

**Comments of Scott M. Harvey and  
William W. Hogan<sup>1</sup>  
On the California ISO's Proposed  
Hour-Ahead Scheduling Process**

**May 12, 2005**

**I. INTRODUCTION**

An ISO could in principle coordinate any number of sequential markets with simultaneous clearing of energy and ancillary services schedules to obtain associated prices and create new financial contracts. The accompanying multiple settlements would each account for imbalances relative to the preceding financial contracts. Thus, an ISO could, for example, coordinate a year-ahead market, a month-ahead market, a day-ahead market, a six-hour ahead market, an hour-ahead market and the necessary real-time market. The principal reasons for adding forward markets with full multiple settlements are to allow for advance scheduling and commitment decisions by market participants along with tools for managing the accompanying financial risks. However, clearing and settling additional such markets would add costs for the ISO and for market participants. The incremental costs of clearing and settling such markets probably do not decrease significantly with the addition of each new market in the sequence. However, the incremental benefits to market participants of risk hedging do decrease with each new step in the sequence and these benefits are smaller as the final required real-time decision point approaches. It is not cost effective for an ISO to coordinate markets in all possible time frames.

Two considerations in evaluating the benefits of clearing and settling an additional market are the changes in information available in that time frame and the irreversible choices that must be made in that time frame. Thus, a day-ahead market is useful primarily because many unit commitment decisions need to be made in that time frame and clearing and settling a day-ahead market provides incentives that support a more efficient and competitive unit commitment process. Moreover, enabling market participants to enter into forward financial commitments for energy and transmission usage in the same time frame in which they must make irreversible unit commitment decisions leads to a more price-elastic supply curve for power in the forward market (the supply curve is much less price-elastic once the unit commitment is fixed) and avoids adverse reliability and market surprises that could occur if the unit commitment process were to take place independent from the forward market for transmission scheduling.

There are also important irreversible decisions that are made in the hour-ahead time frame, principally the scheduling of imports and the commitment of slow-starting gas turbines. An hour-ahead market could be implemented to support these decisions that would clear generation offers and load bids to determine hour-ahead financial schedules that would be settled as deviations against day-ahead schedules in the hour-ahead settlement. These hour-ahead schedules would in turn be settled relative to real-time injections and withdrawals in the final balancing settlement. There could in principle be advantages to being able to rely on such an

hour-ahead market for the scheduling of imports and exports in particular, and such an hour-ahead market could be incorporated within the Cal ISO's MRTU market design.

There are, however, only a few market participant resources that require irreversible choices in the hour-ahead timeframe. Absent such choices, there is little need to reflect new information in choices and support them with a full market and separate settlement. The principal exception are schedules for imports and exports, which must be determined prior to real-time and coordinated with adjacent control areas. The Cal ISO proposes to address the need to schedule and price imports and exports prior to real-time through its hour-ahead scheduling and unit commitment process (the HASP). For the remaining activities, at some stage, the ISO must call for the final information to be used in real-time. The Cal ISO also proposes to acquire this information in its hour-ahead scheduling and unit commitment process. The proposed hour-ahead scheduling and unit commitment process will provide the same opportunity for market participants to adjust schedules and bilateral contracts in anticipation of the final settlements in the real-time balancing market that would be provided by an hour-ahead market.

The introduction of a complete hour-ahead market settlement, however, would likely require moving scheduling deadlines forward, would introduce substantial market design complexity to coordinate incentives between the hour-ahead market and real-time that could be difficult to satisfactorily resolve (and if not satisfactorily resolved could pose reliability risks) and would increase both implementation and operating costs for the Cal ISO settlement system and for Cal ISO market participants. Moreover, an hour-ahead market cleared based on bid load prior to the determination of final import and export schedules and gas turbine commitment in a subsequent scheduling and unit commitment process based on the Cal ISO's load forecast would not serve to support decisions in the subsequent scheduling and unit commitment process. With the improvements the Cal ISO has proposed in its hour-ahead scheduling and unit commitment process, there are not likely to be material incremental benefits from introducing an additional hour-ahead settlement process in conjunction with the initial implementation of the MRTU market design. There would be material incremental costs and implementation risks. Hence, the cost-benefit tradeoff indicates that the benefits would not justify the costs.

It is noteworthy that the same cost benefit conclusion is apparent in other organized markets. The most important step is to get the ISO coordinated real-time market established. The next priority for establishing ISO coordinated forward markets has been the day-ahead market. Both PJM and NYISO have been operating ISO coordinated day-ahead markets based on security-constrained unit commitment for nearly five years. And, both PJM and NYISO have operated successfully for a number of years without a full hour-ahead settlement process. The market participants of both ISOs have on various occasions considered adding a third settlement but have never reached the conclusion that such a step was necessary or cost effective. While there are reliability evaluations and scheduling decisions that need to be made in the hour-ahead time frame, both PJM and NYISO have been able to address these needs without adding a full third settlement. The Cal ISO already plans to implement a day-ahead market. Absent identification of important irreversible decisions that Cal ISO market participants would make in such an hour-ahead market but that do not confront market participants in PJM or NYISO, there is no need to increase the administrative and market design complexity, and cost, of the Cal ISO's initial implementation task by requiring that it begin operation of its LMP markets with an

additional settlement process that has not been necessary to date in either of the successful LMP markets.

## **II. ADVANTAGES OF AN HOUR-AHEAD SCHEDULING PROCESS**

The Cal ISO's proposed HASP would achieve most of the purposes of an hour-ahead market, so there would be few if any benefits from the implementation of a full hour-ahead market with the associated additional settlement process. Both the Cal ISO and its market participants, however, would incur additional implementation and operating costs in the development of such an hour-ahead market. Moreover, the operation of a market in the hour-ahead time frame would give rise to market design complexities that could have unintended consequences, giving rise to both market inefficiency and reliability risks if not satisfactorily resolved.

In understanding these conclusions it is useful to begin by discussing the alternative structures within which an hour-ahead market might be implemented and consider how operational and reliability requirements constrain the choice among these alternatives.

There are four broad alternatives for the process leading up to real-time.

- Hour-Ahead Least Cost Scheduling and Unit Commitment Process and Real-Time Dispatch
- Hour-Ahead Market, Hour-Ahead Least Cost Scheduling and Unit Commitment Process and Real-Time Dispatch
- Hour-Ahead Market, Hour-Ahead Reliability Scheduling and Unit Commitment Process and Real-Time Dispatch
- Hour-Ahead Market and Real-Time Dispatch

The first of these alternatives is the approach the Cal ISO proposes to implement: an hour-ahead least cost scheduling and unit commitment process based on forecast load, followed by a real-time dispatch to meet actual load. The second alternative would include a hour-ahead market cleared against bid load, followed by an hour-ahead least cost scheduling and unit commitment process based on forecast load, followed by the real-time dispatch to meet actual load. The third alternative would include a hour-ahead market cleared against bid load, followed by a hour-ahead reliability scheduling and unit commitment process based on forecast load, then followed by the real-time dispatch to meet actual load.<sup>1</sup> The fourth and final alternative would be to clear a hour-ahead market against bid load and then move directly to the real-time dispatch against actual load.

---

<sup>1</sup> The second and third approaches differ in that the second approach would schedule imports and adjust the schedules of units not following real-time dispatch instructions so as to meet forecast load at least cost, whereas the third approach would only schedule imports or adjust unit schedules if required to avoid reserve shortages.

The second and third approaches both include an hour ahead market as well as an additional hour-ahead scheduling and unit commitment process. This feature of these alternatives is important for two reasons. First, by maintaining a scheduling and unit commitment evaluation based on forecast load, in addition to the hour-ahead market clearing based on bid load, these approaches attempt to avoid the potential reliability risks that could arise absent some form of hour-ahead reliability evaluation process based on forecast load. Second, however, these approaches have several disadvantages relative to the structure of the proposed HASP because of the need to introduce an additional hourly process.

The existence of both an hour-ahead market and a subsequent hour-ahead scheduling and unit commitment process would introduce market design issues that would need to be satisfactorily resolved to avoid adverse impacts on market efficiency and reliability. Some of the significant market design issues that would arise under the second or third alternatives include:

- Would import suppliers and export buyers be permitted to revise their bids and offers between the hour-ahead market and the hour-ahead scheduling and unit commitment process?
- Would internal generation suppliers be permitted to revise their bids and offers between the hour-ahead market and real-time?
- Would virtual demand and supply bids be permitted in the hour-ahead market?
- Would load serving entities (LSEs) be permitted to submit additional bilateral schedules in the hour-ahead scheduling and unit commitment process following the Hour-Ahead market?
- Would export buyers be permitted to schedule exports in the hour-ahead market that were not scheduled in the day-ahead market?

Some of the considerations involved in resolving these issues would be:

- If import suppliers were not permitted to offer additional supplies in the hour-ahead scheduling and unit commitment process, introduction of the hour-ahead market would move forward the effective deadline for scheduling imports, potentially reducing import supply offers.
- Such a structure could introduce incentives for LSEs to bid less than their expected load into the hour-ahead market, seeking to price discriminate between suppliers selling power in the hour-ahead market and the real-time market. While the outcomes could be profitable for an individual LSE they could lead to a change in offer prices by suppliers or even a reduction in supply that would raise costs for the market as a whole.
- If suppliers were not permitted to revise their offers between the hour-ahead market and real-time and there were no virtual bidding in the hour-ahead market, suppliers would be likely to offer their output into the hour-ahead market at the

expected real-time price, rather than at incremental cost, leading to market inefficiency, complicating market power mitigation and likely raising costs for consumers and suppliers.

- If suppliers were permitted to revise their offers between the hour-ahead market and real-time, or if import suppliers were permitted to offer additional supplies in the hour-ahead scheduling and unit commitment process, this would expand the time interval required between the posting of schedules for the hour-ahead market and the running of the subsequent hour-ahead scheduling and unit commitment process.
- If export buyers were permitted to schedule exports in an hour-ahead market that preceded the hour-ahead scheduling and unit commitment process, price capped load bids by LSEs in the hour-ahead market based on mistaken price expectations could result in exports being scheduled at a level that results in reserve shortages in real-time, despite adequate resources committed in the day-ahead RUC.

In this regard it is particularly important to recognize that while some market participants may anticipate that with the introduction of an hour-ahead market hour-ahead prices would be systematically lower than real-time prices and see an advantage in such an outcome, this would be an unfortunate outcome. A market design in which hour-ahead prices were systematically lower than real-time prices would be precisely the kind of outcome that would need to be avoided in a market design that includes both an hour-ahead market and real-time settlement if the Cal ISO is to avoid adverse impacts on reliability. If, for example, the hour-ahead market were structured in such a way as to allow LSEs to price discriminate between the hour-ahead market and real-time, such a circumstance would serve to drive price sensitive supply offers out of the hour-ahead market, raising prices and making overall operating day supply and imbalance prices more volatile.

Moreover, among other purposes, the structure of the hour-ahead scheduling and unit commitment process proposed by the Cal ISO is intended to assure that capacity scheduled in the day-ahead RUC is available to meet control area load and is not used to meet export demand if this would leave inadequate resources to meet control area load. This end would be accomplished by determining real-time exports (i.e., those not scheduled in the day-ahead market) in the hour-ahead scheduling and unit commitment process which will take account both of export demand and the Cal ISO's control area load forecast.

In the circumstance in which there is excess demand at the bid cap in the HASP (i.e., internal load plus export demand at the price cap price exceeds supply offers at the price cap price), hourly schedules will be determined in part based on scheduling priorities. The proposed scheduling priorities for the transactions scheduled in the HASP (imports, exports, wheel-throughs and schedules for units unable to follow real-time dispatch instructions) would be: 1) Final day ahead schedules submitted without energy bids; 2) hour-ahead deviations associated with ETC schedules; 3) hour-ahead self-scheduled deviations from must-take/must-run resources; 4) all other hour-ahead self-scheduled deviations; and 5) hour-ahead supply and demand deviations with energy bids.

Priority 4 will include internal California load based on the Cal ISO's load forecast and self-scheduled exports supported by wheels or self-committed generation not scheduled in the day-ahead market or day-ahead RUC. Priority 5 will include all hour-ahead exports not supported by wheelthroughs or self-committed generation not scheduled in the day-ahead market or day-ahead RUC. These load priorities will be relevant if there are insufficient resources available at the bid cap price to meet the Cal ISO's load forecast.<sup>2</sup> In this situation, Priority 5 exports will be scheduled to the extent that resources are available to support those exports in addition to those required to meet the ISO's load forecast and day-ahead export schedules.

If export bids were cleared in a separate hour-ahead market that took account only of bid load, there would be a potential (if control area load bid into the hour-ahead market was less than forecast load) for exports to be scheduled in such an hour-ahead market supported by capacity committed in the day-ahead RUC, even if the scheduling of those exports left inadequate resources to meet control area load in real-time. To avoid this outcome in a market design including an hour-ahead market, it would be necessary to either impose other restrictions on exports scheduled in a hour-ahead market that could create seams and price disparities in the West during non-shortage conditions, or accept the possibility that capacity committed in the day-ahead RUC could be used to support exports during periods in which the Cal ISO control area was reserve-short.

The hour-ahead scheduling and unit commitment process proposed by the Cal ISO is intended to avoid this outcome because export schedules would be determined taking into account both export demand and the Cal ISO's load forecast. Real-time exports (i.e., exports not scheduled in the day-ahead market) would be scheduled in the HASP if they did not compromise the Cal ISO's ability to reliably meet control area load but real-time exports would not be supported by capacity scheduled to meet control area load in the day-ahead market if the scheduling of those exports were expected to have adverse reliability impacts (i.e., if insufficient capacity were available at the bid cap to both meet export demand and control area load). This will be accomplished by assigning exports bids and schedules submitted in the HASP a lower priority than internal Cal ISO control area load, unless the exports are supported by resources not committed in the Cal ISO day-ahead market or by day-ahead export schedules.<sup>3</sup> The structure of

---

<sup>2</sup> In fact, these priorities will only be relevant in the circumstance in which schedules in the hour-ahead scheduling and unit commitment process are cleared either at the bid floor or the bid cap. While the \$250 bid cap is a soft bid cap and it is possible that the Cal ISO would buy power at prices above \$250/MWh in the HASP, we presume that export bids at the bid cap and export self-schedules not scheduled day-ahead would not be cleared in the HASP if clearing these exports required purchasing power at offer prices in excess of the bid cap. Requiring an ISO that is at the margin buying power on a pay-as-bid basis at prices in excess of its bid cap to sell power for export at prices determined by the bid cap price would give rise to incentives for inefficient arbitrage while making no contribution to maintaining reliability. Raising the bid cap to a level less likely to constrain the market clearing price would reduce the likelihood of either the bid cap binding or the Cal ISO needing to make purchases on a pay-as-bid basis at offer prices in excess of the bid cap in order to maintain reliability, but if the bid cap were raised to \$1,000/MWh or more, it would still not be appropriate for the Cal ISO to pay above bid cap prices to support sales of power for export at prices determined by the bid cap.

<sup>3</sup> Since exports scheduled in the Cal ISO's day-ahead market are not recallable by the Cal ISO in the hour-ahead process but can be cancelled by the market participant and sold into the Cal ISO market in real-time, market participants wanting to export firm power can do so under the proposed hour-ahead scheduling process by scheduling those exports in the day-ahead market.

the day-ahead market allows the Cal ISO to take account of export schedules in the day-ahead RUC commitment and ensures that sufficient capacity is committed to meet control area load, to the extent that sufficient capacity is available at the bid cap.

A second disadvantage of introducing the additional hour-ahead market required under the second and third approaches is that because the hour-ahead market would be in addition to the other hour-ahead processes, it must precede them in time, requiring that the hour-ahead market be moved forward in time, relative to the proposed hour-ahead scheduling process, resulting in a greater time difference between such an hour-ahead market and real-time than between the proposed HASP and real-time.

Under the hour-ahead scheduling and unit commitment process proposed by the Cal ISO, scheduling coordinators would submit bids and hour-ahead self-schedules and self-schedule changes for resources and imports, as well as changes to wheeling schedules, by 75 minutes prior to the operating hour. If this hour-ahead scheduling and unit commitment process were to be preceded by an hour-ahead market, the bid submission deadline for the hour-ahead market would need to be moved further forward in time. If market participants were provided an opportunity to rebid between the hour-ahead market and the hour-ahead scheduling and unit commitment process, the time frame for submission of bids and schedules to the hour-ahead market would certainly be two or more hours in advance of real-time.

A third disadvantage of the second and third approaches relative to the hour-ahead scheduling and unit commitment process proposed by the Cal ISO is that the introduction of a complete third settlement process for energy (in addition to the day-ahead market and real-time imbalances) would increase the administrative costs of both the Cal ISO and its market participants. While there may have been a need to bear the administrative costs of a third settlement under the prior market design, as a result of the constraints placed on the real-time dispatch by the market separation doctrine, that is no longer the case. One of the potential cost savings from the introduction of LMP and elimination of market separation is elimination of these additional settlement costs. The administrative costs of implementing an additional market are not insignificant and need to be considered in choosing among these alternatives.

The fourth alternative for the scheduling process leading up to real-time differs from the second and third in that the hour-ahead market would replace the hour-ahead scheduling and unit commitment process, rather than preceding such a process. This difference is significant in reducing the impact on scheduling deadlines of introducing an hour-ahead market. This feature of the fourth alternative also introduces a fundamental reliability issue, however, which is that if the bid load clearing in the hour-ahead market were less than expected real-time load, there would be no subsequent process in which additional imports could be scheduled or the schedules of units not following real-time dispatch instructions could be adjusted to ensure that the import and off-dispatch unit schedules were adequate to maintain reliability (i.e., meet control area load). While such an approach can be workable, such a reliance on the bids and schedules of LSEs for maintaining reliability would be a big step for the California market and careful consideration would need to be given to whether such a fundamental change should be

introduced in conjunction with the other changes associated with MRTU implementation.<sup>4</sup> It would be essential if this approach were adopted that FERC, market participants and the Cal ISO all be satisfied that there were no informational or other impediments to LSEs submitting as accurate load forecasts as those the Cal ISO would develop for use in the hour-ahead scheduling process.

The fourth approach also gives rise to some of the same market design issues that would arise under the second or third approach. In particular:

- Would internal generation suppliers be permitted to revise their bids and offers between the hour-ahead market and real-time?
- Would virtual demand and supply bids be permitted in the hour-ahead market?

An important feature of the fourth approach is that a satisfactory resolution of these market design issues would be necessary not only to ensure market efficiency, but also to maintain reliability. There would be no safety net provided by a subsequent scheduling and unit commitment process based on forecast load if potential strategic bidding by market participants, arising from potential differences between hour-ahead and real-time prices combined with free rider incentives arising from the absence of shortage pricing or other consequences for an LSE that is short in real-time, caused too few imports, from a reliability perspective, to be scheduled in the hour-ahead market. A satisfactory resolution of these market design issues could require substantial and perhaps fundamental changes in the current market design.

A final disadvantage of the fourth approach relative to the proposed hour-ahead scheduling process is that like the second and third approaches the addition of another complete settlement process would raise the administrative costs of both the Cal ISO and market participants.

### **III. POTENTIAL ADVANTAGES OF AN HOUR-AHEAD MARKET**

The FERC suggested in its September Rehearing Order that the Cal ISO evaluate the costs and benefits of employing a financially binding hour-ahead market instead of the simplified hour-ahead schedule process currently reflected in the MRTU market design.<sup>5</sup> As suggested by

---

<sup>4</sup> If an hour-ahead market were cleared based on the Cal ISO load forecast rather than based on market participant load bids, then there would be no separate hour-ahead scheduling and unit commitment process and these reliability issues would be avoided. Such a market design, however, would require resolution of a number of additional settlement issues relating to assignment of costs arising from differences between the Cal ISO load forecast used to clear this hour-ahead market and actual real-time load. For example, if real-time load and prices exceeded the Cal ISO's hour-ahead load forecast and prices, how would the high cost real-time purchases be allocated across LSEs? Conversely, if real-time load and prices were less than the Cal ISO's hour-ahead load forecast and prices, how would the cost of selling back excess hour-ahead purchases at lower real-time prices be assigned to LSEs? Since this does not appear to be the market design envisioned either by FERC or any of the market participants recommending implementation of an hour-ahead market, it is not discussed further below.

<sup>5</sup> Sept FERC ¶ 45-46.



FERC, the Cal ISO would clear a financial hour ahead market based on bid load and then subsequently run a hour-ahead scheduling and unit commitment process to ensure that sufficient resources were available to meet the Cal ISO's load forecast for the hour.

We understand that three broad areas of concern have been identified with respect to reliance on an hour-ahead scheduling and unit commitment process that is not accompanied by an hour-ahead market. These areas of concern are import scheduling, ancillary service scheduling and load scheduling. We discuss these concerns below and conclude that all of these concerns can be addressed within the structure of the Cal ISO's proposed HASP without the need to incur the costs, time lags and market design complications associated with implementation of a full hour-ahead market.

### **A. Import Scheduling**

In discussing the potential need for an hour-ahead market, the FERC suggested in its September Rehearing Order that given the importance of imports in meeting Cal ISO control area load and the need for the Cal ISO to commit to a specific level of imports in the hour-ahead timeframe, it is important that hour-ahead import schedules be accurate.<sup>6</sup> Regardless of whether it is actually the case that the Cal ISO is more dependent on imports than other ISOs or RTOs, the implementation of a hour-ahead financial market would not contribute to achieving the objective of more accurate hour-ahead import schedules. Under the second and third approaches discussed above the hour-ahead import schedules that would need to be accurate would be those determined in the hour-ahead scheduling and unit commitment process to meet forecast load that follows the hour-ahead market. The addition of an hour-ahead market that would be cleared against bid load, before the Cal ISO scheduled imports based on forecast load, would not improve the Cal ISO's scheduling of imports to meet forecast load. On the contrary, the addition of an hour-ahead market could potentially adversely impact the supply of imports offered in the hour-ahead time frame, unless the market design for the hour-ahead market were carefully structured to provide price convergence between the hour-ahead market, hour-ahead scheduling and unit commitment process and real-time. The potential for import transactions to be cleared at low prices in a financially binding hour-ahead market due to low bid load while real-time prices are high, could discourage external suppliers from offering real-time imports unless the dual markets are carefully designed.

Under the fourth approach, import schedules would be determined solely in the hour-ahead market, but achieving accurate import schedules based on bid load would require that the LSEs would be able to obtain the information needed for accurate load bidding within the time-constraints of the hour-ahead market and that the market design provide efficient incentives for accurate load bidding. Absent assurance that these requirements can be met, implementation of the fourth approach is likely to reduce, rather than increase, the accuracy of hour-ahead import schedules.

---

<sup>6</sup> Sept FERC ¶ 46.

The FERC also suggested that a financially binding hour-ahead market would be useful in minimizing uplift charges on imports.<sup>7</sup> This would only be the case under the fourth approach in which imports were scheduled in the financially binding hour-ahead market and there was no subsequent hour-ahead scheduling unit commitment process in which additional imports would be scheduled. Under either the second or third approach, additional imports or exports could be scheduled in a hour-ahead scheduling and unit commitment process that followed the hour-ahead market, so depending on the settlement rules for the hour-ahead scheduling and unit commitment process, there could still be a potential for uplift on imports as well as a need to carefully coordinate the two markets to avoid deterring external suppliers from offering imports.

While implementation of the fourth approach would have the advantage of eliminating most or all uplift charges attributable to the scheduling of imports, the uplift costs associated with import schedules under the first three approaches will be small if real-time prices are not materially below the cost of marginal imports. If real-time prices are materially below the cost of the level of imports needed to reliably meet load and maintain reserves, then the hour-ahead scheduling and unit commitment process could give rise to material uplift costs, but in this circumstance an hour-ahead market not accompanied by a scheduling and unit commitment process based on forecast load would be likely to schedule insufficient imports from a reliability standpoint. Significant uplift costs associated with imports scheduled in the hour-ahead scheduling and unit commitment process are a symptom of a problem of some sort in the hour-ahead scheduling and unit commitment process, in real-time operating protocols, or in pricing and if they arise their cause needs to be identified and addressed. If there is in fact an inconsistency between the level of imports that are economic at real-time prices and the quantity needed from a reliability standpoint, then limiting the scheduling of imports to those scheduled in an hour-ahead market based on bid load will undermine reliability. If the scheduling of imports that are needed from a reliability standpoint gives rise to substantial uplift costs, the cause of these uplift costs needs to be identified and if possible addressed. The appropriate market design response, however, is not to change the market design in such a way that the imports needed to maintain reliability would not be scheduled.

An hour-ahead market would also be useful in pricing congestion on the ties, but this issue has been addressed by the Cal ISO's revised HASP pricing mechanism. If there is congestion on the ties in the HASP, the imports scheduled in this process (deviations against day-ahead schedules) will be paid the lower of the price determined at the external bus in the hour-ahead scheduling process or the real-time price, subject to a bid production cost guarantee that assures that resources providing imports always at least recover their as bid costs.<sup>8</sup> Similarly, bilateral import schedules will pay congestion based on the lower of the price determined at the external bus in the hour-ahead scheduling process or the real-time price. Conversely, if there is congestion on a tie, exports scheduled on that tie in this process (deviations against day-ahead schedules) will pay the higher of the price determined in the hour-

---

<sup>7</sup> Sept FERC ¶ 45.

<sup>8</sup> The Cal ISO is considering applying this pricing rule to imports whether or not congestion exists in the HASP.

ahead scheduling process or the real-time price and bilateral export transactions will pay congestion charges on the same basis.<sup>9</sup>

More generally, FERC suggested that such an hour ahead market might be helpful because of the variability of load in California and the importance that hour-ahead scheduling adjustments be accurate.<sup>10</sup> The implementation of such an hour-ahead financial market would contribute little to achieving this objective, however, because the hour-ahead schedules whose accuracy would be important would be those determined in the hour-ahead scheduling and unit commitment process based on forecast load.

While an hour-ahead market would provide an additional market in which LSEs could purchase imports at market clearing prices prior to real-time, market participants that wish to lock in the cost of imports or exports prior to real-time can do so under the proposed hour-ahead scheduling process by entering into bilateral contracts and scheduling these import or export transactions in the hour-ahead scheduling and unit commitment process.

## **B. Ancillary Services**

A concern has been expressed that the hour-ahead scheduling and unit commitment process would not provide for a real-time auction market for ancillary services, would not provide for ancillary service suppliers to be paid the market clearing price, and would not provide for a capacity payment for import suppliers of ancillary services.<sup>11</sup> These concerns are addressed in the structure of the hour-ahead scheduling and unit commitment process proposed by the Cal ISO as ancillary service schedules and compensation will be determined prior to real-time in the hour-ahead scheduling and unit commitment process.

The FERC suggested that these kinds of concerns could be addressed by clearing an hour-ahead ancillary services market in conjunction with an hour-ahead energy market.<sup>12</sup> It needs to be kept in mind that if the day-ahead ancillary services schedules were adjusted in such an hour-ahead market, the assignment of ancillary service schedules to individual units in the hour-ahead market would be determined by scheduling resources to meet bid load, rather than in conjunction with the scheduling of resources to meet the Cal ISO's load forecast as will be the case in the HASP. Thus, the proposed HASP will jointly schedule ancillary services for the operating hour in combination with the determination of intertie schedules and schedules for resources not being dispatched on a five or ten minute basis. The process will produce real-time

---

<sup>9</sup> This pricing rule closely parallels the current NYISO pricing rule for imports scheduled in NYISO hour-ahead scheduling process (originally implemented as ECA B). A pricing rule similar to that employed by the NYISO will be appropriate for the markets coordinated by the Cal ISO because the Cal ISO's proposed modeling of tie line flows and redispatch for pricing purposes (internal generation has zero impact on tie lines) is analogous to the real-time modeling implemented by NYISO. In the event that the Cal ISO changes its modeling of internal generation to account for its impact on tie line flows, i.e., modeling the loopflows through the rest of the WSCC, a switch to the PJM pricing approach for tie line schedules would likely be appropriate.

<sup>10</sup> Sept FERC ¶ 45.

<sup>11</sup> Request for Rehearing of Powerex Corp, Docket ER02-1656-017 etc., June 19, 2004, p. 2-3, 5

<sup>12</sup> Sept FERC ¶ 46.

ancillary services awards for any incremental<sup>13</sup> ancillary service capacity needed as a result of load forecast changes, outages or other real-time operational considerations,<sup>14</sup> that would be generally consistent with the expected real-time dispatch of the resources.

The total quantity of ancillary services scheduled in a separate hour-ahead market would be based on the Cal ISO's load forecast (to the extent that the quantity needed depends on the load level), but the unit commitment and scheduling decisions in such an hour-ahead market would be based on a dispatch to meet bid load, rather than forecast load. However, if there is a hour-ahead scheduling and unit commitment process based on forecast load subsequent to the hour-ahead market in which ancillary service schedules were determined, the opportunity cost of carrying ancillary services on particular on-line units could be very different between the hour-ahead market cleared based on bid load and real-time. To the extent that day-ahead ancillary service schedules were adjusted in such a hour-ahead market, these inconsistencies between opportunity costs in the hour-ahead market and in real-time would raise the cost of meeting load. Thus, market participants could incur the costs of clearing and settling an additional market in order to produce higher cost ancillary service schedules. Moreover, systematic differences between the opportunity costs in the hour-ahead market in which ancillary service payments were determined and actual real-time opportunity costs could adversely affect the willingness of market participants to offer ancillary services in the hour-ahead market.

### **C. Load Schedules**

A further concern has been expressed that, absent an hour-ahead market, the hour-ahead scheduling process would preclude "load from providing bids or providing self-schedule changes including balanced self-schedule changes. The Hour-Ahead market, if simplified, must allow load to adjust schedules and resources," and should not "limit load in its ability to respond to system and market conditions."<sup>15</sup> This concern is addressed by the structure of the proposed

---

<sup>13</sup> Incremental to the resources scheduled in the day-ahead market

<sup>14</sup> While the Cal ISO anticipates that the changes in ancillary service schedules between those determined in the day-ahead market and those in the hour-ahead scheduling process will typically be small, it is desirable that the Cal ISO's market design have the flexibility to accommodate the need for such changes. These changes are most likely to be necessary during periods of stressed system conditions in which generation or transmission outages over the course of the day may cause the set of on line resources to differ materially from those scheduled in the day-ahead market and reflected in day-ahead ancillary service schedules.

There is a separate question of whether it would be desirable and cost effective to financially settle differences between day-ahead ancillary service schedules and those determined in the HASP. Implementation of such a financial settlement does not depend on implementation of an hour-ahead market, however, so it is not necessary to resolve whether there should be such a second settlement for ancillary services in assessing whether the Cal ISO should clear and settle an hour-ahead market in addition to the HASP. As discussed below, if such a second settlement for ancillary services were implemented, it would be preferable to implement it in the Cal ISO's HASP, rather than in a preceding hour-ahead market, to reduce the potential for inconsistencies arising from differences between the opportunity costs of providing ancillary services from particular resources evaluated based on bid load and actual real-time load.

<sup>15</sup> Motion to Accept Late Filed Comments and Comments of Pacific Gas and Electric Company Regarding the Proposals of the California Independent System operator Corporation Regarding Technical Conference; Docket ER02-1656-000. June 8, 2004, pp. 5-6 and Pacific Gas and Electric Company's Request for Rehearing or

hour-ahead scheduling and unit commitment process, which will permit loads to submit resource self-schedule changes up to 75 minutes before the beginning of the operating hour. These resource schedules would automatically be balanced against the submitting LSE's real-time load for settlement purposes. These resource schedules would include incremental and decremental bids carried forward for dispatchable load in real-time. There will therefore be no apparent need for LSEs to separately submit load bids or load schedule changes in the hour-ahead scheduling and unit commitment process. LSEs need only schedule the energy supply for any bilateral transactions that the LSE wishes to use to meet its load, which transactions will automatically be settled against the LSE's real-time load. The structure of the proposed hour-ahead scheduling and unit commitment process therefore does not discriminate against adjustment of load schedules. Rather, the load schedule of LSEs would effectively be automatically adjusted upwards to reflect their real-time load to the extent that the LSE has scheduled resources to meet that load. The net transactions in the real-time market, on which credit requirements are determined, would therefore be limited to the difference between the LSE's real-time load and the resource schedules it submitted in the HASP.

A related concern has been expressed that the structure of the hour-ahead scheduling and unit commitment process could lead to the allocation of uplift costs associated with the hour-ahead unit commitment to LSEs that have scheduled resources to meet their load after the day-ahead market has been settled, but are not short in real-time.<sup>16</sup> The Cal ISO has clarified that hour-ahead unit commitment costs will be assigned to load that was neither scheduled in the DAM nor met in real-time with resources scheduled in the hour-ahead scheduling and unit commitment process. Thus, LSEs that submit schedules in the HASP that are sufficient to cover the difference between their real-time load and day-ahead schedules will not be assigned hour-ahead unit commitment costs for having underscheduled their real-time load.

Similarly, a concern that an inability to schedule load in an hour-ahead market would provide a disincentive for LSEs to procure resources intra-day would not apply under the structure of the Cal ISO's hour-ahead scheduling and unit commitment process as LSEs would be able to schedule intra-day resources to meet their load in the HASP.<sup>17</sup> On the contrary, because the hour-ahead scheduling and unit commitment process would close closer to real-time, the proposed structure of the Cal ISO hour-ahead scheduling and unit commitment process would facilitate intra-day scheduling of resources by LSEs.

Finally, a concern has been expressed that absent load schedules, the Cal ISO may commit resources or schedule imports to meet loads that will not materialize in real-time.<sup>18</sup> The Cal ISO's hour-ahead scheduling and unit commitment process should be based on the most accurate and up to date load forecast that is available at the time that the Cal ISO makes these

---

Clarification of October 28, 2003 and June 17, 2004 Further Orders on California ISO Market Design, pp. 4-6, July 16, 2004 (hereafter PG&E July).

<sup>16</sup> PG&E July, pp. 5-6.

<sup>17</sup> PG&E July, pp. 5-6.

<sup>18</sup> See for example, Request for Rehearing of the Metropolitan Water District of Southern California of Order on Further Development of CAISO Market Design. ER02-1656-017, etc., pp. 7-8.

decisions. On the other hand, as discussed above there could be reliability risks in moving to an operational system that relies exclusively on the hour-ahead load bids and schedules of LSEs to ensure that adequate resources are available to meet control area load in real-time. And there must be some time which is the last time for forward decisions. It is therefore intrinsic to the Cal ISO proposal, and any other structure in which there is a hour-ahead scheduling and unit commitment process based on forecast load, that sufficient resources would be committed to meet the Cal ISO's load forecast even if that load were not bid by LSE's in a hour-ahead market process. If there is an hour-ahead scheduling and unit commitment process based on forecast load, then there is a potential for Cal ISO load forecast errors to raise costs by scheduling more imports than necessary or committing more short-start units than necessary. This potential for ISO error is not reduced if there is an hour-ahead market that clears based on bid load prior to the hour-ahead scheduling and unit commitment process.

The basic market design principle is to match the procedures and incentives with the requirements of a reliable electricity system while allowing flexibility for market participants to express their choices in a market driven system. Supply and demand decisions should be voluntary but made with consistent prices that provide incentives to match the choices and account for impacts on the system. The principal exceptions occur when the dictates of reliability (e.g., in the day-ahead RUC) or the timing of critical decisions (e.g., hour-ahead imports) require physical and financial commitments that may not be fully voluntary or that cannot be made with fully consistent contemporaneous prices. In these cases, the Cal ISO applies design principles to (i) minimize the necessary exceptions; (ii) employ pricing rules to avoid substantial conflicts with market incentives; and (iii) require little socialization through uplift charges.

---

<sup>i</sup> William W. Hogan is the Lucius N. Littauer Professor of Public Policy and Administration, John F. Kennedy School of Government, Harvard University and a Director of LECG, LLC. This paper draws on work for the Harvard Electricity Policy Group and the Harvard-Japan Project on Energy and the Environment. The author is or has been a consultant on electric market reform and transmission issues for Allegheny Electric Global Market, American Electric Power, American National Power, Australian Gas Light Company, Avista Energy, Brazil Power Exchange Administrator (ASMAE), British National Grid Company, California Independent Energy Producers Association, California Independent System Operator, Calpine Corporation, Central Maine Power Company, Comision Reguladora De Energia (CRE, Mexico), Commonwealth Edison Company, Conectiv, Constellation Power Source, Coral Power, Detroit Edison Company, Duquesne Light Company, Dynegy, Edison Electric Institute, Edison Mission Energy, Electricity Corporation of New Zealand, Electric Power Supply Association, El Paso Electric, GPU Inc. (and the Supporting Companies of PJM), GPU PowerNet Pty Ltd., GWF Energy, Independent Energy Producers Assn, ISO New England, Luz del Sur, Maine Public Advocate, Maine Public Utilities Commission, Midwest ISO, Mirant Corporation, Morgan Stanley Capital Group, National Independent Energy Producers, New England Power Company, New York Independent System Operator, New York Power Pool, New York Utilities Collaborative, Niagara Mohawk Corporation, NRG Energy, Inc., Ontario IMO, Pepco, Pinpoint Power, PJM Office of Interconnection, PP&L, Public Service Electric & Gas Company, Reliant Energy, Rhode Island Public Utilities Commission, San Diego Gas & Electric Corporation, Sempra Energy, SPP, Texas Utilities Co, TransEnergie, Transpower of New Zealand, Westbrook Power, Western Power Trading Forum, Williams Energy Group, and Wisconsin Electric Power Company. The views presented here are not necessarily attributable to any of those mentioned, and any remaining errors are solely the responsibility of the author. (Related papers can be found on the web the web at [www.whogan.com](http://www.whogan.com).)