

## APPENDIX L – CALCULATION OF LOAD CURTAILMENT QUANTITY AND LOAD CURTAILMENT PRICE

### L.1 PURPOSE AND DEFINITIONS

L.1.1 This Appendix describes the procedures that shall be used to determine the *load curtailment price* and *load curtailment quantity* for the *real-time schedules* for *LRFs with REB*.

L.1.2 In this Appendix,

L.1.2.1 “*deviating load registered facility*” or “*deviating LRF*” means the *LRF with REB* which is deemed as such under section 3.6.3 of Chapter 5;

L.1.2.2 “*LRF p*” refers to a given *load registered facility* associated with *restricted energy bid p*;

L.1.2.3 the use of subscript “*h*” in respect of any value is a reference to the value for a given *dispatch period h* or its corresponding *settlement interval h*, as the case may be; and

L.1.2.4 the following definitions apply:

$USEP_h$  = *uniform Singapore energy price* (in \$/MWh) at the *SHUB* for the *settlement interval* corresponding to *dispatch period h*, which is to be determined as provided in section D.24.6 of Appendix 6D;

$CUSEP_h$  = *counterfactual uniform Singapore energy price* (in \$/MWh) at the *SHUB* for the *settlement interval* corresponding to *dispatch period h*, pursuant to the re-solving of the linear program described in section D.22A of Appendix 6D and calculated in accordance with section D.24.8 of Appendix 6D;

$NRQ_h$  = total non-regulatory withdrawal energy quantity (in MWh) for the *settlement interval* corresponding to *dispatch period*  $h$ , determined as:

$$(\text{TotalLoadForecast}_h \times \frac{1}{2}) - \text{RegulatoryLoadQuantity}_h$$

where:

$\text{TotalLoadForecast}_h$  = forecast of total load (in MW), comprising *non-dispatchable load* forecast received from the *PSO* in accordance with section G.2.1 of Appendix 6G and the aggregate of the quantities in all *price-quantity pairs* of *restricted energy bids* for the *dispatch period*  $h$ ; and

$\text{RegulatoryLoadQuantity}_h$  = the aggregate of vesting quantities (in MWh) for the *settlement interval* corresponding to *dispatch period*  $h$  across all *settlement accounts* received by the *EMC* from the *MSSL counterparty* in accordance with section 2.5 of Chapter 7;

$LCQ_{p,h}$  = *load curtailment quantity* (in MWh) for *LRF*  $p$  for *dispatch period*  $h$ , determined in accordance with section L.3.1, subject to section L.3.2;

$\text{NonDispLoad}_{p,h}$  = non-dispatchable portion of *load* (in MW) for *LRF*  $p$  for *dispatch period*  $h$ , determined as:

$$\text{TotalLoad}_{p,h} - \text{BidQuantities}_{p,h}$$

where  $\text{BidQuantities}_{p,h}$  is the sum of the quantities in all *price-quantity pairs* of *restricted energy bid*  $p$  for *dispatch period*  $h$ ;

$LCP_h$  = *load curtailment price* (in \$/MWh) for *dispatch period*  $h$ , determined in accordance with section L.4;

$\text{ReferenceEnergyWithdrawal}_{p,h-1}$  = reference *energy* withdrawal target (in MW) for *LRF*  $p$  for the *dispatch period* immediately preceding *dispatch period*  $h$ , given by the value of  $\text{ReferenceEnergyWithdrawal}_p$  calculated in accordance with section D.23.5 of Appendix 6D;

- ReferenceEnergyWithdrawal<sub>p,h</sub> = reference *energy* withdrawal target (in MW) for *LRF* p for *dispatch period* h, given by the value of ReferenceEnergyWithdrawal<sub>p</sub> calculated in accordance with section D.23.5 of Appendix 6D, subject to section L.3.2;
- TotalLoad<sub>p,h</sub> = total *load* capacity of *LRF* p as stated in a *restricted energy bid* for *LRF* p under section 5.2A.2.4 of Chapter 6 for *dispatch period* h;
- PurchaseEndMax<sub>p,h</sub> = projected maximum withdrawal of *energy* of *LRF* p, based on its ramp-up rate as stated in its *restricted energy bid* p for *dispatch period* h, calculated in accordance with section D.12.8 of Appendix 6D;
- EndPeriodLoad<sub>p,h</sub> = assumed *load* withdrawal quantity (in MW) of *LRF* p for the purposes of calculating its offered implied *energy* consumption for *dispatch period* h, determined in accordance with section L.2.1.2;
- StartLoad<sub>p,h</sub> = forecast *load* withdrawal quantity (in MW) of *LRF* p at the beginning of *dispatch period* h, determined in accordance with section L.2.1.1;
- OIEC<sub>p,h</sub> = offered implied *energy* consumption quantity (in MWh) of *LRF* p for *dispatch period* h, which is to be determined in accordance with section L.2.2;
- SIEC<sub>p,h</sub> = scheduled implied *energy* consumption quantity (in MWh) of *LRF* p for *dispatch period* h, which is to be determined in accordance with section L.2.3;
- UpRampRate<sub>p,h</sub> = ramp-up rate (in MW/minute) for *LRF* p as stated in its *restricted energy bid* p used in determining the *real-time dispatch schedule* for *dispatch period* h; and
- DownRampRate<sub>p,h</sub> = ramp-down rate (in MW/minute) for *LRF* p as stated in its *restricted energy bid* p used in determining the *real-time dispatch schedule* for *dispatch period* h.

**L.2 CALCULATION OF OFFERED IMPLIED ENERGY CONSUMPTION AND SCHEDULED IMPLIED ENERGY CONSUMPTION QUANTITIES**

L.2.1 For each given *LRF*  $p$  for a given *dispatch period*  $h$ ,

L.2.1.1 its  $StartLoad_{p,h}$  shall be:

L.2.1.1.1 if the *restricted energy bids* submitted for the *LRF* have a total *load capacity* of more than zero in the *dispatch period* immediately preceding that given *dispatch period*, then:

$$StartLoad_{p,h} = ReferenceEnergyWithdrawal_{p,h-1};$$

L.2.1.1.2 otherwise,

$$StartLoad_{p,h} = TotalLoad_{p,h}; \text{ and}$$

L.2.1.2 its  $EndPeriodLoad_{p,h}$  shall be the lower of its  $TotalLoad_{p,h}$  and  $[PurchaseEndMax_{p,h} + NonDispLoad_{p,h}]$ .

L.2.2 The offered implied *energy consumption* (OIEC) quantity for each given *LRF*  $p$  for a given *dispatch period*  $h$  shall be calculated as follows:

a. When  $StartLoad_{p,h} = EndPeriodLoad_{p,h}$ ,

$$OIEC_{p,h} = \frac{1}{2} \times StartLoad_{p,h};$$

b. When  $StartLoad_{p,h} > EndPeriodLoad_{p,h}$ ,

$$OIEC_{p,h} = \left( \frac{1}{2} \times EndPeriodLoad_{p,h} \right) + \frac{\frac{1}{2} \times (StartLoad_{p,h} - EndPeriodLoad_{p,h})^2}{DownRampRate_{p,h} \times 60},$$

except where  $DownRampRate_{p,h} = 0$ , then  $OIEC_{p,h} = (\frac{1}{2} \times EndPeriodLoad_{p,h})$ ; and

c. When  $StartLoad_{p,h} < EndPeriodLoad_{p,h}$ ,

$$OIEC_{p,h} = \left( \frac{1}{2} \times EndPeriodLoad_{p,h} \right) - \frac{\frac{1}{2} \times (EndPeriodLoad_{p,h} - StartLoad_{p,h})^2}{UpRampRate_{p,h} \times 60},$$

except where  $UpRampRate_{p,h} = 0$ , then  $OIEC_{p,h} = (\frac{1}{2} \times EndPeriodLoad_{p,h})$ .

L.2.3 The scheduled implied *energy* consumption (SIEC) quantity for each given *LRF*  $p$  for a given *dispatch period*  $h$  shall be calculated as follows:

a. When  $\text{StartLoad}_{p,h} = \text{ReferenceEnergyWithdrawal}_{p,h}$ ,

$$\text{SIEC}_{p,h} = \frac{1}{2} \times \text{StartLoad}_{p,h};$$

b. When  $\text{StartLoad}_{p,h} > \text{ReferenceEnergyWithdrawal}_{p,h}$ ,

$$\text{SIEC}_{p,h} = \left( \frac{1}{2} \times \text{ReferenceEnergyWithdrawal}_{p,h} \right) + \frac{\frac{1}{2} \times \left( \text{StartLoad}_{p,h} - \text{ReferenceEnergyWithdrawal}_{p,h} \right)^2}{\text{DownRampRate}_{p,h} \times 60},$$

except where  $\text{DownRampRate}_{p,h} = 0$ , then  $\text{SIEC}_{p,h} = \left( \frac{1}{2} \times \text{ReferenceEnergyWithdrawal}_{p,h} \right)$ ; and

c. When  $\text{StartLoad}_{p,h} < \text{ReferenceEnergyWithdrawal}_{p,h}$ ,

$$\text{SIEC}_{p,h} = \left( \frac{1}{2} \times \text{ReferenceEnergyWithdrawal}_{p,h} \right) - \frac{\frac{1}{2} \times \left( \text{ReferenceEnergyWithdrawal}_{p,h} - \text{StartLoad}_{p,h} \right)^2}{\text{UpRampRate}_{p,h} \times 60},$$

except where  $\text{UpRampRate}_{p,h} = 0$ , then  $\text{SIEC}_{p,h} = \left( \frac{1}{2} \times \text{ReferenceEnergyWithdrawal}_{p,h} \right)$ .

### **L.3 LOAD CURTAILMENT QUANTITY**

L.3.1 The *load curtailment quantity* for each given *LRF*  $p$  for *dispatch period*  $h$  shall be defined as:

$$\text{LCQ}_{p,h} = \text{OIEC}_{p,h} - \text{SIEC}_{p,h}$$

L.3.2 Notwithstanding section L.3.1, for the purposes of determining whether an *LRF with REB* is a deviating *LRF* under section E.3.1 of Appendix 5E, calculating the financial penalty to be imposed on a *market participant* in respect of each of its deviating *LRFs* under section E.3.2 of Appendix 5E and determining the *settlement* quantity data to be used in section 10.3.7 of Chapter 6, where the *EMC* is notified by the *PSO* pursuant to section 9.1.6A of Chapter 5 that *dispatch instructions* have been issued to an *LRF with REB* between the release of the *real-time dispatch schedule* and the start of the *dispatch period*, then for the purposes of calculating the *load curtailment quantity* of such *LRF with REB*, the value of  $\text{ReferenceEnergyWithdrawal}_{p,h}$  shall be recalculated as:

$$\text{ReferenceEnergyWithdrawal}_{p,h} = \text{NonDispLoad}_{p,h} + \text{Max} [\text{Min} (\text{PurchaseEndMax}_{p,h}, \text{BidQuantities}_{p,h}) - \text{PSOCurtailedLoad}_{p,h}, 0]$$

where:

$PSOCurtailedLoad_{p,h}$  is the MW amount of *load curtailment* in the *PSO's dispatch instruction* to the *LRF with REB* provided to the *EMC* pursuant to section 9.1.6A of Chapter 5, and

$BidQuantities_{p,h}$  is the sum of the quantities in all *price-quantity pairs* of *restricted energy bid p* for *dispatch period h*.

#### **L.4 LOAD CURTAILMENT PRICE**

L.4.1 The *load curtailment price* (in \$/MWh) for a given *dispatch period h* where the *temporary price cap* is not in effect shall be calculated as:

$$LCP_h = \frac{\text{Max} \left[ (CUSEP_h - USEP_h) \times \frac{1}{3} \times NRQ_h, 0 \right]}{\sum_p LCQ_{p,h}}$$

where:

$\sum_p$  = sum over all *LRF p*

L.4.1A The *load curtailment price* (in \$/MWh) for a given *dispatch period h* where the *temporary price cap* is in effect shall be calculated as:

$$LCP_h = \frac{\text{Max} \left[ (CUSEP_h - RUSEP_h) \times \frac{1}{3} \times NRQ_h, 0 \right]}{\sum_p LCQ_{p,h}}$$

where:

$\sum_p$  = sum over all *LRF p*

L.4.2 If the *load curtailment price* (in \$/MWh) referred to in section L.4.1 and L.4.1A exceeds the applicable upper price limit for the *load curtailment price* specified in section J.1.2B of Appendix 6J, then the *load curtailment price* shall be modified and set to that upper limit.

<p><b>Explanatory Note: The lower limit on the load curtailment price is zero.</b></p>
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