.2.3 or section 10.2.3A as appropriate.

10.2.3 If a price revision *advisory notice* is issued by the *EMC* under section 9.3.2B in respect of a *dispatch period*:

10.2.3.1 and if an *energy shortfall advisory notice* was in effect at the beginning of that *dispatch period*, the *EMC* shall use the process described in sections 10.2.7 to 10.2.8 to determine

- the *settlement* data described in section 10.2.1 for that *dispatch period*; and
- 10.2.3.2 in all other cases, the *EMC* shall use the process described in section 10.2.4 to determine the *settlement* data described in section 10.2.1 for that *dispatch period*.
- 10.2.3A If a price revision *advisory notice* is issued by the *EMC* under section 9.3.2E in respect of a *dispatch period* and:
- 10.2.3A.1 if the *EMC* has received the maximum actual line flow values requested from the *PSO* under section 9.3.2D, the *EMC* shall use the process described in section 10.2.4A to determine the settlement data described in section 10.2.1 for that *dispatch period*; and
- 10.2.3A.2 if the *EMC* has not received the maximum actual line flow values requested from the *PSO* under section 9.3.2D, the *EMC* shall determine *settlement* data referred to in section 10.2.1 for that *dispatch period* by re-running the *market clearing engine* with the application of section D.16.4 of Appendix 6D.
- 10.2.4 Where section 10.2.3.2 applies, the *EMC* shall, as soon as possible but no later than 1 *business day* prior to the time at which the *preliminary settlement statements* for the relevant *dispatch day* must be issued in accordance with section 5.2.1 of Chapter 7, calculate in accordance with sections 10.2.5 and 10.2.6 and *publish* revised values of the *settlement* data described in section 10.2.1 to be used for *settlement* purposes for that *dispatch period*.
- 10.2.4A Where section 10.2.3A.1 applies, the *EMC* shall, as soon as possible but no later than 1 *business day* prior to the time at which the *preliminary settlement statements* for the relevant *dispatch day* must be issued in accordance with section 5.2.1 of Chapter 7, calculate in accordance with sections 10.2.5A and 10.2.5B and *publish* revised values of the *settlement* data described in section 10.2.1 to be used for *settlement* purposes for that *dispatch period*.
- 10.2.5 The revised values referred to in section 10.2.4 shall, if possible, be determined by re-running the *market clearing engine* for the *dispatch period* using all the input data that should have been supplied to the *market clearing engine* at the time the *real-time dispatch schedule* for that *dispatch period* would normally have been produced.
- 10.2.5A The revised values referred to in section 10.2.4A shall, if possible, be determined by re-running the *market clearing engine* for that *dispatch period* using the maximum actual line flow values provided by the *PSO*

under section 9.8.2 of Chapter 5 and applying the rest of the input data that have been supplied to the *market clearing engine* at the time the *real-time dispatch schedule* for that *dispatch period* would normally have been produced.

10.2.5B If any *constraint violation costs*, including the *constraint violation costs* referred to in section 9.3.2C, are still present in the revised values determined after re-running the *market clearing engine* in accordance with section 10.2.5A, the *EMC* shall determine *settlement* data referred to in section 10.2.1 by re-running the *market clearing engine* with the application of Section D.16.4 of Appendix 6D.

10.2.6 If it is not possible to re-run the *market clearing engine* in accordance with section 10.2.5 or section 10.2.8, the *settlement* data described in section 10.2.1 shall be determined for that *dispatch period* as being equal to the average of the *settlement* prices for the *dispatch period* corresponding to the time of the day of that *dispatch day* over the 30 days immediately preceding that *dispatch day* unless:

10.2.6.1 *load shedding* occurred during the *dispatch period* for which *settlement* data is being determined under this section 10.2.6, in which case each of *MEP* and the *uniform Singapore energy price* shall equal the *energy price ceiling*;
or

10.2.6.2 any *settlement* data calculated as the average referred to above exceeds the applicable upper limit described in Appendix 6J, then that *settlement* data shall be set to that upper limit.

- 10.2.7 Where section 10.2.3.1 applies, the *EMC* shall use its best endeavours to calculate and *publish*, as soon as possible but no later than 1 *business day* prior to the time at which the *preliminary settlement statements* for the relevant *dispatch day* must be issued in accordance with section 5.2.1 of Chapter 7, revised values of the *settlement* data described in section 10.2.1 in accordance with section 10.2.8 to be used for *settlement* purposes for that *dispatch period*.
- 10.2.8 The revised values described in section 10.2.7 shall be determined by re-running the *market clearing engine* for the *dispatch period* using the same input data as was used in preparing the *real-time schedules* described in section 9.2.1, except that the *nodal load forecast* used shall be the *nodal load forecast* determined without any adjustment for any *energy* shortfall referred to in section 9.1.2. If it is not possible to re-run the *market clearing engine* the *EMC* shall determine the *settlement* data described in section 10.2.1 in accordance with section 10.2.6.

Explanatory Note: This means that the revised MCE solution is an analysis of “what might have happened” if the load shedding perfectly matched the available capacity. Load shedding in practice generally occurs in large blocks of load, so that the load shed may not match the shortfall in capacity exactly.

- 10.2.9 Where the *EMC* determines revised values pursuant to section 10.2.8, the *EMC* shall also calculate, in accordance with Appendix 6I, compensation payments for *market participants* with *generation registered facilities* that were scheduled to produce less *energy* in the *real-time dispatch schedule* described in section 9.2.1 than in the revised *real-time dispatch schedule* produced by re-running the *market clearing engine* pursuant to section 10.2.8. Such compensation shall be paid to applicable *market participants* by means of a credit on the next applicable *preliminary settlement statement* and shall be recovered by the *EMC* pursuant to section I.2 of Appendix 6I.

Explanatory Note: Because load shedding is not expected to occur frequently, it is likely that the special MCE runs and compensation calculations will take place in a manual offline process, with the compensation payments and the cost recovery via ad-hoc payments, rather than an adjustment of settlement prices.

10.3 DETERMINING SETTLEMENT QUANTITY DATA

- 10.3.1 Subject to 10.3.3, for *settlement* purposes, the quantity in MWh of *reserve* of each *reserve class* supplied from a *registered facility* in a *dispatch period* shall equal one-half of the MW quantity described in the *real-time dispatch schedule* for the corresponding *reserve class* for that *dispatch period*.
- 10.3.2 Subject to 10.3.3, for *settlement* purposes, the quantity in MWh of *regulation* supplied from a *registered facility* in a *dispatch period* shall equal one-half of the quantity described in the *real-time dispatch schedule* for that *dispatch period*.
- 10.3.3 Where the *EMC* has issued a price revision *advisory notice* under section 9.3.2B for a *dispatch period* with no useable *real-time dispatch schedule* for *energy*, *reserve* and *regulation*, the *EMC* shall determine, for *settlement* purposes:
- 10.3.3.1 the size of a *GRF* in section A.2.1.1 of Appendix 7A;
 - 10.3.3.2 the quantity of *reserve* supplied from a *registered facility* in section 10.3.1; and
 - 10.3.3.3 the quantity of *regulation* supplied from a *registered facility* in section 10.3.2,

by re-running the *market clearing engine* for the *dispatch period*. The *market clearing engine* shall be re-run using all the input data that should have been supplied to it when the *real-time dispatch schedule* for that *dispatch period* would normally have been produced.

Where it is not possible to so re-run the *market clearing engine*, the *EMC* shall determine the quantities in sections 10.3.3.1 to 10.3.3.3 based on the *PSO's dispatch instructions* for *energy*, *reserve* and *regulation* for that *dispatch period*.

Explanatory Note:

For settlement purposes, the quantity in MWh of energy supplied from a registered facility or generation settlement facility or the net flow on the intertie in a dispatch period shall be determined from metering data in accordance with the metering code and does not need to be stated in this section.

When no timely real-time dispatch schedule is received by PSO, the dispatch instructions for reserve and regulation issued by the PSO for the applicable dispatch period are based on the procedure described in the system operation manual as revised from time to time.

10.4 GATE CLOSURE

10.4.1 No *offer variation* or revised *standing offer* shall be submitted by or for a *market participant* within 65 minutes immediately prior to the *dispatch period* to which the *offer variation* or revised *standing offer* applies, except:

10.4.1.1 where it is intended:

- a. for a *generation registered facility*, to reflect its expected ramp-up and ramp-down profiles during periods following *synchronisation* or preceding *desynchronisation*; or
- b. for a *generation registered facility*, to reflect its revised capability during a *forced outage*; or
- c. to contribute positively to the resolution of an *energy surplus* situation by allowing for decreased supply of *energy*; or
- d. to contribute positively to the resolution of *energy, reserve* or *regulation* shortfall situations by allowing for increased supply of *energy, reserve* or *regulation*; and

10.4.1.2 where the price so offered, other than for additional quantities of *energy, reserve* or *regulation*, is the same as that previously offered for that *dispatch period*.

10.4.2 The *EMC* shall report to the *market surveillance and compliance panel* for investigation, *offer variations* or revised *standing offers* submitted during the 65-minute period referred to in section 10.4.1, and provide any factors of which the *EMC* is aware that could reasonably justify the *offer variations* or revised *standing offer*.