California ISO
Your Link to Power

California Independent
System Operator Corporation

November 4, 2008

The Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: California Independent System Operator Corporation

Docket No. ER09-____- 000
Amendments to MRTU Tariff to Include Market Parameters

Docket No. ER06-615-___
MRTU Tariff Compliance Filing on LAP Demand Clearing

Dear Secretary Bose:

Pursuant to Section 205 of the Federal Power Act ("FPA"),[1] 16 U.S.C. § 824d, and Section 35.13 of the regulations of the Federal Energy Regulatory Commission ("FERC" or the "Commission"), 18 C.F.R. § 35.13 (2007), the California Independent System Operator Corporation ("CAISO") respectfully submits for filing an original and five copies of an amendment to the CAISO's Market Redesign and Technology Upgrade ("MRTU") Tariff.

Two extra copies of this filing are also enclosed. Please stamp these copies with the date and time filed and return them to the messenger.

I. EXECUTIVE SUMMARY

As the CAISO moves closer to MRTU *go live*, this filing reflects the culmination of an important stakeholder process regarding the review of certain configurable features of the MRTU optimization software. The MRTU software, like all other market systems that utilize security constrained unit commitment and economic dispatch, contains a set of configurable parameters that enable the CAISO Markets to clear optimally under a wide range of potential grid and

[1] Capitalized terms not otherwise defined herein have the meanings set forth in the Master Definitions Supplement, Appendix A to the MRTU Tariff, and in Part G (Definitions) of Appendix BB to the MRTU Tariff.

market conditions. Having completed its review of the settings of these parameters, the CAISO is now proposes to modify certain existing rules and include other rules that govern the setting of such parameters.

The MRTU software parameters in question are numerical values pre-set by the CAISO in the market optimization software that guide the software through the adjustment of certain market inputs or constraints that have no inherent economic value or market participant-specified bid price associated with them, in contrast to the economic bids, which consist of supply and demand quantities paired with bid prices. Examples of such market inputs are the flow limits on transmission lines, Ancillary Service procurement requirements, and submitted price-taker self-schedules. This filing and the attached tariff language refer to these market inputs that have no associated prices as *non-priced quantities.* Within the MRTU optimization software each of these non-priced quantities is assigned a numerical scheduling parameter and a pricing parameter. The scheduling parameters tell the market optimization at what value threshold it should adjust that *non-priced quantity* instead of pursuing a more costly re-dispatch solution, whereas the pricing parameters guide the price calculation function of the optimization in instances where the associated non-priced quantity or quantities have been adjusted.

The optimization software is designed to utilize, as a first priority, economic bids as far as possible to clear the market and produce feasible schedules and dispatches. In certain circumstances, however, particularly when the volume of self-schedules is relatively high compared to economic bids, adjusting one or more non-priced quantities will yield a solution that is more economically rational and operationally sound than would result from continuing to utilize economic bids to clear the market. The tariff amendments proposed herein provide the rules that specify thresholds for the software to adjust non-priced quantities when necessary and set appropriate prices, in accordance with previously approved MRTU policy as reflected in the current MRTU tariff.

In this filing, the CAISO first proposes to modify an existing inflexible tariff provision that requires the market clearing software to exhaust all economic bids before engaging in any adjustments to submitted self-schedules. Relaxation of this inflexible rule is necessary because market simulation results have clearly demonstrated that it could lead to market solutions that are not well founded in either economics or good utility practice. The CAISO also proposes to include in its tariff the following rules to guide the setting of these parameters so that in clearing the market the optimization software will:

- Relax a transmission constraint instead of pursuing a re-dispatch solution at system costs above $5,000 per MWh of congestion relief;

- Use the Energy bid cap as the pricing parameter for calculating five-minute interval prices when there is a shortage of Energy bids in Real-Time;
- Use the Energy bid cap as the pricing parameter for calculating Energy prices in the Integrated Forward Market and the Real-Time Market after a transmission constraint has been relaxed;
- Use the Ancillary Services offer cap as the pricing parameter when the supply of an Ancillary Service is not sufficient to meet the procurement requirement;
- Set the value of the scheduling parameter associated with self-schedules submitted under existing rights (TOR, ETC, CVR) to a level higher than the $5,000 scheduling parameter associated with transmission constraints to ensure that ETC/TOR/CVR self-schedules are not adjusted in the Day-Ahead Market.

These rules and the associated parameter values are just and reasonable because they (1) implement Commission-approved MRTU scheduling priorities, including the emphasis on utilizing economic bids as far as possible before adjusting self-schedules; (2) ensure that high scheduling parameters necessary to implement those priorities do not unduly impact settlement prices, while at the same time allowing prices to reflect the underlying circumstances that led to the adjustment of one or more non-priced quantities; (3) support the fundamental MRTU objective to create feasible and operationally prudent schedules and dispatch instructions; and (4) honor the least-cost solution principle underlying MRTU by ensuring that the market optimization does not pursue unnecessarily expensive re-dispatch solutions when a *non-priced quantity* can be adjusted at lower cost to the system. With regard to point (2), the CAISO proposes herein to consistently use the applicable approved bid caps as pricing parameters, as the way to strike a just and reasonable balance between the competing objectives of allowing prices to signal the conditions that required non-priced quantities to be adjusted to clear the market, versus protecting market participants from the extreme prices that would result if the high scheduling parameter values needed to enforce the required adjustment hierarchy among non-priced quantity types were used for price-setting purposes.

This filing also addresses an outstanding compliance requirement arising out of the Commission's September 21, 2006 and June 25, 2007 orders[2] that is related to a special case of the use of these parameters. Specifically, the CAISO has a pending obligation to better explain the use of parameters to relax a

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[2] *California Independent System Operator Corp.*, 116 FERC ¶ 61,274 (2006) ("September 21 Order") and *California Independent System Operator Corp.*, 119 FERC ¶ 61,313 (2007) ("June 25 Order").

transmission constraint in the Day-Ahead Market. This filing will address those outstanding questions.

The testimony of Dr. Lorenzo Kristov, attached to this filing as Exhibit ISO-1, explains in detail the process of using market parameters for the adjustment of *non-priced quantities*. He further explains the rationale behind each parameter value filed in this amendment.[3]

II. BACKGROUND

On February 9, 2006, the CAISO filed the MRTU Tariff with the Commission in Docket No. ER06-615. Over the course of the last two years, as the result of a series of Commission orders, compliance filings, and an ongoing stakeholder process, the CAISO has further defined the MRTU market design and enhanced and refined its software requirements.

An important aspect of the MRTU market design and software development is the use of MRTU market parameters to adjust self-schedules and transmission constraints, referred to as *non-priced quantities*.[4] This issue was first introduced in the MRTU Tariff in Sections 31.3.1.1, 31.3.1.3,[5] 31.4 and 34.10. Section 31.3.1.1, introduced the concept that in performing its optimization, the IFM first tries to clear the market utilizing Economic Bids without adjusting self-schedules, and adjusts self-schedules only if it is not possible to balance Supply and Demand and manage Congestion with available Economic Bids. This section was approved by the Commission in the September 21 Order. Sections 31.4 and 34.10 provided the relative priorities that would be enforced in

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[3] The memorandum to the CAISO Board of Governors on this issue can be found at http://www.caiso.com/2067/2067ddd24b2b2.pdf. The CAISO whitepapers and stakeholder comments on this issue can be found at http://www.caiso.com/1fb1/1fb1b2f7c080.html.

[4] Throughout much of the stakeholder process on these parameter issues, the terms "uneconomic adjustments" and "parameter tuning" were used to refer to the rules and procedures for adjusting non-priced quantities and setting appropriate prices, as well as the analytical process whereby the CAISO determines the proper settings of the specific parameter values. Uneconomic adjustments is the term used in the current tariff Sections 31.4 and 34.10, which contain the relative scheduling priorities the CAISO Market software must enforce when it is necessary to adjust submitted self-schedules. With the instant filing this term has been removed from the tariff because it appears to cause some confusion about the nature and purpose of the adjustments. In particular, the process of employing certain adjustments (for example relaxing a constraint) can be characterized as being actually *more* economically efficient in that it protects against needlessly-extreme dispatch instructions and resulting extreme LMPs. That process is only "uneconomic" in the sense that it adjusts quantities that do not have submitted economic bids associated with them, such as price-taker self-schedules and operating constraints.

[5] What the CAISO originally filed and to what Commission referred to in its orders as Section 31.3.1.2 now resides in Section 31.3.1.3 due to the creation of a new Section 31.3.1.2 addressing how Ancillary Services will be treated in the IFM. Accordingly, this filing will repeatedly refer to this section as 31.3.1.3.

the event that non-priced quantities or self-schedules needed to be modified. Section 31.4 and 34.10 were also approved by the Commission in its September 20 Order, subject to certain compliance requirements which the CAISO has since submitted. All of these sections embodied the principle that all Economic Bids must be exhausted before the software can engage in adjustments of the non-priced quantities, which the CAISO is proposing to modify in this filing.

Section 31.3.1.3, as first filed, discussed how and when the CAISO might relax a transmission constraint to avoid problems with the settlement of load at the Default LAP. In the September 21 Order, the Commission found the parameters that govern the CAISO's use of MRTU Tariff section 31.3.1.3 could significantly impact rates and determined that the CAISO should provide further details on those parameters in the MRTU Tariff.[6] The Commission further directed the CAISO to revise this section to include the parameters that would govern its use of MRTU Tariff section 31.3.1.3. The CAISO complied with that directive in a compliance filing on November 20, 2006.

Ruling on the CAISO's compliance filing in Paragraphs 162-164 of the June 2007 Order, the Commission directed the CAISO to clarify, in another compliance filing, proposed Tariff language in MRTU Tariff section 31.3.1.3 that addresses the CAISO's proposed procedure for limiting potentially severe reduction of demand at a load aggregation point in the IFM due to a congested non-competitive transmission constraint. The Commission directed the CAISO to:

- provide further details about the impact of proposed transmission constraint violation penalty levels in the Integrated Forward Market ("IFM");
- submit revised tariff language clearly indicating that the penalty is not a financial penalty in the traditional sense;
- clarify what constitutes an effective Economic Bid for purposes of determining when the CAISO would relax transmission constraints;
- articulate what the revised provision does;
- explain how the provision works in practice;
- explain the practical and financial effect of the provision on the Market Participants; and,
- provide detailed answers to the questions raised by commenters concerning this provision.

The Commission also accepted the CAISO's commitment to conduct market simulations in order to evaluate the performance of the proposed constraint

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[6] *See* September 2006 Order, 116 FERC ¶ 61,274 at P 618.

violation penalty, and directed the CAISO to propose modifications if necessary.[7]

Throughout the course of market simulation and the process of working with stakeholders to satisfy the compliance obligations described above, the CAISO has worked with its stakeholders on several important market parameters beyond those addressed in Section 31.3.1.3. Accordingly, the instant filing is not confined to the LAP demand clearing issue that is the focus of the pending compliance obligations.

III. SPECIFICATION OF SCHEDULING AND PRICING PARAMETERS FOR MRTU START-UP

The first purpose of this filing is to amend or revise the MRTU Tariff to include several of the market parameters described above. Having concluded the bulk of its market simulation and analysis of the scheduling and pricing parameters with its stakeholders -- and based on the results of the market simulation and analysis -- the CAISO has determined the appropriate set of parameters that should govern adjustments to *non-priced quantities* by the CAISO market optimization software.

A. Overview of Market Parameters

The MRTU market software will use Economic bids for supply and demand (bid prices paired with bid quantities) as the primary means of achieving the optimal feasible market solution. This is a central tenet of the security-constrained unit commitment and economic dispatch algorithms utilized in the MRTU markets. However, requiring that all economic bids available to the market be completely exhausted to solve every constraint can result in the inefficient and uneconomic procurement of large quantities of energy from a resource that has little impact on the constraint the market optimization is trying to resolve. This can result in excessive costs being incurred to resolve the constraint as well as correspondingly high LMPs. These costs can be "excessive" because their incurrence is often unnecessary in instances where adjusting a *non-priced quantity* can resolve the constraint at a lower system cost. In other words, adjusting a non-priced quantity would be more" effective" at resolving the constraint and less costly than procuring large quantities of energy from a marginally effective resource that happens to have bids in the market. The *non-priced quantities* include the price-taker, quantity-only self-schedules submitted by scheduling coordinators, as well as certain constraints that are set

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[7] *See* June 25 Order at PP 158, 164. On January 4, 2008 and February 1, 2008, the Commission issued a "Notices of Extension of Time" that granted the CAISO's requests for an extension of time, not later than sixty-two days prior to the start of its operations under MRTU, to comply with paragraphs 162-164 of the June 25 Order.

by the CAISO such as transmission flow limits and ancillary services procurement requirements.

An important design principle of LMP-based markets such as MRTU is that the market optimization and software are designed to combine the economics of the market with the physics of operating an integrated grid reliably. While other congestion management systems, such as the CAISO's original zonal markets and traditional contract path market models, continue to divorce these two complementary aspects of serving load reliably, MRTU will produce market solutions that combine these two aspects and therefore should reflect both efficient economic outcomes and operationally sound good utility practice.

A critical requirement for achieving this fundamental LMP design objective is to provide mechanisms in the software – namely, the scheduling and pricing parameters that are the subject of the instant filing – that enable the market to reach feasible solutions that are optimal both economically and operationally under a wide and realistic range of potential market and grid conditions. At the same time, approved MRTU policy also dictates that the CAISO honor the expectation by participants that the markets will rely primarily on Economic Bids to achieve solutions and their self-schedules will be accepted without adjustment under most normal circumstances. As a result, the extent to which market participants rely on self-schedules and the overall volume of self-schedules relative to economic bids in each trading hour will, in combination with other market and grid conditions, affect the ability of the market software to reach a feasible solution based on economic bids alone.

Therefore, the crux of this filing is to assign appropriate "parameter" values to *non-priced quantities*, so that the optimization is given a parameter that guides to the point at which it should adjust a *non-priced quantity* instead of seeking to find a re-dispatch solution at a higher cost (*i.e.* at a cost above the parameter value to the constraint or non-priced quantity). This process of assigning parameter values is necessary because *non-priced quantities* are market inputs that have no inherent price value.

Once these parameters are set, any adjustments to the non-priced quantities are carried out directly by the optimization software itself and do not require any manual adjustments by the CAISO to arrive to a market solution. Therefore, in the event that the market is required to modify these schedules (either as supply or demand) in order to yield a market solution, these quantities must be assigned a value *a priori* in order for the market optimization to enforce the relative priorities of such amounts. The parameter settings thus provide the software with objective criteria for reaching solutions that utilize effective economic bids to the greatest extent possible, in a manner that is consistent with sound grid operating practice, while enforcing the tariff-specified relative priorities among different self-schedule types.

There are two basic categories of parameters in the MRTU optimization: scheduling parameters and pricing parameters. In his testimony, Dr. Kristov describes these categories in detail and discusses why the MRTU market operates using a "scheduling run" for determining energy schedules and AS procurement using the scheduling parameters to implement adjustments of *non-priced quantities* where needed, and a "pricing run" that uses the pricing parameters to determine appropriate settlement prices to be associated with the energy and Ancillary Services schedules that result from the scheduling run.[8] Dr. Kristov explains that the primary reason for the two runs is that the software must use extremely high and extremely low numerical values for the scheduling parameters, well outside of the allowable Economic Bid price range, to enforce the hierarchal priorities of the various non-priced quantities reflected in Sections 31.4 and 34.10 of the MRTU Tariff, values which would not be appropriate for setting the market settlement prices.[9] Without the separate scheduling and pricing runs there would likely be unacceptable compromises of the tariff requirements under some circumstances, either in the form of excessive adjustment of non-priced quantities, or unreasonably high LMPs. The scheduling and pricing run each have their own set of configurable parameters that must be configured in a manner that ensures that the market solutions are consistent with the intended MRTU policy.

The parameters being addressed in this filing do not constitute the entire set of configurable parameters. Through the stakeholder process, based on the rule of reason, the CAISO sought to determine which of the scheduling and pricing parameters should be included in the tariff and which could safely remain addressed elsewhere. With the exception of one *scheduling* parameter that will be housed in the tariff, the CAISO determined that only the *pricing* parameters need to be included in the MRTU Tariff because they can have a direct impact on prices. The CAISO proposes to retain the complete set of the configurable parameters in its business practice manuals and the modification of any of these parameters will be subject to the change management process established for the business practices manuals.[10]

It is important to note that while the CAISO and its stakeholders have endeavored to establish the set of scheduling and pricing parameters for *go live*, it is possible that some of these parameters may require further adjustment before MRTU *go live*. If any such changes are required, the CAISO will update the parameters no later than forty-five days before *go live*. However, the CAISO

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[8] Exhibit No. ISO-1 at 6-12

[9] Exhibit No. ISO- 1 at 10-11.

[10] The complete set of the most current parameters can be found at: http://www.caiso.com/206f/206fe2af4ddf0.pdf.

does not anticipate that the parameters that are included in the tariff by this tariff amendment will require any further modification before MRTU *go live*. Even after MRTU *go live*, the CAISO will continue to evaluate its market results and as necessary will modify the parameters to ensure that results continue to be consistent with MRTU policy as reflected in its tariff. These changes will be governed by the BPM change management process and to the extent the parameters filed in the tariff today require modification, the CAISO will further file any appropriate tariff amendments with the Commission.

B. Modification of Requirement to Use All Economic Bids Before Adjusting Self-Schedules.

This proposed tariff amendment directly addresses a threshold question that arises from the process discussed above: at what point should the optimization software be programmed to adjust self-schedules rather than continue to utilize Economic Bids in seeking a solution that is both economically and operationally sound. The current MRTU Tariff requires that the CAISO Markets completely exhaust *all* economic bids before adjusting self-schedules to reach a feasible solution, without regard to the operational or economic consequences of potentially extreme dispatch results. As explained by Dr. Kristov, this is economically desirable in theory because economic bids are the foundation of LMP markets, and for this reason the MRTU market design provides strong economic incentives for parties to offer economic bids.[11] This principle should not be viewed as absolute, however, so that it is enforced at the expense of market results that are operationally sound and economically reasonable.

The CAISO's MRTU market simulation results to date demonstrate that under certain conditions and given certain bidding patterns that include relatively high volumes of self-schedules, strict enforcement of the current tariff requirements to fully utilize the only available economic bids may require the re-dispatch of resources that offer minimal effectiveness in relieving a constraint and therefore from an operational perspective would not be appropriate to use.[12] For example, to force the software to exhaust all economic bids in the market before modifying non-priced quantities may require the re-dispatch of geographically distant and ineffective supply to relieve a particular congested transmission constraint. While such a solution might be technically be feasible, it would be inconsistent with conventional standards of prudent grid operations. In addition, such a process would allow the shadow price on the binding constraint to rise without limit, resulting in LMPs potentially in the thousands of dollars.

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[11] *See* Exhibit ISO-1 at 14-19.

[12] Id.

To illustrate this numerically, consider as discussed below that the scheduling parameter for relaxing an internal constraint is set at $5,000, and suppose that the optimization finds that relying on economic bids it would need to spend $5,500 to achieve one MW of congestion relief on the binding constrain due to a dearth of bids that are effective on the constraint. The market optimization will choose to relax the transmission constraint by one MW, rather than pay $5,500 (a price in excess of the parameter value) for that same MW of congestion relief through re-dispatch. In short, the rule proposed for revision, as currently reflected in Sections 31.3.1.1 for the IFM, would require the optimization software to adopt solutions that are nominally "feasible" but that violate prudent operating practice or are economically irrational.

In order to relieve the market software of having to accept solutions that utilize high volumes of bids from resources that have relatively little impact on a congested constraint, the CAISO is proposing to program the market algorithm to adjust so-called *non-priced quantity* when they can be adjusted more economically. *Non- priced quantity* refers to the universe of inputs that may be adjusted by the optimization when the relevant dollar-value parameter for that *non-priced quantity* is reached. Sections 31.3.1.1, 31.3.1.3, 31.4 and 34.10 specify priority sequences of self-schedule types and other *non-priced quantities* that can be adjusted as needed to avoid unreasonable scheduling and pricing outcomes. The proposed amendments to these sections will retain the relative priorities among self-schedule types as originally approved, while eliminating the requirement that the software adhere to the principle that all economic bids must be exhausted before adjusting any self-schedules. Instead, the revised tariff provisions would require only that *Effective* Economic Bids be exhausted before resorting to adjustments of *non-priced quantities*.

As Dr. Kristov explains, the rules and procedures governing adjustment of non-priced quantities are completely objective, transparent, subject to empirical analysis and verifiable.[13]

Pivotal in this change are two new defined terms. Effective Economic Bids is defined as those Economic Bids that are not Ineffective Economic Bids. Ineffective Economic Bids are defined as those bids that, while available to the optimization, are deemed not to be acceptable for relieving the constraint at issue because the per-MW cost of using such bids would exceed the parameter for adjusting a non-priced quantity. In essence, continuing to accept Ineffective Economic Bids in order to relieve a constraint and refraining from modifying non-priced quantities would result in a solution that may technically be a feasible solution, but would not be consistent with good operating practice nor would it be economically rational.

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[13] Exhibit No. ISO-1 at 19.

C. Scheduling and Pricing Parameters for MRTU Start-Up

In addition to pricing rules already in the MRTU Tariff, the CAISO is proposing to adopt and include in the MRTU Tariff several key scheduling and pricing parameters that will govern its setting of parameters to deal with specific market situations. As described below, these parameters will be included in new subsections of Section 27 of the MRTU Tariff. More specifically, the CAISO proposes to include the following requirements in its tariff:

1. For the scheduling run, to indicate to the CAISO Market software when to relax an internal transmission constraint rather than continue to adjust supply or demand Economic bids or *non-priced quantities*, CAISO will use a value of $5,000 per MWh in both the Integrated Forward Market and the Real-Time Market as the scheduling parameter;

2. When there is a shortage of supply to meet load in the Real-Time Market, the CAISO will use the applicable Energy bid cap as already reflected in the MRTU Tariff (initially $500 per MWh, increasing to $1000 in two annual) as the pricing parameter for calculating five-minute interval prices;

3. When a transmission constraint is relaxed to achieve a feasible market solution, the CAISO will use the Energy bid cap as reflected in the MRTU Tariff (initially $500 per MWh, increasing to $1000 in two annual steps) as the pricing parameter for calculating Energy prices in the Integrated Forward Market and the Real-Time Market.

4. When an Ancillary Service procurement requirement cannot be fully met in the Day-Ahead Market or the Real-Time Market, the CAISO will use the Ancillary Services offer cap as already reflected in the MRTU Tariff ($250 per MWh) as the pricing parameter for determining the price of meeting the insufficient Ancillary Service;

5. In the Integrated Forward Market, the CAISO will set the value of the scheduling parameter associated with self-schedules submitted under existing rights (*i.e.*, Transmission Ownership Rights (TOR), Existing Transmission Contracts (ETC), and Converted Rights (CVR)) to a level higher than the scheduling parameter associated with internal transmission constraints to ensure that ETC/TOR/CVR self-schedules are not adjusted in the Day-Ahead Market.

1. Transmission Constraint Relaxation Scheduling Parameter

The first parameter to be included in the MRTU Tariff consists of the scheduling parameter for relaxation of a transmission constraint. This scheduling parameter instructs the CAISO Market software as to when it is appropriate to adjust *non-priced quantities* as opposed to relaxing a given internal transmission constraint. Essentially, if the software is seeing congestion on a particular constraint, it will first try to relieve the congestion by using economic bids to re-dispatch supply resources in the least-cost manner. Typically this requires increasing the output of higher-priced resources while lowering the output of cheaper resources to maintain system energy balance, so there is a net cost of such re-dispatch which adds to the value of the objective function (*i.e.*, the total bid cost of the market solution). Dr. Kristov provides a numerical example to explain this mechanism.[14] This parameter is set so that while additional Economic Bids could have been accepted to provide congestion relief, the parameter essentially defines these additional Economic Bids to be *ineffective* with respect to the constraint, and directs the software to forego these bids and to adjust a *non-priced quantity*, in this case to relax the transmission limit.

The MRTU Tariff specifies several levels of scheduling priority for different types of non-priced quantities in the IFM and RTM. As a result the MRTU software must use scheduling parameters ranging from the market bid cap up to many thousands of dollars in order to maintain sufficient separation between consecutive priority levels. Although the tariff allows for adjustments to *non-priced quantities* in order to enforce the flow limits of transmission facilities, there is a point at which very large megawatt adjustments costing thousands of dollars would be needed to obtain one megawatt of congestion relief on the constraint, at which point the software will relax the transmission constraint rather than incur higher costs.

The CAISO believes that this precise point should be set in the software to approximate as closely as possible the actions of prudent grid operators, *i.e.,* to relax a transmission constraint as the point where further adjustment to bids and self-schedules would lead to a resource adjustments that grid operators following accepted good operating practice would not typically perform.

To be clear, the $5,000 value is used for scheduling purposes only, as the cost threshold where the market software will cease trying to relieve congestion on a line through re-dispatch of supply and demand resources, and will instead relax the constraint. The pricing parameter, discussed below, impacts how the amount of energy relaxed at that constraint will be priced.

The transmission constraint relaxation scheduling parameter was not previously in the tariff, and the CAISO proposes to include it in new Section 27.4.3.1 of the MRTU Tariff. This is the only *scheduling* parameter proposed for inclusion in the tariff. While this parameter does not directly impact prices to the extent *pricing* parameters do, the CAISO believes that this particular scheduling

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[14] *See* Exh. ISO-1 at 17-19.

parameter warrant inclusion in the tariff for two reasons. First, the relaxation of transmission constraints was the subject of some confusion under the MRTU Tariff as originally filed (as discussed in detail in Section IV below) and the CAISO has a compliance obligation to include particular clarity on this issue in the tariff. Second, inclusion of this parameter in the tariff is necessary to implement the priority of TOR/ETC/CVR self-schedules by setting the scheduling parameter for ETC/TOR/CVR self-schedules higher than the scheduling parameter for internal transmission constraint relaxation.

2. Real-Time Energy Balance Constraint Parameter

An important market parameter is the Energy balance constraint pricing parameter for the Real Time Market. This parameter governs how real-time 5-minute prices should be set when there is a supply shortfall, *i.e.,* when the CAISO load forecast cannot be met by available supply. When there is a supply shortfall in real-time, the Real-Time Dispatch process relaxes the energy balance constraint (i.e. the constraint in the algorithm that says supply must equal demand plus losses) using a pre-set scheduling run parameter, and the resulting shortfall quantity is then sent to the pricing run and associated with a pricing run parameter. The CAISO proposes to set that pricing run parameter value at the Energy Bid cap, which is currently set at $500, for the purpose of setting the Real-Time 5-minute interval prices when there is a supply shortfall.

The CAISO and its stakeholders evaluated several options for how to set real-time five-minute interval prices when there is supply shortfall, including using the Energy bid cap, the last accepted economic bid (last economic signal), or using something higher than Energy bid cap such as the $1,500 value originally proposed as the pricing parameter associated with transmission constraint relaxation. The CAISO chose to use the Energy bid cap for several reasons.

First, the $500 level is most consistent with how Energy is priced in the IFM when there is insufficient supply to serve self-scheduled demand. In the IFM, unlike the RTM, when supply is not available to meet all self-scheduled demand, self-scheduled demand can be reduced to clear the market. Under such circumstances, it is assumed that the adjusted self-scheduled demand is priced at the Energy bid cap, which is the only logical conclusion since the submission of a self-scheduled means that the load would not want to be curtailed at any price lower than the Energy bid cap, while the Energy bid cap itself prevents the load from submitting a higher curtailment price. In contrast to the IFM situation, in the real-time market load for the most part cannot be adjusted in the market in response to prices; rather, the CAISO operators must dispatch sufficient supply in the right locations to maintain system balance without curtailing firm load unless absolutely necessary. Therefore, in tight supply conditions the real-time market software will use all available supply to meet the load even if that requires relaxing transmission constraints for one or

more five-minute intervals. Using the Energy bid cap in association with the energy balance shortfall in these circumstances renders the real-time pricing consistent with the IFM pricing.

Second, using the Energy bid cap will result in pricing outcomes that remain consistent with the already established tariff requirement in Section 34.8 of the MRTU tariff that when CAISO operators decide to utilize Contingency Only Reserves to supplement the Real-Time Market under non-contingency conditions, the software will insert energy bids at the bid cap to reflect the supply shortage.[15] In such situations the bid cap energy bids will be accepted by the market and should be on the margin for setting prices, so it would be consistent to utilize the energy bid cap as pricing parameter for an energy shortfall when operators decide not to utilize Contingency Only reserves to supply energy.

This pricing parameter directly affects the energy price when the real-time the energy balance constraint must be relaxed due to an insufficiency of supply, and, therefore will be included in the MRTU Tariff in new Section 27.4.3.3.

3. Transmission Constraint Relaxation Pricing Parameter

In cases where a transmission constraint has been relaxed in the Day-Ahead or Real-Time scheduling run as discussed above, the pricing parameter associated with the relaxed transmission constraints must be considered. Dr. Kristov explains this parameter in detail in his testimony.[16]

This pricing parameter determines how the relaxation of the constraint will affect the calculation of market prices. For consistency with the Real-Time Energy balance constraint pricing parameter, among other reasons, the CAISO proposes to set this parameter at the Energy bid cap. This is a change from section 31.3.1.3 of the MRTU Tariff as originally filed, which specified that for the IFM the price would be at three times the Energy bid cap when the transmission constraint was relaxed. After consultation with the stakeholders and evaluation of testing and market simulation results, this change was implemented to ensure consistency between the integrated forward market and the real-time market, as well as for consistency with the CAISO's general approach of using the approved bid caps as pricing parameters for MRTU start-up to strike a reasonable balance between sending meaningful market signals reflecting the adjustment of non-priced quantities versus protecting the market against unduly extreme price impacts.

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[15] It is important to understand, as discussed in detail in the testimony of Dr. Kristov, that setting the pricing run parameter to the Energy Bid Cap does not prevent prices from going above the Energy Bid Cap.

[16] *See* Exh. ISO-1 at 39-45.

Also, as Dr. Kristov explains, if the pricing parameter for any relaxed transmission constraints is set to a higher level than the pricing parameter for supply-demand balance discussed above, the transmission constraint parameter could be the dominant factor in affecting real-time energy prices, instead of allowing the energy-balance parameter at the energy bid cap to play that role. Because the shortfall of supply is the more fundamental driving factor behind the need for adjustment, the pricing parameter on the energy balance constraint should be the primary parameter influencing price determination.

The transmission constraint relaxation pricing parameter directly affects prices and therefore, the CAISO is proposing including this parameter in new Section 27.4.3.2 of the MRTU Tariff.

4. Pricing Parameter for Ancillary Service Shortage

For MRTU *go live*, the CAISO proposes that when supply of an ancillary service in the integrated forward market or the real-time market is not sufficient to meet ancillary service procurement requirements, the market will use the ancillary service offer cap ($250 per MWh) as the pricing parameter for determining the price of the deficient reserve. In other words, this pricing parameter will determine the price of the deficient ancillary service when economic bids to supply that ancillary service are not sufficient to satisfy the CAISO's reserve obligation. This pricing approach is consistent with how energy prices are determined when energy is in short supply, as discussed above. The CAISO believes that this approach is appropriate for MRTU *go live* because it provides a basis for a logical transition to the more refined scarcity pricing approach to be implemented after MRTU *go live* that uses tiered pricing, yet it will not artificially suppress ancillary service prices under supply shortfall because it will invoke the ancillary service offer cap as the pricing parameter for the deficient reserve. Moreover, as pointed out by the Market Surveillance Committee,[17] this approach will provide less incentive and opportunity for suppliers with potential ancillary service market power to try to inflate ancillary service prices in the integrated forward market, which at start-up does not require all certified, capable resources to offer ancillary services to the market.

The role of this pricing parameter is discussed in greater detail in the testimony of Dr. Kristov.[18] Dr. Kristov also addresses a recommendation by the Market Surveillance Committee that, in addition to establishing this parameter at the bid cap, the CAISO should lower that bid cap to $150. As Dr. Kristov

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[17] *See* "Comments on 'Uneconomic Adjustment in the MRTU Market Optimizations'" by the Market Surveillance Committee of the California ISO, October 8, 2008. In its comments the Committee also recommended lowering the ancillary service offer cap from the current $250 to $150 per MW/hour.

[18] *See* Exh. ISO-1 at 33-36.

explains, the CAISO did not adopt this suggestion because the levels of the bid caps have been approved by the Commission and the CAISO has already committed to revisit them if it implements more granular procurement of Ancillary Services.

Using the offer cap as the pricing parameter for a deficient service does not ensure that the ancillary service price will be limited by the bid cap. Higher ancillary service prices can occur because these prices include, in addition to the ancillary service offer price, an additional price component that reflects the opportunity cost a resource foregoes by providing reserves instead of energy. Ancillary service prices can also rise above the offer cap due to the nested structure of ancillary service procurement regions, which can experience supply shortfalls in more than one nested region in the same market interval.

This parameter will be included in the MRTU Tariff in a new Section 27.1.2.3, because as discussed above, under certain circumstances this pricing parameter will have a direct impact on the ASMP.

5. Protection of ETC/TOR/CVR Self-Schedules from Adjustment in the Day-Ahead Market

Throughout the market simulation process and related parameter tuning stakeholder process, several parties who hold ETC, TOR, or CVR rights raised concerns that the MRTU market optimization procedures could reduce what was perceived as the firmness of their scheduling rights in the Day-Ahead Market and expose them to financial costs that diminish the value of their existing contracts.

The parties expressed a concern that if the market optimization were to permit adjustment of an ETC, CVR or TOR Self-Schedules before exhausting all economic bids, those self-schedules could be subjected to what those parties viewed as unreasonable adjustments in the day-ahead market. The CAISO staff met directly with representatives of State Water Project, City and County of San Francisco, and Metropolitan Water District to review CAISO staff's test results, better understand the concerns of these parties, and explore potential solutions. At a September 25, 2008, joint meeting of CAISO stakeholders and the CAISO Market Surveillance Committee, the CAISO's staff presented a series of numerical examples to illustrate the extreme nature of conditions that would be required to result in an ETC, CVR, or TOR Self-Schedule being adjusted in the Day-Ahead Market under the CAISO's proposed parameter values. At the same meeting, the CAISO also demonstrated how an alternative set of proposed parameter values presented by the parties would perform in terms of the perceived "firmness" of existing rights. These presentations did not, however, allay concerns among holders of existing rights regarding the possibility that TOR/ETC/CVR self-schedules could nevertheless be curtailed in the IFM, thereby exposing these schedules to unanticipated financial consequences.

As a result, the CAISO proposes in this filing a conservative solution to ensure that TOR/ETC/CVR Self-Schedules are not adjusted in the Day-Ahead Market.[19] The CAISO proposes to increase the IFM parameter values used for TOR/ETC/CVR self-schedules up to a value above the parameter value for relaxing internal transmission constraints. Dr. Kristov discusses this solution at length in his testimony.[20] Such parameter settings will mean that when there is a binding transmission constraint near the location of a supply or load resource self-scheduled under an TOR, ETC or CVR right, the IFM software will relax the transmission constraint rather than curtail the TOR/ETC/CVR self-schedule.

Because this protection mechanism for ETC/TOR/CVR holders requires the adoption of an explicit rule in the IFM that sets a higher level priority for these self-schedules than the transmission constraint relaxation parameter discussed above, this rule is also included in the tariff. It was especially important for the participants requesting this relief that specific language be included in the tariff to ensure this rule would be implemented. The affected parties also submitted specific tariff language changes, some of which the CAISO adopted. Although the CAISO did not fully adopt the tariff changes proposed by these parties, the CAISO believes that the proposed tariff language fully captures the proposed policy because it explicitly states that these TOR/ETC/CVR Self-Schedules will receive a higher priority than the transmission constraint relaxation parameter to ensure that these Self-Schedules will not be adjusted in the IFM. In particular, the CAISO does not believe that including the percentage ratios recommended by the parties for the numerical values of the scheduling parameters is prudent because, depending on actual market experiences, the percentages may need to be adjusted to ensure the outcome desired by the parties. The new rule described above will be incorporated through revisions to existing Section 31.4 and is specifically provided in Section 27.4.3.4.

IV. MRTU PARAMETER VALUES ARE JUST AND REASONABLE

The parameter values described above are just and reasonable for several reasons. First, they implement Commission-approved MRTU scheduling priorities, including the emphasis on utilizing economic bids as far as possible before adjusting self-schedules. In section 31.4 for the integrated forward market

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[19] It is important to note that the stakeholder process on this issue included a healthy debate among stakeholders and CAISO staff regarding the precise scope of the contractual rights under ETCs, TORs, and CVRs. That issue is not relevant to this solution or this filing. The CAISO notes that it proposes to protect ETC/TOR/CVR self-schedules from day-ahead adjustment as a policy resolution to reasonably accommodate the needs of its stakeholders. However, the CAISO's willingness to implement this policy solution should not be interpreted to endorse or capitulate to any particular legal position on the scope of these existing rights.

[20] *See* Exh. ISO-1 at 36-39.

and section 34.10 for the real-time market, the MRTU tariff sets out a hierarchy of different classes of non-priced quantities, focusing on self-schedules. These hierarchies specify the sequence the market software must follow when adjustments to these quantities are necessary, starting with the lowest scheduling priority among self-schedules, which is first class to be available for adjustment, going to the highest scheduling priority or the last class to be available for adjustment. In addition, in Section 31.3.1.1, the tariff specifies that the IFM software should utilize economic bids as far as possible before adjusting self-schedules. These scheduling priorities were established through the lengthy MRTU development process, and it is the CAISO's intention with the current proposals and the parameter settings to respect and implement these priorities, not to modify or overturn them.

Second, these parameter values ensure that high scheduling parameters necessary to implement those priorities do not unduly impact settlement prices, while at the same time allowing prices to reflect the underlying circumstances that necessitated the adjustment of one or more non-priced quantities. As Dr. Kristov discusses in some detail, assigning parameter values to implement the MRTU scheduling priorities requires that these values be set to very high levels.[21] This is done to ensure that effective economic bids are used to the greatest possible extent and also that the necessary separation is created between successive types of n*on-priced quantities*. However, if those administratively set scheduling parameters were used to establish settlement prices, they would result in inappropriately high LMPs. Such high LMPs would be inappropriate because the scheduling parameters were set as high as they were not to reflect any underlying economics, but simply to achieve the two tariff requirements of relying first on economic bids and observing the priority sequence among self-schedule types. Therefore, the creation of pricing parameters distinct from and less extreme than the scheduling parameters ensures the desired operational result (i.e., least-cost dispatch in accordance with the tariff-specified priorities) without artificially inflating market-clearing prices. At the same time, the CAISO's proposals do allow prices to signal the underlying conditions that caused some non-priced quantities to be adjusted by utilizing, in all the instances addressed in this filing, the applicable approved bid caps as pricing parameters. The CAISO submits that using the applicable bid caps as pricing parameters strikes a just and reasonable balance between the need to send meaningful price signals and the need to prevent unduly excessive price impacts.

Third, the CAISO's proposed parameter values support a fundamental objective of the MRTU design to have the markets create feasible and operationally prudent schedules and dispatch instructions. As Dr. Kristov's testimony describes in greater detail, the proposed scheduling parameters associated with relaxation of internal transmission constraints were specified and

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[21] *Id.* at 6-12.

confirmed through market simulation and other test cases to strike an appropriate balance between limiting the frequency of transmission constraint relaxation (and thus enforcing feasible schedules) and avoiding re-dispatch solutions that utilize high volumes of costly resources to obtain small amounts of congestion relief.

Fourth, these parameters protect the least-cost solution principle underlying MRTU. When the market optimization is driven by inflexible rules to ignore operational options that would otherwise be available to grid operators acting in a prudent manner, like relaxing a transmission constraint by a manageable amount for a brief period of time, the market would be forced to accept a solution that is not economically or operationally rational and is therefore more expensive than necessary. In other words, the software would be prevented from finding the least cost solution available based on the resources available to it. By ensuring that the market optimization does not pursue unnecessarily expensive re-dispatch solutions when a *non-priced quantity* can be adjusted at lower cost to the system, the basic premise of least-cost dispatch is protected and system costs are controlled.

V. COMPLIANCE ISSUES ON LAP DEMAND CLEARING

The CAISO also addresses here several compliance obligations related to the relaxation of transmission constraints and the use of market parameters generally. As discussed above, Section 31.3.1.3 was included in the MRTU Tariff to address the so-called Load Aggregation Point ("LAP") demand clearing problem the CAISO identified early on in the IFM. Dr. Kristov explains this issue in detail in his testimony.[22]

In the MRTU design, Demand Bids (including Self Schedules) submitted at the LAP are distributed to PNodes using load distribution factors (LDFs) and these LDFs are preserved in the clearing of Demand against Supply for the LAP. This is a necessary feature for obtaining internally consistent prices in the IFM, because it ensures that nodal LMPs and cleared nodal Demand quantities will aggregate to a LAP price and quantity that is on the LAP Demand curve. This same feature had a potential to lead to undesirable consequences, however, under certain rare conditions. The typical case occurs when there is internal congestion and a shortage of supply within the LAP that creates a load pocket.[23]

For example, when a transmission line going into a load pocket is loaded to its limit, the combination of this energy imported into the load pocket plus the

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22 *See* Exh. ISO-1 at 37-45.

23 It is important to note that even if the CAISO were not to use LAP Demand Bids in the IFM, high LMPs in a load pocket can occur when supply into that area is severely constrained, for which the MRTU design includes effective local market power mitigation to minimize the impacts of such conditions on Demand.

energy available from supply inside the load pocket may not be sufficient to meet the portion of the self-scheduled LAP demand that is inside the load pocket according to the applicable LDFs. In this situation, in order for the optimization to reach a feasible solution, either: (1) the self-scheduled LAP demand must be reduced across the entire LAP, (2) additional Energy supply within the load pocket must be found (for example, by making available the Energy from self-provided Ancillary Services), (3) the transmission constraint must be relaxed, or (4) the relationship among the LDFs must be varied so that self-scheduled demand within the load pocket can be reduced without reducing such demand across the entire LAP. Reducing LAP Demand in the IFM shifts that Demand into Real-Time and potentially leading to a higher level of RUC procurement, or extremely high Day-Ahead LMPs within the load pocket, or both.[24]

As discussed above, in the September 21 Order, the Commission found the parameters that govern the CAISO's use of MRTU Tariff section 31.3.1.3 could significantly impact rates and determined that the CAISO should provide further details on those parameters in the MRTU Tariff.[25] In response to the CAISO's compliance filing, in the June 2007 Order, the Commission directed the CAISO to clarify, in another compliance filing, proposed Tariff language in MRTU Tariff section 31.3.1.3 that addresses the CAISO's proposed procedure for relaxation of transmission constraints when Economic Bids are insufficient to clear the market.

The CAISO submits the following explanation, which builds on the more general discussion of the constraint relaxation process discussed above in further compliance to the Commission September 21 MRTU Order and in Compliance with the June 2007 Order.

A. Revised Implementation Approach to Clearing of LAP Demand

Before responding to the specific compliance requirements of the June 2007 Order, the CAISO notes that it has made a modest but important revision to its approach to clearing LAP Demand in the IFM. Dr. Kristov explains the history of this compliance obligation and the new approach to Section 31.3.1.3 in his testimony.[26]

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[24] In general this problem is avoidable with an effective Resource Adequacy (RA) program that requires well-specified local capacity requirements, combined with clear, effective obligations on RA capacity under the CAISO market rules to make itself available in the IFM. Such obligations ensure that local supply scarcity – a key condition for the above scenario to occur – will be uncommon, limited to situations where facility outages or derates severely constrain the supply into a load pocket. In addition, the problem is more likely to occur when there are large-area LAPs that contain load pockets, instead of establishing a separate LAP for each known load pocket.

[25] *See* September 2006 Order, 116 FERC ¶ 61,274 at P 618 (2006).

[26] *See* Exh. ISO-1 at 37-45.

The approach detailed in the attached tariff sheets for Section 31.3.1.3 differs from the original MRTU filing (although as discussed below, the Commission's findings on this issue are still relevant). The changes proposed below are the result of further understanding the CAISO gained on the utility and performance of the configurable parameters discussed above through market simulation. Without this much needed testing and market simulation period the CAISO could not have known precisely how this process would actually work. The CAISO included the provisions in Section 31.3.1.2 (now 31.3.1.3) in its initial filing based on a preliminary evaluations of its optimization software that under certain circumstances it would not be possible to clear the LAP level demand. At that time, the CAISO did not have the benefit of the more robust testing and market simulation that has since ensued. Without this knowledge, the CAISO could not have safely made the refinements provided below, nor provided the explanations regarding the role of the "penalty prices" in its markets set forth throughout this filing.

The revised LAP demand clearing mechanism utilizes the same conceptual approach as set forth in Tariff Section 31.3.1.3, but improves upon that approach by internalizing the procedure in the IFM rather than performing a sequence of discrete tests and optimization re-runs in the pre-IFM processes. The IFM optimization will clear LAP demand through the use of parameters described in this filing that enable it to call on Ancillary Services or relax transmission constraints in tight supply conditions.

The scheduling parameters in the IFM are set so as to replicate through adjustment priorities the same sequence of steps one and two described in the current tariff section 31.3.1.3, but within the context of the IFM market optimization process as opposed to the pre-IFM.

The CAISO has configured the parameters so that the software will essentially follow this decision tree to arrive to a feasible solution in the IFM. Conditionally qualified self-provided AS is considered "conditionally" qualified precisely because of the fact that it may, by virtue of its obligation to provide Energy if needed (under an RMR or RA contract) be utilized by the IFM to provide energy to relieve a congestion constraint if the constraint would otherwise cause a reduction in self-scheduled LAP demand. The CAISO is also clarifying, consistent with the rules specified in Section 8.6.2, that the CAISO will only consider in this process any capacity from self-provided Ancillary Services that is not under a must-offer obligation such as RMR or Resource Adequacy to the extent the resource has also submitted an Energy bid for that capacity.

In this manner, the procedure implemented in the MRTU software corresponds to the first step of the LAP demand clearing mechanism described in the originally filed MRTU Tariff section 31.3.1.3.

Consistent with the requirement in the second step of Section 31.3.1.3, the CAISO has set the parameter on internal transmission constraints that would affect LAP Demand is at $5000. This means that the optimization would accept an Economic Supply bid priced at the $500 bid cap that is at least 10 percent effective in relieving the binding constraint. Thus if the first step of releasing self-provided AS within the load pocket does not yield sufficient additional Energy to relieve the constraint – considering all Energy bids for which the product of bid price times effectiveness is no greater than $5,000 – then the IFM scheduling run will relax the constraint. In the pricing run, the pricing parameter of $500 is used for the amount of constraint relaxation from the line's normal limit up to the relaxation level determined in the scheduling run.

With respect to the final "step" in Section 31.3.1.3 in the current MRTU Tariff, the CAISO determined that the LAP demand clearing mechanism implemented in the MRTU software does not have any provisions comparable to step three (which involves modifying some of the LDFs for the LAP so that demand within the load pocket can be reduced without reducing demand across the entire LAP). In considering how to implement step three the CAISO found that it would be extremely difficult and costly at this late a juncture. In addition, the CAISO has determined, based on market simulation results, that it is unlikely that that steps one and two, as internalized into the IFM, would both be insufficient to clear the LAP Demand. Therefore, the CAISO determined that the anticipated benefit of step three is not worth the cost of implementing it.

B. Compliance with Paragraph 162 of the June 2007 Order

In Paragraph 162 of the June 2007 Order, the Commission required the CAISO to "give further details about the impact of the proposed parameter levels in the IFM. In this filing and in the prepared testimony of Dr. Kristov accompanying this filing, the CAISO has now provided a detailed description of (i) what market parameters are; (iii) at what levels key parameters will be set; (iii) what function they play in the market; and (iv) how they do or do not impact settlement LMPs. In addition, the CAISO has revised the relevant MRTU tariff sheets as described in Section III above to reflect the fact certain parameter values are now included in the tariff.

C. Compliance with Paragraph 163 of the June 2007 Order

First, in Paragraph 163 of the June 2007 Order, the Commission directed the CAISO to "resubmit tariff language that clearly indicates that the penalty is not a financial penalty in the traditional sense and clarify what constitutes an effective economic bid. To clarify apparent confusion, the CAISO has revised the tariff to remove references to penalties in this context. Instead, as described at length above, the CAISO will rely on the term "parameter." The CAISO has

revised Section 31.3.1.3 -- the subject of the CAISO's compliance obligation -- accordingly. With respect to the issue of what constitutes an effective economic bid, the CAISO has created a new defined term – "Ineffective Economic Bid" – to clarify what types of bids will not be called upon to solve the market algorithm. The accompanying tariff language makes clear that Ineffective Economic Bids are those bids that, while available to the optimization, are not effective on the constraint at issue because the per-MW cost of using that bid would exceed the parameter for adjusting a *non-priced quantity*. The term "Effective Economic Bid" is defined to refer to all other Economic Bids that are not ineffective.

Second, in Paragraph 163, the Commission (in reference to the revised Section 31.3.1.3) directed the CAISO to clearly articulate "(1) what the revised provision does" and "(2) how the provision works in practice. The CAISO provided a detailed description of the process of relaxing a transmission constraint in Section III above and in the Direct Testimony of Dr. Kristov. The CAISO also notes that Section 27.4.3 sets forth how these provisions and describe scheduling and pricing parameters as discussed herein.

Third, in Paragraph 163, the Commission directed the CAISO to clearly articulate "the practical and financial effect of the provision on the market participants." The CAISO provided this description in Section III above and in the Direct Testimony of Dr. Kristov. Specifically, the tariff language and supporting testimony make clear that by setting the scheduling parameter for constraint relaxation to $5,000, the practical impact of Section 31.3.1.3 is that the market will relax a transmission constraint instead of choosing a redispatch solution at cost of over $5,000 per megawatt of constraint relief. The financial impact of such a constraint relaxation is that the amount of Energy by which the transmission constraint has been relaxed will be priced at the Energy bid cap.

Fourth, in Paragraph 163, the Commission directed the CAISO to clearly articulate "detailed answers to the questions raised by commenters." Specifically, the Commission found that, in its January 16, 2007 compliance filing, the CAISO failed to respond to comments on this issue from Southern California Edison (SCE) and Six Cities.[27]

SCE asked whether, when a constraint relaxation parameter is reached triggering the relaxation of a constraint, the price at the impacted nodes will: (1) remain at three times the cap after relaxing the constraint, (2) return back to unconstrained levels, or (3) be somewhere in between. The CAISO clarifies that the constraint will only be relaxed, and the prices impacted according to the rules above, for those 5-minute intervals for which such relaxation is part of the market solution. SCE also argued it is unclear whether, when the CAISO relaxes a

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[27] Six Cities are comprised of the Cities of Anaheim, Azusa, Banning, Colton, Pasadena, and Riverside, California.

constraint, whether the CAISO will relax all transmission constraints, or just those constraints that violate the criteria. The CAISO clarifies that only the transmission constraints that are preventing the algorithm from solving, *i.e.* those constraints that are binding, will be relaxed in order to reach a feasible solution.

Six Cities argued that step 3 of the proposed rules is not clear and requires further explanation. As noted above, the CAISO has done away with "step 3" as described in the originally filed tariff language.

VI. THE USE OF MARKET PARAMETERS IS CONSISTENT WITH THE PRACTICES OF OTHER RTOs

As noted above, all LMP markets use some form of parameters as a means to program the market optimization to take certain actions besides finding the lowest economic bid. However, the level of detail the CAISO is presenting to the Commission and including in its tariff exceeds what other organized markets have included in their tariffs. The following are relevant examples from other RTOs.

It appears that the Midwest ISO employs what it calls a "relaxation algorithm" that contains certain penalty factors to govern similar operations in its markets.[28] In the Midwest ISO's recent Ancillary Services Market proposal, an intervenor asked for a detailed explanation about how the penalty factors governing the relaxation of constraints impacted prices and caused any divergence between ex ante and ex post prices. The Commission deferred the issue and ordered "the Midwest ISO to submit a section 205 filing explaining the use of such penalty factors to relax constraints in the dispatch and explaining how prices will be set in such instances."[29]

The Southwest Power Pool (SPP) uses what it calls Violation Relaxation Limits (VRLs) to tell its market software at which price point it should relax a transmission constraint or other operational actions instead of pursuing costlier re-dispatch options. VRLs in SPP appear to play very similar roles to the CAISO's MRTU parameters. According to SPP, "VRLs identify points at which [the optimization] will consider operational options to balance system injections and withdrawals that involve violation of limiting factors.... When a constraint is both binding and violated, its shadow price will be capped at the associated VRL. Units that can be dispatched in a manner that will help relieve the constraint or

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[28] See 2007 Midwest ISO State of the Market Report, available at http://www.midwestiso.org/publish/Document/24743f_11ad9f8f05b_-7b890a48324a/2007%20MISO%20SOM%20Report_Final%20Text.pdf?action=download&_property=Attachment at p. xvi).

[29] *See Midwest ISO*, 122 FERC ¶ 61,172 at P 557 (2008).

limit will be so dispatched, starting with the unit that makes the lowest contribution to the shadow price, up to the point that the aggregate shadow price associated with all dispatched units would exceed the value associated with the VRL."[30]

The New York ISO uses a similar mechanism, which it calls the "Transmission Shortage Cost" of $4,000 per MWh to cap shadow prices to avoid inefficient dispatch solutions during shortage conditions. The Transmission Shortage Cost is essentially the level that the optimization cannot exceed in redispatching to resolve a constraint.[31]

ISO-New England uses what it calls "Reserve Constraint Penalty Factors", which it defines as "the rates, in $/MWh, that are used within the real-time dispatch and pricing algorithm to reflect the value of operating-reserve shortages."[32] In addition, ISO-NE's Market Monitor recently recommended that ISO-NE adopt "Transmission Constraint Penalty Factors" to avoid economically unreasonable outcomes.[33] In a few instances, such outcomes have exceeded $11,000/MWh.[34] The market monitor recommended using hard penalty factors that he thinks better reflect the value of a constraint.

VII. STAKEHOLDER PROCESS AND ISSUES RAISED

The formal stakeholder process began with a May 8, 2008 whitepaper describing the rationale for the *adjustment of non-priced quantities* provisions and the initial proposed parameter values for MRTU start-up. Updates to that whitepaper were published on June 9, 2008, July 30, 3008, September 19, 2008, October 16, 2008 and October 29, 2008. Each publication of the whitepaper except the last[35] was followed by a round of written stakeholder comments and formal presentations to stakeholders with extensive data analysis coming from the market simulation process and from specially constructed test cases. Thus this filing follows an extensive collaborative process with CAISO stakeholders and the final parameters proposed in this filing reflect the results of that collaboration and stakeholder input. Formal meetings or conference calls on

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[30] *See* SPP Market Protocols, revision 8.0a, *available at* http://www.spp.org/publications/Mkt_Protocols_8.0a.doc.

[31] *See* Section 2.191a of the NYISO tariff.

[32] See Section III.2.7A(c) of the ISO-NE Tariff.

[33] http://www.iso-ne.com/pubs/spcl_rpts/2007/isone_2007_immu_rpt_fin_6-30-08.pdf

[34] Id.

[35] This last whitepaper only corrected errors discovered in a prior version and did not contain substantive policy changes.

these issues were held on May 13, 2008, June 13, 2008, July 30, 2008, September 25, 2008, and October 27, 2008.

Over the course of this collaboration, stakeholders offered a host of comments, questions, and recommendations, most of which have been thoroughly addressed. There have been some recent comments made about the final parameter proposal that warrant some attention here.

A. Participating Loads

First, the California Department of Water Resources ("CDWR") has raised an issue regarding Participating Loads in the MRTU Market. As articulated to the CAISO, CDWR's concern is that the CAISO would reduce the day-ahead self-schedule of a Participating Load even when the load has not submitted a bid for load-drop (e.g., a bid to supply non-spinning reserve), and regardless of whether that load was being served via an ETC schedule. This concern was raised in written comments on October 29, 2008. While the CAISO has studied this issue since it was raised and believes that the probability of this happening in the market are slight, the CAISO cannot ensure that this is not likely to ever occur for Participating Load that is not served under an ETC.[36]

The CAISO does not believe this issue should stand in the way of the resolution of the instant filing for several reasons. In the first instance, this issue was raised by CDWR very late in the process and therefore was not the subject of the stakeholder process that preceded this filing. This issue arises from the fact that Participating Load is scheduled and settled nodally in all hours, instead of at a Default Load Aggregation Point ("LAP") like most other loads. This treatment of Participating Load is a long established principle of MRTU policy as reflected in Section 27.2 of the current MRTU tariff, and through the current process and filing the CAISO did not set out to change this policy. In that sense, CDWR's issue is beyond the scope of this filing. Nodal scheduling of Participating Load results in the possibility that if faced with a congested constraint in the area of the Participating Load, while the software is configured to treat all generic self-scheduled load equally, nodal load may be more effective at relieving the constraint than load scheduled at the LAP, because it would take a much larger MWh reduction in LAP load to obtain the same amount of congestion relief as a smaller MWh reduction in the nodal Participating Load. Therefore it is conceivable, as suggested by CDWR, that self-scheduled participating load may be adjusted while load at the LAP is not. Moreover, CDWR is correct in pointing out that such reduction in the IFM could occur

[36] The CAISO's proposal submitted herein regarding the treatment of existing rights self-schedules in the IFM does effectively address this issue for Participating Loads served under existing rights. The remaining CDWR concern therefore should be viewed as limited to Participating Loads that are not served under existing rights.

irrespective of whether the Participating Load has submitted a bid to supply non-spinning reserve, as the market software cannot make such a distinction.

Second, while this appears to be a concern to CDWR, there is no simple solution that can be adopted to immediately address CDWR's concerns. The current MRTU tariff, unlike the case of TOR/ETC/CVR self-schedules, has never contemplated that Participating Load would ever receive any higher priority than other self-scheduled load. Sections 31.4 and 34.10, do not explicitly call out participating load from the plain-vanilla load self-schedules. To imbue in Participating Load a priority different than what is already in the tariff without a stakeholder process would be inappropriate. Therefore, the CAISO cannot simply elevate the priority of Participating Load self-schedules relative to generic load self-schedules by changing the setting of its parameters.

Notwithstanding that this issue is beyond the scope of this filing and does allow a simple solution, the CAISO commits to working closely with CDWR to resolve this issue as soon as possible, understanding that any change in policy is likely to require further stakeholder process and a tariff amendment and therefore cannot be implemented until some time after MRTU *go live*.

B. Resolution of Existing Rights Issues

The treatment of ETC/TOR/CVR self-schedules discussed at length above was one of the most discussed issues in this stakeholder process. As discussed by Dr. Kristov, the CAISO's proposal is designed to address the specific concern raised by the existing rights holders that their IFM self-schedules could be reduced to relieve a congested transmission constraint for which their locally-scheduled loads are more effective than load scheduled at the Default LAP. The CAISO's solution changes the priority of ETC/TOR/CVR self-schedules relative to relaxation of an internal transmission constraint, but without changing their priority relative to all other self-scheduled load contemplated under Sections 31.4 and 34.10. The proposal obviates the need for further analysis of alternatives offered by the parties, including financial compensation, because this more simple approach just eliminates the possibility that the TOR/ETC/CVR self-schedules will be curtailed.

In recent comments, San Diego Gas & Electric, Southern California Edison and Pacific Gas & Electric have, to varying degrees, questioned the level of analytical support for the resolution described above. It is unclear to the CAISO what data these parties seek. To the extent that San Diego Gas & Electric, Southern California Edison and Pacific Gas & Electric are concerned about some unintended, and as of yet unidentified, consequence of placing a higher parameter value on ETC/TOR/CVR self-schedules than the parameter for transmission constraints, the CAISO notes that in its discussions regarding this topic, CAISO staff demonstrated that the possibility that these TOR/ETC/CVR

self-schedules would be curtailed in the first instance is slim.[37] Therefore, protecting them to the point that they will never be adjusted in the IFM only slightly reduces the available pool of self-schedules that could otherwise be adjusted prior to relaxing an internal transmission constraint, in order to provide assurance to the holders of such rights that their IFM self-schedules will not be reduced.

C. Parallel Path Flows

Sacramento Municipal Utility District ("SMUD") has raised concerns about schedules within the PG&E service territory causing parallel path flows through the SMUD Balancing Authority Area, which SMUD asserts the CAISO would represent in its markets as "compensating injections." Specifically, SMUD is concerned that although these parallel path flows represented as compensating injections may contribute to congestion, they would not be subject to reduction like a self-schedule would be in the event such adjustments were necessary, and would consequently reduce the availability to SMUD of transmission capacity between the CAISO and SMUD Balancing Authority Areas. SMUD's argument reflects a misunderstanding of the compensating injections, which the CAISO uses to represent flows across the CAISO boundary that are *not* produced by schedules within the CAISO market and Balancing Authority Area. The compensating injections are not subject to adjustment in the CAISO's scheduling and dispatch because they originate from external sources and sinks over which the CAISO has no control, other than to apply "pro rata" cuts in interchange schedules or use the Unscheduled Flow Mitigation Procedure in coordination with adjacent Balancing Authority Areas. Flows between sources and sinks within the PG&E area are fully represented in the full network model, and do not need any representation as compensating injections. Moreover, SMUD's concern does not appear to pertain to the substance of the non-priced quantity adjustment parameters, and is thus outside of the scope of this filing.

D. Value of the Pricing Parameter for Real-Time Energy

In recent comments, the Western Power Trading Forum has raised two related issues. First, they argue the pricing parameter should be higher than the bid cap for Real-Time Energy when there is a shortage of supply bids. This represents a general concern of supply, i.e., that a higher real-time parameter would result in higher LMPs, and therefore more accurately reflect the lack of bids. This concern is thoroughly addressed in Dr. Kristov's testimony. He explains that this parameter does not cap LMPs. Rather, it establishes the value of the system-wide energy price component of the LMPs, while allowing individual LMPs to vary in accordance with the costs of losses and congestion.

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[37] Mr. Price's presentation, detailing the small likelihood of ETC/TOR/CVR adjustment in the day-ahead can be found at http://www.caiso.com/204b/204bdfbd2b9b0.pdf.

Thus, in effect, this ensures that prices are not artificially low in Real-Time. While setting a higher parameter value would likely result in higher market-clearing prices, for MRTU start-up, the CAISO felt consistency with the Commission-approved $500 bid cap was paramount and did not want to create artificially high administrative pricing under the guise of parameter setting.

WPTF also raised a concern that software parameters should not be employed to manage price excursions caused by software anomalies. WPTF voiced a similar concern in response to the CAISO's price cap proposal, which is being proposed in a filing concurrently with this parameter filing. Suffice it to say, the setting of market parameters will not be used to "manage price excursions caused by software anomalies." The CAISO will diligently investigate the causes of any instances of extreme prices, regardless of whether they set the market clearing price.

E. Ancillary Services Pricing Issues

PG&E submitted comments that the CAISO's revisions to Section 31.3.1.3 increase the pool of self-provided AS bids that might be drawn upon to provide energy beyond those with capacity obligated to offer an energy bid to all self-provided AS bids. The CAISO has addressed this concern by including tariff language in Section 31.3.1.3 specifying that non-RA resources can carve themselves out of this by not submitting an energy bid.

PG&E has also commented that the CAISO should adopt the entirety of the MSC's opinion on the issue of Ancillary Services pricing parameter levels. Specifically, in addition to using the bid cap for Ancillary Services as a the pricing parameter for the deficient reserve product, PG&E argues the CAISO should also lower the Ancillary Services bid cap to $150 per MW as added protection against the exercise of market power in the Ancillary Services markets. The CAISO does not necessarily oppose lowering the Ancillary Services bid cap, but at this time has not identified any new information that suggests increased risk of the exercise of market power in these markets which would support a proposal to lower the cap this close to MRTU go live. As with all bid cap levels, the CAISO will be monitoring the Ancillary Services cap level under MRTU and will work with stakeholders to address any deficiencies in the Commission-approved levels.

F. Level of Energy Bid Floor

CitiGroup, in recent stakeholder comments, has raised a host of technical issues regarding the implementation of the MRTU bid floor, approved by the Commission at -$30 per MW. CitiGroup's concern appears to be that, through the parameter stakeholder process, CitiGroup has come to understand that in some circumstances market clearing prices could result in LMPs lower than the bid floor, but resources are not permitted to bid lower than -$30. The CAISO notes that the levels of the MRTU bid caps have been approved by the

Commission, have not been a topic of discussion in this stakeholder process, and are not being changed in this filing. Moreover, the CAISO will be closely monitoring all aspects of MRTU market performance, in compliance with its obligation to submit quarterly reports to the Commission about MRTU performance. If in the first year of MRTU, the level of the bid floor appears to be causing problems or somehow discouraging activity that would help the market clear efficiently, the CAISO will work with stakeholders and the MSC to revisit those levels.

VIII. OTHER TARIFF CHANGES

In addition to the changes described above dealing with the inclusion of relevant parameter values in the tariff, additional supporting tariff changes are proposed in this filing.

Section 11.10.1.1 (Ancillary Services in the DAM) is revised to reflect the fact that a large portion of Ancillary Services pricing tariff language has been moved to Section 27, where additional pricing data remains. Of the language in Section 11.10.1.1 that remains, additional clarifying language is proposed. Similar revisions are proposed for Section 11.10.1.3 (Ancillary Services in Real-Time).

Section 27.1 is revised to reflect the fact that Ancillary Services pricing language will now be housed in Section 27. The Ancillary Services pricing information that was already in the tariff in section 11.10.1.1 and 11.10.1.3 is moved to section 27.1 to facilitate the inclusion of the rule in 27.1.2.3, discussed above, that indicates the pricing parameter the CAISO market software will use in the event that there is a shortage of an Ancillary Service. As shown in the blackline tariff sheets, much of this language is simply imported from Section 11.10.1., and additional clarifications are provided without changing the already established Ancillary Services pricing requirements. The clarifications regarding the Ancillary Service prices is further proved in response to an issue raised by SAIC, an independent auditor engaged by the CAISO to ensure consistency between the tariff, business practice manuals and software specifications.[38] Specifically, SAIC commented that there is currently no discussion in the tariff that specifies how resources participating in multiple regions would be paid. In addition, the CAISO moved the detail regarding how the opportunity cost of Energy is determined for the purposes of calculating ASMPs into Section 27.1.2.2 but did not modify this detail except for conforming changes. Section 34.19.2.4 is proposed to be deleted because the CAISO has found that the

[38] *See* Item IFM/RTN-037 in the document summarizing responses to the SAIC audit issues, at http://www.caiso.com/205c/205c1056526470.doc.

pricing for Energy when in real-time contingency dispatch is already adequately covered in Section 34.when in RTUC is already covered in Section 34.3.2 and 34.8 and therefore 34.19.2.4 is redundant.

This amendment also creates three new defined terms. These terms, Effective Economic Bid, Ineffective Economic Bid, and *non-priced quantities* are discussed in the body of this letter. In addition to the new defined terms addressed in the body of this transmittal letter, the existing term "Ancillary Service Marginal Prices" has been revised only to reflect the movement of AS pricing rule to Section 27.

IX. EFFECTIVE DATE

Consistent with a decision rendered by the CAISO Governing Board on October 29, 2008, the CAISO also requests that the Commission approve the proposed changes in this Amendment to the MRTU Tariff effective as of January 31, 2009, *i.e.*, one day prior to the anticipated implementation date of MRTU, February 1, 2009. However, in the unanticipated event that MRTU is implemented more than 120 days after the submittal of this Amendment, the CAISO requests waiver, pursuant to Section 35.11 of the Commission's regulations (18 C.F.R. § 35.11), of Section 35.3 of the Commission's regulations (18 C.F.R. § 35.3), in order to permit the changes to the MRTU Tariff proposed herein to become effective as of that implementation date. Granting a waiver in this instance would be consistent with the similar waivers of Section 35.3 that the Commission has granted for other MRTU-related filings.

X. COMMUNICATIONS

Communications regarding this filing should be addressed to the following individuals, whose names should be placed on the official service list established by the Secretary with respect to this submittal:

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XI. SERVICE

The CAISO has served copies of this transmittal letter, and all attachments, on the California Public Utilities Commission, the California Energy Commission, the California Electricity Oversight Board, all parties with effective Scheduling Coordinator Service Agreements under the ISO Tariff, and all parties in Docket No. ER06-615. In addition, the CAISO is posting this transmittal letter and all attachments on the CAISO website.

XII. ATTACHMENTS

The following documents, in addition to this transmittal letter, support the instant filing:

Exhibit ISO-1	Prepared Direct Testimony of Dr. Lorenzo Kristov
Attachment A	Revised MRTU Tariff Sheets – Clean
Attachment B	Revised MRTU Tariff Sheets – Blackline

XIII. CONCLUSION

For the foregoing reasons, the CAISO respectfully requests that the Commission approve this tariff revision as filed. Please feel free to contact the undersigned if you have any questions concerning this matter.

Respectfully submitted,

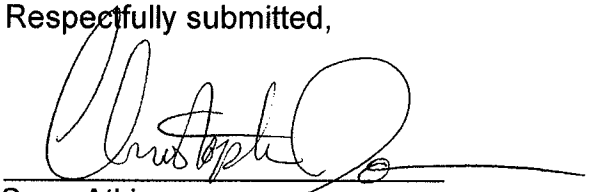

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Exhibit ISO-1

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation)	**Docket No. ER09-___-000**

PREPARED DIRECT TESTIMONY OF LORENZO KRISTOV

Q. Please state your name and business address.

A. My name is Lorenzo Kristov. My business address is 151 Blue Ravine Road, Folsom, California 95630.

Q. By whom and in what capacity are you employed?

A. I am the Principal Market Architect, within the Department of Market and Product Development at the California ISO.

Q. Please describe your professional and educational background.

A. I have 17 years of experience in the electric utility industry, which began in 1991 working on demand forecasting at the California Energy Commission. In 1993 and 1994 I worked in Indonesia as a Fulbright scholar on the development of a commercial and regulatory framework to support private power investment. Then at the end of 1994 I returned to the California Energy Commission and for the next few years represented the Commission in all the retail electric restructuring

proceedings and stakeholder working groups that were developing the rules for Direct Access. In 1999 I joined the CAISO in the Department of Market Analysis and shortly thereafter became part of the internal team formed to reform the CAISO's congestion management design. That effort was unfortunately interrupted by the crisis of 2000-2001, but at the end of 2001 I was able to reformulate the internal team and re-initiate the CAISO market redesign effort, which was the project known as Market Design 2002 or "MD02," which later was renamed MRTU. Since that time I have been one of a small group of internal experts working to design and now finalize the CAISO's MRTU Markets. I received a master's degree in Statistics from North Carolina State University, and a Ph.D in Economics from the University of California at Davis.

Q. What is the purpose of your testimony?

A. My testimony will explain and support the CAISO's tariff amendment filed with the Commission today to provide additional information in the MRTU Tariff regarding the procedures and parameters for adjustment of non-priced quantities by the market software. More specifically I will explain:

- The role and nature of *non-priced quantities* in the MRTU market optimizations;
- The reasons why *adjustment of non-priced quantities* is a necessary feature of the market design;

- The role of the scheduling and pricing parameters used to implement the provisions for *adjustment of non-priced quantities*, and the need for separate scheduling and pricing runs in the market optimizations;
- The guiding principles behind the provisions governing *adjustment of non-priced quantities*, the specification of parameter values and the associated pricing rules; and
- The specific provisions proposed by the CAISO in this filing, and the rationale for the associated parameter values proposed herein for Commission approval.

I. Overview of Adjustment of Non-Priced Quantities

Q. What are non-priced quantities in the MRTU markets?

A. To explain this it will be helpful to review a few of the fundamentals of how the MRTU markets work. Each MRTU market is executed by a software program that performs a mathematical algorithm known as *constrained optimization*. The two main types of constrained optimization used in MRTU are "Security Constrained Unit Commitment" or "SCUC," and "Security Constrained Economic Dispatch" or "SCED," both of which are discussed in the current MRTU tariff. The idea of constrained optimization is that the algorithm optimizes an objective function – in this context, it tries to minimize the total bid cost of the cleared resources – subject to a set of constraints that in some way limit the available choices. To achieve the optimal value of the objective function, the algorithm adjusts the variables available to it – primarily, it accepts or clears

the optimal amounts of the economic bids, which contain prices paired with quantities, submitted by the scheduling coordinators. The constraints, meanwhile, are quantitative values in the software that typically are not available to the software for adjustment in the optimization process, including the flow limits on transmission facilities, performance characteristics of generators (ramp rates, minimum run and minimum down times), procurement requirements for ancillary services, and self-schedules submitted by scheduling coordinators which contain bid supply and demand quantities without associated prices. These and a few other types of quantitative constraint values comprise the set of *non-priced quantities*, which stand in contrast to the economic bids submitted by scheduling coordinators which have bid prices associated with bid quantities.

Q. Your last answer says that the non-priced quantities are not available to the software to adjust to reach a solution, yet the phrase *adjustment of non-priced quantities* implies that these quantities can be adjusted. Please explain.

A. The software is designed to try to achieve a feasible solution by accepting effective economic bids as far as possible. A feasible solution means that (a) energy supply plus losses equals energy demand, (b) required quantities of ancillary services are fully procured, and (c) all physical operating limits – transmission limits and generator performance limits – are fully enforced. In some situations, however – some combinations of bidding behavior, market and grid conditions – the available effective economic bids will not be sufficient to achieve a feasible solution. To address such situations the MRTU tariff and the

market software provide specific rules for *adjustment of non-priced quantities* so that a feasible market solution can be achieved.

Q. Was the element of *adjustment of non-priced quantities* included in the original MRTU design?

A. Yes. The February 2006 MRTU tariff contained provisions for *uneconomic adjustment*, which we are now calling *adjustment of non-priced quantities*. In section 31.4 for the integrated forward market (IFM) and section 34.10 for the real-time market (RTM), the MRTU tariff sets out a hierarchy of different classes of non-priced quantities, focusing on self-schedules. These hierarchies specify the sequence the market software must follow when adjustments to these quantities are necessary, starting with the lowest scheduling priority among self-schedules, which is first class to be available for adjustment, going to the highest scheduling priority or the last class to be available for adjustment. In addition, section 31.3.1.3 describes an IFM procedure for adjusting non-priced quantities to avoid excessive curtailment of self-scheduled Default LAP demand due to a local transmission constraint.

Q. Given these existing tariff provisions, why is the CAISO proposing additional tariff provisions and changes at this time?

A. As I will discuss in the next section, the rules for *adjustment of non-priced quantities* are implemented in the software through the setting of scheduling and pricing parameters. In the process of determining the appropriate settings for the

required parameters, the CAISO ran numerous test cases and analyses over the past year, and initiated a stakeholder process to present these analyses and to discuss more fully with stakeholders the whole topic of *adjustment of non-priced quantities*. As a result of this process it became apparent that some modifications to the existing MRTU tariff provisions are needed to characterize the adjustment rules more accurately, and some new provisions are needed to specify the rules for setting prices in the markets when *adjustment of non-priced quantities* is performed. In addition, with this filing the CAISO is fulfilling an outstanding compliance requirement regarding section 31.3.1.3 mentioned above. As a result of the lessons learned through the recent testing and analysis as well as the stakeholder discussions, this compliance requirement also entails some changes to the original tariff language.

II. Scheduling and Pricing Parameters

Q. What are the scheduling and pricing parameters in the MRTU markets?

A. These parameters are numerical values that are pre-set by the CAISO in the market optimization software as the means to implement the provisions for adjusting non-priced quantities and determining appropriate settlement prices when non-priced quantities are adjusted. The simplest way to think about the parameters is to view them as filling in for the fact that the non-priced quantities do not have associated bid prices. As I mentioned at the beginning, the optimization software wants to minimize the total bid cost required to balance supply and demand and procure required ancillary services, subject to the various

constraints. If this can be accomplished without adjusting any non-priced quantities, then everything that clears the market will have an associated bid price and it is straightforward to calculate total bid cost. But if non-priced quantities need to be adjusted, the optimization needs some way to determine how any given adjustment will contribute to total bid cost. That's where these parameters – commonly called "penalty prices" or "penalty factors" in the optimization jargon – come in. It is typical in setting up constrained optimization software to assign a penalty price to each category of constraint, and these penalty prices then play a role analogous to economic bid prices by guiding the software to selectively relax constraints in a manner that minimizes total bid costs as it finds the feasible solution.

Q. What principles guided the CAISO's current proposals and choice of parameter values for *adjustment of non-priced quantities*?

A. The principles derive first and foremost from the primary objectives of the MRTU design. First among these is the objective of producing feasible schedules and feasible real-time dispatch instructions as results of the markets. Feasible in the sense of respecting the laws of physics – the way power actually flows on the CAISO network, the flow limits of grid facilities, operating characteristics of resources, the balance of supply and demand, and so forth. This principle implies that the market software should rarely adjust these types of non-priced quantities that reflect physical operating constraints and, if it does adjust such a constraint,

does so in a way that provides the operators with sufficient and timely information to take any appropriate actions that may be needed.

Second, the rules must respect the expectations of scheduling coordinators who submit self-schedules that these price-taker supply and demand quantities will generally be accepted by the market, without being subject to adjustment by the market optimizations. This principle implies that the market software should utilize economic bids as far as possible, and should resort to adjusting self-schedules only when further use of economic bids would lead to a solution that departs significantly from prudent operating practices. I will elaborate further on what this means shortly when I discuss the first of the CAISO's proposed tariff amendments.

Third, in instances where it is necessary to adjust self-schedules, the rules must respect the priorities previously established in the MRTU tariff (Sections 31.4 and 34.10) which specify an adjustment sequence or scheduling priority hierarchy for different classes of self-schedules. These scheduling priorities were established through the lengthy MRTU development process, and it is the CAISO's intention with the current proposals and the parameter settings to respect and implement these priorities, not to modify or overturn them.

Fourth, the rules must strike a reasonable balance between allowing meaningful price signals to reflect the conditions that triggered the use of *adjustment of non-priced quantities*, yet at the same time must not cause extreme price impacts on market participants. As I will explain below, the CAISO adheres

to this principle by using the relevant bid caps in those situations where an administrative pricing parameter is needed for determining prices.

Fifth, another formative principle behind MRTU is consistency of pricing mechanisms between day-ahead and real-time markets. This implies that the rules for *adjustment of non-priced quantities* should not introduce any factors that may cause systematic inconsistency across market time frames.

Q. Do the CAISO's proposals in this filing reflect these principles?

A. Yes they do, though I must emphasize that these principles necessarily entail tradeoffs. As I will explain further when I discuss the specific proposals, the tradeoffs imply that there is no objectively right or optimal resolution to each issue. Rather, each proposal must strike a balance among somewhat competing goals.

Q. Please describe the different roles of the scheduling and pricing parameters.

A. The scheduling parameters instruct the market optimization software as to the sequence to follow in making adjustments to the different categories of non-priced quantities, and the thresholds for moving from one category of non-priced quantities to the next. The pricing parameters then affect how the software will determine prices when one or more non-priced quantities have been adjusted.

Q. It sounds like you described two sequential steps that the software follows – first, making adjustments of non-priced quantities, and second, determining prices once the non-priced quantities have been adjusted. Is that how it works?

A. Yes. Each MRTU market consists of two successive runs – a scheduling run followed by a pricing run. This is true for all of the main MRTU market processes – the pre-IFM (the Market Power Mitigation – Reliability Requirements Determination), the integrated forward market, the residual unit commitment (RUC), the hour-ahead scheduling process (HASP), the real-time unit commitment (RTUC) and the real-time dispatch (RTD).

Q. Why are the two runs necessary?

A. The two-run structure is driven by the need to use extremely high and extremely low numerical values for the scheduling parameters, values which would not be appropriate for setting the market settlement prices. Recall earlier I explained the principle that the software should rely primarily on economic bids to reach a solution, and refrain from adjusting self-schedules unless further use of economic bids would lead to a departure from prudent operating practice. For the software to implement this logic, the CAISO must set scheduling parameters on self-schedules that are outside the range of economic bids, so that using economic bids will be preferred by the software.

Furthermore, the hierarchies for self-schedule adjustment specified in MRTU tariff sections 31.4 and 34.10 require as many distinct scheduling

parameter values as there are self-schedule categories, and also require that these distinct values be far enough apart so that the hierarchy will be observed by the software. In the IFM and the RTM the scheduling parameters on the different self-schedule types range from $550 to $6000 in magnitude. (Negative parameter values are associated with reductions of supply self-schedules, whereas positive values are associated with reductions of demand self-schedules.) Using such values for determining market settlement prices would result in unnecessarily extreme prices. Although it may seem like we could simply compress these values to lower overall levels so as to make them usable for setting prices, compressing them would reduce their effectiveness in maintaining the separate levels of the adjustment hierarchy. Keep in mind that the scheduling parameters are calculated primarily to enforce the adjustment hierarchy, not to ensure just and reasonable prices. Therefore, after the software determines schedules using the scheduling parameters to adjust non-priced quantities as needed, it performs a second run using different parameter values, pricing parameters, to determine the market settlement prices associated with the schedules established by the scheduling run.

Q. Doesn't the use of pricing parameters that are less extreme than the scheduling parameters suppress market prices?

A. No. Although it is true that the scheduling run does produce a complete set of prices when it produces schedules (just as the pricing run produces a complete set of schedules when it produces prices – both runs are runs of the same

optimization algorithm), there is nothing intrinsically correct or true about the scheduling run prices that makes them more valid than the pricing run prices. Remember that the scheduling run prices are the result of administratively selected parameter values, selected based on empirical assessment with the main purpose of maintaining a preferred adjustment sequence among non-priced quantities. These values are not intended to reflect underlying economic fundamentals or market values, so it is not appropriate to imbue the scheduling run prices with any definitive correctness.

It is also important to recognize that market participants have somewhat limited ability to manage the price impacts that might otherwise result from *adjustments of non-priced quantities* if there were not a separate pricing run based on more moderate parameter values. Of course, one obvious protection against price impacts is to submit economic bids and minimize the use of self-schedules, because self-schedules are price takers in the markets and will be exposed to whatever prices result (except to the extent they are protected from congestion charges by existing rights such as TOR, ETC and CVR). But economic bids are limited by the bid caps to the range from -$30 to $500 for energy. While these are prudent values to start the new markets, they also mean that market participants cannot use economic bids to send economic signals outside this range. For example, a buyer of energy has no way to indicate a willingness to pay up to $750 per MWh but no higher. Such a buyer either bids $500 or self-schedules and becomes a price taker. Having separate scheduling and pricing runs with distinct sets of parameters is the best way to balance the multiple principles and objectives

I stated earlier. In particular, using pricing parameters in the range of the established MRTU bid caps is the appropriate way to ensure just and reasonable prices without suppressing valid and necessary market price signals.

III. Proposed Tariff Amendments Related to Adjustment of Non-Priced Quantities.

Q. Please summarize the tariff amendments the CAISO is now proposing.

A. The CAISO's filing addresses seven issues. I'll provide an overview here and then discuss each one in detail.

1. Relaxing the requirement to use all economic bids before adjusting any self-schedules. This is the first and actually a threshold change, because it goes to the heart of how the optimization software really works. The original tariff requirement as written cannot and should not be followed absolutely, inflexibly, because that could lead to extreme scheduling and pricing results that do not make sense operationally or economically.
2. Setting the scheduling parameter for relaxation of internal transmission constraints to $5000 per MWh in the IFM and RTM, and to $1250 in the RUC. As I will explain, these parameter settings have been chosen to strike a balance between minimizing any relaxation of transmission constraints in the markets to ensure feasible schedules and dispatches, versus avoiding operationally unsound congestion management solutions that utilize large quantities of re-dispatch of ineffective resources to obtain a few MW of congestion relief.

3. Using the energy bid cap as the pricing parameter when there is shortage of supply in the RTM.

4. Using the applicable bid caps as the pricing parameters when a transmission constraint is relaxed in the IFM, the RUC or the RTM.

5. Using the Ancillary Services bid cap as the pricing parameter when there is insufficient supply to meet an Ancillary Services requirement.

6. Protecting the self-schedules of the holders of Transmission Ownership Rights, Existing Transmission Contracts and Converted Rights from reduction in the IFM by setting their scheduling parameters above the parameter for internal transmission constraint relaxation.

7. Revisions to Section 31.3.1.3 on the Provisions to Prevent Severe Curtailment of Default LAP Demand in the IFM Due to a Congested Non-competitive Transmission Constraint.

1. <u>Relaxing the requirement to use all economic bids before adjusting any self-schedules.</u>

Q. Please explain the need for this particular tariff amendment.

A. The first proposed tariff amendment that resulted from the stakeholder process and perhaps the most basic issue is to modify section 31.3.1.1, which says that the IFM optimization will utilize *all* economic bids before adjusting any self-schedules. While the notion of utilizing *all* economic bids first reflected the high-level principle of how the CAISO had proposed the market would work in an ideal sense, it is a practical impossibility for the constrained optimization algorithms being used in these markets. This impossibility is not a characteristic

of the MRTU markets alone, it also pertains to the market software of the other ISOs and RTOs that have Locational Marginal Pricing (LMP) markets. These market systems enforce many constraints of different types, not all of which does it make sense to enforce 100 percent of the time. Moreover, all types of constraints should not get the same level of enforcement, so the software must be able to discriminate. But once you introduce different classes of constraints (i.e., the non-priced quantities) with some hierarchy or adjustment sequence among the classes, the software cannot maintain the hierarchy in a 100 percent absolute sense. That is, it cannot completely exhaust one class before moving to the next. Instead, the there are thresholds specified in the software that tell the software to stop using more of a given class at a certain point and move on to the next class. The point is that the original tariff language – to utilize *all* economic bids before adjusting any self-schedules – was based on a conceptual ideal which is at variance with how the LMP market optimization software actually works. This impossibility became fully apparent through CAISO's analysis of initial test cases and early market simulation results. Thus one key issue the CAISO's current filing addresses is to clear up this variance and make the tariff language more accurately reflect how the markets work.

Q. Can you provide an illustration of a situation where it would be appropriate for the software to pass up some remaining economic bids and make adjustments to non-priced quantities?

A. In the course of MRTU market simulation, it has become clear that under some combinations of system conditions and bidding patterns, usually involving high volumes of self-schedules relative to the volume of economic bids, the only available economic bids may be geographically distant from and have very low effectiveness on a particular congested constraint. In such a situation, absent provisions for *adjustment of non-priced quantities*, the market would be required to re-dispatch potentially hundreds of megawatts at one end of the CAISO Balancing Authority Area to obtain very few megawatts of congestion relief on a constraint at the other end. Although such a solution would technically be feasible, it would be inconsistent with conventional standards of prudent grid operation, and it would allow the constraint shadow price to rise without limit, resulting in LMPs potentially in the thousands of dollars.

Instead of requiring absolute adherence to a principle that *all* economic bids must be exhausted before adjusting any non-priced quantities, the market design appropriately specifies a priority sequence of self-schedule types which can be adjusted as needed to avoid unreasonable scheduling and pricing outcomes. Not only does such an approach make more sense from an operational perspective, as I mentioned earlier it is unavoidable in a constrained optimization market algorithm that has multiple types of non-priced quantities having different degrees of priority or protection from such adjustment.

Q. Please summarize the impact of this particular proposed change to the MRTU tariff.

A. The impact, as I mentioned earlier, is simply to have the MRTU tariff reflect the reality of how the market optimization operates with respect to the preference for economic bids versus self-schedules and the priority sequence among self-schedule types specified in sections 31.4 and 34.10. Rather than an absolute requirement to utilize *all* economic bids before adjusting any self-schedules, which is currently the language of the MRTU tariff, the modification will clarify that the software may forego some *ineffective* economic bids and adjust self-schedules once a threshold level of the cost of using the *ineffective* economic bids is exceeded. Similarly, the different priority levels among the self-schedule types cannot be enforced in as absolute sense, such that all self-schedules of one type must be completely exhausted before the software can access the next priority level. Rather, there will be a threshold beyond which the software will see the remaining self-schedules of the lower priority type as *ineffective* and will start to utilize the next priority type. That is the essence of the first and most basic tariff amendment the CAISO is proposing in this filing.

Q. You referred to the concept of a threshold whereby the software determines that some economic bids are *ineffective* and begins to adjust self-schedules. Do the thresholds and the distinction between *effective* and *ineffective* economic bids have concrete, objective meaning that is transparent to the market?

A. Yes they do. These concepts are given precise operational meaning through the settings of the scheduling parameter values I discussed earlier, all of which will be publicly available in the Business Practices Manuals.

Q. Please explain how the scheduling parameter values operationalize the concepts of *effective* and *ineffective* economic bids.

A. Let me use the illustration of a congested transmission constraint. One of the current CAISO proposals is to set the scheduling parameter for relaxation of an internal transmission constraint to $5000 per MWh. I will return to this topic shortly, so for the moment let us take this parameter value as given, to see how it works. If the software is seeing congestion on a particular constraint, it will try to relieve the congestion using economic bids to re-dispatch supply resources in the least-cost manner. Typically this requires increasing the output of higher-priced resources while lowering the output of cheaper resources to maintain system energy balance, so there is a net cost of such re-dispatch which adds to the value of the objective function (i.e., the total bid cost of the market solution). Moreover, since the output of any particular resource is typically much less than 100 percent effective on any given constraint, it will take several MWh of increase and decrease of different resources to obtain just one MWh of congestion relief on the constraint. Suppose, then, that the first and cheapest MWh of congestion relief costs $1200, but still there is congestion on the line, and the next MWh of relief costs $2300, and so on … $3500 for the next MWh … $4600 for the next … and finally $5500. With the relaxation parameter set at $5000, the software will

accept the re-dispatch costs of $1200 up to $4600, but if the line is still congested and the next MWh of congestion relief costs more than $5000, the software will relax the constraint. Thus the threshold for constraint relaxation and how it works are completely transparent. Moreover, although additional economic bids could have been accepted to provide congestion relief at a cost of $5500, the $5000 setting of the parameter essentially defines these economic bids to be *ineffective* with respect to that constraint and directs the software to forego these bids and to adjust a non-priced quantity, in this case to relax the transmission limit.

Q. So what you are saying is that the distinction between *effective* and *ineffective* economic bids is not an inherent, objective property of the bids themselves, but is a result of how the scheduling parameters are set. Is that correct?

A. Yes. Economic bids are seen as *effective* or *ineffective* by the software by comparison of the cost of using them to the cost threshold specified by the scheduling parameters. Another way to think of this is that any given economic bid will be *effective* or *ineffective* with respect to a particular constraint in the optimization, based on the bid's relative contribution to relieving that constraint when it is binding. But as ephemeral as this may sound, it is important to keep in mind that the rules and procedures governing *adjustment of non-priced quantities* are completely objective, transparent, subject to empirical analysis and verifiable, even though the properties of effectiveness and ineffectiveness depend on the context and are not absolute, inherent qualities of specific economic bids.

2. Setting the scheduling parameter for relaxation of internal transmission constraints to $5000 per MWh in the IFM and RTM, and to $1250 in the RUC.

Q. Please explain the ratonale for this CAISO proposal.

A. Recall from the example I discussed a moment ago this scheduling parameter instructs the software when to relax the internal transmission constraint rather than continue re-dispatching resources to relieve congestion. The values were picked initially based on balancing two completing objectives, and then were tested and validated through market simulation cases as well as some specially contrived test cases to see how they perform under a broad variety of conditions. The two competing objectives are to set the parameter (1) high enough to avoid overuse of constraint relaxation in the markets, since a guiding principle of the MRTU market design is to produce feasible day-ahead schedules and real-time dispatch instructions, and (2) low enough to avoid accepting the kind of extreme scheduling outcomes I mentioned earlier, where a large volume of re-dispatch from ineffective resources is used to obtain a small amount of congestion relief on a geographically distant constraint.

Q. Is there specific justification for the $5000 value?

A. One can think of the $5000 value intuitively as the cost of obtaining one MWh of additional energy from a resource that is bidding at the bid cap and is 10 percent effective in relieving the given constraint. Because the resource is 10 percent effective, it takes 10 MWh of energy from the resource to change the flow on the

constraint by one MW for the hour, thus the cost of one MWh of congestion relief is the cost of 10 MWh of energy or $5000.

But this too can be interpreted incorrectly. Some stakeholders have referred to this 10 percent reference as a lower bound on the effectiveness of resources that would be acceptable by the software to relieve a constraint. But it really is not so. The software could accept a $200 bid from a resource that is only five percent effective, accepting 20 MWh at a cost of $4000 to obtain one MWh of congestion relief. Alternatively the software could accept a self-schedule adjustment that has a scheduling parameter of $1000 and is 25 percent effective, accepting four MWh at a cost to the objective function of $4000 to obtain one MWh of congestion relief. Thus the 10 percent figure of my intuitive explanation is neither an upper bound nor a lower bound on effectiveness.

The true validation of the $5000 value is based on empirical analysis of two different types. First, the value has been in use in the MRTU market simulation software for the last six months, where it has been observed to result in a reasonable and appropriate balance between the objectives I mentioned earlier, i.e., to avoid overuse of constraint relaxation, while also avoiding extremely large re-dispatch quantities to achieve small quantities of congestion relief. Second, we have created several test cases featuring extreme grid conditions such as multiple transmission line derates in an area where there are high-priority self-schedules under existing transmission rights, and have found that the software appropriately protects the self-schedules and relaxes the binding constraints. Thus we have

confidence that the $5000 value on internal transmission constraints is set at the right level for the IFM and the RTM.

Q. Please explain the proposed $1250 value for transmission constraints in RUC.

A. Like the corresponding parameter used in the IFM and RTM, this parameter in the RUC provides a threshold for the software to relax an internal transmission constraint rather than continue to re-dispatch resources to relieve congestion. The proposed value again has been validated through the analysis of market simulation cases as well as specially contrived test cases and has proved to be workable. Intuitively, we would expect the value for RUC to be lower than that for IFM and RTM because the economic bid prices are substantially lower. First of all, the bid cap on RUC availability bids is $250. Second, Resource Adequacy (RA) capacity is required to offer RUC capacity at a zero-price availability bid, and we have found in market simulation that RA capacity typically dominates the RUC procurement, providing in the area of 90 percent or higher except in those cases where there is a very large gap between the RUC procurement target based on the CAISO's load forecast and the final IFM load schedule. Thus $1250 has been demonstrated empirically to be an appropriate level for the RUC.

3. Using the energy bid cap as the pricing parameter when there is shortage of supply in the RTM.

Q. Please describe the CAISO's proposal regarding the parameter for real-time energy pricing in a shortage situation.

A. Going back to one of the principles I mentioned earlier, the MRTU market design is structured to provide consistency between market time frames, day-ahead and real-time, of the mechanisms for price determination. In applying this principle to energy shortage situations, there is an important difference between the IFM and the RTM in terms of the role of demand in each market. In the IFM, when available supply is insufficient to meet all self-scheduled demand, that self-scheduled demand can be reduced to a level where supply is sufficient. In the RTM, however, demand is physical and real – it is based on the very short-term forecasts calculated from telemetry and state estimator. Apart from issuing dispatches to participating loads, there is no reduction of demand in the RTM unless and until the system enters staged emergency conditions.

Given this important difference, we still want to have consistent pricing mechanisms between the IFM and the RTM, to ensure that the market design does not introduce systematic price disparities between the two markets. In the IFM when self-scheduled load is curtailed, for pricing purposes that load is deemed to be willing to pay the energy bid cap. Clearly, if the load was not willing to pay at least the energy bid cap, the scheduling coordinator for the load could have submitted an economic bid at a lower value, so the fact that the load was submitted as a price taker Self-Schedule means that it did not want to be curtailed at any price lower than the energy bid cap. To preserve the consistency in pricing mechanisms between the IFM and the RTM, then, we want a mechanism that inserts the energy bid cap as the pricing parameter when supply is short in the RTM.

Q. You said that apart from dispatching participating load, load in real time cannot be reduced until the CAISO enters emergency conditions. Assuming all available participating load has been dispatched, what does the RTM do to reach a feasible solution when supply is still short?

A. The RTM itself will not reduce firm load; curtailing load is managed by the operators under emergency conditions. Nevertheless, there are conditions short of curtailing firm load in which energy offers in the RTM are not sufficient to meet the load forecast, but actual demand can by met by the operators through other measures such as dispatching energy from some contingency-only operating reserves or, for small, short-lived load fluctuations that cannot be met by energy bids in the RTM, relying on available regulating reserves to equalize supply and demand. In these cases, the use of these other measures is signaled by the software in the form of an adjustment to the supply-demand balance constraint – in technical terms, a positive slack variable on that constraint – which then affects RTM prices in accordance with the setting of the pricing parameter on that slack variable.

Q. What exactly is the CAISO's proposal at this time, and what change to the MRTU tariff is required to implement the proposal?

A. The supply shortfall situation in the RTM is analogous to reducing self-scheduled price-taker demand in the IFM. Therefore, to preserve the principle of consistency of pricing mechanisms between the IFM and the RTM, the CAISO

proposes to set the pricing parameter on the RTM energy-balance slack variable at the energy bid cap, i.e., $500 for the first year of MRTU and escalating in the next two years in step with the energy bid cap. The current MRTU tariff does not address this pricing mechanism, and the CAISO believes it is appropriate to incorporate this in the tariff because, as explained above, this parameter will have a direct impact on LMPs.

Q. Is there another aspect of consistency that this proposal addresses?

A. Yes. It has to do with one of the options I just mentioned that is available to operators to deal with real-time supply shortages, which is to utilize some contingency-only operating reserves to provide energy. In general contingency-only reserves are intended to be used for contingency conditions, such as the unexpected outage of a transmission or generation facility. Nevertheless, the MRTU tariff does provide for operators to use these reserves when there is an energy shortfall but no system contingency. The important difference, however, is that when the reserves are used for a contingency the RTM dispatch uses their submitted energy bids, whereas when they are used for a supply shortage when there is no contingency, the software inserts energy bids at the bid cap to reflect the supply shortage. This is the mechanism the CAISO called *limited scarcity pricing of energy* in the original MRTU tariff filing. The use of this mechanism is a matter of operator discretion, however, which they will decide based on current or anticipated system conditions. Thus there is a potential for inconsistency of the pricing mechanism between situations where the operators utilize contingency-

only reserves with bid-cap energy bids, versus situations where they do not utilize these reserves, unless we use the energy bid cap as the pricing parameter on the energy balance constraint as the CAISO is proposing. The CAISO believes that the pricing of energy should not vary significantly depending on whether or not the operators take this discretionary decision, and using the energy bid cap as the pricing parameter will minimize the potential for such variation.

Q. Does this pricing parameter effectively place a cap on RTM prices in these shortage situations?

A. No it does not. It is important to understand that setting this pricing parameter to the energy bid cap does not prevent real-time energy prices, individual LMPs, from rising above the bid cap. To the contrary, what this pricing parameter will do is ensure that the system-wide energy price (that is, the load-weighted average of all LMPs for that time interval across the CAISO grid, which is also the constant energy component of the individual LMPs) will be at least as high as the energy bid cap, thus reflecting the supply shortfall condition. Thus the CAISO's proposal is fully consistent with the *limited scarcity pricing of energy* I discussed above, which kicks in when the operators utilize contingency-only reserves to meet a supply shortfall.

4. Using the applicable bid caps as the pricing parameters when a transmission constraint is relaxed in the IFM, the RUC or the RTM.

Q. What pricing parameters is the CAISO proposing when a transmission constraint is relaxed in the IFM, the RTM, and the RUC?

A. The CAISO proposes to use the energy bid cap as the pricing parameter for the IFM and RTM when a transmission constraint is relaxed, and the RUC availability bid cap when a transmission constraint is relaxed in the RUC. These pricing parameter values would change as these caps change over time.

Q. You explained the rationale for using $5000 as the scheduling parameter for transmission constraint relaxation in the IFM and RTM, and $1250 in RUC. Section 31.3.1.3 of the original MRTU tariff, which describes the procedure for mitigating excessive reductions of Default LAP demand in the IFM due to a local transmission constraint, says that the CAISO will use three times the energy bid cap as the pricing parameter when a transmission constraint is relaxed. Please explain why the CAISO is proposing to use these much lower values as the pricing parameters.

A. The CAISO used three times the energy bid cap, $1500, as the starting setting for the IFM and RTM pricing parameter in the market simulation. After discussing these proposals with stakeholders over the past several months and observing the performance of the $1500 value in market simulation, we decided to change it for several reasons. First, the energy bid cap is more consistent with the other pricing parameter proposals in this filing which follow the principle, articulated earlier in this testimony, of utilizing the Commission-approved bid caps for pricing purposes when a non-priced quantity is relaxed in the scheduling run.

Second, using the energy bid cap as the pricing parameter for transmission constraints in the RTM is needed for consistency with the pricing parameter used

with shortage of supply, which is also the energy bid cap. As I explained earlier, in the RTM, the load for the most part is fixed by the forecast and cannot be reduced in response to prices. Instead, the RTM will signal a shortage through relaxation of the energy balance constraint, and the CAISO operators will determine whether to utilize contingency-only reserves or take some other action. Before it gets to that point, however, in tight supply conditions the RTM software will use all available supply to meet the load forecast and avoid relaxing the energy balance constraint, even if that means relaxing transmission constraints for one or more five-minute intervals to allow more energy to be provided. If the pricing parameter for any relaxed transmission constraints is set to a higher level than the pricing parameter for supply-demand balance, the transmission constraint parameter could become the dominant factor in affecting real-time energy prices, instead of allowing the energy-balance parameter at the energy bid cap to play that role. But in such cases the relaxation of any transmission constraints was actually driven by the overall shortfall in energy supply, so the pricing parameter on the energy balance constraint should be the more influential factor influencing price determination. Given the importance of this consideration in the RTM, which implies that we should use the energy bid cap as the pricing parameter for relaxed transmission constraints in the RTM, the principle of consistency across market time frames implies that we should use the same value in the IFM.

Third, there is the principle I discussed above to strike a reasonable balance between allowing meaningful price signals to come through while avoiding administrative pricing mechanisms that may cause extreme price

impacts on the markets. As I said, with this entire set of proposals the CAISO is trying to strike the proper balance by utilizing the applicable bid caps as the pricing parameters.

And finally I reemphasize the important point that the scheduling parameters are not intended to have accurate economic meaning. Their main purpose is operational. The parameter values are a device to enable the software to utilize scheduling and dispatch options, including constraint relaxation, in a manner that reflects prudent system operation, comparable to how operators would operate the grid, when the optimization searches for a feasible solution under difficult system conditions. As such there is nothing inherently or objectively true or correct about the prices they result in.

Q. How will these pricing parameters work in practice and what impact will they have on prices?

A. For clarity sake let me talk about this with reference to the $5000 scheduling parameter in the IFM or RTM; the principles remain the same in the RUC. There are a few basic points to understand: (1) the parameter in question, whether it is the scheduling parameter or the pricing parameter, directly affects the shadow price of the constraint in the associated market run; (2) unless the transmission constraint is radial (i.e., not linked to multiple nodes as are almost all lines in a network), the shadow price of a transmission constraint does not imply a congestion cost differential of the same value on either side of the constraint; e.g., a $5000 shadow price does not mean that LMPs at either end of the constraint will

differ by $5000, unless the constraint is radial; and (3) the pricing parameters the CAISO is proposing set a lower bound – not an upper bound – on the shadow price for pricing purposes.

I'll start by explaining point (3). Earlier I described how the $5000 value works as a threshold for the software to decide whether to accept one more MWh of congestion relief or to relax the congested constraint. In my numerical example above there was a rising sequence of re-dispatch costs per MWh, with the last accepted MWh of re-dispatch costing $4600. In this example the $4600 value represents what we call the *last economic signal* before the constraint was relaxed. It is the cost of the last MWh of re-dispatch that was accepted by the optimization before it decided to relax the constraint. What the pricing parameter does in the pricing run is to cause the shadow price of the relaxed constraint to rise to the maximum of the pricing parameter and the last economic re-dispatch signal. In this example the shadow price would be $4600, and the $500 pricing parameter would have no effect. Alternatively, if the last MWh of re-dispatch accepted by the market cost less than $500, the shadow price of the constraint would be $500 in the pricing run.

Regarding point (1), in relatively non-technical terms the shadow price of the constraint is the amount of reduction in the value of the objective function that could be achieved if the flow limit of the constraint were one MW higher. Recall that the objective function is the total bid cost of the market solution, which the market tries to minimize. In my numerical example, suppose that by accepting the $4600 MWh of re-dispatch, the market completely relieved the constraint.

Then we would see that if the flow limit were one MW higher we would have avoided the $4600 cost, so the shadow price would be $4600. Alternatively, if that $4600 MWh was not enough to relieve the constraint and the constraint is relaxed, the market sees a $5000 cost for each MW by which the flow limit is relaxed. Thus each additional MW of additional capacity on the line would translate to a $5000 saving, so that the shadow price would be $5000.

Finally, point (2) addresses how constraint shadow prices affect LMPs. If the constraint is a radial line, then the shadow price translates to the congestion cost differential across the line. But in a network, the LMP at each network node is affected by the shadow price of a constraint times the shift factor of that node with respect to the constraint. Shift factors quantify the portion of each MWh of energy injected at a node that will flow over each line connected to the node. Thus if the shadow price on a constraint is $4600 and the shift factor of a given node on that constraint is five percent, then the constraint will contribute $230 to the congestion component of the LMP at the node. Ultimately the congestion component of the LMP at a node is the sum over the entire network of these products of shift factor times shadow price, some of which may be positive and some negative.

Q. What will be the effect on prices of reducing the pricing parameter from $1500 as stated in the original MRTU tariff to $500 as the CAISO now proposes?

A. I expect the effect to be minimal, based on my earlier explanation that the pricing parameter will drive the shadow price of the constraint to the maximum of the *last economic re-dispatch signal* or the pricing parameter. With a pricing parameter of $1500, whenever the last economic re-dispatch signal is less than $1500 the shadow price will be set to $1500. With a pricing parameter of $500, whenever the last economic re-dispatch signal is less than $1500 but more than $500 it will be allowed to stand as the shadow price. But there is a lot of range for potential re-dispatch costs between $1500 and the $5000 scheduling parameter, and in practice I expect that the last economic re-dispatch signal will be greater than $1500 far more often than it will be less, in which case the choice of $500 as the pricing parameter rather than $1500 would have little impact.

Q. Does setting the pricing parameter at $500 have any drawbacks when compared to the original $1,500 level?

A. As I said above, I don't expect the change from $1500 to $500 to make very much difference to the resulting prices. In earlier CAISO issue papers on this topic, and in public discussion with the Market Surveillance Committee, we described some observations in market simulation where LMPs in the area of a constraint turned out to be lower when the constraint was relaxed than they were if congestion was relieved through re-dispatch without relaxing the constraint. Intuitively this seems like the economic signals are inverted, since it is a more severe situation to have to relax a transmission constraint than to relieve that constraint through re-dispatch of resources, albeit costly re-dispatch. Upon further examination we

recognized that the observed outcome was indeed an effect of using a pricing parameter that is significantly lower than the scheduling parameter value. But, given that fact, there was no real difference between using $500 versus $1500 as the pricing parameter since both values are enough below $5000 to produce the observed results. These findings are consistent with my explanation above of how the pricing parameter works in relation to the last economic re-dispatch cost signal, and also with my earlier explanation that prices created in the scheduling run based on scheduling parameters will tend to be less extreme than the prices created in the pricing run based on pricing parameters. Indeed, the whole point of having a separate pricing run to calculate settlement prices, as I explained, is because we need to use more extreme parameter values in the scheduling run to enforce the required hierarchy among non-priced quantities, but such parameters are not appropriate for setting settlement prices. So the answer to your original question is no.

Q. Has the Market Surveillance Committee issued an opinion on this parameter choice?

A. Yes. In its comments on the CAISO's proposals on *adjustment of non-priced quantities*, the MSC supported this proposal on the transmission constraint pricing parameter while recognizing the possibility of lowered LMPs as a result. The MSC recommended that the CAISO monitor market outcomes for this phenomenon and "be prepared to raise this penalty price" if this concern

materializes. The CAISO is incorporating this item into its program of potential market issues to monitor.

5. <u>Using the Ancillary Services bid cap as the pricing parameter when there is insufficient supply to meet an Ancillary Services requirement</u>.

Q. Please explain this CAISO proposal.

A. Currently the MRTU tariff provides a lot of detail on how Ancillary Services prices are determined in general, but does not address how they are determined when there is not sufficient supply to meet any particular Ancillary Services procurement requirement. For such situations at MRTU start-up it is important to have a mechanism that allows the price of a deficient service to reflect the deficiency, while providing for a logical progression to the new reserve scarcity pricing mechanism to be implemented within a year after start-up. (This reserve scarcity pricing proposal is still being finalized and has not yet been filed with the Commission.) For MRTU start-up the CAISO proposes to use the $250 Ancillary Services bid cap as the pricing parameter associated with an Ancillary Services procurement requirement that has to be relaxed in the scheduling run of the IFM or the RTM. This value is consistent with the principle I articulated earlier in this testimony of using applicable bid caps as pricing parameters when non-priced quantities are adjusted to reach a feasible market solution.

Q. Please explain how this parameter will work in practice.

A. When there is a shortfall of a particular Ancillary Service in a particular region such that the procurement requirement cannot fully be met in either the IFM or

the RTM, the procurement requirement will be relaxed. Then in the pricing run the proposed $250 pricing parameter will set a minimum value on the marginal price of the deficient Ancillary Service. The bid cap as the pricing parameter is a lower bound on the marginal price, rather than a cap, because of the way Ancillary Services prices are calculated as described in the current MRTU tariff. Under the co-optimization of energy and Ancillary Services in the MRTU markets, Ancillary Services prices reflect the opportunity cost or lost revenue that a resource foregoes by providing unloaded Ancillary Service capacity instead of being scheduled or dispatched for energy, in addition to the submitted bids for Ancillary Services capacity, which are capped at $250. Thus an accepted Ancillary Services bid can cost the market more than the bid cap, which means in turn that the economic value to the objective function of a one MW-hour reduction in a binding Ancillary Service procurement requirement could also be greater than the bid cap. The $250 pricing parameter simply ensures that the marginal price of the deficient Ancillary Service will not be less than $250.

Q. Has the Market Surveillance Committee expressed an opinion about this?

A. Yes. As pointed out by the Market Surveillance Committee,[1] this approach will provide less incentive and less opportunity for suppliers with potential Ancillary Service market power to try to inflate Ancillary Service prices in the IFM. By ensuring that the shadow price for a binding Ancillary Service requirement rises

[1] See "Comments on 'Uneconomic Adjustment in the MRTU Market Optimizations'" by the Market Surveillance Committee of the California ISO, October 8, 2008.

to at least the bid cap, suppliers of Ancillary Services are incentivized to bid as competitively as possible to be selected, while being assured that they will not miss out on a price reflective of shortage conditions should that occur.

Q. Was that the extent of the MSC's recommendation on this matter?

A. No. The MSC recommended additionally that the CAISO seek to lower the Ancillary Services bid cap to $150 instead of $250, if the CAISO had any further concern about potential exercise of market power in the ancillary services markets. The CAISO did not adopt this element of the MSC's recommendation, mainly because the CAISO had previously proposed a lower bid cap for Ancillary Services which the Commission rejected, and since no new evidence has emerged to indicate increased market power concerns in the Ancillary Services markets. During 2005, when the CAISO conducted the last major phase of market design stakeholder processes prior to filing the MRTU tariff, the subject of market power in the Ancillary Services markets was thoroughly discussed and the prevailing view, which the CAISO shared and adopted, was that the Ancillary Services markets are expected to be competitive as long as the CAISO does not set procurement requirements at any finer geographic granularity than the major north-south division of the CAISO system around Path 15 or Path 26. The CAISO agreed at that time that this issue would be revisited whenever greater procurement granularity is being considered.

6. Protecting the self-schedules of the holders of Transmission Ownership Rights, Existing Transmission Contracts and Converted Rights from reduction in the IFM by setting their scheduling parameters above the parameter for internal transmission constraint relaxation.

Q. Please explain the motivation for this CAISO proposal.

A. This was a topic of much discussion among the stakeholders, initiated by the holders of existing rights which include transmission ownership rights (TOR), existing transmission contracts (ETC), and converted rights (CVR). The rights holders were concerned that the CAISO's policies on *adjustment of non-priced quantities* would result in (1) curtailments of their submitted self-schedules to an extent or with a frequency that would degrade the firmness of their existing rights, and (2) unwarranted exposure to CAISO settlement charges in the event that their IFM self-schedules were reduced in an unbalanced manner. In the course of the stakeholder process several alternatives were explored, including some suggested by the existing rights parties. These alternatives addressed both enhancement of the scheduling priority of existing rights in the IFM, as well as financial offsets to be applied in the event an existing rights self-schedule is exposed to congestion and other charges due to an unbalanced adjustment in the IFM. After carefully assessing the options the CAISO settled on the current proposal as the most direct and simplest way to address the concerns. The current proposal deals with the IFM scheduling priority concern so effectively that there is no further need to provide a financial offset, because the financial exposure identified will not occur.

Q. How will the CAISO's proposal work in practice?

A. In the IFM the CAISO will set the scheduling parameters associated with existing rights Self-Schedules to be higher than the scheduling parameter associated with internal transmission constraint relaxation, i.e., above $5000. The proposal will preserve the priority sequence of tariff section 31.4, so that TOR will have the highest priority among the existing rights, while ETC and CVR have a common priority level below that of TOR, with additional capability in the software to set different parameter values for different ETCs if their rights as communicated to the CAISO via the Transmission Reservation and Transmission Curtailment (TRTC) instructions warrant such differentiation. What this means in practice is that when there is a binding transmission constraint near the location of a supply or load resource that is Self-Scheduled under an existing right, the IFM software will relax the transmission constraint rather than curtail the existing right Self-Schedule. This simple proposal will ensure the firmness of existing rights Self-Schedules in the IFM, and will obviate the need for any financial offsets for day-ahead schedule reductions because the existing rights holders' valid day-ahead Self-Schedules will not be reduced under the *adjustment of non-priced quantities* procedures.

Q. It sounds like this proposal will mean that internal transmission constraints may be relaxed more frequently in the IFM due to the unavailability of existing rights self-schedules for adjustment to relieve congestion. Does this present any operational concerns?

A. No. First of all, it is important to realize that transmission congestion situations in the IFM involving the existing rights are expected to be quite rare. The special test cases we created to investigate the impacts of *adjustment of non-priced quantities* on existing rights self-schedules have demonstrated that they are not curtailed under normal grid and market conditions, even using the scheduling parameters the CAISO originally proposed in the range from $3200 to $4500 (i.e., below the $5000 transmission constraint relaxation parameter). In order to obtain curtailment of existing rights self-schedules in our test cases, we had to either increase the amounts of the self-schedules to substantially exceed the MW value of their rights, or derate multiple transmission lines in the local area of the existing rights loads and supply resources. The latter contrived cases were so severe that, should they occur in practice, the operators would be scrambling to manage a major local contingency.

Second, while it is true that the current proposal may result in more relaxation of transmission constraints than would otherwise occur if the existing rights self-schedules were available for adjustment, the CAISO operators will promptly be alerted to all instances of constraint relaxation in the IFM, including the magnitude and time duration of such relaxation, so that they may decide what if any action they may need to take to deal with the situation. CAISO operators contributed to the development of the current proposal and are fully comfortable with it. The point to realize is that today any real-time actions to curtail the use of existing rights is managed by the operators in coordination with the rights holders

and/or the relevant Participating Transmission Owners anyway, so this proposal does not in any way increase the burden on them relative today.

7. Revisions to Section 31.3.1.3 on the Provisions to Prevent Severe Curtailment of Default LAP Demand in the IFM Due to a Congested Non-competitive Transmission Constraint

Q. Please provide some background on Section 31.3.1.3.

A. Section 31.3.1.3 was included in the CAISO's original February 2006 filing of the MRTU tariff to address a concern arising from the way demand bid at a Default LAP is treated in the IFM. When demand located at one of the large Default LAPs bids into the IFM, either with an economic bid or a self-schedule, the market software represents this demand as having a fixed distribution over the various load nodes comprising the Default LAP, using pre-calculated numerical values called load distribution factors. Then, if the demand is reduced in the market clearing process, it is reduced at each of the constituent nodes in the same fixed proportions. This aspect of clearing Default LAP demand is necessary to ensure economically consistent and operationally sound market outcomes. If the market software did not force the Default LAP demand to move down according to the fixed load distribution factors – if instead the software just saw individual demand curves at each of the nodes, all having the same price structure that was submitted with the Default LAP demand bids, and could adjust the nodal demand bids independently – then the results would be problematic from both an economic and an operational perspective. In areas where LMPs are higher, less demand would be cleared, while in areas where the LMPs are lower, more

demand would be cleared. When the market then sums up the quantities and the quantity-weighted prices over all the nodes, the resulting aggregated price and quantity will invariably not be a point on the Default LAP demand curve because that curve was predicated on the original load distribution factors. What this means is that some Default LAP load may be scheduled at a price higher than what it was willing to pay, or conversely, some Default LAP load that was willing to pay the resulting price was not scheduled. That is the inconsistent economic outcome.

To see the inconsistent operational outcome, note that the load distribution factors are calculated to reflect the expected actual distribution of real-time load on the CAISO grid. If the IFM schedules a lower quantity of load in high LMP areas and a higher quantity of load in low LMP areas, then the IFM will commit too few resources in the high LMP areas – typically congested load pockets, and will commit too many resources in the low LMP areas. Thus there will be systematic skewing of the IFM unit commitment. To avoid these problems the IFM was structured to hold the load distribution factors fixed in clearing Default LAP demand bids.

Unfortunately this solution of the problems just described has an unintended consequence that the CAISO has previously articulated to the Commission. If there is a congested transmission constraint that is internal to the Default LAP area that cannot be relieved through re-dispatch of supply resources, the IFM software will have to reduce demand across the entire Default LAP to relieve the constraint. This could mean reducing many MWh of Default LAP

demand in order to obtain a few MW of congestion reduction. To address this concern the CAISO included Section 31.3.1.3 which provided some steps the IFM would follow to prevent severe reductions in Default LAP demand. These provisions addressed one particular situation that would give rise to *adjustments of non-priced quantities*, in this case the use of self-provided Ancillary Services to provide energy within the constrained area (referred to as Step 1 in the original tariff), relaxation of the constraint (Step 2), and possibly local relaxation of the load distribution factors (Step 3).

Q. What changes to Section 31.3.1.3 is the CAISO now proposing?

A. There are two changes that affect the overall design of the procedure described in Section 31.3.1.3, and some additional changes to the provisions for relaxation of the congested transmission constraint to be consistent with the other provisions on constraint relaxation discussed above.

First, the original tariff language says that the procedure will be performed within the pre-IFM component of the day-ahead market software. But this was written at a point in the software development process when it appeared that the pre-IFM offered the only way to implement these steps. Later in the process of developing the software the CAISO discovered a way to integrate the procedure directly into the IFM, which was immediately thought to be superior by virtue of being an integral part of the IFM optimization. Because we did not see the use of the pre-IFM as essential to the intent of the policy, and because integration within

the IFM optimization was clearly a superior approach, the CAISO embarked on this direction, and now needs to modify the tariff to reflect this change.

Second, the original Section 31.3.1.3 specifies a third step of the process, namely, relaxation of load distribution factors to allow load to be adjusted locally to relieve the constraint. Given my explanation above of why it is important to keep the factors fixed in clearing the market, this step was much less desirable than the first two steps and was added to the procedure only as a last resort. In the software development process, CAISO staff explored various ways to implement this step and found all options to be difficult and frought with unintended side-effects. Given the expected effectiveness of the first two steps, the CAISO felt that expending further effort on finding an acceptable way to implement the third step would not be warranted by the relatively small expected benefit, so this step was dropped. Again, the tariff needs to be modified to reflect this change.

With regard to the relaxation of the transmission constraint (Step 2), the proposed new tariff language mainly adopts the provisions discussed above for the $5000 scheduling parameter and the energy bid cap pricing parameter. The reasons for using these values are no different from the reasons explained above for their use in general with regard to relaxation of transmission constraints. In addition, the revised tariff language drops some of the original language that tried to define operational considerations as to which transmission constraints would be acceptable candidates for relaxation, again based on the evolution of the market software development process. Such distinctions as the original language tried to describe would be too dependent on prevailing market conditions to be specifiable

through fixed parameter settings. Moreover, the CAISO operators will receive full information regarding any transmission constraints relaxed in the market clearing process and will have the opportunity to take any actions they deem necessary for reliability purposes, so this provision was determined to be unnecessary.

Finally, the revised section drops the idea of a sequence of discrete steps. In reality the procedure works through the priorities established by the settings of the scheduling parameters described earlier, which the software sees and acts on simultaneously in the optimization process, not as a temporal sequence of steps.

Q. Did stakeholders raise any concerns about these changes to Section 31.3.1.3?

A. Most recently, the draft tariff language the CAISO posted indicated that the CAISO was proposing to drop an aspect of the dispatch of energy from self-provided Ancillary Services, which originally said that this provision would utilize only capacity that was under an obligation to offer energy to the CAISO markets by virtue of its Resource Adequacy or Reliability Must Run status. Some stakeholders were concerned that the procedure would utilize capacity that did not have an obligation to offer energy, and therefore should not have its self-provision of Ancillary Services disqualified to allow the IFM to access its energy. This concern was raised during the stakeholder conference call the CAISO held to review the draft tariff language. Only later did we realize that the proposed tariff language on this matter was in error because we had overlooked another tariff provision (Section 8.6.2) that had previously been approved and provided a clear

mechanism for such capacity to protect its Ancillary Services self-provision by not submitting associated energy bids in the IFM. The tariff language submitted with the instant filing incorporates an appropriate reference in Section 31.3.1.3 and therefore addresses this stakeholder concern.

Q. With these changes to Section 31.3.1.3 do you believe that the CAISO has fulfilled its outstanding compliance requirement?

A. Not through the Section 31.3.1.3 changes alone. But, in combination with the other tariff provisions discussed above, including a new tariff section that describes the process of adjusting non-priced quantities and setting the corresponding prices, plus the explanations in this testimony which address the questions raised by the parties in the earlier Commission proceedings on this topic, I believe the CAISO has fulfilled its outstanding compliance requirement.

Q. Does this conclude your testimony?

A. Yes it does.

Attachment A – Clean Sheets

Uneconomic Adjustment/Pricing and Scheduling Parameters

4th Replacement Tariff (MRTU)

November 4, 2008

11.10.1.1 Ancillary Services in DAM.

Payments to Scheduling Coordinators with AS Awards shall be equal to the ASMP calculated as provided in Section 27.1.2 for each Ancillary Service multiplied by the quantity of the capacity awarded for the Ancillary Service in each of the Ancillary Service Regions. Suppliers with Self-Provided Ancillary Services are not eligible to receive payment for Ancillary Service Awards based on ASMPs; Self-Provided Ancillary Services are compensated at the user rate for the service being self-provided as described in Section 11.10.2, 11.10.3 and 11.10.4.

11.10.1.2.1 Congestion Charges for HASP Intertie Ancillary Service Awards.

Suppliers of HASP Ancillary Services Awards at Scheduling Points are also charged for Congestion if the Ancillary Service Award is at a congested Scheduling Point. The charge shall be equal to the simple average of the 15 minute Shadow Price of the applicable congested Scheduling Point multiplied by the quantity of the Ancillary Service Award for the Settlement Period.

11.10.1.3 Ancillary Services Provided in Real-Time.

Suppliers of Ancillary Services from resources awarded in RTUC are paid a price equal to ¼ of the fifteen (15) minute ASMP (in $/MW/h) in each fifteen (15) minute interval for the each Ancillary Service times the amount of the capacity awarded (MW) for the Ancillary Service in the relevant Ancillary Services Region. For each Ancillary Service, the ASMP is calculated as set forth in Section 27.1.2. Suppliers that self-provide Ancillary Services in the Real-Time Market are not eligible to receive payment using the ASMP; rather to extent the self-provision is qualified it will be valued at the user rate for the relevant service (i.e., will either reduce the Ancillary Services Obligation or receive the user rate if it exceeds the Scheduling Coordinator's Ancillary Service Obligation) as described in Section 11.10.2, 11.10.3 and 11.10.4.

11.10.1.3.1 Congestion Charges for Real-Time Intertie Ancillary Service Awards from Dynamic System Resources.

For each Settlement Period, the Congestion Charge for Suppliers of Real-Time Ancillary Services Awards at Scheduling Points for Dynamic System Resources shall be equal to the simple average of the fifteen (15) minute Shadow Prices at the applicable Scheduling Point multiplied by the quantity of the Ancillary Service Award for the Settlement Period.

ARTICLE III – MARKET OPERATIONS

27 CAISO MARKETS AND PROCESSES.

In the Day-Ahead and Real-Time time frames the CAISO operates a series of procedures and markets that together comprise the CAISO Markets Processes. In the Day-Ahead time frame, the CAISO conducts the MPM-RRD, an Integrated Forward Market (IFM) and the Residual Unit Commitment (RUC) process. In the Real-Time time frame, the CAISO conducts the Market Power Mitigation and Reliability Requirement Determination, the Hour-Ahead Scheduling Process (HASP), the Short-Term Unit Commitment (STUC), the Real-Time Unit Commitment (RTUC) and the five-minute Real-Time Dispatch (RTD). The CAISO Markets Processes utilize transmission and Security Constrained Unit Commitment and dispatch algorithms in conjunction with a Full Network Model to optimally commit, schedule and Dispatch resources and determine marginal prices for Energy, Ancillary Services and RUC Capacity. Congestion Revenue Rights are available and entitle holders of such instruments to a stream of hourly payments or charges associated with revenue the CAISO collects or pays from the Marginal Cost of Congestion component of hourly Day-Ahead LMPs. Through the operation of the CAISO Markets Processes the CAISO develops Day-Ahead Schedules, Day-Ahead AS Awards and RUC Schedules, HASP Advisory Schedules, HASP Intertie Schedules and AS Awards, Real-Time AS Awards and Dispatch Instructions to ensure that sufficient supply resources are available in Real-Time to balance Supply and Demand and operate in accordance with Reliability Criteria.

27.1 Locational Marginal Prices and Ancillary Services Marginal Prices.

The CAISO Markets are based on: 1) Locational Marginal Prices as provided below in Section 27.1.1 and further provided in Appendix C; and 2) Ancillary Services Marginal Prices as provided below in Section 27.1.2.

27.1.1 Locational Marginal Prices for Energy.

The LMP for Energy at any PNode is the marginal cost of serving the next increment of Demand at that PNode consistent with existing transmission facility Constraints and the performance characteristics of resources. The LMPs calculated in the IFM, the HASP for Scheduling Points, and the RTD are based on

shall assess the cost of Transmission Losses to Scheduling Coordinators using each such facility based on the quantity of losses agreed upon with the neighboring Balancing Authority multiplied by the LMP at the PNode of the Transmission Interface with the neighboring Balancing Authority Area. The MCLs calculated for Locations within the CAISO Balancing Authority Area shall not reflect the cost of Transmission Losses on those facilities.

27.1.1.3 Marginal Cost of Congestion.

The Marginal Cost of Congestion at a PNode reflects a linear combination of the Shadow Prices of all binding Constraints in the network, each multiplied by the corresponding Power Transfer Distribution Factor (PTDF). The Marginal Cost of Congestion may be positive or negative depending on whether a power injection (i.e., incremental Load increase) at that Location marginally increases or decreases Congestion.

27.1.2 Ancillary Service Prices.

27.1.2.1 Ancillary Service Marginal Prices.

As provided in Section 8.3, Ancillary Services are procured and awarded through the IFM and the Real-Time Market. The IFM calculates hourly Day-Ahead Ancillary Service Awards and establishes Ancillary Service Marginal Prices (ASMPs) for the accepted Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserve Bids. The IFM co-optimizes Energy and Ancillary Services subject to resource, network and regional constraints. In the Real-Time Market, the RTUC process that is performed every fifteen (15) minutes establishes fifteen (15) minute Ancillary Service Schedules, Awards, and prices for the upcoming quarter of the given Trading Hour. ASMPs are determined by first calculating the Ancillary Services shadow prices for each Ancillary Service type and the applicable Ancillary Services Regions. The Ancillary Services shadow prices are produced as a result of the co-optimization of Energy and Ancillary Services for each Ancillary Service Region through the IFM and the Real-Time Market, subject to resource, network, and requirements constraints. The Ancillary Services shadow prices

represent the cost sensitivity of the relevant binding regional constraint at the optimal solution, or the marginal reduction of the combined Energy and Ancillary Service procurement cost associated with a marginal relaxation of that constraint. If the regional constraint is not binding for an Ancillary Services Region, then the corresponding Ancillary Services shadow price in the Ancillary Services Region is zero. The ASMP for a particular Ancillary Service type and Ancillary Services Region is then the sum of the Ancillary Services shadow prices for the specific type of Ancillary Service and all the other types of Ancillary Services for which the subject Ancillary Service can substitute, as described in Section 8.2.3.5, and for the given Ancillary Service Region and all the other Ancillary Service Regions that include that given Ancillary Service Region.

27.1.2.2 Opportunity Cost in Ancillary Services Marginal Prices.

The Ancillary Services shadow price, which as described above, is a result of the Energy and Ancillary Service co-optimization, includes the forgone opportunity cost of the marginal resource, if any, for not providing Energy or other types of Ancillary Services the marginal resource is capable of providing in the relevant market. The ASMPs determined by the IFM or RTUC optimization process for each resource whose Ancillary Service Bid is accepted will be no lower than the sum of (i) the Ancillary Service capacity Bid price submitted for that resource, and (ii) the foregone opportunity cost of Energy in the IFM or RTUC for that resource. The foregone opportunity cost of Energy is measured as the positive difference between the IFM or RTUC LMP at the resource's Pricing Node and the resource's Energy Bid price. If the resource's Energy Bid price is higher than the LMP, the opportunity cost is $0. If a resource has submitted an Ancillary Service Bid but no Energy Bid and is under an obligation to offer Energy in the DAM (e.g. a non-hydro Resource Adequacy Resource), its Default Energy Bid will be used, and its opportunity cost will be calculated accordingly. If a resource has submitted an Ancillary Service Bid but no Energy Bid and is not under an obligation to offer Energy in the DAM, its Energy opportunity cost is $0 since it cannot be dispatched for Energy.

27.1.2.3 Ancillary Services Pricing in the Event of a Supply Insufficiency.

In the event that there is not sufficient supply to meet an Ancillary Services procurement requirement in a particular Ancillary Services Region in the IFM or RTM as required by Section 8.3, the applicable market will relax the relevant Ancillary Service procurement requirement and will use the maximum Ancillary Service Bid price permitted under Section 39.6.1.3 as the pricing parameter for determining the price of the deficient Ancillary Service.

27.1.3 Maximum and Minimum CAISO Markets Prices

For Settlements purposes, all LMPs, ASMPs and RUC Availability Prices for the IFM, RUC, HASP and Real-Time Market, as applicable, shall not exceed $2500 per MWh and shall not be less than negative $2500 per MWh. All prices produced by the CAISO Markets will be posted in accordance with the posting of market results as further provided in Section 6.5. Prices exceeding $2500 or less than negative $2500 will be modified for Settlements purposes pursuant to price correction process in Section 35 and the CAISO will post the results. The CAISO will conduct a stakeholder process during the first year of operation after the effective date of this provision to assess whether and how the maximum and minimum prices for Settlements should be modified or eliminated after the first twelve (12) months of operation.

27.2 Load Aggregation Points (LAP).

The CAISO shall create Load Aggregation Points and shall maintain Default LAPs at which all Demand shall Bid and be settled, except as provided in Sections 27.2.1 and 30.5.3.2.

27.2.1 Metered Subsystems.

The CAISO shall define specific MSS LAPs for each MSS. The MSS LAP shall be made up of the PNodes within the MSS that have Load served off of those Nodes. The MSS LAPs have unique Load Distribution Factors that reflect the distribution of the MSS Demand to the network Nodes within the MSS. These MSS LAPs are separate from the Default LAPs, and the Load Distribution Factors of the Default LAP do not reflect any MSS Load. As further provided in Sections 11.2.3 and 11.5, MSS Demand is settled either at the price at the Default LAP for MSS Operators that have selected gross Settlement or at the price at the applicable MSS LAP for MSS Operators that have selected net Settlement.

27.2.2 Determination of LAP Prices.

comprising the last fifteen (15) minutes of the imminent Trading Hour and the entire next four Trading Hours. The CAISO will also utilize the SCUC algorithm on a two-day-ahead basis to commit Extremely Long Start Resources, for which commitment in the DAM does not provide sufficient time to Start-Up and be available to supply Energy during the next Trading Day as provided in Section 31.7.

27.4.1.1 Timing of Unit Commitment Instructions.

For the Time Horizon of any given CAISO Markets Process, the associated SCUC optimization will typically commit resources having different Start-Up Times, not all of which need to be started up immediately upon completion of that CAISO Markets Process. The CAISO may defer issuing a Start-Up Instruction to a resource that can be started at a later time and still be available to supply Energy at the time the CAISO Markets Process indicated it would be needed. The CAISO shall re-evaluate the need to commit such resources in a subsequent CAISO Markets Process based on the most recent forecasts and other information about system conditions.

27.4.2 Security Constrained Economic Dispatch.

SCED is the optimization engine used to run the RTD to determine the optimal five-minute Dispatch Instructions throughout the Trading Hour consistent with resource and transmission Constraints within the CAISO Balancing Authority Area. The SCED runs every five (5) minutes and utilizes a Time Horizon comprised of up to thirteen (13) five-minute intervals, but produces Dispatch Instructions only for the first five-minute interval of that Time Horizon. The SCED produces LMPs at each PNode that are used for Settlements as described in Section 11.5.

27.4.3 CAISO Markets Scheduling and Pricing Parameters.

The SCUC and SCED optimization software for the CAISO Markets utilize a set of configurable scheduling and pricing parameters to enable the software to reach a feasible solution and set appropriate prices in instances where Effective Economic Bids are not sufficient to allow a feasible solution. The scheduling parameters specify the criteria for the software to adjust Non-priced Quantities when such adjustment is necessary to reach a feasible solution. The scheduling parameters are configured so that the SCUC and SCED software will utilize Effective Economic Bids as far as possible to reach a feasible solution, and will skip Ineffective Economic Bids and perform adjustments to Non-priced Quantities

pursuant to the scheduling priorities for Self-Schedules specified in Sections 31.4 and 34.10. The scheduling parameters utilized for relaxation of internal transmission constraints are specified in Section 27.4.3.1. The pricing parameters specify the criteria for establishing market prices in instances where one or more Non-priced Quantities are adjusted by the Market Clearing software. The pricing parameters are specified in Sections 27.1.2.3, 27.4.3.2, 27.4.3.3 and 27.4.3.4. The complete set of scheduling and pricing parameters used in all CAISO Markets is maintained in the Business Practice Manuals.

27.4.3.1 Scheduling Parameters for Transmission Constraint Relaxation.

The internal transmission Constraint scheduling parameter is set to $5000 per MWh for the purpose of determining when the SCUC and SCED software in the IFM and RTM will relax an internal transmission constraint rather than adjust Supply or Demand bids or Non-priced Quantities as specified in Sections 31.3.1.3, 31.4 and 34.10 to relieve Congestion on the constrained facility. The effect of this scheduling parameter value is that if the optimization can re-dispatch resources to relieve Congestion on a constrained transmission facility at a cost of $5000 per MWh or less, the Market Clearing software will utilize such re-dispatch, but if the cost exceeds $5000 per MWh the market software will relax the constraint. The corresponding scheduling parameter in RUC is set to $1250 per MWh.

27.4.3.2 Pricing Parameters for Transmission Constraint Relaxation.

For the purpose of determining how the relaxation of a transmission Constraint will affect the determination of prices in the IFM and RTM, the pricing parameter of the Constraint being relaxed is set to the maximum Energy Bid price specified in Section 39.6.1.1. The corresponding pricing parameter used in the RUC is set at the maximum RUC Availability Bid price specified in Section 39.6.1.2.

27.4.3.3 Insufficient Supply to Meet Self-Scheduled Demand in IFM.

In the IFM, when available supply is insufficient to meet all Self-Scheduled demand, Self-Scheduled demand is reduced to the point where the available supply is sufficient to clear the market. For price-setting purposes in such cases, the cleared Self-Scheduled demand is deemed to be willing to pay the maximum Energy Bid price specified in Section 39.6.1.1.

27.4.3.4 Insufficient Supply to Meet CAISO Forecast of CAISO Demand in the RTM.

In the RTM, in the event that Energy offers are insufficient to meet the CAISO Forecast of CAISO Demand, the SCUC and SCED software will relax the system energy-balance constraint. In such cases the software utilizes a pricing parameter set to the maximum Energy Bid price specified in Section 39.6.1.1 for price-setting purposes.

27.4.3.5 Protection of TOR, ETC and CVR Self-Schedules in the IFM.

In accordance with the submitted and accepted TRTC Instructions, valid Day-Ahead TOR Self-Schedules, Day-Ahead ETC Self-Schedules and Day-Ahead CVR Self-Schedules shall not be adjusted in the IFM in response to an insufficiency of Effective Economic Bids. The scheduling parameters associated with the TOR, ETC, or CVR Self-Schedules will be set to values higher than the scheduling parameter associated with relaxation of an internal transmission Constraint as specified in Section 27.4.3.1, so that when there is a congested transmission Constraint that would otherwise subject a Supply or Demand resource submitted in a valid and balanced ETC, TOR or CVR Self-Schedule to adjustment in the IFM, the IFM software will relax the transmission Constraint rather than curtail the TOR, ETC, or CVR Self-Schedule. This priority will be adhered to by the operation of the IFM Market Clearing software, and if necessary, by adjustment of Schedules after the IFM has been executed and the results have been reviewed by the CAISO operators.

27.5 Full Network Model.

31.3.1 Market Clearing and Price Determination.

31.3.1.1 Integrated Forward Market Output.

The IFM produces: (1) a set of hourly Day-Ahead Schedules, AS Awards, and AS Schedules for all participating Scheduling Coordinators that cover each Trading Hour of the next Trading Day; and (2) the hourly LMPs for Energy and the ASMPs for Ancillary Services to be used for settlement of the IFM. The CAISO will publish the LMPs at each PNode as calculated in the IFM. In determining Day-Ahead Schedules, AS Awards, and AS Schedules the IFM optimization will minimize total Bid Costs based on submitted and mitigated Bids while respecting the operating characteristics of resources, the operating limits of transmission facilities, and a set of scheduling priorities that are described in Section 31.4. In performing its optimization, the IFM first tries to complete its required functions utilizing Effective Economic Bids without adjusting Self-Schedules, and skips Ineffective Economic Bids and adjusts Self-Schedules only if it is not possible to balance Supply and Demand and manage Congestion in an operationally prudent manner with available Effective Economic Bids. The process and criteria by which the IFM adjusts Self-Schedules and other Non-priced Quantities are described in Sections 27.4.3, 31.3.1.3 and 31.4. The Day-Ahead Schedules are binding commitments, including the commitment to Start-Up, if necessary, to comply with the Day-Ahead Schedules. The CAISO will not issue separate Start-Up Instructions for Day-Ahead commitments. A resource's status, however, can be modified as a result of additional market processes occurring in the HASP and RTM.

31.3.1.2 Treatment of Ancillary Services Bids in IFM.

As provided in Section 30.7.6.2 the CAISO shall co-optimize the Energy and Ancillary Services Bids in clearing the IFM. To the extent that capacity subject to an Ancillary Services Bid submitted in the Day-Ahead Market is not associated with an Energy Bid, there is no co-optimization, and therefore, no opportunity cost associated with that resource for that Bid for the purposes of calculating the Ancillary Services Marginal Price as specified in Section 27.1.2.2. When the capacity associated with the Energy Bid overlaps with the quantity submitted in the Ancillary Services Bid, then the Energy Bid will be used to determine the opportunity cost, if any, in the co-optimization to the extent of the overlap. Therefore, the capacity that will be considered when co-optimizing the procurement of Energy and Ancillary Services from Bids in the IFM will consider capacity up to the total capacity of the resource as reflected in the Ancillary Services Bid as derated through SLIC, if at all. In the case of Regulation, the capacity that will be considered is the lower of the capacity of the resource offered in the Ancillary Services Bid or the upper Regulation limit of the highest Regulating Range as contained in the Master File.

31.3.1.3 Reduction of Self-Scheduled LAP Demand.

In the IFM, to the extent the market software cannot resolve a non-competitive transmission Constraint utilizing Effective Economic Bids such that Self-Scheduled Load at the LAP level would otherwise be reduced to relieve the Constraint, the CAISO Market software will adjust Non-priced Quantities in accordance with the process and criteria described in Section 27.4.3. For this purpose the priority sequence, starting with the first type of Non-priced Quantity to be adjusted, will be:

(a) Schedule the Energy from Self-Provided Ancillary Service Bids from capacity that is obligated to offer an Energy Bid under a must-offer obligation such as from an RMR Unit or a Resource Adequacy Resource. Consistent with Section 8.6.2, the CAISO Market software could also utilize the Energy from Self-Provided Ancillary Service Bids from capacity that is not under a must-offer obligation such as from an RMR or a Resource Adequacy Resource, to the extent the Scheduling Coordinator has submitted an Energy Bid for such capacity. The associated Energy Bid prices will be those resulting from the MPM process.

(b) Relax the Constraint consistent with Section 27.4.3.1, and establish prices consistent with Section 27.4.3.2. No Constraints on Interties with adjacent Balance Authority Areas will be relaxed in this procedure.

[NOT USED]

31.4 CAISO Market Adjustments to Non-priced Quantities in the IFM.

All Self-Schedules are respected by SCUC to the maximum extent possible and are protected from curtailment in the Congestion Management process to the extent that there are Effective Economic Bids that can relieve Congestion. If all Effective Economic Bids in the IFM are exhausted, resource Self-Schedules between the resource's Minimum Load and the first Energy level of the first Energy Bid point will be subject to adjustments by the CAISO Market optimization based on the scheduling priorities listed below. This functionality of the optimization software is implemented through the setting of scheduling parameters as described in Section 27.4.3 and specified in Section 27.4.3.1 and the BPMs. Through this process, imports and exports may be reduced to zero, Demand Bids may be reduced to zero, Price Taker Demand (LAP load) may be reduced, and Generation may be reduced to a lower operating limit (or Regulation Limit) (or to a lower Regulation Limit plus any qualified Regulation Down award or Self-Provided Ancillary Services, if applicable). Any Self-Schedules below the Minimum Load level are treated as fixed Self-Schedules and are not subject to these adjustments for Congestion Management. The provisions of this section shall apply only to the extent they do not conflict with any MSS Agreement. In accordance with Section 27.4.3.5 the resources submitted in valid TOR, ETC or CVR Self-Schedule shall not be adjusted in the IFM in response to an insufficiency of Effective Economic Bids. Thus the adjustment sequence for the IFM, from highest priority (last to be adjusted) to lowest priority (first to be adjusted), is as follows:

(a) Reliability Must Run (RMR) Generation pre-dispatch reduction;

(b) Day-Ahead TOR Self-Schedules reduction;

(c) Day-Ahead ETC and CVR Self-Schedule reduction; different ETC priority levels will be observed based upon global ETC priorities provided to the CAISO by the Responsible PTOs;

(d) Internal transmission Constraint relaxation for the IFM pursuant to Section 27.4.3.1;

(e) Other Self-Schedules of CAISO Demand reduction subject to Section 31.3.1.3, exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports, and Self-Schedules of exports at Scheduling Points explicitly sourced by non-Resource Adequacy Capacity;

(f) Self-Schedules of exports at Scheduling Points not explicitly sourced by non-Resource Adequacy Capacity, except those exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports as set forth in Section 31.4(e);

(g) Day-Ahead Regulatory Must-Run Generation and Regulatory Must-Take Generation reduction; and

(h) Other Self-Schedules of Supply reduction.

31.5 Residual Unit Commitment.

The CAISO shall perform the RUC process after the IFM. In the event that the IFM did not commit sufficient resources to meet the CAISO Forecast of CAISO Demand and account for other factors such as Demand Forecast error, as described in the Business Practice Manuals, the RUC shall commit additional resources and identify additional RUC Capacity to ensure sufficient on-line resources to meet Demand for

34.10 CAISO Market Adjustment to Non-priced Quantities in the RTM.

All Self-Schedules are respected by the SCED and SCUC to the maximum extent possible and are protected from curtailment in the Congestion Management process to the extent that there are Effective Economic Bids that can relieve Congestion. If all Effective Economic Bids for the RTM are exhausted, all Self-Schedules between the Minimum Load and the lowest Energy level of the first Energy Bid point will be subject to adjustments based on assigned scheduling priorities. This functionality of the optimization software is implemented through the setting of scheduling parameters as described in Section 27.4.3 and specified in Section 27.4.3.1 and the BPMs. Through this process, imports and exports may be reduced to zero, Demand may be reduced to zero, and Generation may be reduced to a lower operating limit (or Regulation Limit) (or to a lower Regulation Limit plus any qualified Regulation Down Award or Self-Provided Ancillary Services, if applicable). Any Self-Schedules below the Minimum Load level are treated as fixed Self-Schedules and are not subject to uneconomic adjustments for Congestion Management but may be subject to decommitment via an Exceptional Dispatch if necessary as a last resort to relieve Congestion that could not otherwise be managed.

34.10.1 Increasing Supply.

The scheduling priorities as defined in the RTM optimization to meet the need for increasing Supply as reflected from higher to lower priority are as follows:

(a) Non-Participating Load reduction, exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports, or Self-Schedules for exports at Scheduling Points in HASP served by Generation from non-Resource Adequacy Capacity or from non-RUC Capacity;

(b) Self-Schedules for exports at Scheduling Points in HASP not offered by Generation from non-Resource Adequacy Capacity or not offered by Generation from non-RUC Capacity, except those exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports as set forth in Section 34.10.1(a); and

(c) Contingency Only Operating Reserve if activated by Operator to provide Energy (as indicated by the Contingency Flag and the Contingency condition).

34.10.2 Decreasing Supply.

The scheduling priorities as defined in the RTM optimization to meet the need for decreasing Supply as reflected from higher to lower priority are as follows:

(a) Non-Participating Load increase;

(b) Reliability Must Run (RMR) Schedule (Day-Ahead manual pre-dispatch or Manual RMR Dispatches or Dispatches that are flagged as RMR Dispatches following the MPM-RRD process);

(c) Transmission Ownership Right (TOR) Self-Schedule;

(d) Existing Rights (ETC) Self-Schedule;

(f) Regulatory Must-Run and Regulatory Must-Take (RMT) Self-Schedule;

(g) Participating Load increase;

(h) Day-Ahead Supply Schedule; and

(i) Self-Schedule submitted in HASP.

These dispatch priorities as defined in the RTM optimization may be superseded by operator actions and procedures as necessary to ensure reliable operations.

34.11 Means of Dispatch Communication.

The CAISO dispatches Regulation by AGC to Participating Generators and, for Dynamic System Resources, through dedicated communication links that satisfy the CAISO's standards for external imports of Regulation. The CAISO communicates all other Dispatch Instructions electronically, except

Ramping through a Forbidden Operating Region, the resource will not be eligible to set the LMP. Resources identified as MSS Load following resources are not eligible to set the LMP. A resource constrained at an upper or lower operating limit, a boundary of a Forbidden Operating Region or dispatched for a quantity of Energy such that its full Ramping capability is constraining the ability of the resource to be dispatched for additional Energy in target interval, cannot be marginal (i.e., it is constrained by the Ramping capability) and thus is not eligible to set the Dispatch Interval LMP. Non-Dynamic System Resources are not eligible to set the Dispatch Interval LMP. Dynamic System Resources are eligible to set the Dispatch Interval LMP. A Constrained Output Generator that has the ability to be committed or shut off within the two-hour Time Horizon of the RTM will be eligible to set the Dispatch Interval LMP if any portion of its Energy is necessary to serve Demand. Dispatches of Regulation resources by EMS in response to AGC will not set the RTM LMP. Dispatches of Regulation resources to a Dispatch Operating Point by RTM SCED will be eligible to set the RTM LMP.

34.19.2.4 [Not Used]

34.19.2.5 Price for Uninstructed Deviations for Participating Intermittent Resources.

Deviations associated with each Participating Intermittent Resource in a Scheduling Coordinator's portfolio shall be settled as provided in Section 11.12 at the monthly weighted average Dispatch Interval LMP, as calculated in accordance with Section 11.5.4.1 at each Pnode associated with the Participating Intermittent Resource, and using the monthly weighted average with weights equal to total Real-Time Generation.

Aggregated Pricing Node (Aggregated PNode)	A Load Aggregation Point, Trading Hub or any group of Pricing Nodes as defined by the CAISO.
Alert, Warning or Emergency (AWE) Notice	A CAISO operations communication issued to Market Participants and the public, under circumstances and in a form specified in CAISO Operating Procedures, when the operating requirements of the CAISO Controlled Grid are marginal because of Demand exceeding forecast, loss of major Generation sources, or loss of transmission capacity that has curtailed imports into the CAISO Balancing Authority Area, or if insufficient Bids for the Supply of Energy and Ancillary Services have been submitted in the HASP for the CAISO Balancing Authority Area.
All Constraints Run (ACR)	The second optimization run of the MPM-RRD process through which all known transmission Constraints are enforced.
Ancillary Service Award or AS Award	The notification by the CAISO indicating that a Bid to supply an Ancillary Service has been selected to provide such service in the DAM, HASP, or RTM.
Ancillary Service Bid Cost or AS Bid Cost	An amount equal to the product of the AS Award from each accepted AS Bid, reduced by any applicable No Pay capacity, and the relevant AS Bid price.
Ancillary Service Bid or AS Bid	The Bid component that indicates the quantity in MW and a price in dollars per MW for a specific Ancillary Service, including Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserve, that a Scheduling Coordinator is offering to supply in a CAISO Market from a Generating Unit or System Resource, and only for Non-Spinning Reserve from the Load of a Participating Load.
Ancillary Service Marginal Price (ASMP)	The marginal cost of providing an Ancillary Service as further provided in Section 27.1.2.
Ancillary Service Obligation or AS Obligation	A Scheduling Coordinator's hourly obligation for Regulation Down, Regulation Up, Spinning Reserves, and Non-Spinning Reserves calculated pursuant to Section 11.10.2.1.3, 11.10.2.2.2, 11.10.3.2, and 11.10.4.2, respectively.

DSHBAOA	Dynamic Scheduling Host Balancing Authority Operating Agreement
Dynamic Resource-Specific System Resource	A Dynamic System Resource that is a specific generation resource outside the CAISO Balancing Authority Area.
Dynamic Schedule	A telemetered reading or value which is updated in Real-Time and which is used as an Interchange Schedule in the CAISO Energy Management System calculation of Area Control Error and the integrated value of which is treated as an Interchange Schedule for Interchange accounting purposes.
Dynamic Scheduling Host Balancing Authority Operating Agreement (DSHBAOA)	An agreement entered into between the CAISO and a Host Balancing Authority governing the terms of dynamic scheduling between the Host Balancing Authority and the CAISO in accordance with the Dynamic Scheduling Protocol set forth in Appendix X, a pro forma version of which agreement is set forth in Appendix B.9
Dynamic System Resource	A System Resource that has satisfied the CAISO's contractual and operational requirements for submitting a Dynamic Schedule, and for which a Dynamic Schedule has been submitted, including a Dynamic Resource-Specific System Resource.
E&P Agreement	Engineering & Procurement Agreement
Economic Bid	A Bid that includes quantity (MWh) and price ($) for specified Trading Hours.
Economic Planning Study	A study performed to provide a preliminary assessment of the potential cost effectiveness of mitigating specifically identified Congestion.
EEP	Electrical Emergency Plan
Effective Economic Bid	An Economic Bid that is not an Ineffective Economic Bid.
ELC Process	Extremely Long-Start Commitment Process
Electrical Emergency Plan (EEP)	A plan to be developed by the CAISO in consultation with Utility Distribution Companies to address situations when Energy reserve margins are forecast to be below established levels.

Independent Entity	The entity, not affiliated with the CAISO or any Market Participant, that assists the CAISO in the determination of reference prices.
Independent System Operator (ISO)	See California Independent System Operator Corporation.
Ineffective Economic Bid	An Economic Bid that is not accepted in a CAISO market because its impact on the value of the CAISO Markets objectives, as specified in Section 31.3 and 34.5, would exceed the impact of adjusting a Non-priced Quantity. The CAISO maintains in the Business Practice Manuals the current values of the scheduling parameters that specify the thresholds, including the provisions of Section 27.4.3.1, whereby the market software determines whether to adjust a Non-priced Quantity rather than accept Economic Bids.
Information System (OASIS)	CAISO maintains on the CAISO Website that allows all transmission customers to view the data simultaneously.
Initial Settlement Statement Reissue	The reissue of an Initial Settlement Statement T+38BD by the CAISO on the fifty-first (51st) Business Day from the relevant Trading Day (T+51BD) if T+51BD falls on a calendar day that is on or before the day the Invoice or Payment Advice for the bill period containing the relevant Trading Day is scheduled to publish.
Initial Settlement Statement T+38BD	A Settlement Statement generated by the CAISO for the calculation of Settlements for a given Trading Day, which is published on the thirty-eight Business Day from the relevant Trading Day (T+38BD) and is prior to the Invoice or Payment Advice published for the relevant bill period.
In-Service Date	The date upon which the Interconnection Customer reasonably expects it will be ready to begin use of the Participating TO Interconnection Facilities to obtain back feed power.
Instructed Imbalance Energy (IIE)	The portion of Imbalance Energy resulting from Dispatch Instructions and HASP Intertie Schedules.

Integrated Balancing Authority Area (IBAA)	A Balancing Authority Area as provided in Section 27.5.3 that has been determined to have one or more direct interconnections with the CAISO Balancing Authority Area, such that power flows within the IBAA significantly affect power flows within the CAISO Balancing Authority Area, and whose network topology is therefore modeled in further detail in the CAISO's Full Network Model beyond the simple radial modeling of interconnections between the IBAA and the CAISO Balancing Authority Area.
Integrated Forward Market (IFM)	The pricing run conducted by the CAISO using SCUC in the Day-Ahead Market, after the MPM-RRD process, which includes Unit Commitment, Ancillary Service procurement, Congestion Management and Energy procurement based on Supply and Demand Bids.
Interchange	Imports and exports between the CAISO Balancing Authority Area and other Balancing Authority Areas.
Interchange Schedule	A final agreed-upon schedule of Energy to be transferred between the CAISO Control Balancing Authority Area and another Balancing Authority Area.

Non-Overlapping Optimal Energy	The portions of Optimal Energy that are not Overlapping Optimal Energy, which are indexed against the relevant Energy Bid and sliced by Energy Bid price.
Non-Participating TO	A TO that is not a party to the Transmission Control Agreement or, for the purposes of Section 16.1, the holder of transmission service rights under an Existing Contract that is not a Participating TO.
Non-priced Quantity	As set forth in Section 27.4.3, a quantitative value in a CAISO Market that may be adjusted by the SCUC or SCED in the CAISO market optimizations but that does not have an associated bid price submitted by a Scheduling Coordinator. The Non-priced Quantities that may be so adjusted are: Energy Self-Schedules, transmission constraints, market energy balance constraints, Ancillary Service requirements, conditionally qualified and conditionally unqualified Ancillary Service self-provision, limits in RUC on minimum load energy, quick start capacity and minimum generation, Day-Ahead Energy Schedules resulting from the IFM, and estimated HASP Energy Self-Schedules used in RUC.
Non-Spinning Reserve	The portion of generating capacity that is capable of being synchronized and Ramping to a specified load in ten minutes (or Load that is capable of being interrupted in ten minutes) and that is capable of running (or being interrupted).
Non-Spinning Reserve Cost	The revenues paid to the suppliers of the total awarded Non-Spinning Reserve capacity in the Day-Ahead Market, HASP, and Real-Time Market, minus, (ii) the payments rescinded due to either the failure to conform to CAISO Dispatch Instructions or the unavailability of the Non-Spinning Reserves under Section 8.10.8.
Non-Spinning Reserve Obligation	The obligation of a Scheduling Coordinator to pay its share of costs incurred by the CAISO in procuring Non-Spinning Reserve.
No Pay	The rescission of a payment made for provision of Spinning Reserve and/or Non-Spinning Reserve when, subsequent to the AS Award for such Ancillary Service and payment, the Ancillary Service becomes Undispatchable Capacity, Unavailable Capacity, Undelivered Capacity, or, in certain circumstances, unsynchronized capacity.
NOROCAF	Negative Operating Reserve Obligation Credit Adjustment Factor
NRC	The Nuclear Regulatory Commission or its successor.
NRC Standards	The reliability standards published by the NRC from time to time.
OASIS	Open Access Same-Time Information System

Attachment B - Blacklines

Uneconomic Adjustment/Pricing and Scheduling Parameters

4th Replacement Tariff (MRTU)

November 4, 2008

* * *

11.10.1.1 Ancillary Services in DAM.

~~The IFM calculates hourly Day-Ahead Ancillary Service Awards and establishes Ancillary Service Marginal Prices (ASMPs) for the accepted Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserve Bids. The IFM co-optimizes Energy and Ancillary Services subject to resource, network and regional constraints, and awards Ancillary Services resources in economic merit order subject to those constraints. For each service, the economic merit order is determined as the sum of the Ancillary Service capacity Bid price of the resource and the foregone opportunity cost of Energy in the IFM for that resource.~~ Payments to Scheduling Coordinators with AS Awards shall be equal to the ASMP calculated as provided in Section 27.1.2 for ~~the~~ each Ancillary Service multiplied by the quantity of the capacity awarded for the Ancillary Service in each of the Ancillary Service Regions. ~~The ASMP is marginal cost of providing an Ancillary Service in the relevant resource location ($/MW/hr). The ASMPs determined by the IFM optimization process at each resource location where an Ancillary Service Bid is accepted will be no lower than the sum of (i) the Ancillary Service capacity Bid price submitted for that resource, and (ii) the foregone opportunity cost of Energy in the IFM for that resource. The foregone opportunity cost of Energy is measured as the positive difference between the IFM LMP at the resource's Pricing Node and the resource's Energy Bid price (e.g., if the resource's Energy Bid price is higher than the LMP, the opportunity cost is $0). If a resource has submitted an Ancillary Service Bid but no Energy Bid and is under an obligation to offer Energy in the DAM (e.g. a non-hydro Resource Adequacy Resource), its Default Energy Bid will be used, and its opportunity cost calculated accordingly. If a resource has submitted an Ancillary Service Bid but no Energy Bid and is not under an obligation to offer Energy in the DAM, its Energy opportunity cost is $0 (since it cannot be dispatched for Energy even if the LMP at its Location goes to the Bid cap).~~ Suppliers with Self-Provided Ancillary Services are not eligible to receive payment for Ancillary Service Awards based on ASMPs; Self-Provided Ancillary Services are compensated at the user rate for the service being self-provided as described in Section 11.10.2, 11.10.3 and 11.10.4.

* * *

11.10.1.3 Ancillary Services Provided in Real-Time.

~~For Ancillary Services provided from resources internal to the CAISO Balancing Authority Area in the Real-Time Market, the RTUC process that is performed every fifteen (15) minutes establishes fifteen (15) minute Ancillary Service Schedules, awards, and prices for the upcoming quarter of the Operating Hour.~~ Suppliers of Ancillary Services from resources ~~internal~~awarded in RTUC ~~to the CAISO Balancing Authority Area~~ are paid a price equal to ¼ of the fifteen (15) minute ASMP (in $/MW/h) in each fifteen (15) minute interval for ~~the~~ each Ancillary Service times the amount of the capacity awarded (MW) for the Ancillary Service in the relevant Ancillary Services Region. For each Ancillary Service, the ASMP is calculated as set forth in Section 27.1.2. ~~Suppliers with Ancillary Service Awards receive the ASMP at the resource's location.~~ Suppliers that self-provide Ancillary Services in the Real-Time Market are not eligible to receive payment using the ASMP; rather to the extent the self-provision is qualified it will be valued at the user rate for the relevant service (i.e., will either reduce the Ancillary Services Obligation or receive the user rate if it exceeds the Scheduling Coordinator's Ancillary Service Obligation) as described in Section 11.10.2, 11.10.3 and 11.10.4.

* * *

27.1 Locational Marginal Price~~s~~~~ing~~ and Ancillary Services Marginal Prices.

The CAISO Markets are based on: 1) Locational Marginal Prices as provided below in Section 27.1.1 and further provided in Appendix C; and 2) Ancillary Services Marginal Prices as provided below in Section 27.1.2.

*** * ***

27.1.2 Ancillary Service Prices.

27.1.2.1 Ancillary Service Marginal Prices.

As provided in Section 8.3, Ancillary Services are procured and awarded through the IFM and the Real-Time Market. The IFM calculates hourly Day-Ahead Ancillary Service Awards and establishes Ancillary Service Marginal Prices (ASMPs) for the accepted Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserve Bids. The IFM co-optimizes Energy and Ancillary Services subject to resource, network and regional constraints. In the Real-Time Market, the RTUC process that is performed every fifteen (15) minutes establishes fifteen (15) minute Ancillary Service Schedules, Awards, and prices for the upcoming quarter of the given Trading Hour. ASMPs are determined by first calculating

the Ancillary Services shadow prices for each Ancillary Service type and the applicable Ancillary Services Regions. The Ancillary Services shadow prices are produced as a result of the co-optimization of Energy and Ancillary Services for each Ancillary Service Region through the IFM and the Real-Time Market, subject to resource, network, and requirements constraints. The Ancillary Services shadow prices represent the cost sensitivity of the relevant binding regional constraint at the optimal solution, or the marginal reduction of the combined Energy and Ancillary Service procurement cost associated with a marginal relaxation of that constraint. If the regional constraint is not binding for an Ancillary Services Region, then the corresponding Ancillary Services shadow price in the Ancillary Services Region is zero. The ASMP for a particular Ancillary Service type and Ancillary Services Region is then the sum of the Ancillary Services shadow prices for the specific type of Ancillary Service and all the other types of Ancillary Services for which the subject Ancillary Service can substitute, as described in Section 8.2.3.5, and for the given Ancillary Service Region and all the other Ancillary Service Regions that include that given Ancillary Service Region.

27.1.2.2 Opportunity Cost in Ancillary Services Marginal Prices.

The Ancillary Services shadow price, which as described above, is a result of the Energy and Ancillary Service co-optimization, includes the forgone opportunity cost of the marginal resource, if any, for not providing Energy or other types of Ancillary Services the marginal resource is capable of providing in the relevant market. **[NOTE: The following language is being moved from Section 11.10.1.1. and is not shown as new language in this Section 27.1.2.2]** The ASMPs determined by the IFM or RTUC optimization process ~~at~~for each resource ~~location where an~~ whose Ancillary Service Bid is accepted will be no lower than the sum of (i) the Ancillary Service capacity Bid price submitted for that resource, and (ii) the foregone opportunity cost of Energy in the IFM or RTUC for that resource. The foregone opportunity cost of Energy is measured as the positive difference between the IFM or RTUC LMP at the resource's Pricing Node and the resource's Energy Bid price. ~~(e.g., i~~If the resource's Energy Bid price is higher than the LMP, the opportunity cost is ~~$0)~~. If a resource has submitted an Ancillary Service Bid but no Energy Bid and is under an obligation to offer Energy in the DAM (e.g. a non-hydro Resource Adequacy Resource), its Default Energy Bid will be used, and its opportunity cost will be calculated accordingly. If a resource has submitted an Ancillary Service Bid but no Energy Bid and is not under an obligation to offer

Energy in the DAM, its Energy opportunity cost is $0 ~~(~~since it cannot be dispatched for Energy~~ even if the LMP at its Location goes to the Bid cap)~~.

27.1.2.3 Ancillary Services Pricing in the Event of a Supply Insufficiency.

In the event that there is not sufficient supply to meet an Ancillary Services procurement requirement in a particular Ancillary Services Region in the IFM or RTM as required by Section 8.3, the applicable market will relax the relevant Ancillary Service procurement requirement and will use the maximum Ancillary Service Bid price permitted under Section 39.6.1.3 as the pricing parameter for determining the price of the deficient Ancillary Service.

* * *

27.4.3 CAISO Markets Scheduling and Pricing Parameters.

The SCUC and SCED optimization software for the CAISO Markets utilize a set of configurable scheduling and pricing parameters to enable the software to reach a feasible solution and set appropriate prices in instances where Effective Economic Bids are not sufficient to allow a feasible solution. The scheduling parameters specify the criteria for the software to adjust Non-priced Quantities when such adjustment is necessary to reach a feasible solution. The scheduling parameters are configured so that the SCUC and SCED software will utilize Effective Economic Bids as far as possible to reach a feasible solution, and will skip Ineffective Economic Bids and perform adjustments to Non-priced Quantities pursuant to the scheduling priorities for Self-Schedules specified in Sections 31.4 and 34.10. The scheduling parameters utilized for relaxation of internal transmission constraints are specified in Section 27.4.3.1. The pricing parameters specify the criteria for establishing market prices in instances where one or more Non-priced Quantities are adjusted by the Market Clearing software. The pricing parameters are specified in Sections 27.1.2.3, 27.4.3.2, 27.4.3.3 and 27.4.3.4. The complete set of scheduling and pricing parameters used in all CAISO Markets is maintained in the Business Practice Manuals.

27.4.3.1 Scheduling Parameters for Transmission Constraint Relaxation.

The internal transmission Constraint scheduling parameter is set to $5000 per MWh for the purpose of determining when the SCUC and SCED software in the IFM and RTM will relax an internal transmission constraint rather than adjust Supply or Demand bids or Non-priced Quantities as specified in Sections 31.3.1.3, 31.4 and 34.10 to relieve Congestion on the constrained facility. The effect of this scheduling parameter value is that if the optimization can re-dispatch resources to relieve Congestion on a

constrained transmission facility at a cost of $5000 per MWh or less, the Market Clearing software will utilize such re-dispatch, but if the cost exceeds $5000 per MWh the market software will relax the constraint. The corresponding scheduling parameter in RUC is set to $1250 per MWh.

27.4.3.2 Pricing Parameters for Transmission Constraint Relaxation.

For the purpose of determining how the relaxation of a transmission Constraint will affect the determination of prices in the IFM and RTM, the pricing parameter of the Constraint being relaxed is set to the maximum Energy Bid price specified in Section 39.6.1.1. The corresponding pricing parameter used in the RUC is set at the maximum RUC Availability Bid price specified in Section 39.6.1.2.

27.4.3.3 Insufficient Supply to Meet Self-Scheduled Demand in IFM.

In the IFM, when available supply is insufficient to meet all Self-Scheduled demand, Self-Scheduled demand is reduced to the point where the available supply is sufficient to clear the market. For price-setting purposes in such cases, the cleared Self-Scheduled demand is deemed to be willing to pay the maximum Energy Bid price specified in Section 39.6.1.1.

27.4.3.4 Insufficient Supply to Meet CAISO Forecast of CAISO Demand in the RTM.

In the RTM, in the event that Energy offers are insufficient to meet the CAISO Forecast of CAISO Demand, the SCUC and SCED software will relax the system energy-balance constraint. In such cases the software utilizes a pricing parameter set to the maximum Energy Bid price specified in Section 39.6.1.1 for price-setting purposes.

27.4.3.5 Protection of TOR, ETC and CVR Self-Schedules in the IFM.

In accordance with the submitted and accepted TRTC Instructions, valid Day-Ahead TOR Self-Schedules, Day-Ahead ETC Self-Schedules and Day-Ahead CVR Self-Schedules shall not be adjusted in the IFM in response to an insufficiency of Effective Economic Bids. The scheduling parameters associated with the TOR, ETC, or CVR Self-Schedules will be set to values higher than the scheduling parameter associated with relaxation of an internal transmission Constraint as specified in Section 27.4.3.1, so that when there is a congested transmission Constraint that would otherwise subject a Supply or Demand resource submitted in a valid and balanced ETC, TOR or CVR Self-Schedule to adjustment in the IFM, the IFM software will relax the transmission Constraint rather than curtail the TOR, ETC, or CVR Self-Schedule. This priority will be adhered to by the operation of the IFM Market Clearing

software, and if necessary, by adjustment of Schedules after the IFM has been executed and the results have been reviewed by the CAISO operators.

* * *

31.3.1.1 Integrated Forward Market Output.

The IFM produces: (1) a set of hourly Day-Ahead Schedules, AS Awards, and AS Schedules for all participating Scheduling Coordinators that cover each Trading Hour of the next Trading Day; and (2) the hourly LMPs for Energy and the ASMPs for Ancillary Services to be used for settlement of the IFM. The CAISO will publish the LMPs at each PNode as calculated in the IFM. In determining Day-Ahead Schedules, AS Awards, and AS Schedules the IFM optimization will minimize total Bid Costs based on submitted and mitigated Bids while respecting the operating characteristics of resources, the operating limits of transmission facilities, and a set of scheduling priorities that are described in Section 31.4. In performing its optimization, the IFM first tries to complete its required functions utilizing Effective Economic Bids without adjusting Self-Schedules, and skips Ineffective Economic Bids and adjusts Self-Schedules only if it is not possible to balance Supply and Demand and manage Congestion in an operationally prudent manner with available Effective Economic Bids. The process and criteria by which the IFM adjusts Self-Schedules and other Non-priced Quantities are described in Sections 27.4.3, 31.3.1.3 and 31.4. The Day-Ahead Schedules are binding commitments, including the commitment to Start-Up, if necessary, to comply with the Day-Ahead Schedules. The CAISO will not issue separate Start-Up Instructions for Day-Ahead commitments. A resource's status, however, can be modified as a result of additional market processes occurring in the HASP~~, STUC and RTUC~~ and RTM.

* * *

31.3.1.2 Treatment of Ancillary Services Bids in IFM.

As provided in Section 30.7.6.2 the CAISO shall co-optimize the Energy and Ancillary Services Bids in clearing the IFM. To the extent that capacity subject to an Ancillary Services Bid submitted in the Day-Ahead Market is not associated with an Energy Bid, there is no co-optimization, and therefore, no opportunity cost associated with that resource for that Bid for the purposes of calculating the Ancillary Services Marginal Price as specified in Section ~~11.10.1.1~~27.1.2.2. When the capacity associated with the Energy Bid overlaps with the quantity submitted in the Ancillary Services Bid, then the Energy Bid will be used to determine the opportunity cost, if any, in the co-optimization to the extent of the overlap.

Therefore, the capacity that will be considered when co-optimizing the procurement of Energy and Ancillary Services from Bids in the IFM will consider capacity up to the total capacity of the resource as reflected in the Ancillary Services Bid as derated through SLIC, if at all. In the case of Regulation, the capacity that will be considered is the lower of the capacity of the resource offered in the Ancillary Services Bid or the upper Regulation limit of the highest Regulating Range as contained in the Master File.

31.3.1.3 Reduction of Self-Scheduled LAP Demand.

In the IFM, ~~T~~to the extent the ~~CAISO~~ market software cannot resolve a non-competitive transmission Constraint utilizing ~~e~~Effective Economic Bids such that Self-Scheduled Load at the LAP level ~~in the pre-IFM pass 2 (ACR)~~ would otherwise be ~~adjusted~~ reduced to relieve the Constraint, the CAISO Market software will adjust Non-priced Quantities in accordance with the process and criteria described in Section 27.4.3. For this purpose the priority sequence, starting with the first type of Non-priced Quantity to be adjusted, will be~~take the following actions in sequence~~:

(a)~~Step 1:~~ Schedule the Energy from Self-Provided Ancillary Service Bids from capacity that is obligated to offer an Energy Bid under a must-offer obligation such as from an RMR Unit or a Resource Adequacy Resource. Consistent with Section 8.6.2, the CAISO Market software could also utilize the Energy from Self-Provided Ancillary Service Bids from capacity that is not under a must-offer obligation such as from an RMR or a Resource Adequacy Resource, to the extent the Scheduling Coordinator has submitted an Energy Bid for such capacity. ~~Since the otherwise Self-Provided Ancillary Services capacity in question is under a must-offer obligation, t~~The associated Energy Bid prices will be those resulting from the MPM process.~~either: (a) submitted Energy Bids; or (b) Default Energy Bids to the extent an Energy Bid was not submitted for the Self-Provided Ancillary Services capacity, but not lower than any Energy Bids from the same resource that may have cleared pre-IFM pass 1 (ACR).~~

~~Step 2: In case the measure in Step 1 is insufficient to avoid adjustment of Load at the LAP level, the CAISO will evaluate the validity of the binding transmission Constraint and if it is determined that the Constraint can be relaxed based on the operating practices, will~~ (b) R~~r~~elax the Constraint consistent with Section 27.4.3.1, and establish prices consistent with Section 27.4.3.2. No Constraints on Interties with

adjacent Balance Authority Areas will be relaxed in this procedure. ~~operating practices. The CAISO will use the following rules in relaxing the transmission Constraints in this step 2:~~

~~(a) No Constraints on WECC rated paths or Interties with adjacent Balancing Authority Areas would be relaxed.~~

~~(b) Only the transmission Constraints that can be mitigated in the Real-Time Market or Real-Time operation are candidates for Constraint relaxation. The criteria used to assess whether or not the Constraint can be mitigated in Real-Time can include, but are not limited to, the following: (1) there is a Submission to Self-Provide an Ancillary Service for Operating Reserves from non-Resource Adequacy Resources or non-RMR Units within the transmission constrained Load pocket constrained by the transmission path in question; provided, however, such Submissions to Self-Provide an Ancillary Service cannot be used in Step 1, but are available in Real-Time; (2) Scheduling Coordinators have submitted Self-Schedules for Participating Load in the constrained Load pocket; or (3) there are non-Resource Adequacy Resources and non-RMR Units within the constrained Load pocket that did not participate in the Day-Ahead Market but can be called upon under their Participating Generator Agreement before the CAISO curtails firm Load.~~

~~(c) Candidate Constraints will be relaxed by assigning a high penalty for Constraint violation (as opposed to enforcing them as hard Constraints) in this Step 2. Such penalty will be lower than the penalty for curtailing firm (Price Taker) Load.~~

~~(d) The higher of the facility rating or the pre-IFM flows through the facility with relaxed Constraints in this Step 2 will be used as hard limits in IFM.~~

~~(e) To avoid unwarranted price impact in IFM, a Constraint violation penalty equal to three times the prevailing Energy Bid cap as specified in Section 39.6 will be applied to the Constraints relaxed in Step 2 between their operating limit and the relaxed limit determined.~~

~~(f) The information relating to the relaxed Constraints will be forwarded to the CAISO Operator together with the necessary mitigating measures.~~

~~Step 3: In case the measures in Step 1 and Step 2 are insufficient, the CAISO may "soften" the LDF Constraints on a Node or sub-LAP basis, i.e., adjust Load at individual Nodes or, in aggregate, a group of Nodes to relieve the Constraint in such a way that minimizes the quantity of load curtailed. The adjustment to Load at individual Nodes shall be facilitated by adjustment and renormalization of applicable LDFs.~~

* * *

31.4 ~~Uneconomic~~ CAISO Market Adjustments to Non-priced Quantities in the IFM.

All Self-Schedules are respected by SCUC to the maximum extent possible and are protected from curtailment in the Congestion Management process to the extent that there are Effective Economic Bids that can relieve Congestion. If all Effective Economic Bids in the IFM are exhausted, resource Self-Schedules between the resource's Minimum Load and the first Energy level of the first Energy Bid point will be subject to ~~uneconomic~~ adjustments by the CAISO Market optimization based on the scheduling priorities listed below. This functionality of the optimization software is implemented through the setting of scheduling parameters as described in Section 27.4.3 and specified in Section 27.4.3.1 and the BPMs. Through this process, imports and exports may be reduced to zero, Demand Bids may be reduced to zero, Price Taker Demand (LAP load) may be reduced, and Generation may be reduced to a lower operating limit (or Regulation Limit) (or to a lower Regulation Limit plus any qualified Regulation Down award or Self-Provided Ancillary Services, if applicable). Any Self-Schedules below the Minimum Load level are treated as fixed Self-Schedules and are not subject to these~~uneconomic~~ adjustments for Congestion Management. The provisions of this section shall apply only to the extent they do not conflict with any MSS Agreement. In accordance with Section 27.4.3.5 the resources submitted in valid TOR, ETC or CVR Self-Schedule shall not be adjusted in the IFM in response to an insufficiency of Effective Economic Bids. Thus~~e scheduling priorities~~ the adjustment sequence for the IFM, from highest priority (last to be adjusted) to lowest priority (first to be adjusted), is~~are~~ as follows:

~~-~~(a) Reliability Must Run (RMR) Generation pre-dispatch reduction;

(b) Day-Ahead TOR Self-Schedules reduction~~(balanced demand and supply reduction)~~;

(c) Day-Ahead ETC and CVR Self-Schedule~~s~~ reduction ~~(balanced demand and supply reduction)~~; different ETC priority levels will be observed based upon global ETC priorities provided to the CAISO by the Responsible PTOs;

(d) Internal transmission Constraint relaxation for the IFM pursuant to Section 27.4.3.1;

~~(~~(~~d~~e) Other Self-Schedules of CAISO Demand reduction subject to Section 31.3.1.3, exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports, and Self-Schedules of exports at Scheduling Points explicitly sourced by non-Resource Adequacy Capacity;

(~~e~~f) Self-Schedules of exports at Scheduling Points not explicitly sourced by non-Resource Adequacy Capacity, except those exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports as set forth in Section 31.4(~~d~~e);

(~~f~~g) Day-Ahead Regulatory Must-Run Generation and Regulatory Must-Take Generation reduction; and

(~~g~~h) Other Self-Schedules of Supply reduction.~~; and~~

~~(h) Economic Bids of Demand and Supply.~~

* * *

34.10 CAISO Market ~~Uneconomic~~ Adjustment~~s~~ to Non-priced Quantities in the RTM.

All Self-Schedules are respected by the SCED and SCUC to the maximum extent possible and are protected from curtailment in the Congestion Management process to the extent that there are ~~e~~Effective Economic Bids that can relieve Congestion. If all Effective Economic Bids for the RTM are exhausted, all Self-Schedules between the Minimum Load and the lowest ~~e~~Energy level of the first Energy Bid point will be subject to ~~uneconomic~~ adjustments based on assigned scheduling priorities. This functionality of the

optimization software is implemented through the setting of scheduling parameters as described in Section 27.4.3 and specified in Section 27.4.3.1 and the BPMs. Through this process, imports and exports may be reduced to zero, Demand may be reduced to zero, and Generation may be reduced to a lower operating limit (or Regulation Limit) (or to a lower Regulation Limit plus any qualified Regulation Down Award or Self-Provided Ancillary Services, if applicable). Any Self-Schedules below the Minimum Load level are treated as fixed Self-Schedules and are not subject to uneconomic adjustments for Congestion Management but may be subject to decommitment via an Exceptional Dispatch if necessary as a last resort to relieve Congestion that could not otherwise be managed.

34.10.1 Increasing Supply.

The scheduling priorities as defined in the RTM optimization to meet the need for increasing Supply as reflected from higher to lower priority are as follows:

(a) Non-Participating Load reduction, exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports, or Self-Schedules for exports at Scheduling Points in HASP served by Generation from non-Resource Adequacy Capacity or from non-RUC Capacity;

(b) Self-Schedules for exports at Scheduling Points in HASP not offered by Generation from non-Resource Adequacy Capacity or not offered by Generation from non-RUC Capacity, except those exports explicitly identified in a Resource Adequacy Plan to be served by Resource Adequacy Capacity explicitly identified and linked in a Supply Plan to the exports as set forth in Section 34.10.1(a); and

(c) Contingency Only Operating Reserve if activated by Operator to provide Energy (as indicated by the Contingency Flag and the Contingency condition);.

~~(d) Economic Bids submitted in the HASP or RTM.~~

34.10.2 Decreasing Supply.

The scheduling priorities as defined in the RTM optimization to meet the need for decreasing Supply as reflected from higher to lower priority are as follows:

(a) Non-Participating Load increase;

(b) Reliability Must Run (RMR) Schedule (Day-Ahead manual pre-dispatch or Manual RMR Dispatches or Dispatches that are flagged as RMR Dispatches following the MPM-RRD process);

(c) Transmission Ownership Right (TOR) Self-Schedule;

(d) Existing Rights (ETC) Self-Schedule;

(f) Regulatory Must-Run and Regulatory Must-Take (RMT) Self-Schedule;

(g) Participating Load increase;

(h) Day-Ahead Supply Schedule; and

(i) Self-Schedule submitted in HASP~~; and~~.

~~(j) Economic Bids submitted in the HASP or RTM.~~

These dispatch priorities as defined in the RTM optimization may be superseded by operator actions and procedures as necessary to ensure reliable operations.

* * *

34.19.2.4 [Not Used]~~Real-Time LMP When Responding To A Contingency.~~

~~In cases when a Contingency occurs and the CAISO must activate its Operating Reserves, it may perform a Real-Time Contingency Dispatch (RTCD) for a target interval 10 minutes from the current time. When activating a Contingency Dispatch and returning to normal Dispatch in RTM, LMPs shall be based on the last available price from either the Contingency Dispatch or normal Dispatch run relative to the five-minute pricing target.~~

* * *

CAISO Tariff Appendix A

Master Definitions Supplement

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Ancillary Service Marginal Price (ASMP)	The marginal cost of providing an Ancillary Service ~~in the relevant resource Location ($/MW)~~as further provided in Section 27.1.2.

* * *

Effective Economic Bid	An Economic Bid that is not an Ineffective Economic Bid.

* * *

Ineffective Economic Bid	An Economic Bid that is not accepted in a CAISO market because its impact on the value of the CAISO Markets objectives, as specified in Section 31.3 and 34.5, would exceed the impact of adjusting a Non-priced Quantity. The CAISO maintains in the Business Practice Manuals the current values of the scheduling parameters that specify the thresholds, including the provisions of Section 27.4.3.1, whereby the market software determines whether to adjust a Non-priced Quantity rather than accept Economic Bids.

* * *

Non-priced Quantity	As set forth in Section 27.4.3, a quantitative value in a CAISO Market that may be adjusted by the SCUC or SCED in the CAISO market optimizations but that does not have an associated bid price submitted by a Scheduling Coordinator. The Non-priced Quantities that may be so adjusted are: Energy Self-Schedules, transmission constraints, market energy balance constraints, Ancillary Service requirements, conditionally qualified and conditionally unqualified Ancillary Service self-provision, limits in RUC on minimum load energy, quick start capacity and minimum generation, Day-Ahead Energy Schedules resulting from the IFM, and estimated HASP Energy Self-Schedules used in RUC.

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