

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

Price Formation in Energy and Ancillary)
Services Markets Operated by Regional)
Transmission Organizations and)
Independent System Operators)

Docket No. AD14-14

**Comments of the California Independent System Operator
Corporation on Technical Workshops**

The California Independent System Operator Corporation (CAISO) submits these comments in response to the notice inviting post-technical workshop comments in this proceeding.¹ The Commission's notice identifies specific goals concerning price formation in organized markets, including the goal of committing resources economically scheduled through market processes. However, the Commission also recognizes that a number of technical and operational considerations impact market outcomes. In these comments, the CAISO explains how its market structure addresses various price formation issues and discusses the activities it is undertaking to improve the energy and ancillary service price formation process.

Each year, the CAISO undertakes a stakeholder initiative catalog process to rank market initiatives that can help advance the efficiency of its market

¹ <http://www.ferc.gov/CalendarFiles/20150116165903-AD14-14-000TC.pdf>
On February 9, 2015, the Commission issued a Notice Granting Extension of Time up to and including March 6, 2015 to submit comments.
<http://elibrary.ferc.gov/idmws/common/opennat.asp?fileID=13768050>

processes.² The CAISO gathers input from stakeholders, prioritizes potential initiatives, and confers with the CAISO's Board of Governors to ensure the efforts it will undertake are consistent with the CAISO's strategic plan and corporate goals. The CAISO presents its policy initiatives roadmap to its Board of Governors in an open meeting at which stakeholders have the opportunity to comment. At the February 2015 CAISO Board of Governors' meeting, the CAISO briefed its Board of Governors on its roadmap, which includes a number of efforts to enhance efficient and transparent price formation in the CAISO's energy and ancillary service markets.³ These efforts include, among others, an initiative to develop a flexible ramping product and market enhancements to secure and compensate capacity to address post-contingency re-dispatch to bring the system within operating limits within 30 minutes (*i.e.* protect against N-1-1 contingencies).

The CAISO appreciates the Commission's ongoing efforts to explore price formation issues in organized markets in order to promote efficient market outcomes. Because many price formation issues are unique to particular markets, the CAISO requests that the Commission allow market operators to continue to work with their stakeholders to identify price formation issues and

² More information about the CAISO's stakeholder initiatives catalog process is available on the following website: <http://www.caiso.com/informed/Pages/StakeholderProcesses/StakeholderInitiativesCatalogProcess.aspx>

³ A copy of the CAISO's presentation to its Board of Governors is available on the following website: <http://www.caiso.com/Documents/BriefingPolicyDevelopmentRoadmap-Presentation-Feb2015.pdf>

propose enhancements to their individual market structures to address these issues.

I. Offer Caps

As discussed at the price formation workshops, high natural gas prices during the winter of 2013-2014, indicated that the current generic \$1,000/MWh cap on energy offers might be insufficient in some markets to allow natural gas-fired generators to recover their costs when natural gas prices spike during constrained winter periods.

a. Should the \$1,000/MWh offer cap be modified?

The CAISO has not identified the need to increase the maximum energy bid price in its markets.⁴ The CAISO opposes spending resources on this market design change absent record evidence that demonstrates that the change will result in sufficient benefits.

The CAISO is not aware of a situation in which the maximum energy bid price of \$1,000/MWh was insufficient for a resource to recover its costs in the CAISO's markets during the winter of 2013-2014. Natural gas prices at trading hubs serving natural gas-fired resources in the CAISO's balancing authority area have remained generally stable, and price spikes during the winter of 2013-2014 did not result in increased fuel costs such that the \$1,000/MWh maximum energy bid price would not cover resources' costs. If the Commission seeks to modify

⁴ In February 2014, the CAISO market did experience an isolated occurrence with respect to whether proxy start-up and minimum load costs for natural gas-fired resources appropriately reflected a gas spike and whether applicable locational marginal prices were sufficient to compensate resource for these commitment costs.

the offer cap, the Commission should provide an opportunity and ensure there is sufficient time for each market operator to conduct a stakeholder process to collect information about actual costs that may justify an increase. Absent a showing of need by market participants, the Commission should allow market operators to retain their current offer cap.

i. If the offer cap is modified, what form should the offer cap take? For instance, should a modified cap be set at a level greater than the current \$1,000/MWh cap and apply even if a resource has costs greater than the new cap or should the offer cap be replaced with a structure that allows offers at the higher of marginal cost or the existing \$1,000/MWh cap? Should it be a fixed cap or a floating cap that varies with the price of fuel (e.g., natural gas)? If a modified cap were set as a fixed offer cap, what should the new offer cap be? What should be the basis for determining the fixed offer cap?

As described above, the CAISO has not identified the need to increase the maximum energy bid price in its markets. The CAISO recommends that the Commission only approve proposals to raise this offer cap if it observes the \$1,000/MWh maximum energy bid price does not cover resources' costs. The CAISO recommends that any offer cap should cover the marginal resource's costs under peak load conditions.

The CAISO has concerns with a structure that would allow bids above a fixed offer cap based on demonstrations of actual costs incurred by the suppliers because there is not a definite means to verify the cost of natural gas to a specific supplier at the time a supplier submits an offer. Market participants do not always purchase natural gas before submitting offers. For instance, the information available might only be a price quotation, which would be difficult for the CAISO to verify and could be open to manipulation. Even if this difficulty can

be overcome, a “soft cap” or “floating cap” approach that allows bids above the offer cap based on demonstrations of costs is problematic. Besides verifying costs, the CAISO would have to modify its market model set-up each time suppliers submitted bids above the offer cap in order to change constraint penalty prices that are set relative to the offer cap. This step would be necessary so that that the market would dispatch economic bids rather than relax constraints.

ii. If the offer cap should not be modified or set such that marginal costs could be greater than \$1000/MWh, how should the Commission ensure that suppliers with costs greater than the cap have the opportunity to recover those costs?

Again, the CAISO has not identified the need to increase the maximum energy bid price in its markets. If the Commission decides to examine an approach that provides for after-the-fact reimbursement of costs above an offer cap, the CAISO would have concerns with such an approach. The CAISO may not have access to information necessary to verify that a gas invoice represents gas costs associated with a particular CAISO dispatch. If the Commission does pursue such an approach, it will need to define how to assess whether cost recovery is appropriate. Cost recovery could be assessed hourly, daily, or over longer periods and any assessment of cost recovery should consider hedging arrangements entered into by the supplier. Given the complexity of hedging instruments and programs, this assessment would likely be challenging for the CAISO or the Commission to complete.

The Commission would also have to define the gas costs eligible for reimbursement. Resources critical to the reliability in the CAISO’s system receive

compensation for capacity obligations under resource adequacy provisions. These capacity obligations include fuel costs associated with the resources' obligations to ensure they have fuel and are available to the market as required by resource adequacy obligations. The CAISO believes, if it were to provide reimbursement for fuel costs above the bid cap, these costs should only include incremental fuel costs supporting the resource's offer as opposed to other costs related to a resource's capacity obligation such as natural gas pooling arrangement costs, imbalance penalties, or risk premiums to cover the cost of selling natural gas at a loss when a resource procures gas and then is not dispatched by the CAISO. The CAISO believes these costs are more appropriately recovered through compensation the resource receives for providing capacity as a resource adequacy resource as opposed to through the CAISO's energy markets.

iii. Do the real-time and day-ahead market clearing processes allow sufficient time to verify the cost-basis of the marginal resources that exceed the offer cap? Does the settlement process allow sufficient time to verify costs of resources that receive uplift associated with offers that exceed the offer cap?

The CAISO does not believe there is a firm basis to verify the natural gas price on which offers are based at the time suppliers submit offers because market participants do not always purchase gas before submitting offers. While there could conceivably be time for the CAISO to verify the cost incurred by resources during the settlement process, the CAISO believes there are many challenges to do so. In addition to the reasons described in the answer to question I.a.ii, the CAISO may have to correct prices after-the-fact based on the

natural gas cost information. Accordingly, two potential remedies may exist: (1) the CAISO would need to re-run the market; or (2) the CAISO would need to incorporate the after the fact verified costs into bid cost recovery calculations for the resource. For the first option, the CAISO could not reverse the optimal schedules originally awarded and this fact may create inconsistencies between original awards and the market re-run. For the second option, the CAISO could in theory incorporate costs into bid cost recovery calculations, but the process to verify these costs would be a significant challenge due to the time and access to information necessary to verify the actual costs.

b. What are the advantages and disadvantages of having offer caps be set at the same level across all RTOs/ISOs? Would different offer caps across the RTOs/ISOs exacerbate interface pricing issues at RTO/ISO borders? If so, how? Would an offer cap that takes the form of the higher of marginal cost or \$1,000/MWh create the same issues as setting different offer caps across RTOs/ISOs?

The CAISO does not believe it is necessary to increase offer caps above \$1,000/MWh to address natural gas procurement in the West because the CAISO is not aware of a situation in which the maximum energy bid price of \$1,000 MWh was insufficient for a resource in the CAISO markets to recover its costs. The CAISO does not have specific comments in response to the sub-parts of question I.b.

c. What impact would adjusting the offer cap have on other aspects of RTO/ISO price formation (e.g., mitigation rules or shortage pricing rules)? Would other market rule changes be necessary if offer cap levels were adjusted? Do other challenges associated with modifying offer cap rules exist? If so, what are they? If offer cap rules are adjusted, how quickly could RTOs/ISOs incorporate adjusted offer cap rules into their software and the market clearing process?

In the CAISO's markets, changes to the maximum energy bid price would affect the administrative prices in the CAISO's scarcity pricing demand curves.⁵ The maximum energy bid price also informs the CAISO's penalty price when the CAISO relaxes a transmission constraint or the constraint to match supply and demand so that the CAISO market software can generate a feasible solution.⁶ If the Commission modified the CAISO's offer cap, the CAISO estimates it would need approximately 9-12 months to develop business rules to incorporate an adjusted offer cap in the CAISO's market clearing process and allow market participants time to update their systems.⁷ Also, because of significant resource burdens (on the CAISO and market participants) and general system needs, the CAISO has moved to a paradigm where it has one market-related release in the fall and one general system maintenance release in the spring each year. Depending on the timing of any change directed by the Commission, the implementation date could occur more than a year later.

d. Should the same offer cap that applies to generation also apply to load bids? What are the advantages and disadvantages of applying an offer cap to load bids?

The CAISO believes that any market mitigation rules should treat all resources in a comparable fashion. Under the CAISO's current tariff, all resources are subject to the maximum energy bid price. To the extent the Commission plans to structure offer caps based on the cost to a participating

⁵ CAISO tariff section 27.1.2.3.

⁶ *Id.* at sections 27.4.3.2, 27.4.3.3, 27.4.3.4

⁷ Under the CAISO's nodal markets implemented in 2009, the CAISO increased its maximum energy bid price once in 2010 and once in 2011.

resource - such as load - not consuming power as opposed to the cost of participating resource - such as a generator - to produce power, the Commission should undertake a generic proceeding to gather additional record evidence. Based on the record in this proceeding, the CAISO does not believe its current offer cap prevents a participating resource such as load from recovering its costs of not consuming power.

II. Transparency

At the Uplift and Operator Actions Workshops, some panelists addressed issues concerning insufficient transparency of uplift and operator actions.⁸

Improved transparency could inform resource entry and exit and market rule discussions; improved transparency could also improve market understanding, predictability, and confidence.

a. What should RTOs/ISOs do to improve transparency of uplift credits and charges, unit commitment, and other operator actions? Please comment on the type of information that would be useful, why it is necessary, whether it should be shared with specific resources or available to all, the timing of its release, and whether it is feasible to release the information in real-time.

Currently, the CAISO has several mechanisms to provide information to and discuss market performance with market participants and interested stakeholders. Among these, the CAISO publishes monthly market performance reports, which address multiple metrics regarding CAISO market performance

⁸ See, e.g., Operator Actions Workshop, Docket No. AD14-14-000, Tr. 180:8-183:4 (Dec. 9, 2014); Uplift Workshop, Docket No. AD14-14-000, Tr. 168:1-16 (Sept. 8, 2014). For this purpose we are defining uplift credits as payments made to resources whose commitment and dispatch by an RTO/ISO result in a shortfall between the resource's offer and the revenue earned through market clearing prices.

and trends of bid cost recovery. The CAISO has enhanced these metrics to provide more granularity and identify patterns to gauge the reasons for and impacts of bid cost recovery.⁹ The CAISO also issues price correction reports that provide visibility on market issues requiring price corrections.¹⁰ The CAISO holds regular market performance and planning meetings with market participants and interested stakeholders at which it discusses market performance issues. These discussions include the topic of uplift that is occurring in the CAISO system and the reasons for uplift costs. At these meetings, the CAISO also discusses how it models transmission constraints and minimum online commitments in its integrated forward market and real-time market. The CAISO provides presentations on these issues and makes these materials available to market participants.¹¹

In addition to the reports and meetings described above, the CAISO's Department of Market Monitoring publishes quarterly and annual reports on market performance. These reports typically provide the Department of Market Monitoring's independent assessment of uplift credits and charges, unit commitment, and other ISO-operator actions.

⁹ See e.g. Monthly Market Performance Report for December 2014: http://www.aiso.com/Documents/MarketPerformanceReport_December_2014.pdf

¹⁰ See e.g. Price Correction Report for the week of February 23-27, 2015: http://www.aiso.com/Documents/WeeklyPriceCorrectionReportFeb23-27_2015.pdf

¹¹ See e.g. Agenda and presentation at January 20, 2015 market a planning an performance forum: http://www.aiso.com/Documents/Agenda-Presentation_MarketPerformance-PlanningForum_Jan20_2015.pdf

The CAISO also makes available outage information through two sources. First, the CAISO posts information regarding outages impacting a defined path through its open access same-time information system. Second, the CAISO provides information regarding specific transmission elements that are out of service to market participants that have signed a non-disclosure agreement through a secure access site. Every month, the CAISO also releases a network model - the monthly congestion-revenue-right network model - that reflects certain significant outages. CAISO market participants, however, have expressed interest in obtaining outage information sooner so they can use it for market analysis.

With respect to other operator actions¹², the CAISO explains exceptional dispatch trends to market participants and provides the reasons why the CAISO issued any exceptional dispatches. The CAISO files two monthly reports with the Commission that provide data on the frequency and reasons for exceptional dispatches. These reports include the following information: (1) the reason for the exceptional dispatch; (2) the location of the resource by participating transmission operator service area; (3) the local reliability area, where applicable; (4) whether the exceptional dispatch occurred in day-ahead or real-time; and (5) the date of the exceptional dispatch. For each exceptional dispatch, the CAISO also identifies megawatt quantities, whether a unit commitment occurred,

¹² The CAISO issues exceptional dispatch instructions to address conditions that cannot be addressed through the market. These operator interventions generally arise from one of three reasons: (1) System emergencies that involve conditions beyond our control such as forced generation and transmission outages; (2) transmission modeling constraints—planned outages that cannot be fully modelled and require exceptional dispatches to support; or (3) other modeling limitations such as software limitations or anything that the market either cannot respond to at all or within the time needed to prevent a system emergency.

whether the dispatch was incremental or decremental, the costs of each exceptional dispatch, the number of hours dispatched, as well as the dispatch beginning and end time. With respect to information closer to real-time, the CAISO posts information concerning exceptional dispatches on OASIS.

Some level of operator intervention will necessarily continue to occur in the CAISO's markets. However, since 2012, the CAISO has reduced the amount of exceptional dispatches it issues. Several factors have contributed to these reductions, including:

- Improving the accuracy of the CAISO's day-ahead load forecasts.
- Improving the accuracy of day-ahead renewable forecasts.
- Improving transmission constraint and contingency modeling.
- Enforcing minimum online commitment constraints in the integrated forward market and real-time market to address operational needs that require a minimum quantity of committed online resources to maintain reliability.
- Implementing the flexible ramping constraint to ensure sufficient resources are committed through the market to meet upward ramping needs.

The CAISO will continue to work with its stakeholders to consider other data release measures that provide greater transparency into its market's operation.

b. What types of information should not be shared publicly? Why? What are the concerns with commercially sensitive information?

Under the CAISO tariff, the CAISO maintains certain market information as confidential.¹³ Examples of confidential information include individual bids, resource-specific outage programs, and individual resource adequacy plans. The CAISO, however, can release composite data and other information developed from this confidential information. For example, the CAISO releases bid information 90 days after the trading day but does not reveal the identity of the scheduling coordinators that submitted those bids.¹⁴

The CAISO believes that information that reveals commercial strategies of market participants should remain confidential. In addition, critical energy infrastructure information should also remain confidential. Disclosing commercially sensitive information may jeopardize the legitimate interests of buyers and sellers to participate on level terms in the electric market. At the same time, the CAISO acknowledges that all market participants must have relevant information to inform their participation in the market.

The CAISO has a process through which market participants can request the CAISO release additional information. When the CAISO receives such a request, it confers with its legal department to ensure the information is not considered confidential under the CAISO tariff and then discusses the request with market participants through the CAISO's market performance and planning forum. For example, market participants have requested the CAISO release

¹³ See CAISO tariff, section 20.

¹⁴ See CAISO tariff, section 20.4(a).

additional information each day showing energy scheduled by variable energy resources in the integrated forward market compared to the CAISO's forecast output for these resources to better inform their bidding and scheduling in the markets. The CAISO is now working to make this information available to market participants and interested stakeholders. Consistent with prior data release stakeholder initiatives, the CAISO will continue to explore opportunities to make more information about operator actions transparent to the market.

c. Commission Staff's August 2014 report on uplift noted several issues with the consistency and granularity of uplift data provided as part of the Electric Quarterly Reports.¹⁵ What steps could be taken to improve the quality of uplift data required to be reported as part of the Electric Quarterly Reports?

The CAISO has no comment on this question at this time.

¹⁵ FERC, *Staff Analysis of Uplift in RTO and ISO Markets*, Docket No. AD14-14-000, at 21-28 (Aug. 2014), available at <http://www.ferc.gov/legal/staff-reports/2014/08-13-14-uplift.pdf>.

III. Pricing Fast-Start Resources

Commission Staff's December 2014 paper regarding operator-initiated commitments discussed how RTOs/ISOs relax the minimum operating level of resources to make certain block-loaded fast-start resources appear dispatchable to the pricing software, and thus eligible to set the market clearing price as the marginal resource.¹⁶ The paper also discussed how some RTOs/ISOs have modified the locational marginal price framework to include start-up and no-load costs of certain fast start resources (e.g., New York Independent System Operator, Inc.'s (NYISO's) Hybrid Pricing).¹⁷

a. During the Operator Actions Workshop, panelists explained that relaxing resource minimum operating limits can lead to incentive and operational issues such as over-generation.¹⁸ What tradeoffs are involved with relaxing the minimum operating limits of block-loaded resources to zero for purposes of price setting? Should relaxing the minimum operating level be limited to block-loaded fast-start resources, or should relaxation be available to a larger set of resources?

As explained in the December 2014 Commission staff report, *Operator-Initiated Commitments in RTO and ISO Markets*, relaxing resource minimum operating limits for price setting purposes can lead to potential over-generation condition and not align prices with incentives. In these circumstances, resources

¹⁶ FERC, *Price Formation in Organized Wholesale Electricity Markets: Staff Analysis of Operator-Initiated Commitments in RTO and ISO Markets*, Docket No. AD14-14-000, at 28-30 (Dec. 2014), available at <http://www.ferc.gov/legal/staff-reports/2014/AD14-14-operator-actions.pdf>.

¹⁷ *Id.*

¹⁸ Operator Actions Workshop, Docket No. AD14-14-000, Tr. 282:9-25 (Dec. 9, 2014).

with marginal costs below the locational marginal price have an incentive to over-generate even if they are backed down.¹⁹

The CAISO has balanced these concerns by limiting the relaxation of minimum operating levels in the market model's pricing run to only resources that have a minimum operating level that is very close to their maximum operating level. There currently are very few of these resources in the CAISO market. The CAISO has concerns about expanding this treatment to other resources because the CAISO is facing potential over-generation during the middle of the day when it must keep generation on-line to meet large ramps in the evening as solar production increases. Higher prices during the middle of the day would not provide an incentive for decremental energy and export bids to resolve over-generation.

b. What are the merits of expanding the set of costs included in the energy component of LMP (i.e., start-up and no-load costs)? What factors should be considered when expanding the set of costs included in the energy component of LMP? If the start-up and no-load costs of block-loaded fast-start resources are included in the LMP, how should they be included? For example, should start-up costs only be included during intervals when the resource starts up?

The objective of a market clearing process is to establish prices that accurately reflect the system and market conditions. There are limitations, however, in establishing prices that recover all costs such as resources' minimum load and start-up costs. As a result, the CAISO has developed a bid cost recovery mechanism that results in uplift costs. The CASIO is aware of

¹⁹ Although the CAISO currently does not have an uninstructed deviation penalty that may help address this issue, the CAISO is examining means to allocate market costs caused by deviations. For example, the CAISO is considering allocating of a portion of its proposed flexible ramping product costs to resources for their uninstructed deviations.

proposals to account for commitment costs in locational marginal prices, e.g., extended locational marginal pricing. Although different approaches may reduce uplift, they pose implementation and other challenges because they make the market solution unnecessarily complex, may create operational challenges and it is difficult to quantify their benefit. While the CAISO continues to examine market enhancements that will support market efficiency and the effective integration of additional variable energy resources, the CAISO does not currently see the need to include start-up and minimum load costs in locational marginal prices to generate an efficient market solution. Instead, the CAISO believes locational marginal prices should reflect the marginal costs of serving the next increment of load so that the market optimization calculates an efficient dispatch. Approaches such as amortizing minimum load and start-up costs over a resource's incremental energy costs likely distort this objective. In any case, the CAISO market ensures that resources recover their costs through the market's bid cost recovery mechanisms.

c. Should off-line resources be eligible to set the LMP? If so, should start-up and no-load costs be included in the price, or just incremental energy costs?

As described above, the CAISO's current approach is to, with the exception of constrained output generators, base locational marginal prices on the cost of serving the next increment of load using a resource's incremental energy costs. The CAISO continues to examine market enhancements that will support market efficiency and the effective integration of additional variable energy resources. At this time, however, the CAISO does not have a position

concerning whether allowing off-line resources - through the use of their start-up costs - to set the locational marginal price will advance either of these objectives.

IV. Settlement Intervals

Panelists at the Shortage Pricing/Mitigation and Operator Actions

Workshops generally supported sub-hourly, rather than hourly, settlement intervals as providing better incentives for resources to perform during shortage events and to make investments to enhance resource flexibility.²⁰

a. What are the advantages and disadvantages of moving to sub-hourly settlements for the real-time market as they relate to price signals, market efficiency, and operations?

The CAISO's real-time market provides for 15 minute and 5 minute settlement intervals. The real-time market calculates prices for 15-minute granularity schedules based on conditions 37.5 minutes prior to each interval and calculates 5-minute interval schedules based on conditions 7.5 minutes prior to each interval. These scheduling and settlement timeframes provide a dynamic pricing signal to reflect grid conditions. Because intertie resources, with the exception of dynamically-scheduled intertie resources, are not scheduled with 5-minute granularity, 15-minute scheduling and pricing enables the CASIO to price all resources, interties and internal generators, on the same basis.

Moreover, 15-minute schedules and prices incentivize variable energy resources to offer economic bids into the CAISO market. These bids can reduce

²⁰ See Operator Actions Workshop, Docket No. AD14-14-000, Tr. 253:23-254:2 (Dec. 9, 2014); Scarcity and Shortage Pricing, Offer Mitigation and Offer Price Caps Workshop, Docket No. AD14-14-000, Tr. 52:21-22, 53:11-16, 54:10-17 (Oct. 28, 2014).

variable energy resources' exposure to the difference between day-ahead market prices and 5-minute prices. These scheduling timeframes also enable variable energy resources to earn revenues and benefit the system through downward economic dispatches from their 15-minute schedules in the 5-minute dispatch. Using a 15-minute settlement interval also appropriately limits the amount of energy settled in the 5-minute dispatch to energy that is dispatched due to conditions that did not exist when the market ran and cleared for the corresponding 15-minute interval. This has particular benefit because it tends to reduce the number of price increases from congestion in the 5-minute real time dispatch.

b. What metering and RTO/ISO software changes would be needed to change settlement intervals from hourly to sub-hourly for the real-time market, and how long would these changes take to implement? Are there significant costs to RTOs/ISOs, and to market participants, of such changes? Are there any other impediments to adjusting settlement intervals?

Upon implementing the nodal market in 2009, the CAISO had 15- and 5-minute real-time market intervals. That 15-minute market produced non-binding schedules and prices. When the CAISO implemented tariff revisions to comply with FERC Order 764 on May 1, 2014, the 15-minute market became a financially binding market. This required a broad range of changes to the CAISO's market functionality and settlement systems. Market participants also had to make parallel changes to their business processes and systems.

c. What are the advantages and disadvantages of changing from hourly to sub-hourly settlements in the day-ahead market?

Consideration of any change from hourly to sub-hourly settlements in the day-ahead market requires a thorough bid to bill impact assessment, including whether market software would still be able to calculate schedules and prices in the time necessary to run the day-ahead market. The Commission should consider the benefits of such a change as well as the risks and implementation costs. While the day-ahead market is financially binding, its primary purpose is to position supply resources to meet demand based on known conditions at the time the market clears. Developing additional granularity in the settlement process may provide benefits if an RTO/ISO can accurately anticipate significant intra-hour changes in operating conditions. In the CAISO day-ahead market, supply clears against bid-in hourly demand. Under this construct, changing from an hourly to a sub-hourly settlement in the day-ahead market would also require changing the CAISO's bidding rules to allow both supply and demand to submit bids at a more granular timeframe. An understanding of the costs to move to sub-hourly settlements in the day-ahead market is necessary before proceeding with any such market design.

Among the possible benefits of sub-hourly settlements in the day-ahead market are aligning unit commitment decisions between the day-ahead and real-time timeframes. For example, moving to 15-minute granularity in the day-ahead market would align unit commitment between the day-ahead the real-time market. This alignment would allow the CAISO to identify more granular resource needs across an operating hour in the day-ahead timeframe. This alignment would likely also improve the effectiveness of convergence bidding.

Currently, virtual bids in the CAISO market are settled at the day-ahead hourly price and then liquidated at the simple average of the relevant four 15-minute intervals. Sub-hourly settlements would allow the CAISO to liquidate virtual bids against day-ahead 15-minute prices, potentially better aligning convergence bids with system conditions evaluated at 15-minute intervals.

Additionally, sub-hourly day-ahead prices could potentially improve forward scheduling of variable energy resources and help align the CAISO ramping requirements with resource operating characteristics. For example, solar resources are subject to imbalance energy settlements in the real-time market across an entire hour when they schedule in the day-ahead market. Solar resources would have a smaller quantity of real-time market imbalance energy settlements if they scheduled in the day-ahead market in 15-minute settlements in 15-minute granularity. The CAISO could also more accurately price ramping needs and select the most optimal resources for providing ramping capacity through its planned flexible ramping product in the day-ahead time frame, because the time interval over which the day-ahead market assesses a resource's ramping capability would be more consistent with the time intervals used by the real-time market.

V. New Products to Incent Flexibility

Flexible resources that are capable of ramping up and down and/or starting up quickly provide value to the electric system. Panelists at the Operator Actions Workshop said that market designs that reward flexibility may stimulate

investment in flexible capacity and incent resources to submit flexible offers.²¹

One panelist commented that existing market rules can create disincentives for resources to submit supply offers that reflect the full flexibility (for example, ramp rate, minimum run time, minimum operating level, maximum operating level, minimum down time) of their resources.²² In addition, panelists at the workshops discussed the need for locational reserve products to better reflect local needs for flexibility.

a. How do RTOs/ISOs currently ensure that they will have sufficient flexibility during real-time? Specifically, to what extent are residual unit commitments used to acquire anticipated needed flexibility?

The CAISO clears bid-in supply with bid-in demand in its day-ahead market clearing process. Thereafter, the CAISO runs its residual unit commitment to secure any necessary resources to meet CAISO forecast demand. As part of the residual unit commitment process, the CAISO attempts to ensure it has committed sufficient resources to meet the system's projected capacity needs. This process, however, does not anticipate all changes in operating conditions between the day-ahead timeframe and real-time, nor does it guarantee that ramping needs in real-time are met.

As part of the real-time market, the CAISO assesses flexible ramping needs by optimizing its resource fleet. This includes looking-ahead up to four and a half hours to ensure the CAISO has committed sufficient resources to meet ramping needs. For this purpose, the CAISO enforces a flexible ramping

²¹ Operator Actions Workshop, Docket No. AD14-14-000, Tr. 149:7-11; 151:3-6; 291:6-8 (Dec. 9, 2014).

²² See *id.* at 291:9-22.

constraint in the real-time market to address upward ramping needs.²³ The CAISO market compensates resources held back in the fifteen-minute market from being dispatched for energy to provide ramping in future dispatch intervals.

The CAISO is currently developing a flexible ramping product as an improvement to its currently implemented flexible ramping constraint. The flexible ramping product will result in better price formation for capacity needed for ramping in the upward or downward direction in future intervals by calculating a marginal cost for ramping capability.²⁴ Under the CAISO real-time market's multi-interval optimization, ramping capability for future dispatch intervals are currently priced into projected locational marginal prices for future intervals. If actual system conditions are not exactly as forecast when a future dispatch interval becomes the current dispatch interval, these prices do not materialize, potentially leaving some resources to recover their bid costs through uplift payments. The flexible ramping product will seek to reflect the costs of reserving ramping capability in the current dispatch interval's locational marginal energy price and flexible ramping product price. The CAISO plans to design the flexible ramping product to provide other benefits, including improving the forecasting of ramping needs, a demand curve to optimize the costs and benefits of procuring ramping capability, and a cost-allocation mechanism that allocates the costs of ramping capability to the load and resources driving the need.

²³ See CAISO tariff, section 27.10.

²⁴ More information on this effort is available on the CAISO's website for this stakeholder initiative:
<http://www.caiso.com/informed/Pages/StakeholderProcesses/FlexibleRampingProduct.aspx>

b. How are flexible resources compensated for the value that they provide to the system? Does that compensation reflect the value? Why or why not? If compensation to flexible resources does not reflect their value, how should RTOs/ISOs compensate flexible resources for the service they provide?

The CAISO market processes compensate flexible resources for the capacity and energy they provide. More flexible resources have greater opportunity to be dispatched for energy in the real-time market and as a result are compensated for their flexibility. In addition, the CAISO also enforces a flexible ramping constraint in its real-time market that holds back flexible capacity for upward ramping needs in future intervals.²⁵ Resources that resolve the flexible ramping constraint receive compensation pursuant to a formula set forth in the CAISO tariff.²⁶ As described above, the CAISO is currently working with stakeholders to develop a flexible ramping product that will provide compensation through a market clearing price for both upward and downward ramping capability.

The CAISO also recognizes that flexible attributes of resources have greatly increased in importance, and the CAISO is developing mechanisms to value them appropriately. Under the CAISO's current market structure, scheduling coordinators have flexible capacity resource adequacy obligations. These obligations require scheduling coordinators to ensure they can offer flexible capacity in the CAISO market. This obligation requires load serving

²⁵ CAISO tariff, section 27.10.

²⁶ CAISO tariff, section 11.25.

entities to contract with resources and compensate them for the capacity they provide to the system.

c. What are the tradeoffs between sending a price signal through a short-duration shortage event versus establishing a ramping product that is priced separately?

The CAISO tariff provides for administrative prices when there is insufficient supply of ancillary services, as well as a penalty price when the CAISO relaxes a transmission constraint or the constraint to match supply and demand so that the CAISO market software can generate a feasible solution.²⁷ These administrative prices may not produce the most efficient market outcome. The CAISO believes that establishing a market mechanism to secure flexible ramping capability will result in more efficient market outcomes and help the CAISO secure necessary capacity and ramping capability to avoid short duration shortage events. A flexible ramping product more appropriately reflects the cost of reserving ramping capability for future dispatch intervals in the locational marginal price for the current interval and also provides a market-clearing price for flexible ramping capacity.

d. What are the tradeoffs among procuring flexibility through unit commitments (e.g., headroom requirements) rather than through the ten-minute reserve products or through ramp products?

Having a market mechanism such as a constraint or market product for flexible ramping allows the CAISO to optimize the procurement of flexible ramping needs either by creating the headroom in already committed units or starting up units that can provide more flexibility. Also, incorporating this constraint into market outcomes allows the CAISO to solve not only for the

²⁷ *Id.* at sections 27.1.2.3, 27.4.3.2, 27.4.3.3, and 27.4.3.4.

current binding interval, but also for projected needs. The CAISO's market clearing process will efficiently assess the trade-offs between committing additional units and creating more headroom on units already online.

The CAISO does not believe it is appropriate to use 10-minute reserves to meet routine ramping needs. This is because using 10-minute reserves are priced using opportunity cost of being held back from being dispatched for energy, arguably introducing a double payment if they are routinely dispatched for ramping needs. When the CAISO procures 10-minute reserves, its price includes the energy opportunity cost. If the CAISO dispatches the capacity in the real-time market, then the resource will also receive the energy payment.

Therefore, the same capacity will be compensated twice for the same energy. We expect the CAISO market will procure and deploy ramping capacity very frequently, so using non-contingent spinning reserve for this purpose is not an optimal market solution.

e. Does allowing combined-cycle natural gas resources to submit different offers for different configurations facilitate more efficient price formation?²⁸ What are the advantages and disadvantages to generators of bidding these configurations?

Prior to the implementation of its multi-stage generator model, the CAISO used a forbidden operating regions model with which the CAISO considered operating and business information to identify ranges through which a unit must be ramped up or down, but within which regions it cannot be dispatched. The purpose of the forbidden operating range model was to prevent infeasible

²⁸ See, e.g., *Cal. Indep. Sys. Operator Corp.*, 132 FERC ¶ 61,087, order on compliance filing, 132 FERC ¶ 61,273 (2010).

dispatch of multi-stage units at the start of the CAISO's nodal markets in 2009. Although enforcing forbidden operating region constraints prevents the CAISO market from dispatching units at infeasible output levels, it does not economically optimize the dispatch of multi-stage generating units with respect to costs of their various operating configurations and other resources in the market. In order to more accurately model multi-stage generating resources and reflect these considerations, the CAISO introduced the multi-stage generator model in the CAISO market in December 2010.

Multi-stage generating units have output ranges between their minimum and maximum operating levels at which the CAISO cannot dispatch energy. Transitioning between these operating ranges, or configurations, is costly, takes time, and should be done a limited number of times each operating day. Currently, the CAISO requires combined-cycle natural gas resources to register as multi-stage generators so that the CAISO can model them effectively as separate generating units. This enhancement allows that CAISO to consider operating constraints of these resources in transitioning from one configuration to another configuration.²⁹

The advantages of this approach include allowing the CAISO's market model to accurately reflect the capabilities and limitations of combined cycle natural gas resource and reduce uplift that would otherwise occur because of out of market dispatches to resolve constraints. The disadvantages of this approach include more difficult modelling of the resources that can lead to complex

²⁹ CASIO tariff, section 27.8.1.

optimization considerations and challenges. Multi-stage configuration modeling also gives rise to a more complicated settlements design.

VI. Operating Reserve Zones

A lack of sufficiently granular reserve zones could be muting efficient price signals. At the Shortage Pricing/Mitigation workshop, the NYISO panelist noted that NYISO is considering establishing a new reserve zone³⁰ and the PJM Interconnection, L.L.C. (PJM) external market monitor indicated that he believed PJM's shortage pricing rules were not sufficiently locational. For instance, last year PJM experienced shortages in the American Transmission System, Inc. (ATSI) footprint that did not trigger shortage pricing because the ATSI zone is not a reserve zone.³¹

a. How does the establishment, elimination or reconfiguration of reserve zones affect price formation? What should the triggers be? From experience, do the RTOs/ISOs have the appropriate reserve zones defined? Are additional, fewer, or different reserve zones needed?

Ancillary service zones can impact price formation by imposing constraints in the market model to ensure any market result secures sufficient levels of ancillary services based on system constraints. Insufficient supply of ancillary services within these zones can trigger scarcity pricing.

The CAISO has established two ancillary service regions within its balancing authority area. These regions are (1) the CAISO expanded system

³⁰ Scarcity and Shortage Pricing, Offer Mitigation and Offer Caps Workshop, Docket No. AD14-14-000, Tr.21:16-21 (Oct. 28, 2014).

³¹ *Id.* at 133:6-15.

region, which includes the CAISO balancing authority and its intertie scheduling points with adjacent balancing authorities; and (2) the CAISO system region that does not include interties scheduling points with adjacent balancing authority areas. Within these regions, the CAISO has established eight ancillary service sub-regions.³² These sub-regions nest within the system and expanded system regions, the CAISO is authorized to establish maximum or minimum procurement requirements for ancillary services in individual regions and sub-regions. These constraints ensure the CAISO's market has access to adequate ancillary services, and the market sets the price for ancillary services based on these constraints.

The CAISO may only establish new ancillary service regions and sub-regions after first conducting a stakeholder process, and then obtaining Commission authorization.³³ The CAISO will consider adjusting the boundaries of the existing ancillary service regions or creating a new ancillary service region through a stakeholder process if two conditions are met: (a) there is a persistent difficulty in obtaining an appropriate distribution of ancillary services using market procurement mechanisms; and (b) adjusting the boundaries of the existing ancillary service regions or creating a new ancillary service region would reduce the persistent difficulty in obtaining an appropriate distribution of ancillary services using market procurement mechanisms.³⁴

³² CAISO tariff, section 8.3.3. See also, CAISO Business Practice Manual for Market Operations at 74-78.

³³ CAISO tariff, section 8.3.3.4.

³⁴ *Id.*

b. Are processes in place for adding, removing, or changing reserve zones adequate for efficient price formation?

Yes, as explained in response to question VI.a, the CAISO has processes in place for changing reserve zones. Recently, the CAISO ranked a potential initiative highly in its annual stakeholder initiative catalog process that would modify the ISO's current spinning reserve and non-spinning reserve products to procure them more granularly than the existing ancillary service zones. This effort could provide greater assurance of deliverability of contingency reserves to ensure that the CAISO can recover from a generation contingency.

VII. Uplift Allocation

Uplift allocation rules might impact resource participation decisions in RTO/ISO markets. For example, uplift allocation rules might incent participation in day-ahead markets or drive decisions on how to use financial products.

a. Do uplift allocation rules reflect cost causation or mute potential investment signals? If so, how?

Cost allocation should have a direct effect on market behavior absent other externalities. The CAISO has adopted a set of cost causation guiding principles to help shape cost allocation decisions. These principles set forth the basis for allocating CAISO market costs among market participants.³⁵ The CAISO plans to follow these principles in developing cost allocation rules for its flexible ramping product and other market modifications. With respect to uplift,

³⁵ More information on the CAISO's cost causation principles is available at the following website:
<http://www.caiso.com/informed/Pages/StakeholderProcesses/CompletedStakeholderProcesses/CostAllocationGuidingPrinciples.aspx>

the CAISO plans to discuss the guiding principles through stakeholder initiatives on an ongoing basis. Where changes are appropriate, the CAISO will seek to modify its allocation of uplift costs. However, the CAISO believes any changes to cost allocation rules must recognize that there is a balance between cost allocation and developing overly complex market rules.³⁶

b. What philosophy should govern uplift allocation? Do any of the RTOs/ISOs have a best practice? What is it and why is it a best practice?

The CAISO has adopted a set of cost causation guiding principles to help shape cost allocation decisions. These principles set forth the basis for allocating CAISO market costs among market participants and include seven elements that attempt to balance various competing interests.

- (1) Causation: Allocate costs to resources and/or market participants that benefit from and/or drive the costs.
- (2) Comparable treatment: Treat similarly situated resources and/or market participants the same for purposes of cost allocation.
- (3) Accurate price signals: Provide accurate price signals to support the economically efficient achievement of policy goals by providing accurate price signals.
- (4) Incentivize behavior: Provide appropriate incentives to foster an economically efficient market.
- (5) Manageable: Market participants should have the ability to manage exposure to the allocation.
- (6) Synchronized: The cost drivers of the allocation should align as closely as possible to the selected billing determinant.
- (7) Rational: Implementation costs/complexity should not exceed the benefits that are intended to be achieved by allocating costs.

³⁶ See e.g. Presentation by Jeffrey Nelson at CAISO April 22, 2014 Pricing Forum: http://www.aiso.com/Documents/11_ConcernsOverPriceFormation-Interpretation.pdf

c. Should uplift allocation categories reflect the reasons for committing a unit and incurring uplift? Would disclosing these reasons through publicly available data improve uplift transparency and provide information to facilitate modifications of the allocation of uplift costs?

The CAISO generally agrees that uplift allocation categories should reflect the reasons for committing a unit and incurring uplift, but there are some instances where this is not currently possible. For example, using the minimum online constraint, the CAISO's market model commits resources in a local area through the optimization process recognizing voltage requirements and other operating constraints. The market results, however, do not provide the CAISO with an accounting of which specific units the market cleared to satisfy any minimum online commitment constraint separate and apart from other units clearing the market. Despite the lack of a definitive reason for the commitment, the CAISO has incorporated additional information into its market performance and planning discussions with stakeholders in order to provide greater transparency with respect to the minimum online commitment constraints.³⁷To the extent unit commitment information is available, the CAISO generally supports making this information available to the market subject to appropriate nondisclosure requirements.

VIII. Market and Modeling Enhancements

At the Uplift and Operator Actions Workshops, panelists highlighted various drivers of persistent, concentrated uplift and operator actions, including

³⁷ See e.g. Presentation for CAISO January 20, 2015 Market and Performance planning forum at slides 35-36. http://www.caiso.com/Documents/Agenda-Presentation_MarketPerformance-PlanningForum_Jan20_2015.pdf

constraints that are not incorporated into market models.³⁸ Panelists also noted that certain constraints are difficult to model accurately or to incorporate into both the day-ahead and real-time market models.³⁹ These include local voltage constraints and reliability constraints such as N-1-1 contingency constraints.⁴⁰

a. Assuming that RTOs/ISOs should improve their market models to better reflect the cost of honoring reliability constraints in energy and ancillary services market clearing prices, what types of constraints should RTOs/ISOs include in their market models, and what types of constraints should be handled by manual commitments? Of those reliability constraints that should be in the market models, which reliability constraints should RTOs/ISOs prioritize?

The CAISO's market model incorporates various resource and transmission constraints and takes them into account in the bid optimization process. These constraints improve market efficiency because they are part of the market clearing process and help identify the set of resources dispatched as part of the overall market solution.

The CAISO is also working with stakeholders to develop a mechanism that will separately procure and price capacity needed to address post-contingency re-dispatch to bring the system within operating limits within 30 minutes.⁴¹ This market enhancement will produce a more accurate day-ahead

³⁸ See, e.g., Uplift Workshop, Docket No. AD14-14-000, Tr. 49:7-11 (Sept. 8, 2014); Operator Actions Workshop, Docket No. AD14-14-000, Tr. 16:5-18 (Dec. 9, 2014).

³⁹ See, e.g., Uplift Workshop, Docket No. AD14-14-000, Tr. 192:12-18 (Sept. 8, 2014); Operator Actions Workshop, Docket No. AD14-14-000, Tr. 21:7-23 (Dec. 9, 2014).

⁴⁰ An N-1-1 contingency constraint is a constraint to ensure that following any single contingency (N-1), the system can withstand any other contingency (N-1-1).

⁴¹ More information on this effort is available on the CAISO's website for this stakeholder initiative:
<http://www.caiso.com/informed/Pages/StakeholderProcesses/ContingencyModelingEnhancements.aspx>

commitment and increase market efficiency by avoiding the need to commit additional resources in real-time.

Notwithstanding these efforts, the CAISO cannot anticipate or model every constraint that might arise on its system between the day ahead and real-time. For this reason, the CAISO must continue to use tools such as exceptional dispatch to ensure sufficient energy is available to meet electric demand.

b. In 2013, ISO New England Inc. (ISO-NE) increased its replacement reserve requirement to “reduce the need to schedule additional resources above the load and reserve requirements” in its Reserve Adequacy Analysis.⁴² PJM has a similar proposal to increase day-ahead and real-time reserve requirements when extreme weather is expected.⁴³ In what circumstances can such practices improve efficiency of price formation?

Increasing ancillary service requirements above minimum procurement requirements in the day-ahead timeframe or real-time market can help ensure that adequate reserves exist to address system operating conditions or ensure the CAISO continues to meet minimum ancillary reserve requirements within required timeframes after a contingency. System operators need to balance these considerations with the cost of procuring more reserves than are necessary to meet their ancillary service obligations.

c. Do transmission constraint relaxation penalty factors improve the efficiency of price formation?⁴⁴ If so, should these penalty factors be allowed to set the energy price if a transmission constraint is relaxed?

⁴² ISO-NE, Transmittal Letter, Docket No. ER13-1736-000 at 10 (filed June 20, 2013).

⁴³ PJM Tariff Filing, Docket No. ER15-643-000 (filed December 17, 2014).

⁴⁴ Transmission constraint penalty factors are parameters within the market model that place a cost, known as a penalty factor, on a transmission constraint. These parameters allow the model to “relax” the transmission constraint for a short time at a cost equal to the penalty factor, allowing flow over a given transmission element to exceed its normal limit.

Transmission constraint relaxation penalty factors incentivize scheduling coordinators to submit economic bids to resolve the transmission constraint. When the CAISO relaxes a transmission constraint to obtain a feasible solution, the CAISO's market establishes an administrative price equal to its offer cap.⁴⁵

In 2014, the CAISO lowered its scheduling run transmission constraint relaxation parameter from \$5000 MWh to \$1500 MWh for the real-time market.⁴⁶ The CAISO reduced this parameter because the higher price exacerbated uplift in the form of high real-time congestion offset costs, and analysis showed that economic bids submitted when the cost of the transmission constraint exceeded \$1500 MWh did little to resolve the constraint. Pursuant to this change, when the cost of re-dispatch of economic bids to relieve an internal transmission constraint exceeds \$1500/MWh, the CAISO will relax the transmission constraint reflecting a cost equal to the transmission relaxation parameter, rather than enforcing the constraint to obtain increasingly more expensive economic dispatches. This change allows for a more efficient market solution that reliably relieves congestion at a reasonable cost.

The CAISO is planning to start a stakeholder initiative that will consider enhancements to the structure of the transmission and power balance constraint relaxation parameters. The initiative would evaluate whether the performance of these constraint relaxation parameters could be improved if the ISO were able to calibrate them at different levels depending on either level of constraint relaxation, voltage level of constraint, or the system impact of the constraint.

⁴⁵ CAISO tariff, section 27.4.3.2.

⁴⁶ *Cal. Indep. Sys. Operator Corp.*, 143 FERC ¶ 61,110 (2013).

d. Are there any new constraints that represent other physical characteristics of the system (with corresponding penalty factors), such as N-1-1 reliability constraints, that could be included in the model to improve the efficiency of price formation? If so, what types of constraints should be included and how should the penalty factors be determined?

The CAISO is working with stakeholders to identify constraints that reflect physical characteristics to its system. For instance, the CAISO and its stakeholders are developing a mechanism to procure and price capacity needed to address post-contingency re-dispatch to bring the system within operating limits within 30 minutes. This market enhancement will also produce a more accurate day-ahead commitment, thereby increasing market efficiency by avoiding the need to commit additional resources in real-time. Also, as discussed elsewhere in these comments, the CAISO is developing a product for flexible ramping capacity. This product will ultimately replace the CAISO's existing flexible ramping constraint and will provide a market mechanism to procure the required ramping capability for the system by efficiently dispatching resources for energy and ramping capacity while generating prices to reflect the value of the product. The CAISO is planning to start a stakeholder initiative that will consider enhancements to the structure of the transmission and power balance constraint relaxation parameters.

e. Should RTOs/ISOs create new products that procure the capacity necessary to address reliability constraints that cannot be captured in market models? If so, what should these products look like, and what process should RTOs/ISOs use to design these products?

New market products may be necessary to secure capabilities from resources to address reliability constraints whether or not market models can capture the constraints. For example, the CAISO is considering whether to

initiate a stakeholder process to examine developing a market product for frequency response. Although the CAISO does not know whether it requires a market product to comply with applicable reliability standards, the CAISO can identify, with some accuracy, the amount of frequency responsive capacity it needs on the system to respond to a frequency event. The CAISO and its stakeholders need to assess whether a market product is really necessary to procure this service or whether this capability already exists as part of the requirements of other market products or interconnection requirements (e.g. spinning reserve, governor response).

f. In some cases, creating new products to satisfy system needs (e.g., ramp capability, local reliability product, or additional reserves to account for operational uncertainty) may amount to procuring a level of spinning or non-spinning reserves above the mandatory reliability requirement. If the “new product” can be satisfied by an existing ancillary service product (e.g., ten minute reserves), is it necessary to create a new and separate product with its own price and co-optimization? Rather than developing a new product, could RTOs/ISOs change the cost allocation of any additional ancillary services procured above the mandatory reliability requirement?

No, it is not always necessary to create a new product if increasing the requirements for an existing product will secure the capabilities the system needs. ISO/RTOs must balance this approach, however, with other considerations such as cost and operational impacts of procuring more of an existing ancillary service that would otherwise allow the resource to provide energy or avoid the need to commit the resource. As discussed in these comments, the CAISO is developing a flexible ramping product because, among other reasons, ten minute reserves would provide inappropriate compensation to resources routinely dispatched for ramping requirements. Also, as discussed in

these comments, the CAISO is developing a mechanism to procure and price capacity needed to address post-contingency re-dispatch to bring the system within operating limits within 30 minutes. This mechanism is superior to procuring extra ten minute reserves to meet this need for two reasons: (1) the mechanism being developed by the CAISO will more accurately procure capacity to meet post-contingency re-dispatch than could be achieved through reserves; and (2) meeting a need to re-dispatch the system within 30 minutes using 10 minute reserves would likely entail using more expensive resources.

IX. Shortage Prices

In the questions below, the term “shortage pricing” refers generically to any pricing action taken in response to a shortage event. Not all RTOs/ISOs use this phrase in the same way.⁴⁷ In responding to the questions below, please define terms and distinguish between “shortage pricing” and “scarcity pricing,” if such a distinction is intended.

a. What principles should be used to establish shortage price levels? Should there be one price for any shortage or a set of escalating prices for greater levels of shortage? Is it important to have shortage price levels consistent across adjacent RTOs/ISOs to avoid seams issues?

The fundamental principle the Commission should apply in establishing either shortage pricing for energy or scarcity pricing for ancillary services is what level of compensation will effectively resolve the shortage or scarcity condition without creating undue costs for ratepayers. The CAISO believes this amount

⁴⁷ See, e.g., Scarcity and Shortage Pricing, Offer Mitigation and Offer Price Caps Workshop, Docket No. AD14-14-000, Tr. 20:1-21:7 (Oct. 28, 2014).

will vary across ISO/RTO markets because different operating and transmission constraints will give rise to different levels of shortages and different shortage prices will be necessary to generate economic bids to resolve the constraint. Accordingly, establishing appropriate shortage price levels likely requires empirical analysis that reflects how resources respond to energy shortage or ancillary service scarcity conditions in each ISO/RTO.

b. What are the advantages and disadvantages of implementing shortage pricing in the day-ahead market as well as in the real-time market? If shortage pricing is established only in the real-time market but not in the day-ahead market, are other policies needed to facilitate price convergence between the day-ahead and real-time markets during periods of shortage? If so, what are these other policies? If not, why not?

The CAISO applies energy shortage pricing and ancillary services scarcity pricing in both the day-ahead and real-time markets. This is appropriate to ensure an efficient market clearing process in both the day ahead and real-time markets.

X. Transient Shortage Events

At the Shortage Pricing/Mitigation Workshop, panelists stated different positions regarding pricing transient, or short-duration, shortage events.⁴⁸ Transient shortage events are shortage events that last only a short time, perhaps as short as one or two five-minute dispatch intervals.⁴⁹ For instance, PJM's market clearing process will not invoke shortage pricing if it can resolve

⁴⁸ *Id.* at 38:19-51:8.

⁴⁹ *Id.* at 40:19-24; 41:7-10; 44:16-23; 46:1-6.

the shortage within a certain time.⁵⁰ However, even transient shortage events need a price signal to provide incentives to develop capabilities to respond to the shortage.⁵¹

a. Should there be a minimum duration for a shortage event before it triggers shortage pricing? Why or why not? How would one determine that minimum time, and how does it relate to the settlement interval?

The CAISO recognizes that transient scarcity can result in real-time energy price spikes as well as ancillary service scarcity conditions. However, the CAISO does not believe that the Commission needs to establish a minimum duration for a shortage event before it triggers shortage pricing, given that actual shortage conditions exist.⁵² Establishing a minimum duration would only dampen the signal that the market needs additional fleet capabilities such as more flexible ramping because the CAISO could rely on other products and essentially ignore the transient shortage event. The CAISO will continue to consider market enhancements so that transient market results do not produce price spikes that do not reflect actual shortage conditions.

b. Do RTO/ISO rules regarding transient shortage events result in appropriate price signals? Why or why not? To the extent possible, please provide empirical evidence supporting your answer.

The CAISO believes transient shortage events result in appropriate price signals if they represent actual conditions. For example, the CAISO market

⁵⁰ *Id.* at 48:5-12.

⁵¹ *Id.* at 47:7-11.

⁵² An issue related to transient scarcity involves the dispatch of demand response out of the market during or in anticipation of scarcity conditions. This can cause the market prices to drop to non-scarcity levels when scarcity conditions in-fact exist. The ISO continues to work to integrate demand response into its market so these resources can set prices that reflect actual system conditions.

experiences increasing amounts of short duration ramping needs due to increasing amounts of variable energy resources. However, transient market results that do not reflect actual shortage conditions can also result in inappropriate price signals.

c. Should treatment of transient shortages be consistent across all RTOs/ISOs? Why or why not?

Energy shortages or ancillary service scarcity conditions arise in ISO/RTO markets based on system conditions, operational constraints of resources and load curves. These vary across ISO/RTOs. For this reason, the CAISO believes the Commission need not establish uniform rules for the treatment of transient energy shortages or ancillary service scarcity conditions.

XI. Interchange Uncertainty

Due to the lag between price signals and interchange scheduling for import and export transactions, trade between RTOs/ISOs can result in volatile prices and variable system conditions because the ability of importers to schedule flows across the seam can lag behind actual system needs, creating uncertainty in interchange and contributing to operational issues.⁵³ Several RTOs/ISOs have instituted new rules, such as NYISO's and PJM's Coordinated

⁵³ See, e.g., the experience of Midcontinent System Operator, Inc. and PJM on July 6, 2012 as discussed in FERC, *Price Formation in Organized Wholesale Electricity Markets: Staff Analysis of Shortage Pricing*, Docket No. AD14-14-000, at 21-22 (Oct. 2014), available at <http://www.ferc.gov/legal/staff-reports/2014/AD14-14-pricing-rto-iso-markets.pdf>.

Transaction Scheduling (CTS), which attempt to better coordinate interchange schedules and price signals in order to improve inter-RTO/ISO flows.

a. What can the RTOs/ISOs do to reduce interchange uncertainty? Does CTS help to reduce the uncertainty in interchange created by the lag between price posting and interchange schedules? Does the ability to reduce uncertainty depend on whether all interchange spread bids are incorporated into the RTO/ISO dispatch model (as proposed for the CTS implementation between NYISO and ISO-NE) rather than simply allowing interchange spread bids on a voluntary basis (as proposed for the CTS implementation between NYISO and PJM)? Are there other steps that should be taken to reduce interchange uncertainty?

The CAISO's market accepts self-schedules and clears bids at its interties. The CAISO prices these interchange transactions through its markets which recognizes the scheduling limits at each intertie. The CAISO has no comment on the NYSIO and PJM's coordinated transaction scheduling program.

b. What information do market participants need to better respond to interchange price signals?

The CAISO market clears economic bids at its interties on an hourly and a fifteen-minute basis based on the bid prices submitted by market participants. The CAISO makes these clearing prices available to market participants.

XII. Next Steps

a. Are there other price formation issues that, if addressed, would improve energy and ancillary services price formation in RTO/ISO markets? What are they?

Last year, the CAISO held a pricing forum with market participants and interested stakeholders at which it discussed various issues associated with

pricing in the CAISO's markets.⁵⁴ The CAISO will continue to use the input it received through this effort to help guide initiatives that may affect price formation in its markets. One effort the CAISO is considering is to undertake a stakeholder process to develop an integrated day-ahead market. This effort would involve combining the functionality of the CAISO integrated forward market and the residual unit commitment process into one market application to realize efficiencies in procuring all day-ahead market commodities simultaneously. This effort could enhance the efficiency of price formation in the CAISO's markets by recognizing the operating constraints of resources in satisfying all market needs in one day-ahead market application, including but not limited to energy, ancillary services and ramping constraints.

b. What are the highest-priority price formation issues to address? Is the priority of issues different in different RTO/ISO markets? If so, what are the priorities for each RTO/ISO and are the RTOs/ISOs currently addressing those issues sufficiently?

The CAISO is working to ensure there is sufficient upward and downward resource flexibility to manage large ramps arising from integrating variable energy resources and the CAISO's load curve. In this regard, the CAISO plans to enhance its market to secure both upward and downward ramping needs. The CAISO is also exploring contingency modeling enhancements that will commit resources through the day-ahead market to meet N-1-1 contingency needs that have previously have been met through out of market dispatches. This

⁵⁴ More information about the CAISO's pricing forum, including an agenda, presentation and stakeholder comments is available on the following website:
<http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=CE822342-5F94-4522-A316-664FCF6BAC07>

enhancement will incorporate and price the contingency in the market solution. Finally, the CAISO plans to initiate a stakeholder process to examine constraint relaxation penalty prices so that they result in improved price formation.

XIII. Conclusion

The CAISO is exploring ways to incorporate additional factors into its market processes to inform clearing prices for energy and ancillary services. The CAISO believes these efforts will result in more transparent market clearing prices. When necessary, however, the CAISO may take actions outside of its markets to ensure reliable operation of its transmission system, ensure sufficient capacity is available to meet expected load, and address or avoid system emergencies. When this occurs, the CAISO will strive to make information available to market participants in a timely and meaningful way.

Dated: March 6, 2015

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that I have served the foregoing document upon the parties listed on the official service lists in the above-referenced proceedings, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated at Folsom, California this 6th day of March 2015.

/s/ Anna Pascuzzo

Anna Pascuzzo