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:

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

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

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:

\[\text{TotalLoad}_{p,h} - \text{BidQuantities}_{p,h}\]

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;
ReferenceEnergyWithdrawal\(p,h\) = reference energy withdrawal target (in MW) for LRF \(p\) for dispatch period \(h\), given by the value of ReferenceEnergyWithdrawal\(p\), calculated in accordance with section D.23.5 of Appendix 6D, subject to section L.3.2;

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 \(h\);

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;

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;

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;

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;

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;

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

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 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 EndPeriodLoad\(_{p,h}\) shall be the lower of its 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 StartLoad\(_{p,h}\) = EndPeriodLoad\(_{p,h}\),

\[
\text{OIEC}_{p,h} = \frac{1}{2} \times \text{StartLoad}_{p,h};
\]

b. When StartLoad\(_{p,h}\) > EndPeriodLoad\(_{p,h}\),

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

except where DownRampRate\(_{p,h}\) = 0, then \(\text{OIEC}_{p,h} = (\frac{1}{2} \times \text{EndPeriodLoad}_{p,h})\); and

c. When StartLoad\(_{p,h}\) < EndPeriodLoad\(_{p,h}\),

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

except where UpRampRate\(_{p,h}\) = 0, then \(\text{OIEC}_{p,h} = (\frac{1}{2} \times \text{EndPeriodLoad}_{p,h})\).
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 $\text{StartLoad}_{p,h} = \text{ReferenceEnergyWithdrawal}_{p,h}$,

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

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

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

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

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

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 ReferenceEnergyWithdrawal$_{p,h}$ shall be recalculated as:

$$\text{ReferenceEnergyWithdrawal}_{p,h} = \text{NonDispLoad}_{p,h} + \text{Max} \left(\text{Min} \left(\text{PurchaseEndMax}_{p,h}, \text{BidQuantities}_{p,h}\right) - \text{PSOCurtailedLoad}_{p,h}, 0\right)$$
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 \(h\) shall be calculated as:

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

where:

\(\sum_p = \text{sum over all LRF } p\)

L.4.2 If the *load curtailment price* (in $/MWh) referred to in section L.4.1 exceeds the applicable upper price limit for *energy* specified in section J.1.2 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.