APPENDIX D

IMBALANCE ENERGY CHARGE COMPUTATION

D 1 Purpose of charge

The Imbalance Energy charge is the term used for allocating the cost of not only the Imbalance Energy (the differences between scheduled and actual Generation and Demand), but also any Unaccounted for Energy (UFE) and any errors in the forecasted Transmission Losses as represented by the GMMs. Any corresponding cost of Dispatched Replacement Reserve Capacity that is not allocated as an Ancillary Service is also included along with the Imbalance Energy charge.

D 2 Fundamental formulae

D 2.1 Imbalance Energy Charges on Scheduling Coordinators

Uninstructed Imbalance Energy attributable to each Scheduling Coordinator in each Settlement Period in the relevant Zone shall be deemed to be sold or purchased, as the case may be, by the ISO and payments for Uninstructed Imbalance Energy shall be settled by debting or crediting, as the case may be, the Scheduling Coordinator with an amount for each Settlement Period equal to the sum of:

(a) The quantity of undelivered Instructed Imbalance Energy, multiplied by the Effective Price, and

(b) The quantity of deviation from the final Hour-Ahead Schedule multiplied by the Hourly Ex Post Price.

Imbalance Energy charge will be calculated as follows:

IECharge=DevC + ASSEDevC

Where:

$$DevC = \sum_i GenDevC_i + \sum_i LoadDevC_i + \sum_q ImpDevC_q + \sum_q ExpDevC_q + UFEC$$

$$ASSDevC = \sum_i ASSEGenDevC_i + \sum_i ASSELoadDevC_i + \sum_q ASSEImpDevC_q$$

and

The deviation between scheduled and actual Energy Generation for Generator i represented by Scheduling Coordinator j in Zone x during Trading Interval t is calculated as follows:

$GenDev_i = G_s * GMM_f - [(G_a - G_{adj}) * GMM_{ah} - G_{a/s} - G_{s/e}] - UnavailAncServMW_{ixt}$

Where:

$UnavailAncServMW_{ixt} = Max[- (G_{i,\ oblig} - G_{a/s})\ Min(0, Pmax_i - Ga - (G_{i,\ oblig} - G_{a/s})]$

$GenDevC_i = GenDev_i * P$ *in case of (b) above, and*

If $G_{a/s} + G_{s/e} > 0$ *and* $P < P_{eff}$ *then:*

$ASSEGenDevC_i = Max[0,[G_{a/s} - Max[0,(G_a - G_{adj} - G_s)]]] * (P_{eff\text{-}l} - P)$ *in case of (a) above, or*

If $G_{a/s} + G_{s/e} < 0$ *and* $P > P_{eff}$ *then:*

$ASSEGenDevC_i = Min[0,[G_{a/s} - Min[0,(G_a - G_{adj} - G_s)]]] * (P_{eff\text{-}l} - P)$ *in case of (a) above,*

The deviation between scheduled and actual Load consumption for Load i represented by Scheduling Coordinator j in Zone x during Trading Interval t is calculated as follows:

$$LoadDev_i = L_s - \left[(L_a - L_{adj}) + L_{a/s} + L_{s/e}\right] - UnavailDispLoadMW_{ixt}$$

Where:

$$UnavailDispLoadMW_{ixt} = Max[0, (L_{i,\ oblig} - L_{a/s}) - L_a]$$

$LoadDevC_i = LoadDev_i * P$ *in case of (b) above, and*

If $L_{a/s} + L_{s/e} > 0$ *and* $P < P_{eff}$ *then:*

$ASSELoadDevC_i = Max[0,[L_{a/s} - Max[0,(L_{a/s} - L_{adj} - L_s)]]] * (P_{eff\text{-}l} - P)$ *in case of (a) above, or*

If $L_{a/s} + L_{s/e} < 0$ *and* $P > P_{eff}$ *then:*

$ASSELoadDevC_i = Min[0,[L_{a/s} - Min[0,(L_{a/s} - L_{adj} - L_s)]]] * (P_{eff\text{-}l} - P)$ *in case of (a) above*

The deviation between forward scheduled and Real Time adjustments to Energy imports*, adjusted for losses, for Scheduling Point q represented by Scheduling Coordinator j into Zone x during Trading Interval t is calculated as follows:

$ImpDev_q = I_s * GMM_{fq} - [(I_a - I_{adj}) * GMM_{ahq}] + I_{a/s}$

$ImpDevC_i = ImpDev_i * P$ in case of (b) above, and

If $l_{a/s} > 0$ and $P < P_{eff}$ then:

$ASSEImpDevC_i = Max[0,[l_{a/s} - Max[0, (l_a - l_{adj} - l_s)]]] * (P_{eff\text{-}q} - P)$ in case of (a) above, or

If $l_{a/s} < 0$ and $P > P_{eff}$ then:

$ASSElmpDevC_i = Min[0,[l_{a/s} - Min[0, (l_a - l_{adj} - l_s)]]] * (P_{eff\text{-}q} - P)$ in case of (a) above

The deviation between forward scheduled and Real Time adjustments to Energy exports* for Scheduling Point q represented by Scheduling Coordinator j from Zone x during Trading Interval t is calculated as follows:

$$ExpDev_q = E_s - E_a - E_{adj}$$

$$ExpDevC_q = ExpDev_q * P$$

D 2.2 Unaccounted for Energy Charge

The hourly Unaccounted for Energy Charge on Scheduling Coordinator j for Trading Interval t for each relevant Zone is calculated in the following manner:

The UFE for each utility service territory *k* is calculated as follows,

$$E_{UFE\_UDC\_k} = (I_k - E_k + G_k - (RTM_k + LPM_k) - TL_k)$$

The Transmission Loss calculation per Trading Interval t per relevant Zone for each utility service territory k is calculated as follows,

$$TL_k = \sum [G_a * (1 - GMM_{ah})] + \sum [I_a (1 - GMM_{ahq})]$$

Each metered demand point, either ISO grid connected or connected through a UDC, is allocated a portion of the UFE as follows:

$$E_{UFE\_z} = \frac{D_z}{\sum_z D_z} E_{UFE\_UDC\_k}$$

* Note that this deviation is a difference between a forward Market value and a Real Time value. It is not inadvertent energy.

The UFE charge for Scheduling Coordinator j per Trading Interval per relevant Zone is then,

$$UFEC_j = (\sum_z E_{UFE\_z}) * P_{xt}$$

D 3 Meaning of terms of formulae

D 3.1 **IEC_j – $**

The Imbalance Energy charge on Scheduling Coordinator j in Trading Interval t for each relevant Zone.

D 3.2 **$GenDev_i$ – MWh**

The deviation between scheduled and actual Energy Generation for Generator i represented by Scheduling Coordinator j in Zone x during Trading Interval t.

D 3.3 **$LoadDev_i$ – MWh**

The deviation between scheduled and actual Load consumption for Generator i represented by Scheduling Coordinator j in Zone x during Trading Interval t.

D 3.4 **$ImpDev_q$ – MWh**

The deviation between forward scheduled and Real Time adjustments to Energy imports, as adjusted for losses, for Scheduling Point q represented by Scheduling Coordinator j into Zone x during Trading Interval t.

D 3.5 **$ExpDev_q$ – MWh**

The deviation between forward scheduled and Real Time adjustments to Energy exports for Scheduling Point q represented by Scheduling Coordinator j

from Zone x during Trading Interval t.

D 3.6 **G_s – MWh**

The total scheduled Generation of Scheduling Coordinator j for Generator i in Trading Interval t as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.

D 3.7 **G_a – MWh**

The total actual metered Generation of Scheduling Coordinator j for Generator i in Trading Interval t.

D 3.8 **G_{adj} – MWh**

Deviations in real time ordered by the ISO for purposes such as Congestion Management.

D 3.9 **$G_{a/s}$ – MWh**

The Energy generated from Ancillary Service resource i due to ISO dispatch instructions. This value will be calculated based on the projected impact of the Ancillary Services dispatch instruction(s) over the time period within the Trading Interval for which such Ancillary Services dispatch instruction(s) applies.

D.3.9.1 $G_{s/e}$ -MWh

The Energy generated from Supplemental Energy resource i due to ISO dispatch instructions. This value will be calculated based on the projected impact of the Supplemental Energy dispatch instruction(s) over the time period within the Trading Interval for which such Supplemental Energy dispatch instruction(s) applies.

D 3.10 **GMM_f – fraction**

The forecasted Generation Meter Multiplier (GMM) for Generator i as provided to the Scheduling Coordinator by the ISO in advance of the operation of the Day-Ahead Market.

D 3.11 **GMM_{fq} – fraction**

The forecasted Generation Meter Multiplier for an Energy import at Scheduling Point q as provided to the Scheduling Coordinator by the ISO in advance of the Day-Ahead Market.

D 3.12 **GMM_{ah} – fraction**

The final forecasted Generation Meter Multiplier (GMM) for a Generator i as calculated by the ISO at the hour-ahead stage (but after close of the Hour-Ahead Market).

D 3.13 **GMM_{ahq} – fraction**

The forecasted Generation Meter Multiplier for an Energy import at Scheduling Point q as provided to the Scheduling Coordinator by the ISO after close of the Hour-Ahead Market.

D 3.14 **L_S – MWh**

The total scheduled Demand of Scheduling Coordinator j for Demand i in Trading Interval t as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.

D 3.15 **L_a – MWh**

The total actual metered Demand of Scheduling Coordinator j for Demand i in Trading Interval t.

D 3.16 **L_{adj} – MWh**

The deviation in realtime Demand (i.e., Load bidding into the market) ordered by the ISO for Congestion Management, Overgeneration, etc.]. This value will be calculated based on the projected impact of the Dispatch instruction(s) over the time period within the Trading Interval for which such Dispatch instruction(s) applies.

D 3.17 **$L_{a/s}$ – MWh**

The Energy reduction by curtailable Load due to ISO dispatch of Ancillary Services from such curtailable Load (i.e., Load bidding into the Ancillary Services markets). This value will be calculated based on the projected impact of the Ancillary Services dispatch instruction(s) over the time period within the Trading Interval for which such Ancillary Services dispatch instruction(s) applies.

D 3.17.1 $L_{s/e}$ -MWh

The Energy reduction by curtailable Load due to ISO dispatch of Supplemental Energy from such curtailable Load. This value will be calculated based on the projected impact of the Supplemental Energy dispatch instruction(s) over the time period within the Trading Interval for which such Supplemental Energy dispatch instruction(s) applies.

D 3.18 **I_S – MWh**

The total scheduled Energy import of Scheduling Coordinator j through Scheduling Point q in Trading Interval t as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.

D 3.19 **I_a – MWh**

The total actual Energy import of Scheduling Coordinator j through Scheduling Point q in Trading Interval t. This is deemed to be equal to the total scheduled Energy import I_S.

D 3.20 **I_{adj} – MWh**

The deviation in real time import ordered by the ISO for congestion management, overgeneration, etc. or a result of an import curtailment. This value will be calculated based on the projected impact of the Dispatch instruction(s) (or curtailment event) between the close of the Hour-Ahead Market and the end of the Trading Interval for which such Dispatch Instructions(s) (or curtailment event) applies.

D 3.21 **$I_{a/s}$ – MWh**

The Energy generated from Ancillary Service System Resources pursuant to Existing Contracts or Supplemental Energy from interties due to ISO's Dispatch instruction.

D 3.22 **E_S – MWh**

The total scheduled Energy export of Scheduling Coordinator j through Scheduling Point q in Trading Interval t as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.

D 3.23 **E_a – MWh**

The total actual Energy export of Scheduling Coordinator j through Scheduling Point q in Trading Interval t. This is deemed to be equal to the total scheduled Energy export E_S.

D 3.24 **E_{adj} – MWh**

The deviation in Real Time export ordered by the ISO for Congestion Management, Overgeneration, etc. or as a result of an export curtailment. This value will be calculated based on the projected impact of the Dispatch Instruction(s) (or curtailment event between the close of the Hour-Ahead Market and the end of the Trading Interval for which such Dispatch Instruction (or curtailment event) applies.

D 3.25 **P_{xt} – $/MWh**

The Hourly Ex Post Price for Imbalance Energy for the relevant Trading Interval. This value is calculated as the weighted average of the 12 Five Minute Ex Post Prices in each Zone during each hour. The Five Minute Ex Post Price is equal to the bid price of the marginal resource accepted by the ISO for dispatch and deemed eligible to set the price during a five minute period.

D 3.25.1 **P_{eff} – $**

Effective Price for Instructed Imbalance Energy for the relevant Settlement Period.

D 3.26 **$UFEC_j$ – $**

The Unaccounted for Energy Charge for Scheduling Coordinator j is the cost representing the difference in Energy, for each UDC Service Area and Trading Interval, between the net Energy delivered into the UDC Service Area, adjusted for UDC Service Area Transmission Losses (calculated in accordance with ISO Tariff Section 7.4.3), and the total metered Demand within the UDC Service Area adjusted for distribution losses using Distribution System loss factors approved by the Local Regulatory Authority.

This difference (UFE) which is attributable to meter measurement errors, power flow modeling errors, energy theft, statistical Load profile errors, and distribution loss deviations is multiplied by the Hourly Ex-Post Price.