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:

$(TotalLoadForecast_h \times ½) – RegulatoryLoadQuantity_h$

where:

$TotalLoadForecast_h$ = 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

$RegulatoryLoadQuantity_h$ = 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;

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

$TotalLoad_{p,h} – BidQuantities_{p,h}$

where $BidQuantities_{p,h}$ 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;

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

$\text{ReferenceEnergyWithdrawal}_{p,h}$	=	reference *energy* withdrawal target (in MW) for *LRF* p for *dispatch period* h, given by the value of $\text{ReferenceEnergyWithdrawal}_p$ calculated in accordance with section D.23.5 of Appendix 6D, subject to section L.3.2;
$\text{TotalLoad}_{p,h}$	=	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;
$\text{PurchaseEndMax}_{p,h}$	=	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;
$\text{EndPeriodLoad}_{p,h}$	=	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;
$\text{StartLoad}_{p,h}$	=	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;
$\text{OIEC}_{p,h}$	=	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;
$\text{SIEC}_{p,h}$	=	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;
$\text{UpRampRate}_{p,h}$	=	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
$\text{DownRampRate}_{p,h}$	=	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 $\text{StartLoad}_{p,h}$ 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:

$\text{StartLoad}_{p,h} = \text{ReferenceEnergyWithdrawal}_{p,h-1}$;

L.2.1.1.2 otherwise,

$\text{StartLoad}_{p,h} = \text{TotalLoad}_{p,h}$; and

L.2.1.2 its $\text{EndPeriodLoad}_{p,h}$ shall be the lower of its $\text{TotalLoad}_{p,h}$ and $[\text{PurchaseEndMax}_{p,h} + \text{NonDispLoad}_{p,h}]$.

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 $\text{StartLoad}_{p,h} = \text{EndPeriodLoad}_{p,h}$,

$\text{OIEC}_{p,h} = ½ \times \text{StartLoad}_{p,h}$;

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

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

except where $\text{DownRampRate}_{p,h} = 0$, then $\text{OIEC}_{p,h} = (½ \times \text{EndPeriodLoad}_{p,h})$; and

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

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

except where $\text{UpRampRate}_{p,h} = 0$, then $\text{OIEC}_{p,h} = (½ \times \text{EndPeriodLoad}_{p,h})$.

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 $StartLoad_{p,h} = ReferenceEnergyWithdrawal_{p,h}$,

$SIEC_{p,h} = ½ \times StartLoad_{p,h}$;

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

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

except where $DownRampRate_{p,h} = 0$, then $SIEC_{p,h} = (½ \times ReferenceEnergyWithdrawal_{p,h})$; and

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

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

except where $UpRampRate_{p,h} = 0$, then $SIEC_{p,h} = (½ \times ReferenceEnergyWithdrawal_{p,h})$.

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:

$$LCQ_{p,h} = OIEC_{p,h} - SIEC_{p,h}$$

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 $ReferenceEnergyWithdrawal_{p,h}$ shall be recalculated as:

$ReferenceEnergyWithdrawal_{p,h} = NonDispLoad_{p,h} + Max [Min (PurchaseEndMax_{p,h}, BidQuantities_{p,h}) – PSOCurtailedLoad_{p,h}, 0]$

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:

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

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:

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

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.

Explanatory Note: The lower limit on the load curtailment price is zero.