

**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 BEEP Interval of each Settlement Period calculated in accordance with the following formulae:

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

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

$$DevC_{bjxt} = NetDev_{bjxt} * BIP_{bxt}$$

Where:

$$NetDev_{bjxt} = \left[ \sum_i GenDev_{bixt} - \sum_i LoadDev_{bixt} + \sum_q ImpDev_{bq-xt} - \sum_q ExpDev_{bq-xt} \right]$$

If  $NetDev_{bjxt} < 0$ , then

$BIP_{bxt}$  = BEEP Interval Price for decremental Energy for BEEP Interval b in

Settlement Period t.

If  $NetDev_{bjxt} > 0$ , then

$BIP_{bxt}$  = BEEP Interval Price for incremental Energy in Zone x for BEEP Interval b in Settlement Period t.

The deviation quantity between scheduled and actual Energy Generation for Generator i represented by Scheduling Coordinator j in Zone x during each BEEP Interval b of each Settlement Period t is calculated as follows:

$$GenDev_{ixbt} = \left[ (G_{sb}) * GMM_f - [(G_a - G_{b,adj}) * GMM_a - G_{b,a/s} - G_{b,s/e}] - \frac{UnavailAncServMW_{bx}}{HBI} \right]$$

Where:

If the BEEP Interval Ex Post Price for decremental Energy is negative, then:

$$UnavailAncServMW_{ix} = 0$$

If the BEEP Interval Ex Post Price for decremental Energy is greater than or equal to zero, then:

$$UnavailAncServMW_{ix} = \text{Max} [-(G_{i, oblig} - G_{a/s*6}) \text{ Min}[0, Pmax - G_{a*6} - (G_{i, oblig} - G_{a/s*6})]]$$

The value of  $G_a$  for Generation scheduled on behalf of Participating Generators for each BEEP Interval in each Settlement Period shall be

the actual meter data aggregated on a 10-minute basis. The value of  $G_{sb}$  for Generation scheduled on behalf of Participating Generators for each BEEP Interval in each Settlement Period shall be determined as follows for BEEP Intervals 2 through 5:

$$G_{s,b} = \frac{G_s}{6}$$

For BEEP Interval 1 and BEEP Interval 6, implicit Dispatch instructions for ramping will be applied to adjust the Schedules attributed to those BEEP Intervals as follows:

$$G_{s,1} = \left(\frac{G_s}{6}\right) - \left(\frac{(G_s - G_{s-1})}{24}\right)$$

$$G_{s,6} = \left(\frac{G_s}{6}\right) + \left(\frac{(G_{s+1} - G_s)}{24}\right)$$

The value of  $G_s$  and  $G_a$  for Generation which has not undertaken in writing to be bound by the ISO Tariff in accordance with Article 5 shall be determined as follows for all six BEEP Intervals:

$$G_{s,b} = \frac{G_{s,t}}{6}$$

$$G_a = \frac{G_{at}}{6}$$

The deviation quantity between scheduled and actual Load consumption for Load i represented by Scheduling Coordinator j in Zone x for each BEEP Interval of each Settlement Period t is calculated as follows:

$$LoadDev_{ibxt} = L_{sb} - \left[ \left( L_a - L_{b,adj} \right) + L_{b,a/s} + L_{b,s/e} - \frac{UnavailDispLoadMW_{bx}}{HBI} \right]$$

Where;

If the BEEP Interval Ex Post Price for decremental Energy is negative, then:

$$UnavailDispLoadMW_{ix} = 0$$

If the BEEP Interval Ex Post Price for decremental Energy is greater than or equal to zero, then:

$$UnavailDispLoadMW_{ix} = \text{Max}[0, [(L_j, oblig) - L_a/s*6] - (L_a*6)]$$

The value of  $L_{b,a/s}$ ,  $L_{b,s/e}$  and  $L_{adj}$  are determined on a 10-minute basis. The value of  $L_a$  for Load scheduled on behalf of Participating Loads for each BEEP Interval in each Settlement Period shall be the actual meter data aggregated on a 10-minute basis. The value of  $L_{sb}$  for Load scheduled on behalf of Participating Loads for each BEEP Interval in each Settlement Period  $t$ , shall be determined as follows:

For BEEP Intervals 2 through 5,

$$L_{sb} = \frac{L_s}{6}$$

For BEEP Interval 1 and BEEP Interval 6, implicit Dispatch instructions for ramping will be applied to adjust the schedules attributed to those BEEP Intervals as follows:

$$L_{s,1} = \left( \frac{L_s}{6} \right) - \left( \frac{(L_s - L_{s-1})}{24} \right)$$

$$L_{s,6} = \left( \frac{L_s}{6} \right) + \left( \frac{(L_{s+1} - L_s)}{24} \right)$$

The value of  $L_{sb}$  and  $L_a$  for Loads that are not Participating Loads shall be determined as follows for all six BEEP Intervals:

$$L_{sb} = \frac{L_s}{6}$$

$$L_a = \frac{L_{at}}{6}$$

$L_{at}$  is Load  $i$  hourly metered quantity for Settlement Period  $t$ .

The deviation quantity 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 each BEEP Interval of each Settlement Period is calculated as follows:

$$ImpDev_q = I_{sb} * GMM_{jq} - [(I_a + I_{b,a/s} - I_{b,adj}) * GMM_{ahq}] + I_{b,a/s}$$

The values of  $I_{b,a/s}$ ,  $I_a$  and  $I_{b,adj}$  are determined on a 10-minute basis. The value of  $I_{sb}$  shall be determined as follows:

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

For BEEP Intervals 1 through 6,

$$I_{sb} = \frac{I_s}{6}$$

The deviation quantity between forward scheduled and Real Time adjustments to Energy exports\* for Scheduling Point q represented by Scheduling Coordinator j from Zone x for each BEEP Interval for each Settlement Period t is calculated as follows:

$$ExpDev_q = E_{s,b} - E_a - E_{adj,b}$$

The values of  $E_a$  and  $E_{b,adj}$  are determined on a 10-minute basis. The value of  $E_{s,b}$  shall be determined as follows:

For BEEP Intervals 1 through 6,

$$E_{sb} = \frac{E_s}{6}$$

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:

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

Where:

$BIP_{ix}$  = BEEP Interval Ex Post Prices to be used for settlement of Uninstructed Imbalance Energy. The BEEP Interval Price for incremental Energy will be charged to decremental uninstructed deviations in that interval, and the BEEP Interval Price for incremental Energy will be charged to incremental uninstructed deviations in that interval.

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

$MWh_{jix}$  = 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**

Implicit Dispatch instructions for ramping Energy shall be calculated based on Final Hour Ahead Schedules for Energy to result in a linear ramp by all Participating Generators and Participating Loads

beginning 10 minutes prior to the start, and ending 10 minutes after the start of each Settlement Period. Ramping Energy shall be deemed delivered and settled at a price of zero dollars per MWh.

The amount of Instructed Imbalance Energy to be delivered in each BEEP Interval will be determined based on the ramp rates and time delays bid in accordance with SBP 5 and 6. Payment due a Load, Generator, Import or Export for Instructed Imbalance Energy to be delivered in a BEEP Interval shall be calculated based on the actual Energy delivered to the ISO Grid in accordance with the Dispatch instruction.

Instructed Imbalance Energy by an Import or Export is deemed delivered. The actual Energy delivered by a Load or Generator in response to Dispatch instructions will be determined by first attributing Energy deviations to any Energy associated with redispatch of that Load or Generation in that BEEP Interval according to Section 7.2.6.2, or to Dispatch orders to be settled in accordance with Section 11.2.4.2. If instructions for both incremental and decremental Energy are issued in a BEEP Interval, then any instructions described in the previous sentence for decremental Energy, together with any decremental Dispatch instructions on Supplemental Energy, shall be deemed delivered.

Any remaining deviation will then be sequentially attributed to Instructed Imbalance Energy, first from Supplemental Energy, then from Replacement Reserve, then from Non-Spinning Reserve, and then from Spinning Reserve in that BEEP Interval.

Residual Instructed Imbalance Energy arising due to Dispatch instructions shall be priced based on the applicable BEEP Interval Ex Post Price for the BEEP Interval to which the Dispatch instruction applied. If Instructed Imbalance Energy is to be delivered in the last BEEP Interval of the hour preceeding the Settlement Period to which a Dispatch instruction applies shall be settled at the applicable BEEP Interval Ex Post Price for the first BEEP Interval of the Settlement Period for which the bid was submitted.

Subject to the above conditions, the Instructed Imbalance Energy charge for each BEEP Interval  $b$  of each Settlement Period  $t$  for Scheduling Coordinator  $j$  for Zone  $x$  is calculated using the following formulas:

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

$$\text{IGDC}_{ib} = G_{ib} * P_b$$

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

$$\text{ILDC}_{ib} = L_{ib} * P_b$$

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

$$\text{IIDC}_{qb} = I_{qb} * P_b$$

**D 2.2 Unaccounted for Energy Charge**

The Unaccounted for Energy Charge on Scheduling Coordinator *j* for each BEEP Interval of each Settlement Period *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 for each Settlement Period *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:

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



$$Total\_Branch_{Losses} = \frac{\left( \sum UDC_k - Branch_{Losses} \right)}{6}$$

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 for each BEEP Interval b of each Settlement Period t per relevant Zone is then,

$$UFEC_j = (\sum_z E_{UFE,Z}) * BIP_{b,t}$$

**D 3 Meaning of terms of formulae**

**D 3.1 IEC<sub>j</sub> – \$**

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

**D 3.2 GenDev<sub>i</sub> – 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<sub>i</sub> – 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<sub>q</sub> – 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<sub>q</sub> – 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<sub>s</sub> – MWh**

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

**D 3.6.1 G<sub>s-1</sub>**

The total scheduled Generation of Scheduling Coordinator j for Generator i in settlement Period t-1 as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.

- D3.6.2**       **$G_{s+1}$**
- The total scheduled Generation of Scheduling Coordinator j for Generator i in settlement Period t+1 as a result of both the Day-Ahead Final Schedule and the Hour-Ahead Final Schedule.
- D3.6.3**       **$G_{b,adj}$**
- Is Deviation in real time ordered by the ISO in BEEP Interval b according to Section 7.2.6.2, or for settlement according to Section 11.2.4.2.
- D 3.7**       **$G_{at}$  - MWh**
- The total actual metered Generation of Scheduling Coordinator j for Generator i in Settlement Period 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<sub>ah</sub> – 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<sub>ahq</sub> – 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 Settlement Period 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 BEEP Interval b of Settlement Period t.

**D 3.15.1**     **$L_{at} - MWh$**

The total actual metered Demand of Scheduling Coordinator j for Demand i in Settlement Period t.

**D 3.15.2**     **$L_{b,adj}$**

Is Deviation in real time ordered by the ISO in BEEP Interval b according to Section 7.2.6.2, or for settlement according to Section 11.2.4.2.

**D 3.16**      **[Not Used]**

**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 Settlement Period 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**       **$I_{b,adj}$  – 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 Settlement Period 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 BEEP Interval b of Settlement Period 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<sub>j</sub> – \$**

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 BEEP Interval b of Settlement Period t in utility service territory k.
- D 3.32**       **$D_z$  – MWh**  
The Demand including Exports in BEEP Interval b of Settlement Period t at metered point z.
- D 3.33**       **$I_k$  – MWh**  
The total metered imports into utility service territory k in BEEP Interval b of Settlement Period t.
- D 3.34**       **$E_k$  – MWh**  
The total metered exports from utility service territory k in BEEP Interval b of Settlement Period t.
- D 3.35**       **$RTM_k$  – MWh**  
The Trading Interval t total of the real-time metering in utility service territory k in BEEP Interval b of Settlement Period t.



- D 3.36**       **$LPM_k - MWh$**   
The calculated total of the Load Profile metering in utility service territory k per BEEP Interval b of Settlement Period t.
- D 3.37**       **$TL_k - MWh$**   
The Transmission Losses per BEEP Interval b of Settlement Period t in utility service territory k.
- D 3.38**       **$IGDC_j - \$$**   
The total of instructed Generation deviation payments/charges for Scheduling Coordinator j in BEEP Interval b of Settlement Period t.
- D 3.39**       **$ILDC_j - \$$**   
The total of instructed Load deviation payments/charges for Scheduling Coordinator j in BEEP Interval b of Settlement Period t.
- D 3.40**       **$IIDC_{ib} - \$$**   
The total of instructed import deviation payments/charges for Scheduling Coordinator j in Settlement Period t.
- D 3.41**       **$G_{ib} - MW$**   
Instructed Energy for Generating Unit i during BEEP Interval b.
- D 3.42**       **$L_{ib} - MW$**   
Instructed Energy for Load i during BEEP Interval b.
- D 3.43**       **$I_{iqb} - MW$**   
Instructed Energy for import q during BEEP Interval b
- D 3.44**       **$P_i - \$/MWh$**   
The BEEP Incremental Ex Post Price for BEEP Interval b if the net instructed Energy for resources is positive, or the BEEP decremental Ex Post Price for BEEP Interval b if the net instructed Energy for resources is negative.
- D 3.45**      **HBI – Number**  
The number of BEEP Intervals in Settlement Period t, currently set to 6.

**D 3.46**      **ReplObligRatio<sub>jxt</sub> – fraction**

$$ReplObligRatio_{jxt} = \frac{ReplOblig_{jxt}}{\sum_j ReplOblig_{jxt}}$$

where:

*ReplOblig<sub>jxt</sub>* is the replacement reserve capacity obligation as defined in Appendix C Section 3.67.

**D 3.47**      **G<sub>i, oblig</sub>**

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<sub>i</sub>**

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<sub>i, oblig</sub>**

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) pay, or be paid, Usage Charges in Trading Interval  $t$  calculated in accordance with the following formulae:

In the Day-Ahead Market:

$$UC_{jtd} = \sum_x NetZoneImp_{jxd} * \lambda_{dxt}$$

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) receive a Usage Charge payment from the ISO calculated in accordance with the formulae described in Section E 2.1.

**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  $\mu_{yth}$  for each MW of the adjustment; and
- (c) Each Scheduling Coordinator will be charged an amount equal to its 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            NetZonalImp<sub>jtxh</sub>            (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             $\lambda_{dxt}$             (\$/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             $\lambda_{hxt}$             (\$/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<sub>ntd</sub>        (\$)**  
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<sub>nth</sub>        (\$)**  
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             $\mu_{ytd}$         (\$/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         $\mu_{yth}$         (\$/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<sub>ytn</sub>        (%)**  
The percentage of the Inter-Zonal Congestion revenue allocation 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<sub>ytd</sub>        (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<sub>yth</sub>        (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 shall be as specified in section 7.1.4 of the ISO Tariff.



**F 2.1.2 [Not Used]**

**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 Existing Rights) to the sum of all Participating TOs' TRRs (less the TRRs associated with Existing Rights) as specified in Section 7.1.4.3 of the ISO Tariff. The Low Voltage Wheeling Access Charge shall be disbursed to the appropriate Participating TO. The sum to be paid to Participating TO<sub>n</sub> 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<sub>q</sub> (\$/kWh)**

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

**F 3.2 P<sub>n</sub> (\$/kWh)**

The applicable Wheeling Access Charge rate for TAC Area or Participating TO n in \$/kWh as set forth in Section 7.1.4 of the ISO Tariff and 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 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.

**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:

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

**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<sub>xjm</sub>) 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:

$$VSSTRate_{xt} = \frac{\sum_{ij} VSST_{xijt}}{\sum_j QChargeVS_{xjt}}$$

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:

$$BSE_{ij,t} = (EnQBS_{ijt} * EnBid_{ijt}) + (BSSUP_{ijt})$$

**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:

$$BSRate_t = \frac{\sum_{ij} BSE_{ij,t}}{\sum_j QChargeBlackStart_{jt}}$$

**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<sub>xijt</sub> (\$)**

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<sub>xt</sub> (\$/MWh)**

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

**G 3.3 Sup<sub>xdecit</sub> (\$/MWh)**

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



- G 3.12**      **EnQBS<sub>ijt</sub>**      **(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<sub>ijt</sub>**      **(\$/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<sub>ijt</sub>**      **(\$)**  
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<sub>t</sub>**      **(\$/MWh)**  
The Black Start Energy Payment user rate charged by the ISO to Scheduling Coordinators for Trading Interval t.
- G 3.16**      **QChargeBlackstart<sub>jt</sub>**      **(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**

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**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**

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\_\_\_\_\_