California Independent System Operator

Proposed Modification to the MRTU Real-time LAP Price Computation

Revised White Paper
December 6, 2006

Statement of the Issue

The filed MRTU Tariff (as filed on February 9, 2006) provides for the settlement of real-time Load Aggregation Point (LAP) load deviations (LAP level uninstructed imbalance energy) through a combination of an hourly LAP price (Tier 2 UIE price) and an hourly LAP price adjustment (UIE Adjustment). Overconsumption (real-time LAP load in excess of the day-ahead LAP load schedule) is charged the sum of the LAP price and the LAP price adjustment and underconsumption (real-time LAP load below the day-ahead LAP schedule) is paid the difference of the LAP price and the LAP price adjustment (Tariff Section 11.5.2).

Some stakeholders (SCE and NCPA) stated concerns about this approach. Moreover, in the stakeholder discussions related to the design of Convergence Bidding it appeared that having two different real-time LAP prices (depending on over or under consumption) would not be compatible with the idea of "price convergence" between day-ahead and real-time markets. Further scrutiny, primarily based on input from SCE and NCPA revealed that under some (albeit rare) conditions, the two-price methodology as stated in the Tariff might lead to excessive charges to a single Scheduling Coordinator (SC).

This white paper proposes a change in the real-time LAP settlement methodology to address these concerns[1]. It defines a single real-time price for settlement of both over- and under- consumption[2]. The result is that the real-time LAP settlement may not be revenue neutral. Revenue neutrality was the main reason for having two real-time prices in the filed methodology. This white paper justifies giving up this revenue neutrality provision in the computation of LAP deviation rates in the revised methodology proposed here and provides an allocation scheme for its recovery.

Summary of the New Method Proposed

Compute the real-time LAP price using as weights (for the relevant real-time nodal load LMPs) the real-time LAP nodal loads (rather than the absolute value of LAP nodal load deviations, as initially proposed). Eliminate the LAP price adjustment element. Compute and allocate revenue neutrality resulting from the changes in the LAP Load Distribution Factors (LDFs) between day-ahead and real-time to all metered CAISO Demand (i.e., metered demand excluding exports).

Rationale for the New Method Proposed

The filed methodology was created with two objectives: (1) avoid the potential for excessively high rates ($/MWh) that could result from a single revenue neutral LAP

[1] The change proposed herein if agreed upon by the stakeholders will be included as a 205 filing shortly after the stakeholder process on this issue has been completed.

[2] This is in line with the practice at the Eastern ISOs, where the real-time price for settlement with zonal load deviations in each load zone is the same for over- and under-consumption. In fact, the real-time zonal price in each zone is computed using total real-time zonal load and real-time Load Distribution Factors (LDFs) as proposed in this white paper. However, the resulting revenue neutrality is not separated from other real-time neutrality revenues/costs such as marginal loss surplus or net real-time congestion revenues/costs, and is thus allocated along with other real-time neutrality.

price, (2) achieve revenue neutrality. This led to the need for two prices, namely the LAP price plus or minus the LAP price Adjustment, for over- or under- consumption. The filed methodology does indeed achieve the second objective (revenue neutrality), but as pointed out by SCE and NCPA, under some (rather rare) circumstances may not quite achieve the first objective, i.e., may give rise to excessive or counter-intuitive rates under certain conditions.

The main problem lies in that real-time changes in "nodal" loads derived from LAP schedules may not be only due to changes in the LAP load (over- or under-consumption), but may also be caused by changes in the LAP Load Distribution Factors (LDFs) from day-ahead to real-time. The latter (LDF changes) could give rise to revenue non-neutrality that the current methodology folds into the combination of the LAP price and the LAP price adjustment, i.e. allocates to only those SCs with LAP load deviations. Changes in LDFs between the DA and real-time market may require real-time re-dispatch and thus real-time costs (to compensate for changes in real-time congestion and losses resulting from LDF changes). Under circumstances where real-time re-dispatch costs resulting from the changes in the LDFs are much higher than the real-time re-dispatch cost to meet the change in the LAP load itself (with no change in LDFs), the filed approach may lead to excessive or counter-intuitive prices. A more appropriate approach would be to isolate the real-time revenue requirement due to changes in the LDFs and allocate it to all load rather than to LAP load deviations. This is the basis of the revised methodology proposed above and illustrated via examples below.

Examples

The following examples are intended to clarify and compare the filed methodology with the methodology proposed here.

Example 1[3]

Consider a LAP with only two nodes 1 and 2, and assume there are two SCs, SCA and SCB respectively. The following table shows the day-ahead (IFM) and real-time LAP loads, LDFs, and SC day-ahead LAP schedules and real-time LAP consumptions.

	LAP load (MW)	LDF1	LDF2	Node 1 (MW)	Node 2 (MW)	SCA Load (MW)	SCB Load (MW)	LMP1	LMP2
IFM	20,000	50%	50%	10,000	10,000	10,000	10,000		
Real Time	20,005	51%	49%	10,202.55	9,802.45	10,100	9,905	$25	$10
Change	5			202.55	-197.55	100	-95		

Settlement based on the current (filed) methodology

The LAP price based on the filed methodology is the weighted average of the absolute values of nodal MW deviations:

*LAP Price (filed methodology) = (202.55*$25 + 197.45*$10)/(202.55+197.45) = $17.59*

The LAP price adjustment based on the filed methodology is computed as follows using nodal MW deviations and SC specific LAP MW deviations:

*LAP price Adj. = ((202.55*$25 - 197.45*$10) - $17.59 * (100 - 95)) / (100+95) = $15.39*

[3] This example is similar to that included in Farrokh Rahimi's testimony.

Thus the effective rate for over-consumption (SCA) is $17.59 + $15.39 = $32.98 and for under-consumption (SCB), it is $17.59 - $15.39 = $2.21. Both rates are positive, meaning that the SC(s) with overconsumption (positive real-time LAP deviation MWh) are charged and those with underconsumption (negative real-time LAP deviation MWh) are paid.

The following table summarizes the real-time LAP load deviation settlement with the two SCs under the procedure in the current filing:

	LAP MW Deviation	Real-time Settlement Amounts			Effective Rate ($/MWh)
		LAP price	LAP price Adjustment	Net	
SCA	100	$1,759	$1,539	$3,298	$32.98
SCB	-95	-$1,671	$1,461	-$210	$2.21
Total	5	$88	$3,000	$3,088	$617.65

Settlement based on the proposed new methodology

The LAP price is determined based on the total real-time nodal demand as LMP weights:

*LAP Price (new methodology) = (10,202.55*$25 + 9,802.45*$10)/20,005 = $17.65*

Each SC is charged/paid this rate for over- or under- consumption. This results in a net collection from the SCs of $17.65*(100-95) = $88.

The difference between the total revenue requirement ($3,088), which ISO must collect to stay revenue neutral (based on the underlying nodal settlement), and the net amount ($88) collected from the SCs for their LAP load deviation based on the new proposed rate may be attributed to the change in the LDFs from day-ahead to real-time. In fact, if the real-time LAP MW had stayed at its day-ahead level of 20,000 MW, but the LDFs had changed as in this example, the change in LDFs would have changed the nodal loads at node 1 and node 2 as follows:

Change in Node 1 load: 20,000 * (51% - 50%) = 200 MW

Change in Node 2 load: 20,000 * (49% - 50%) = -200 MW

Assuming this would not have impacted the LMPs, the net real-time cost associated with LDF change would have been $25*200 - $10*200 = $3,000, which is exactly the difference between the total revenue requirement ($3,088) and the amount ($88) collected for LAP deviation based on the new rate. The new proposed method allocates this neutrality amount to all real-time load. The neutrality allocation is thus $1,539 to SCA and $1,461 to SCB.

The following table summarizes the real-time LAP load deviation settlement including the associated neutrality allocation with the two SCs under the new proposed procedure:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	100	$1,765	$1,515	$3,280
SCB	-95	-$1,677	$1,485	-$192
Total	5	$88	$3,000	$3,088

Note that the end result (net settlement amount for each SC) is not markedly different in this example 1 between the filed and the new proposed methods. The difference may be more significant under some conditions as illustrated in the next two examples.

Example 2

Consider a change in the data for example 1 whereby the real-time LDFs are slightly different from those in example 1; also, the real-time LAP MW deviations are 2 MW for SCA and 1 MW for SCB as summarized in the following table.

	LAP load (MW)	LDF1	LDF2	Node 1 (MW)	Node 2 (MW)	SCA Load (MW)	SCB Load (MW)	LMP1	LMP2
IFM	20,000	50%	50%	10,000	10,000	10,000	10,000		
Real Time	20,001	50.9975%	49.0025%	10,200	9,801	10,002	9,999	$25	$10
Change	1			200	-199	2	-1		

Settlement based on the current (filed) methodology

The LAP price based on the filed methodology is the weighted average of the absolute values of nodal MW deviations:

*LAP Price (filed methodology) = (200$25 + 199*$10)/(200+199) = $17.52*

The LAP price adjustment based on the filed methodology is computed as follows:

*LAP price Adj. = ((200*$25 - 199*$10) - $17.52 * (2-1)) / (2+1) = $997.49*

Thus the effective rate for over-consumption (SCA) is $17.52 + $997.49 = $1,015.01, and for under-consumption it is $17.52 - $997.49 = - $979.97. The former is very high, and the latter is counter intuitive (a SC that underconsumes would still have to pay since it will face a negative effective price). The following table summarizes the real-time LAP load deviation settlement with the two SCs:

	LAP MW Deviation	Real-time Settlement Amounts			Effective Rate ($/MWh)
		LAP price	LAP price Adjustment	Net	
SCA	2	$35.04	1,994.99	2,030.03	1,015.01
SCB	-1	-$17.52	997.49	979.97	-979.97
Total	1	$17.52	2,992.48	3,010.00	3,010.00

Settlement based on the proposed new methodology

The LAP price is determined based on the total real-time nodal demand as LMP weights:

*LAP Price (new methodology) = (10,200*$25 + 9,801*$10)/20,001 = $17.65*

Each SC is charged/paid this rate for over- or under- consumption. This results in a net collection from the SCs of $17.65*(2-1) = $17.65.

The difference between the total revenue requirement ($3,010), which ISO must collect to stay revenue neutral, and the net amount ($17.65) collected from the SCs for their LAP load deviation, i.e., $2,992.35, may be attributed to the change in the LDFs from day-ahead to real-time. In fact, if the real-time LAP MW had stayed at its day-ahead level of 20,000 MW, but the LDFs had changed, the change in LDFs would have changed the nodal loads at node 1 and node 2 as follows:

Change in Node 1 load: 20,000 * (50.9975% - 50%) = 199.49 MW

Change in Node 2 load: 20,000 * (49.0025% - 50%) = -199.49 MW

Assuming this would not have impacted the LMPs, the net real-time cost associated with LDF change would have been $25*199.49 - $10*199.49 = $2,992.35. The new proposed method allocates this neutrality amount to all real-time load. The neutrality allocation is thus $1,496.40 to SCA and $1,495.95 to SCB.

The following table summarizes the real-time LAP load deviation settlement including the associated neutrality allocation with the two SCs under the new proposed procedure:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	2	$35.30	$1,496.40	$1,531.70
SCB	-1	-$17.65	$1,495.95	$1,478.30
Total	1	$17.65	$2,992.35	$3,010.00

Note that the effective rate for SCA is still rather high ($1,531.70) and SCB is charged (at a net rate of -$1,478.30) despite having real-time LAP underconsumption. But these allocations (a combination of a real-time LAP rate of $17.65 and revenue neutrality charge) are more transparent and intuitive than the two rates under the filed methodology.

Example 3[4]

Consider a small change in the data for example 2 whereby only one SC (SCA) has a real-time LAP MW deviation of 1 MW, but the other SC (SCB) has no LAP MW deviation as summarized in the following table.

[4] This example is a variant of Example 1 above and is based on an example initially suggested by NCPA in a communication with CAISO dated September 13, 2006.

	LAP load (MW)	LDF1	LDF2	Node 1 (MW)	Node 2 (MW)	SCA Load (MW)	SCB Load (MW)	LMP1	LMP2
IFM	20,000	50%	50%	10,000	10,000	10,000	10,000		
Real Time	20,001	50.9975%	49.0025%	10,200	9,801	10,001	10,000	$25	$10
Change	1			200	-199	1	0		

Settlement based on the current (filed) methodology

The LAP price based on the filed methodology is the weighted average of the absolute values of nodal MW deviations:

*LAP Price (filed methodology) = (200$25 + 199*$10)/(200+199) = $17.52*

The LAP price adjustment based on the filed methodology is computed as follows:

*LAP price Adj. = ((200*$25 - 199*$10) - $17.52 * (1-0)) / (1+0) = $2,992.48*

Thus the effective rate for over-consumption (SCA) is $17.52 + $2,992.48 = $3,010, and for under-consumption it is $17.52 - $2,992.48 = - $2,974.96. Again, the former is very high, and the latter is counter intuitive (a SC that underconsumes would still have to pay since it will face a negative effective price). The following table summarizes the real-time LAP load deviation settlement with the two SCs:

	LAP MW Deviation	Real-time Settlement Amounts			Effective Rate ($/MWh)
		LAP price	LAP price Adjustment	Net	
SCA	1	$17.52	$2,992.48	$3,010	$3,010
SCB	0	$0	$0	$0	-
Total	1	$17.52	$2,992.48	$3,010	$3,010

Settlement based on the proposed new methodology

The LAP price is determined based on the total real-time nodal demand as LMP weights:

*LAP Price (new methodology) = (10,200*$25 + 9,801*$10)/20,001 = $17.65*

Each SC is charged/paid this rate for over- or under- consumption. This results in a net collection from the SCs of $17.65*(1-0) = $17.65.

The difference between the total revenue requirement ($3,010), which ISO must collect to stay revenue neutral, and the net amount ($17.65) collected from the SCs for their LAP load deviation, i.e., $2,992.35, may be attributed to the change in the LDFs from day-ahead to real-time. In fact, if the real-time LAP MW had stayed at its day-ahead level of 20,000 MW, but the LDFs had changed, the change in LDFs would have changed the nodal loads at node 1 and node 2 as follows:

Change in Node 1 load: 20,000 * (50.9975% - 50%) = 199.49 MW

Change in Node 2 load: 20,000 * (49.0025% - 50%) = -199.49 MW

Assuming this would not have impacted the LMPs, the net real-time cost associated with LDF change would have been $25*199.49 - $10*199.49 = $2,992.35. The new proposed

method allocates this neutrality amount to all real-time load. The neutrality allocation is thus $1,496.25 to SCA and $1,496.10 to SCB.

The following table summarizes the real-time LAP load deviation settlement including the associated neutrality allocation with the two SCs under the new proposed procedure:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	1	$17.65	$1,496.25	$1,513.90
SCB	0	0	$1,496.10	$1,496.10
Total	1	$17.65	$2,992.35	$3,010.00

Note that the effective rate for SCA is still rather high ($1,513.90) and that SCB is charged despite having no real-time LAP deviation. But these allocations (a combination of a real-time LAP rate of $17.65 and revenue neutrality charge) are more transparent and intuitive that the two rates under the filed methodology.

Discussion of the New Proposed Method

As stated above, if there is no change in the LAP LDFs between the day-ahead and real-time markets, the filed method and the new proposed method yield identical results. However, it is unlikely that the LDFs will stay the same between day-ahead and real time. Changes in the LDFs can result in real-time re-dispatch costs (real-time revenue non-neutrality). The filed method allocates this cost only to SCs with LAP load deviations, whereas the new proposed method allocates it to all LAP load. The rationale for allocating to all LAP load is that all actual loads of the LAP should share the costs of changes in the LDFs between the day-ahead and real-time time frames.

The examples presented above represent conditions involving very small (almost negligible) volume of net LAP level underscheduling. In these examples, the volume of load underscheduling is only 5 MW in example 1 and only 1 MW in examples 2 and 3, compared to the LAP load of 20,000 MW. Thus in these examples, even small changes in the LAP LDFs between the day-ahead and real-time markets can result in real-time costs (real-time revenue non-neutrality) far exceeding real-time costs attributable to load underscheduling.

With higher levels of load underscheduling, the filed methodology is not expected to result in excessive or counter intuitive rates illustrated in these examples. In fact, in the above examples if only 95% of the LAP load were scheduled in the day-ahead market (i.e., if underscheduling were about 1,000 MW), even with changes in LAP LDFs by as much as 3% (i.e., 53% / 47% in Real-time compared to 50% / 50% in the day-ahead market) the filed methodology would have resulted in relatively small LAP price adjustment rates, i.e., reduced gap between the two effective real-time rates, i.e., the LAP price plus or minus LAP price adjustment (although these effective prices would still be different from the price resulting from the new proposed methodology).

Since underscheduling has been minimal under the current market for the past few years, it is expected that under mature MRTU implementation the level of load underscheduling is likely to remain low and could be much less than 5% (i.e., day-ahead load schedules would exceed 95% of the real-time load and possibly approach 100%), the filed methodology would not be quite suitable for such mature (close to 100% load scheduling) conditions. The new proposed methodology should thus be adopted as soon as practicable.

An Alternative to the New Proposed Method

Since the posting of the white paper within which the original new proposed method was presented, a slightly different alternative to the new proposed method has been identified. Under this alternative, the RT LAP price calculation and the portion of settlement associated with the real-time LAP load deviation is identical to the new proposed method. Revenue neutrality resulting from the changes in the LAP Load Distribution Factors (LDFs) between day-ahead and real-time is allocated to CAISO internal loads cleared in the day-ahead market instead of to all metered CAISO Demand. The rationale for this proposition is that the neutrality charge is a result of changes in LDFs between the DA (LDFs derived from DA LAP load) and the RT market (LDFs derived from RT load). Since the deviation of RT LAP load from DA is already assessed with RT LAP pricing, it should not be subject to an additional uplift allocation. The derivation below supports this rationale.

Consider that the LAP load settlement of scheduling coordinator (SC) in DA is $\sum_j LMP_j^{DA} \cdot \left(LDF_j^{DA} \cdot LAP^{DA,SC}\right)$ where

LMP_j^{DA} denotes the DA LMP of node j of the LAP

LDF_j^{DA} denotes the DA LDF of node j of the LAP

$LAP^{DA,SC}$ denotes the DA LAP load of the SC

Since real-time market is considered as incremental to the day-ahead market, the expression for LAP load DA settlement can be extended for LAP load RT settlement as $\sum_j LMP_j^{RT} \cdot \left(LDF_j^{RT} \cdot LAP^{RT,SC} - LDF_j^{DA} \cdot LAP^{DA,SC}\right)$ where

LMP_j^{RT} denotes the RT LMP of node j of the LAP

LDF_j^{RT} denotes the RT LDF of node j of the LAP

$LAP^{RT,SC}$ denotes the RT LAP load of the SC

Further manipulation of the suggested expression of RT settlement for the SC results in the following.

$$\sum_j LMP_j^{RT} \cdot \left(LDF_j^{RT} \cdot LAP^{RT,k} - LDF_j^{DA} \cdot LAP^{DA,k}\right)$$
$$= \sum_j LMP_j^{RT} \cdot \left(LDF_j^{RT} \cdot LAP^{RT,k} - LDF_j^{RT} \cdot LAP^{DA,k} + LDF_j^{RT} \cdot LAP^{DA,k} - LDF_j^{DA} \cdot LAP^{DA,k}\right)$$
$$= \sum_j LMP_j^{RT} \cdot LDF_j^{RT} \cdot \left(LAP^{RT,k} - LAP^{DA,k}\right) + \sum_j LMP_j^{RT} \cdot LAP^{DA,k} \cdot \left(LDF_j^{RT} - LDF_j^{DA}\right)$$
$$= \left(LAP^{RT,k} - LAP^{DA,k}\right) \cdot \sum_j LMP_j^{RT} \cdot LDF_j^{RT} + LAP^{DA,k} \cdot \sum_j LMP_j^{RT} \cdot \left(LDF_j^{RT} - LDF_j^{DA}\right)$$

The last expression is a summation of 2 terms. The first term is the RT LAP load deviation multiplied by the RT LAP price. This is the portion of settlement associated with the LAP load deviation. The second term is considered the neutrality allocation of the SC in proportional to the day-head LAP load of the SC.

Under the scheme of neutrality allocation on the basis of DA LAP load, the settlements for the three examples are presented next.

The following table summarizes the real-time LAP load deviation settlement with the two SCs for Example 1 under the alternative approach to the new proposed method:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	100	$1,765	$1,500	$3,265
SCB	-95	-$1,677	$1,500	-$177
Total	5	$88	$3,000	$3,088

The following table summarizes the real-time LAP load deviation settlement with the two SCs for Example 2 under the alternative approach to the new proposed method:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	2	$35.30	$1,496.175	$1,531.475
SCB	-1	-$17.65	$1,496.175	$1,478.525
Total	1	$17.65	$2,992.35	$3,010.00

The following table summarizes the real-time LAP load deviation settlement with the two SCs for Example 3 under the alternative approach to the new proposed method:

	LAP MW Deviation	Real-time Settlement Amounts		
		LAP price	Neutrality	Net
SCA	1	$17.65	$1,496.175	$1,513.825
SCB	0	$0	$1,496.175	$1,496.175
Total	1	$17.65	$2,992.35	$3,010.00

Settlements of examples 2 and 3 between the new proposed method and its alternative are extremely close to each other because the changes in LAP loads from DA to RT are so insignificant for both SCs.

Discussion of the Alternative to the New Proposed Method

During the market initiative stakeholder meeting on November 29, 2006, both the new proposed method and its alternative were presented. Assuming that LAP loads for different SCs do not change much between day-ahead and real-time, allocation for neutrality will be very close using either the new proposed method or its alternative. Several stakeholders have expressed their skepticism of the allocation scheme based on the day-ahead LAP load that the positive values for neutrality as used in the examples for demonstration will incite market participants to under schedule load in the day-ahead market in order to avoid being charged for the neutrality allocation. In actuality, the neutrality could assume negative value also which is the case by simply switching the LMPs between the two nodes in the examples. Under such circumstance, neutrality allocations become payments rather than charges to SCs. Anyway, persistency in very positive or very negative value for neutrality could lead to SCs consistently under or over scheduling their LAP loads in day-ahead.

Next Steps

Given the problems identified with the originally filed approach to real-time LAP pricing, the CAISO believes that a new approach is warranted. The CAISO has proposed two alternatives in this white paper. One where the neutrality charge is allocated to all real-time metered load and one where the neutrality charge is allocated to only to DA load. The CAISO views that either alternative is workable provided that the marginal loss surplus is allocated in a similar fashion. The current proposal for marginal loss surplus allocation is based on real-time metered load. The allocation of the neutrality costs arising from real-time LAP pricing and allocation for marginal loss surplus both based on day-ahead LAP load tend to counterbalance each other from offering any incentive to SCs to consistently under schedule their day-ahead LAP load.

The CAISO is soliciting written comments on this white paper from the stakeholders by no later than December 22, 2006. Upon completion of the stakeholder process on this issue, the CAISO will proceed with a 205 Tariff amendment filing.