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 2.1.1 Uninstructed 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 charges or payments for Uninstructed Imbalance Energy shall be settled by debiting 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:

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

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

and

The deviation between scheduled and actual Energy Generation for Generator i represented by Scheduling Coordinator j in Zone x during Settlement Period 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:

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

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

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

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

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

$ASSEGenDevC_i = Min[0,[G_{a/s} + \boldsymbol{G_{s/e}} - Min\ [0,\ (G_a - G_{adj} - G_s)]]] * (P_{eff\text{-}I} - P)$ 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:

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

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

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

The deviation between forward scheduled and Real Time adjustments to Energy imports[1], adjusted for losses, for Scheduling Point q represented by Scheduling Coordinator j into zone x during Settlement Period t is calculated as follows:

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

$ImpDevC_q = ImpDev_q * P$ in case of (b) above, and

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

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

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

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

The deviation between forward scheduled and Real Time adjustments to Energy exports[2] for Scheduling Point q represented by Scheduling Coordinator j from Zone x during Settlement Period *t* is calculated as follows:

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

$ExpDevC_q = ExpDev_q * P$

The Hourly Ex Post Price applicable to uninstructed deviations in Settlement Period t in each zone will equal the Energy weighted average of the BEEP Interval charges in each zone, calculated as follows:

$$P_{xt} = \frac{(\sum_{ji} |MWh_{jix}| * BIP_{ix})}{\sum_{ji} |IMWh_{jix}|}$$

Where:

BIP_{jx}= BEEP Interval Ex Post Price

P_{xt} = the Hourly Ex Post Price in Zone x

---

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

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

IIEC jix = the Instructed Imbalance Energy Charges for Scheduling Coordinator j for BEEP Interval i in Zone x

IMWH jix = the Instructed Imbalance Energy for Scheduling Coordinator j for the BEEP Interval i in Zone *x*

D 2.1.2 Instructed Imbalance Energy Charges on Scheduling Coordinators

The Instructed Imbalance Energy charge for Settlement Period t for Scheduling Coordinator j for Zone x is calculated using the following formula:

$IIEC_j = IGDC_j + ILDC_j + IIDC_j$

The instructed Generation deviation payment/charge is calculated as follows:

$$IGDCj = \sum_{gi} \frac{G_{gi} * P_i}{HBI}$$

The instructed Load deviation payment/charge is calculated as follows:

$$ILDC_j = \sum_{Li} \frac{L_{Li} * P_i}{HBI}$$

The instructed import deviation payment/charge is calculated as follows:

$$IIDC_j = \sum_{Ii} \frac{I_{Ii} * P_i}{HBI}$$

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,

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

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

$$TL_k = Total\_TLRC_{Losses} * (UDC_k\_Branch_{Losses} / Total\_Branch_{Losses})$$

Where:

$$Total\_TLRC_{Losses} = \sum\left[G_a * \left(1 - GMM_a\right)\right] + \sum\left[I_a\left(1 - GMM_{aq}\right)\right]$$

$$Total\_Branch_{Losses} = \sum_{k} UDC_k\_Branch_{Losses}$$

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

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

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.

D 3.27 **$E_{UFE\_UDC\_k}$ – MWh**

The Unaccounted for Energy (UFE) for utility service territory k.

D 3.28 **E_{UFE_z} – MWh**

The portion of Unaccounted for Energy (UFE) allocated to metering point z.

D 3.29 **$RRDC_j$**

The Replacement Reserve Capacity Dispatch Charge for Scheduling Coordinator j for Trading Interval t.

D 3.30 **RRC – $**

The Dispatched Replacement Reserve Capacity Cost which is to be allocated to Scheduling Coordinators in proportion to their contributions to Imbalance Energy requirements. The RRC is, in turn, calculated as the total cost of Replacement Reserve capacity in Trading Interval t (as determined in the Hour-Ahead and Day-Ahead Markets) less the Undispatched Replacement Reserve Capacity Cost. [Note: Both these costs are dealt with in the Ancillary Services payments in Appendix C]

D 3.31 **G_k – MWh**

The total metered Generation in Trading Interval t in utility service territory k.

D 3.32 **D_z – MWh**

The Demand including Exports in Trading Interval t at metered point z.

D 3.33 **I_k – MWh**

The total metered imports into utility service territory k in Trading Interval t.

D 3.34 **E_k – MWh**

The total metered exports from utility service territory k in Trading Interval t.

D 3.35 **RTM_k – MWh**

The Trading Interval t total of the real-time metering in utility service territory k in Trading Interval t.

D 3.36 **LPM_k – MWh**

The calculated total of the Load Profile metering in utility service territory k per Trading Interval t.

D 3.37 **TL_k – MWh**

The Transmission Losses per Trading Interval t in utility service territory k.

D 3.38 **$IGDC_j$ - $**

The total of instructed Generation deviation payments/charges for Scheduling Coordinator j in Settlement Period t.

D 3.39 **$ILDC_j$ - $**

The total of instructed Load deviation payments/charges for Scheduling Coordinator j in Settlement Period t.

D 3.40 **$IIDC_j$ - $**

The total of instructed import deviation payments/charges for Scheduling Coordinator j in Settlement Period t.

D 3.41 **G_{gi} - MW**

Instructed Energy for Generating Unit g during BEEP Interval i.

D 3.42 **L_{Li} - MW**

Instructed Energy for Load L during BEEP Interval i.

D 3.43 **I_i – MW**

Instructed Energy for import I during BEEP Interval i

D 3.44 **P_i -- $/MWh**

The BEEP Incremental Ex Post Price for BEEP Interval i if the net instructed Energy for resources is positive, or the BEEP decremental Ex Post Price for BEEP Interval i if the net instructed Energy for resources is negative.

D 3.45 **HBI – Number**

The number (2-12) of BEEP Intervals in Settlement Period t.

D 3.46 **$ReplObligRatio_{jxt}$ – fraction**

$$ReplObligRatio_{jxt} = \frac{ReplOblig_{jxt}}{\sum_{j} ReplOblig_{jxt}}$$

where:

$ReplOblig_{jxt}$ is the replacement reserve capacity obligation as defined in Appendix C.

D 3.47 **$G_{i,\ oblig}$**

The amount of Spinning Reserve, the amount of Non-Spinning Reserve, and the amount of Replacement Reserve that Generating Unit or System Resource *i* has been selected to supply to the ISO, as reflected in final Ancillary Services Schedules.

D 3.48 **$PMax_i$**

The maximum capability (in MW) at which Energy and Ancillary Services may be scheduled from the Generating Unit or System Resource *i*.

D 3.49 **$L_{i,\ oblig}$**

The amount of Non-Spinning Reserve and Replacement Reserve that dispatchable Load *i* has been selected to supply to the ISO as reflected in final Ancillary Services schedules for Settlement Period *t*.

APPENDIX E

USAGE CHARGE COMPUTATION

E 1 Purpose of Charge

The Usage Charge is payable by Scheduling Coordinators who schedule Energy across Congested Inter-Zonal Interfaces pursuant to Section 7.2.5 of the ISO Tariff. Scheduling Coordinators who counter-schedule across Congested Inter-Zonal Interfaces are entitled to Usage Charge Payments. The right to schedule across a Congested Inter-Zonal Interface is determined through the ISO's Congestion Management procedures.

The following categories of Payments and Charges are covered in this Appendix E:

(a) Usage Charges payable by Scheduling Coordinators for Energy transfers scheduled across Congested Inter-Zonal Interfaces and which contribute to Congestion.

(b) Usage Charge rebates payable to Scheduling Coordinators for Energy transfers scheduled across Congested Inter-Zonal Interfaces and which contribute to relieving Congestion.

(c) Credits of net Usage Charge revenues to Participating TOs and FTR Holders.

(d) Debits of net Usage Charge revenues to Participating TOs and FTR Holders.

(e) Debits and rebates of Usage Charge to Scheduling Coordinators as set out in E 2.3.3.

E 2 Fundamental Formulae

E 2.1 ISO Usage Charges on Scheduling Coordinators

Each Scheduling Coordinator j whose Final Schedule includes the transfer of Energy scheduled across one or more Congested Inter-Zonal Interfaces shall (save to the extent that the transfer involves the use of transmission capacity represented by Existing Rights and/or Non-Converted Rights) pay, or be paid, Usage Charges in Trading Interval t calculated in accordance with the following formulae:

In the Day-Ahead Market:

$$UC_{jtd} = \sum_{x} NetZoneImp_{jtxd} * \lambda_{dxt}$$

In the Hour-Ahead Market:

$$UC_{jth} = \sum_{x} (NetZoneImp_{jtxh} - NetZoneImp_{jtxd}) * \lambda_{hxt}$$

E 2.2 Payments of Usage Charges to Scheduling Coordinators

Each Scheduling Coordinator j whose Final Schedule includes the transfer of Energy from one Zone to another in a direction opposite that of Congestion shall (save to the extent that the transfer involves the use of transmission capacity represented by Existing Rights and/or Non-Converted Rights) receive a Usage Charge payment from the ISO calculated in accordance with the formulae described in section E2.1.

E 2.3 ISO Credits and Debits to Transmission Owners and FTR Holders of Usage Charge Revenues

E 2.3.1 Day-Ahead Market

The ISO will pay to the Participating TO n and FTR Holder n its share of the total net Usage Charge revenue for Trading Interval t in the Day-Ahead Market in accordance with the following formula:

$$PayUC_{ntd} = \sum_{y} \mu_{ytd} * K_{yn} * L_{ytd}$$

E 2.3.2 Hour-Ahead Market

The ISO will pay to the Participating TO n and FTR Holder n its share of the total net Usage Charge revenue for Trading Interval t in the Hour-Ahead Market in accordance with the following formula:

$$PayUC_{nth} = \sum_{y} \mu_{yth} * K_{yn} * (L_{yth} - L_{ytd})$$

Under normal operating conditions, (L_{yth} - L_{ytd}) is positive and Participating TOs and FTR Holders will receive a refund on the net Usage Charge for the relevant Trading Interval t in the Hour-Ahead Market.

E 2.3.3 Debits to Participating TOs and FTR Holders and Debits/Rebates to Scheduling Coordinators

If, after the close of the Day-Ahead Market, Participating TOs instruct the ISO to reduce interface limits based on operating conditions or an unscheduled transmission outage occurs and as a

result of either of those events, Congestion is increased and Available Transfer Capacity is decreased in the Inter-Zonal Interface in the Hour-Ahead Market, the (L_{yth} - L_{ytd}) will be negative. In this case:

(a) Participating TOs and FTR Holders will be charged for the Usage Charge payments they received for the relevant Trading Interval t in the Day-Ahead Market with respect to the reduced interface limits;

(b) Any Scheduling Coordinator whose Schedule was adjusted for the relevant Trading Interval t in the Hour-Ahead Market due to the reduced interface limits will be credited with μ_{yth} for each MW of the adjustment; and

(c) Each Scheduling Coordinator will be charged an amount equal to it proportionate share, based on Schedules in the Day-Ahead Market in the direction of Congestion, of the difference between $\mu_{yth}(L_{yth} - L_{ytd})$ and the total amount charged to Participating TOs and FTR Holders in accordance with item (a) above.

The ISO will issue a notice to Scheduling Coordinators of the operating hour, and extent, for which the derate will apply in the relevant Hour-Ahead Markets. The timing and form of such notices shall be set forth in ISO procedures.

E 3 Meaning of terms of formulae

E 3.1 UC_{jtd} ($)

The Usage Charge payable by or to Scheduling Coordinator j for the relevant Trading Interval t in the Day-Ahead Market.

E 3.2 UC_{jth} - $

The Usage Charge payable by or to Scheduling Coordinator j for Trading Interval t in the Hour-Ahead Market.

E 3.3 $NetZoneImp_{jtxd}$ (MWh)

The net Zonal import scheduled by Scheduling Coordinator j in Zone x for the relevant Trading Interval t in the Day-Ahead Market. For Zones internal to the ISO Control Area, net Zonal import equals scheduled Demand minus scheduled Generation plus transfers. For zones external to the ISO Control Area (i.e., for Scheduling Points), net zonal import equals scheduled imports (i.e., out of the ISO Control Area) minus scheduled exports (i.e., into the ISO Control Area).

E 3.4 **$NetZoneImp_{jtxh}$ (MWh)**

The net Zonal import scheduled by the Scheduling Coordinator j in Zone x for the relevant Trading Interval t in the Hour-Ahead Market. For Zones internal to the ISO Control Area, net Zonal import equals scheduled Demand minus scheduled Generation plus transfers. For Zones external to the ISO Control Area (i.e., for Scheduling Points), net zonal import equals scheduled imports (i.e., out of the ISO Control Area) minus scheduled exports (i.e., into the ISO Control Area).

E 3.5 **λ_{dxt} ($/MWh)**

The reference Zonal marginal price for Zone x for the relevant Trading Interval t in the Day-Ahead Market, as calculated by the ISO's Congestion Management computer optimization algorithm.

E 3.6 **λ_{hxt} ($/MWh)**

The reference Zonal marginal price for Zone x for the relevant Trading Interval t in the Hour-Ahead Market, as calculated by the ISO's Congestion Management computer optimization algorithm.

E 3.7 **$PayUC_{ntd}$ ($)**

The amount calculated by the ISO to be paid to or by the Participating TO n (in respect of its Transmission Revenue Balancing Account) and FTR Holder n for the relevant Trading Interval t in the Day-Ahead Market.

E 3.7.1 **$PayUC_{nth}$ ($)**

The amount calculated by the ISO to be paid to the Participating TO n (in respect of its Transmission Revenue Balancing Account) and FTR Holder n for the relevant Trading Interval t in the Hour-Ahead Market.

E 3.8 **μ_{ytd} ($/MW)**

The Day-Ahead Congestion price (shadow price) at Inter-Zonal interface y for Trading Interval t. This price is calculated by the ISO's Congestion Management computer optimization algorithm.

E 3.8.1 **μ_{yth} ($/MW)**

The Hour-Ahead Congestion price (shadow price) at Inter-Zonal Interface y for Trading Interval t. This price is calculated by the ISO's Congestion Management computer optimization algorithm.

E 3.9 **K_{ytn} (%)**

The percentage of the Inter-Zonal Congestion revenue alocation for Participating TO n and FTR Holder n of the Congested Inter-Zonal interface y for the relevant Trading Interval t for both Day-Ahead and Hour-Ahead Markets.

E 3.10 **L_{ytd} (MW)**

The total loading of Inter-Zonal Interface y for Trading Interval t in the Day-Ahead as calculated by the ISO's Congestion Management optimization algorithm.

E 3.11 **L_{yth} (MW)**

The total loading of Inter-Zonal Interface y for Trading Interval t in the Hour-Ahead as calculated by the ISO's Congestion Management optimization algorithm.

APPENDIX F

WHEELING ACCESS CHARGES COMPUTATION

F 1 Purpose of Charge

The Wheeling Access Charge is paid by Scheduling Coordinators for Wheeling as set forth in Section 7.1.4 of the ISO Tariff. The ISO will collect the Wheeling revenues from Scheduling Coordinators on a Trading Interval basis and repay these to the Participating TOs based on the ratio of each Participating TO's Transmission Revenue Requirement to the sum of all Participating TOs' Revenue requirements.

F 2 Fundamental Formulae

F 2.1 ISO Charges on Scheduling Coordinators for Wheeling

The ISO will charge Scheduling Coordinators scheduling a Wheeling Out or a Wheeling Through, the product of the Wheeling Access Charge and the total of the hourly schedules of Wheeling in MWh for each Trading Interval at each Scheduling Point associated with that transaction pursuant to Section 7.1.4 of the ISO Tariff.

F 2.1.1 Wheeling Access Charge

The Wheeling Access Charge for each Participating TO is its base Transmission Revenue Requirement (TRR) divided by the annual kWh deliveries by the Participating TO or End-Use Customers connected to its transmission and distribution facilities plus the Participating TO's Transmission Revenue Balancing Account (TRBA) adjustment as set forth in Section 5 of the TO Tariff. The Wheeling Access Charge for transmission service will be the TO-specific Wheeling Access Charge at the point in the ISO Controlled Grid where the Energy is scheduled to exit the ISO Controlled Grid.

To the extent that more than one Participating TO owns, or has firm entitlement to, transmission capacity exiting the ISO Controlled Grid at a Scheduling Point, the ISO will charge Scheduling Coordinators for each Trading Interval a rate for Wheeling at that Scheduling Point which reflects an average of the Wheeling Access Charge of those Participating TOs, weighted by the relative share of such ownership or firm entitlements to transmission capacity. The Weighted Average Rate for Wheeling for Scheduling Point q is calculated using the following formula; note if there is only one

Participating TO owning, or having firm entitlement to, transmission capacity at Scheduling Point q then this formula gives the TO-specific Wheeling Access Charge:

$WABC_q = \Sigma (P_n * Q_n / \Sigma Q_n)$

F 2.1.2 Wheeling Charge

The Wheeling Charge by the ISO on Scheduling Coordinator j for Scheduling Point q for each Trading Interval is calculated by the product of (i) the weighted average rate for Wheeling at Scheduling Point q, and (ii) the summation of kWh wheeled over that Scheduling Point in Trading Interval t using the following formula:

$WChg_{jq} = WABC_q * QChargeW_{jqt}$

The total Wheeling Charges by the ISO on Scheduling Coordinator j for all Scheduling Points in Trading Interval t is calculated using the following formula:

$TotalWChg_j = \Sigma_q WChg_{jq}$

F 2.2 ISO Payments to Transmission Owners for Wheeling

The ISO will pay all Wheeling revenues to Participating TOs on the basis of the ratio of each Participating TO's Transmission Revenue Requirement ("TRR") (less the TRR associated with Non-Converted Rights and Existing Rights) to the sum of all Participating TOs' TRRs (less the TRRs associated with Non-Converted Rights and Existing Rights) as specified in Section 7.1.4.3 of the ISO Tariff. The sum to be paid to Participating TO_n for a Trading Interval is calculated as follows:

$$PayTO_n = \frac{TRR_n}{\sum_n TRR_n} * \sum_j totalWChrg_j$$

F 3 Meaning of terms in formulae

F 3.1 $WABC_q$ ($/kWh)

The Weighted Average Rate for Wheeling Service for Scheduling Point q.

F 3.2 P_n ($/kWh)

The Wheeling Access Charge rate for Participating TO n as set forth in Section 5 of the TO Tariff.

F 3.3 **Q_n (MW)**

The Available Transfer Capacity, whether from transmission ownership or contractual entitlements, of each Participating TO n for each ISO Scheduling Point which has been placed within the ISO Controlled Grid. Available Transfer Capacity does not include capacity associated with Non-Converted Rights and Existing Rights of a Participating TO as defined in Section 2.4.4 of the ISO Tariff.

F 3.4 **$WChg_{jq}$ ($)**

The Wheeling Charges by the ISO on Scheduling Coordinator j for Scheduling Point q in Trading Interval t. Both Wheeling Out and Wheeling Through transactions are included in this term.

F 3.5 **$QChargeW_{jqt}$ (kWh)**

The summation of kWh wheeled over Scheduling Point q by Scheduling Coordinator j in Trading Interval t. Both Wheeling Out and Wheeling Through transactions are included in this term.

F 3.6 **$TotalWChg_j$ ($)**

The total Wheeling Charges payable by Scheduling Coordinator j to the ISO for all Scheduling Points over which it has Wheeling transactions in Trading Interval t. Both Wheeling Out and Wheeling Through transactions are included in this term.

F 3.7 **$PayTO_n$ ($)**

The Trading Interval payment of Wheeling Out and Through Revenues from the ISO to Participating TO n.

F 3.8 **TRR_n**

The Transmission Revenue Requirement of Participating TO_n.

APPENDIX G

VOLTAGE SUPPORT and BLACK START CHARGES COMPUTATION

G 1 **Purpose of charge**

G 1.1 Voltage Support (VS) and Black Start (BS) charges are the charges made by the ISO to recover costs it incurs under contracts entered into between the ISO and those entities offering to provide VS or BS. Each Scheduling Coordinator pays an allocated proportion of the VS&BS charge to the ISO so that the ISO recovers the total costs incurred.

G 1.2 All Generating Units are required by the ISO Tariff to provide reactive power by operating within a power factor range of 0.90 lag and 0.95 lead. Additional short term Voltage Support required by the ISO is referred to as supplemental reactive power. If the ISO requires the delivery of this supplemental reactive power by instructing a Generating Unit to operate outside its mandatory MVar range, the Scheduling Coordinator representing this Generating Unit will only receive compensation if it is necessary to reduce the MW output to achieve the MVar instructed output. Supplemental reactive power charges to Scheduling Coordinators are made on a Trading Interval basis. As of the ISO Operations Date the ISO will contract for long term Voltage Support Service with the Owner of Reliability Must-Run Units under Reliability Must-Run contracts.

G 1.3 The ISO will procure Black Start capability through contracts let on an annual basis. The quantities and locations of the Black Start capability will be determined by the ISO based on system analysis studies. Charges to Scheduling Coordinators for instructed Energy output from Black Start units are made on a Trading Interval basis.

G 2 **Fundamental formulae**

G 2.1 **Payments to Scheduling Coordinators for providing Voltage Support**

Payments to Scheduling Coordinators for additional Voltage Support service comprise:

G.2.1.1 Lost Opportunity Cost Payments (supplemental reactive power) to Scheduling Coordinators for Generating Units

When the ISO obtains additional Voltage Support by instructing a Generating Unit to operate outside its mandatory MVar range by reducing its MW output the ISO will select Generating Units based on their Supplemental Energy Bids ($/MWh). Subject to any locational requirements the ISO will select the Generating Unit with the highest decremental Supplemental Energy Bid to reduce MW output by such amount as is necessary to achieve the instructed MVar reactive energy production. Each Trading Interval the ISO will pay Scheduling Coordinator j for that Generating Unit i in Zone x, the lost opportunity cost ($) resulting from the reduction of MW output in Trading Interval t in accordance with the following formula:

$$VSST_{xijt} = Max\ \{0, P_{xt} - Sup_{xdecit}\} * DEC_{xit}$$

G 2.1.2 Long term contract payments to Scheduling Coordinators for Reliability Must-Run Units for Generating Units and other Voltage Support Equipment

The ISO will pay Scheduling Coordinator j for the provision of Voltage Support from its Reliability Must-Run Units located in Zone x in month m a sum ($VSLT_{xjm}$) consisting of:

(a) the total of the Ancillary Service Pre-empted Dispatch Payments if the ISO has decreased the output of the Reliability Must-Run Units for the provision of Voltage Support outside the power factor range of the Reliability Must-Run Unit in any Trading Interval in month m and/or

(b) (if applicable) the total payments for the provision of Voltage Support in month m requested by the ISO from the synchronous condensers of the Reliability Must-Run Units,

calculated in each case in accordance with the terms of the relevant Reliability Must-Run Contract. Data on these payments will not be generated by the ISO. Such data will be based on the invoices issued by the Owners of Reliability Must-Run Generating Units pursuant to their Reliability Must-Run Contracts and will be verified by the ISO.

G 2.2 Charges to Scheduling Coordinators for Voltage Support

G 2.2.1 User Rate

The user rate ($/MWh) for the lost opportunity cost for voltage support referred to in G2.1.1 in Zone x for Trading Interval t will be calculated using the following formula:

$$VSSTRate_{xt} = \frac{\sum_{ij} VSST_{xijt}}{\sum_{j} QCharge\,VS_{xjt}}$$

The user rate ($/MWh) for month m for long term voltage support referred to in G2.1.2 in Zone x will be calculated using the following formula:

$$VSSTRate_{xm} = \frac{\sum_{j} VSLT_{xjm}}{\sum_{jm} QChargeVS_{xjt}}$$

G 2.2.2 Voltage Support Charges

The lost opportunity cost Voltage Support charge ($)payable to recover the sums under G2.1.1 for Zone x for Trading Interval t for Scheduling Coordinator j will be calculated using the following formula:

$$VSSTCharge_{xjt} = VSSTRate_{xt} * QChargeVS_{xjt}$$

The monthly long term voltage support charge ($) payable to recover sums under G2.1.2 for Zone x for month m for Scheduling Coordinator j will be calculated using the following formula:

$$VSLTCharge_{xjm} = VSLTRate_{xm} * \sum_{m} QChargeVS_{xjt}$$

G 2.3 Payments to Participating Generators for Black Start

Payments to Participating Generators that provide Black Start Energy or capability shall be made

in accordance with the agreements they have entered into with the ISO for the provision of Black Start services and shall be calculated as follows:

G 2.3.1 Black Start Energy Payments

Whenever a Black Start Generating Unit provides a Black Start in accordance with the ISO's instructions, the ISO will pay the Black Start Generator for that Unit for the Generating Unit's energy output and start-up costs. The ISO will pay Black Start Generator for Generating Unit i, the Black Start energy and start-up costs ($) in Trading Interval t in accordance with the following formula:

$BSEn_{ijt} = (EnQBS_{ijt} * EnBid_{ijt}) + BSSUP_{ijt}$

G 2.3.2 Black Start Energy Payments to Owners of Reliability Must-Run Units

Whenever a Reliability Must-Run Unit provides a Black Start in accordance with the ISO's instructions, the ISO will pay the Scheduling Coordinator of the Reliability Must-Run Unit the Generating Unit's Energy and start-up costs. The ISO will pay Scheduling Coordinator j for Reliability Must-Run Unit i the Black Start Energy and start-up costs ($) in Trading Interval t in accordance with the following formula:

$BSEn_{ijt} = (EnQBS_{ijt} * EnBid_{ijt}) + (BSSUP_{ijt})$

G 2.4 Charges to Scheduling Coordinators for Black Start

G 2.4.1 User Rate

The user rate ($/MWh) for Black Start Energy payments referred to in G2.3.1 and G2.3.2 for Trading Interval t will be calculated using the following formula:

$$BSRate_t = \frac{\sum_{ij} BSEn_{ijt}}{\sum_j QChargeBlackStart_{jt}}$$

G 2.4.2 Black Start Charges

The user charge ($/MWh) for Black Start Energy to recover the costs of payments under G2.3.1 and G2.3.2 for Trading Interval t for Scheduling Coordinator j will be calculated using the following formula:

$$BSCharge_{jt} = BSRate_t * QChargeBlackStart_{jt}$$

G 3 Meaning of Terms in the Formulae

G 3.1 $VSST_{xijt}$ ($)

The lost opportunity cost paid by the ISO to Scheduling Coordinator j for Generating Unit i in Zone x, resulting from the reduction of MW output in Trading Interval t.

G 3.2 P_{xt} ($/MWh)

The Hourly Ex Post price for Imbalance Energy in Trading Interval t in Zone x.

G 3.3 Sup_{xdecit} ($/MWh)

The Supplemental Energy Bid submitted by Scheduling Coordinator j for Generating Unit i in Zone x in Trading Interval t, whose output is

reduced by the ISO to provide additional short term Voltage Support.

G 3.4 **Dec_{xit}** **(MW)**

The reduction in MW by Scheduling Coordinator j for Generating Unit i in Zone x in Trading Interval t, in order to provide short term additional Voltage Support.

G 3.5 **$VSLT_{xjm}$** **($)**

The payment from the ISO to Scheduling Coordinator j for its Reliability Must-Run Units in Zone x for Voltage Support in month m calculated in accordance with the relevant Reliability Must-Run Contract.

G 3.6 **$VSSTRate_{xt}$** **($/MWh)**

The Trading Interval lost opportunity cost Voltage Support user rate charged by the ISO to Scheduling Coordinators for Trading Interval t for Zone x.

G 3.7 **$VSLTRate_{xm}$** **($/MWh)**

The monthly long term voltage support user rate charged by the ISO to Scheduling Coordinators for month m for Zone x.

G 3.8 **$QChargeVS_{xjt}$** **(MWh)**

The charging quantity for Voltage Support for Scheduling Coordinator j for Trading Interval t in Zone x equal to the total metered Demand (including exports to neighboring Control Areas) for Scheduling Coordinator j in Zone x for Trading Interval t.

G 3.9 **$VSSTCharge_{xjt}$** **($)**

The lost opportunity cost Voltage Support user charge for Zone x for Trading Interval t for Scheduling Coordinator j.

G 3.10 **$VSLTCharge_{xjm}$** **($)**

The long term charge for voltage support for month m for Zone x for Scheduling Coordinator j.

G 3.11 **$BSEn_{ijt}$** **($)**

The ISO payment to Scheduling Coordinator j (or Black Start Generator j) for that Generating Unit i providing Black Start Energy in Trading Interval t.

G 3.12 **$EnQBS_{ijt}$** **(MWh)**

The energy output, instructed by the ISO, from the Black Start capability of Generating Unit i from Scheduling Coordinator j (or Participating Generator j) for Trading Interval t.

G 3.13 **$EnBid_{ijt}$** **($/MWh)**

The price for Energy output from the Black Start capability of Generating Unit i of Scheduling Coordinator j or (Black Start Generator j) for Trading Interval t calculated in accordance with the applicable Reliability Must-Run Contract or Interim Black Start Agreement.

G 3.14 **$BSSUP_{ijt}$** **($)**

The start-up payment for a Black Start successfully made by Generating Unit i of Scheduling Coordinator j (or Black Start Generator j) in Trading Interval t calculated in accordance with the applicable Reliability Must-Run Contract or Interim Black Start Agreement.

G 3.15 **$BSRate_t$** **($/MWh)**

The Black Start Energy Payment user rate charged by the ISO to Scheduling Coordinators for Trading Interval t.

G 3.16 **$QChargeBlackstart_{jt}$** **(MW)**

The charging quantity for Black Start for Scheduling Coordinator j for Trading Interval t equal to the total metered Demand (excluding exports to neighboring Control Areas) of Scheduling Coordinator j for Trading Interval t.

APPENDIX H

[NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

[PAGE NOT USED]

APPENDIX I

DRAFT SAMPLE OF INVOICE

Independent System Operator

MARKET INVOICE

CUSTOMER 1
101 N. Harbor Blvd.
Anaheim CA 92808

Invoice: 181
Date: 20-JUN-97
Customer Number: 1000

Please send payment to:

1000 South Fremont Avenue
Building A-11
Alhambra CA 91803

For all inquiries contact:
1-800-ISO-HELP

Comments:

Charges settlement date: 20-JUN-97 to 20-JUN-97

Charge Type	Description	Amount
0001	0001-Day-Ahead Spinning Reserve due SC	-$845.00
0002	0002-Day-Ahead Non-Spinning Reserve due SC	-$1,025.00
0003	0003-Day-Ahead AGC/Regulation due SC	-$1,025.00
0004	0004-Day-Ahead Replacement Reserve due SC	-$1,385.00
0051	0051-Hour-Ahead Spinning Reserve due SC	-$1,565.00
0052	0052-Hour-Ahead Non-Spinning Reserve due SC	-$1,745.00
0053	0053-Hour-Ahead AGC/Regulation due SC	-$1,925.00
0054	0054-Hour-Ahead Replacement Reserve due SC	-$2,105.00
0101	0101-Day-Ahead Spinning Reserve due ISO	$22,075.00
0102	0102-Day-Ahead Non-Spinning Reserve due ISO	$23,935.00
0103	0103-Day-Ahead AGC/Regulation due ISO	$25,795.00
0104	0104-Day-Ahead Replacement Reserve due ISO	$27,655.00
0251	0251-Hour-Ahead Intra-Zonal Congestion Settlement due ISO	$385.00
0252	0252-Hour-Ahead Intra-Zonal Congestion Charge/Refund due ISO	$4,925.00
0253	0253-Hour-Ahead Inter-Zonal Congestion Settlement due ISO	$5,285.00
0301	0301-Ex-Post A/S Energy due SC	-$6,005.00
0302	0302-Ex-Post Supplemental Reactive Power due SC	-$6,365.00
0303	0303-Ex-Post Replacement Reserve due ISO (Dispatched)	$6,725.00
0304	0304-Ex-Post Replacement Reserve due ISO (Undispatched)	$7,085.00
Invoice Total		