CALIFORNIA ISO

California Independent
System Operator

June 12, 2003

The Honorable Magalie Roman Salas
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: California Independent System Operator Corporation, ER02-1656

Dear Secretary Salas,

The California Independent System Operator Corporation ("ISO") hereby respectfully submits for filing an original and fourteen copies of a report on the performance of the Automated Mitigation Procedures for the three months ended January 31, 2003, as directed by Commission's July 17, 2002 Order, 100 FERC ¶ 61,060 (2002). Please return one file-stamped copy to the messenger.

This report also will be posted on the ISO's web site (http://www.caiso.com).

Thank you for your assistance in this matter.

Respectfully submitted,

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REPORT ON THE PERFORMANCE OF THE AUTOMATED MITIGATION PROCEDURE
OCTOBER 30, 2002 THROUGH JANUARY 31, 2003
California ISO - June 12, 2003

Executive Summary

As directed by the Federal Energy Regulatory Commission (Commission) in its July 17, 2002 Order[1], the ISO has prepared this Quarterly Report on the Performance of the Automated Mitigation Procedure (AMP). AMP, proposed by the ISO in its May 1, 2002 Market Redesign 2002 filing (May 1 MD02 Filing), was approved by the Commission with modifications in the July 17 Order. This report provides observations and analysis of trends pertaining to the effectiveness of AMP mitigation for the first quarter that AMP was in effect, *i.e.*, from October 30, 2002, through January 31, 2003.

It is difficult to determine with certainty the effectiveness of AMP mitigation for this period. Fundamental market demand and supply conditions were favorable over the subject period and, as a result, AMP conduct thresholds were rarely violated. The effectiveness of AMP mitigation will become apparent only when market conditions become less favorable and suppliers' ability to exercise market power increases.

During this period, there was not one failure of the market impact test. However, there were hours in which units have failed the Conduct Test but did not have a material impact on the market clearing price (MCP). Bids into the ISO's real-time Balancing Energy Ex-Post Price auction market (the BEEP Stack) that have actually set the MCP have been generally within the AMP Conduct Test thresholds; that is, below the lesser of $100/MWh or 200 percent above the bidding units' reference levels. Reference levels rose substantially over the quarter in step with the rise in the price of natural gas.

A small number of units consistently fail the AMP conduct test. These units almost exclusively bid above their respective AMP conduct thresholds but are never dispatched. Some have relatively low reference prices, and often bid within the merit order of the BEEP Stack but are not dispatched because of ramp rate constraints; others bid well in excess of their relatively high reference level thresholds. In either case, they fail the Conduct Test in most hours that AMP is applied; *i.e.*, whenever the predicted BEEP price exceeds $91.87/MWh.

The fact that AMP is, out of practical necessity, applied just *prior* to the start of the operating hour based on forecasted energy imbalances and prices undermines the effectiveness of AMP when system contingencies occur *within* the operating hour. For example, one of the price spikes observed during the quarter was due to a contingency that caused a significant re-dispatch of system resources and a subsequent spike in the price of real-time balancing energy. This contingency occurred after the price prediction for the corresponding real-time imbalance energy market. Because the imbalance energy prediction had not taken the contingency into account, the price prediction was below the $91.87/MWh price screen, and thus, AMP was not applied for this hour.

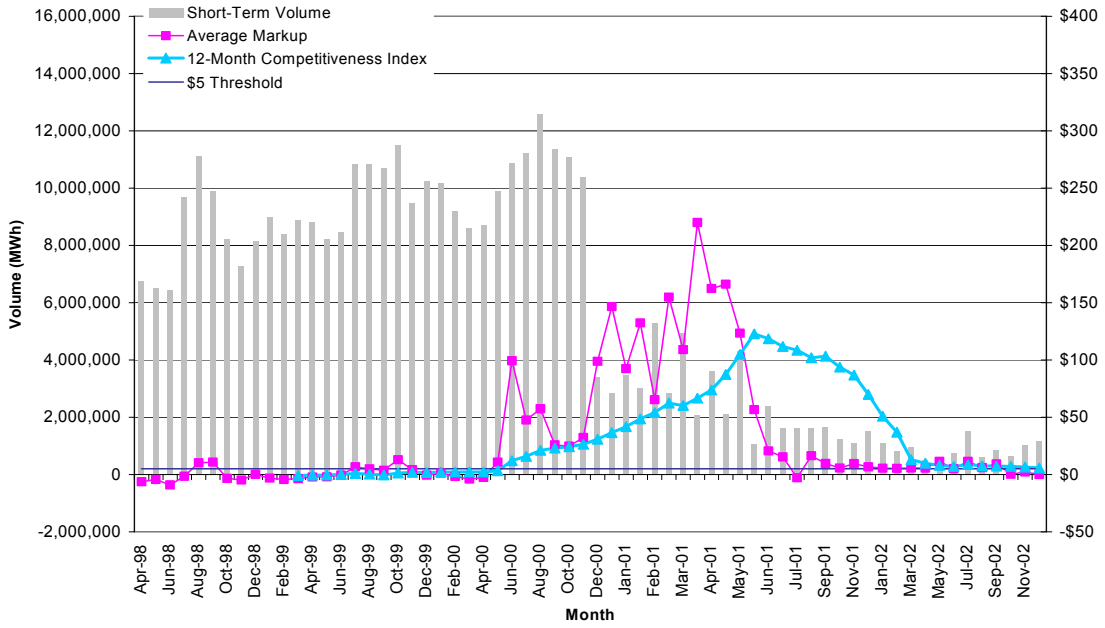
[1] *California Independent System Operator Corporation*, 100 FERC ¶ 61,060 (2002) (July 17 Order).

I. Fundamental Market Conditions

Market Competitiveness. The purpose of the market power mitigation provisions is to promote competitive outcomes during periods in which actual market conditions are not reasonably competitive. Thus, one measure of success would be an index that compares actual market performance to an estimated competitive benchmark. The ISO has developed a Twelve-Month Competitiveness Index (12MCI), which compares, on a rolling twelve-month basis, average actual market prices to estimated competitive prices. Estimated competitive prices are determined by cost-based bids where the MCP reflects the highest cost-based bid dispatched to serve load in each hour. The index tracks spot electricity transactions, or electricity traded in the real-time market and day-ahead and hour-ahead bilateral transactions, because these transactions reflect current market conditions. If the markup, or difference between average actual prices and average estimated competitive prices over the previous 12-months is less than $5/MWh, one can assume that the real-time imbalance energy market is reasonably workably competitive.

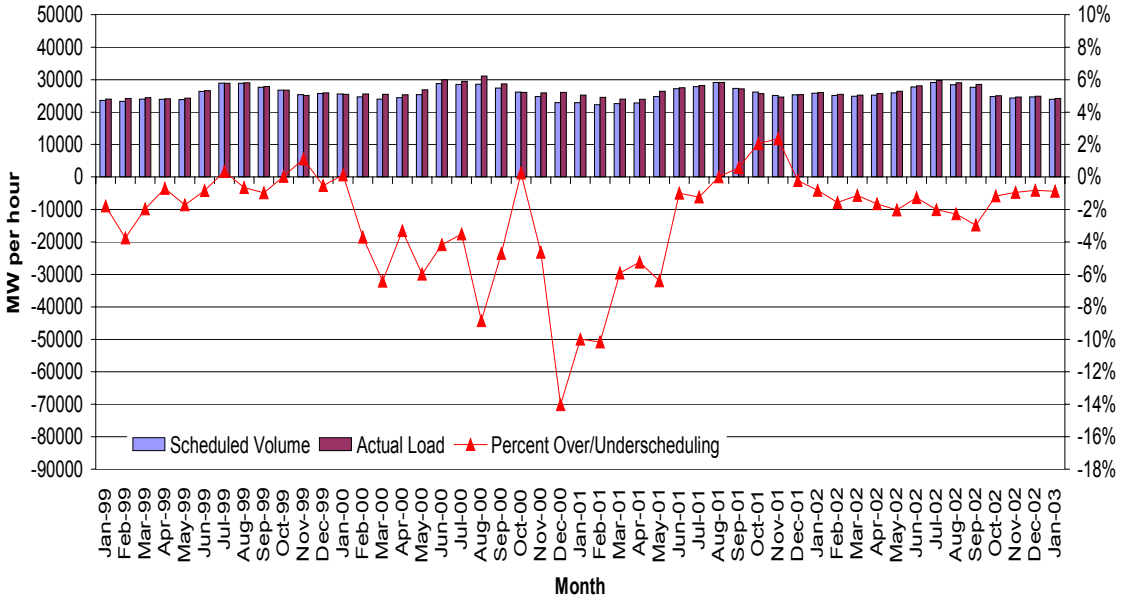
The 12MCI has been below $5/MWh since March 2002, and the monthly markup was near zero from October 2002 through December 2002, the latest month for which the ISO has data necessary to calculate the markup. This suggests that supply over the report period was adequate to mitigate suppliers' ability to exercise market power, and therefore, market conditions were not sufficiently uncompetitive to test the true effectiveness of AMP. Figure 1 shows the 12MCI, the average monthly markup, and the total monthly short-term energy volume from April 1999 through December 2002.

Figure 1. ISO Twelve-Month Competitiveness Index through December 2002



Loads and Scheduling. Loads in the first three months following the implementation of AMP were relatively modest compared with those seen in recent years. Weather in the western region was unseasonably mild, as reflected by the three percent decrease in load in January 2003, when compared with January 2002. Furthermore, forward schedules were remarkably close to load during the season, averaging within one percent of actual load in each month during the quarter. This improved accuracy in scheduling relieved the ISO from dispatching substantial amounts of real-time imbalance energy to manage significant imbalances between schedules and load. Because of the resulting diminished demand in the BEEP Stack and the fact that supplies that were generally sufficient, the real-time market was reasonably workably competitive. The following chart shows average hourly loads and scheduling deviations by month. Note that scheduling deviations have approached zero percent since November 2002.

Figure 2. Scheduling Deviations and Average Hourly Load by Month



II. AMP Mitigation Trends

The Department of Market Analysis (DMA) monitors several indices to assess the performance of AMP mitigation. These include the frequencies of AMP conduct and impact test failures in the entire market, as well as failures by generation type and ownership class. In addition, DMA tracks trends in average reference prices, which are indicators of overall bidding trends. To date, the AMP mitigation measures have not been significantly tested, because favorable supply conditions relative to demand have reduced the ability of suppliers to exercise market power. However, a series of price spikes in the three months after AMP was implemented on October 30, 2002 can be used as a barometer to predict the performance of AMP during prolonged price spikes.

Calculation of Reference Levels. Per the Commission's directive, the ISO hired an independent entity, Potomac Economics, Ltd. (Potomac), to calculate daily reference levels for each unit. Potomac calculates reference levels by following the procedure specified in its documentation of

the reference level calculator (RLC). In short, the RLC calculates reference levels for a particular generating unit as follows:

- The RLC partitions the unit's generation capacity into ten equal steps. For example, a 200-MW unit with a minimum generation level of 50 MW would be partitioned into ten steps of 15 MW each: Step 1 is from 50 MW to 65 MW, Step 2 is from 65 MW to 80 MW, etc. Each step has an independently computed reference price.
- For each step, if the unit has sold electricity into the imbalance energy (BEEP) Stack while operating within that step in any hours in the previous 90 days, the prices during those hours are averaged; this average price is taken as the reference level for that step.
- In the event the unit has not sold electricity into the BEEP Stack in the previous 90 days, Potomac sets the reference level for the step equal to the average of the lowest 25 percent of zonal market-clearing prices (MCPs) in intervals in which the unit was scheduled to produce at an output level within that step.
- Generators may appeal their calculated reference levels by consulting with Potomac, and may adjust them upward or downward as determined in the consultation.
- Potomac adjusts reference level steps upward as needed to make the reference curve monotonically non-decreasing, and fills in reference levels equal to lower-output step reference levels to make the entire curve complete, with no missing steps.

Reference Level Trends. Because reference levels are based primarily on 90-day rolling averages of accepted bids, reference levels serve as indicators of bidding trends. Reference levels for gas-fired thermal units are adjusted to account for changes in the price of natural gas. The increase in gas-fired units' reference prices during the report period can be explained largely by the rise in the cost of natural gas. The chart below shows average reference levels for gas-fired thermal generators, normalized to October 2002 gas prices, and suggests that reference prices generally are stable or decreasing, when controlling for the variation in gas prices.[2] The chart that follows shows non-normalized average reference levels for gas-fired and other generation types.

[2] Since each reference price is based upon a rolling average of accepted bids, DMA observes trends in reference prices by comparing individual hour reference price snapshots across time. The snapshot price is a volume-weighted average of all reference prices for each generation class in HE 16 of the third Wednesday of the month. This average price is then multiplied by the ratio of the October 2002 gas price to the price of the quoted month.

Figure 3. Average Reference Levels for Thermal Generators by Type, Normalized to October Gas Prices

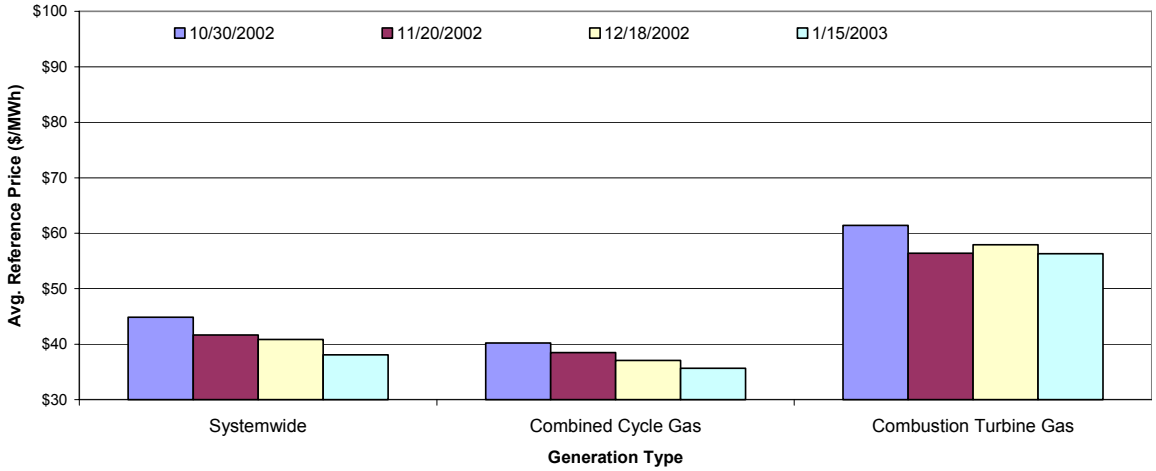
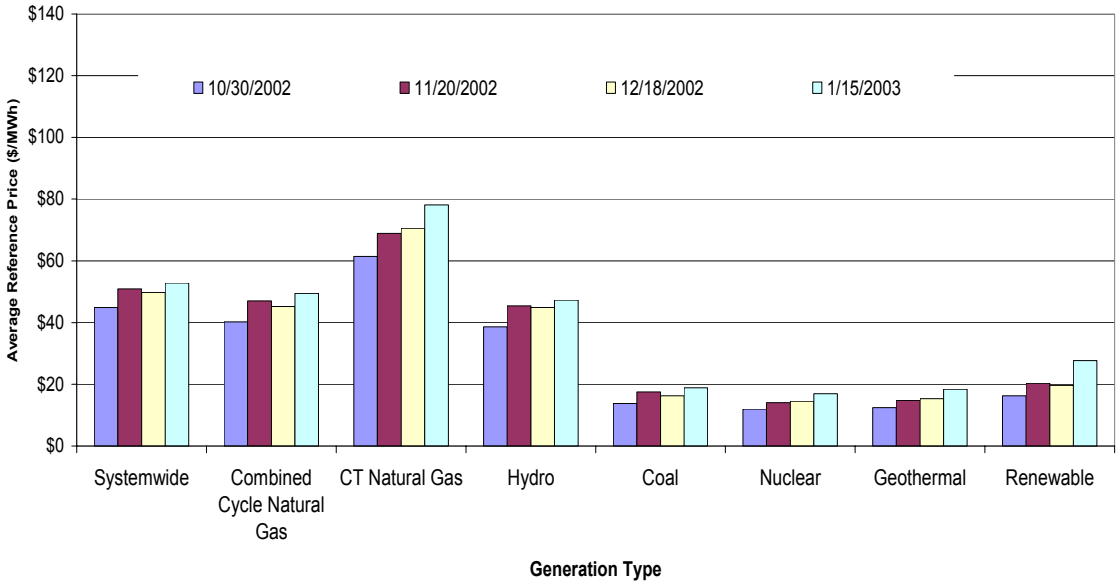


Figure 4. Average Reference Levels for Thermal and Non-Thermal Generators by Type, Not Normalized to Gas Prices



Conduct Test Failures. In the three months after October 30, 2002, there was no failure of the impact test. However, there were hours in which units have failed the conduct test but did not have a material impact on the MCP. Certain units, municipal-owned (muni) gas turbines, qualifying facilities (QF), and hydroelectric units in particular, repeatedly failed the conduct test. Furthermore, fewer than ten units account for at least 75 percent of all conduct test violations. While some of

these units bid excessively high prices, others failed the conduct test because they have very low bid-based reference levels, possibly because they had bid at low prices in order to be accepted for dispatch in the market. Certain muni gas-fired units and QF units repeatedly failed the conduct test, either because they consistently bid well above the incremental soft bid cap of $250/MWh, or because they have unusually low reference levels.

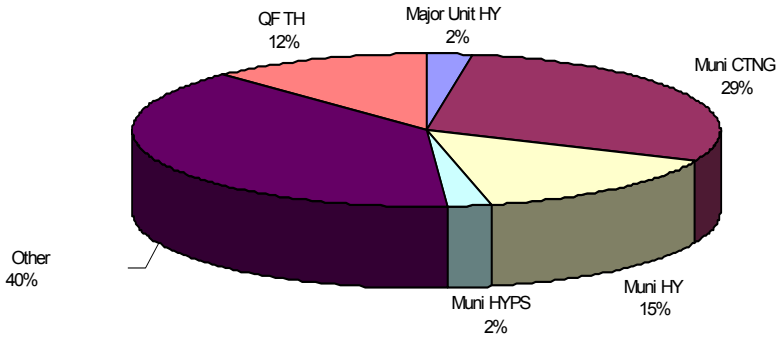
Table 1 below shows the number of hours of conduct test failures during the report period.

Table 1. Hours per Day with AMP Conduct Test Failures

Date	Daily Failures
10/30/02	2
11/1/02	1
11/2/02	1
11/3/02	1
11/4/02	1
11/11/02	2
11/12/02	3
11/20/02	1
11/28/02	3
12/5/02	1
12/13/02	1
12/16/02	7
12/17/02	12
12/18/02	3
12/25/02	1
1/3/03	2
1/7/03	2
1/19/03	1
1/22/03	1
1/31/03	1

The following pie chart shows shares of conduct test failures by ownership and generation type.

Figure 5. Shares of Conduct Test Failures by Unit Ownership and Generation Type

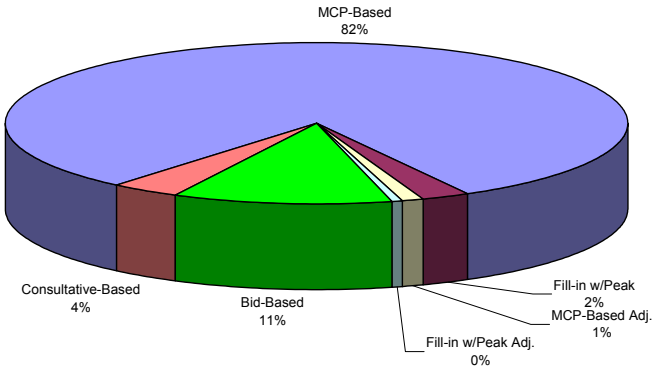


Approximately 11 percent of Conduct Test failures were by units whose reference price was based upon that unit's accepted bids during the previous 90 days, which is the preferred method for establishing reference prices for units where such information exists. Eighty-two percent of conduct test failures were by units whose reference curves were assigned using the zonal MCP for the region. Four percent of conduct test failures were by units whose reference levels were established through consultation between the unit's owner and Potomac. Two small muni gas-fired resources account for all of the violations by units with consultative-based reference levels.[3]

Figure 4 shows shares of conduct test failures categorized by the method Potomac used to produce the reference prices.

[3] In addition to the violations listed, two units fail the conduct test in every hour it is applied, because they are severely constrained by environmental limitations, and are explicitly directed by their Air Quality Management District to bid in excess of the price cap of $250/MWh.

Figure 6. Shares of Conduct Test Failures by Source of Reference Level[4]



III. AMP During Specific Price Spikes

As previously discussed, AMP mitigation was not triggered during any of the price spikes that occurred during the report period. While units that set the MCP during certain price spikes have often bid significantly in excess of their reference levels, this behavior was not sufficient to fail the Conduct Test; *i.e.*, to exceed those units' reference levels by the lesser of $100/MWh or 200 percent. In fact, in several intervals in the report period during which the MCP exceeded $100/MWh, units that set the MCP were able to sell at prices significantly above their marginal operating costs without failing the Conduct Test. Some units' reference prices are significantly higher than their marginal operating costs, by virtue of the fact that they had bid significantly in excess of costs. Moreover, the Conduct Test threshold provided more than ample latitude to mark up prices above marginal costs and/or reference levels without actually exceeding it during most of the quarter. Given the existing loose thresholds, AMP mitigation will likely only take effect during extraordinary price spikes. The ISO real-time market did not see such price spikes in the three months after AMP was implemented.

The increase in average BEEP incremental prices can be attributed in part to price spikes in approximately 53 ten-minute intervals in November, of which three contiguous hours each occurred

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[4] Second steps of reference curves are sampled. Sources are usually consistent across units, except that some units have "fill-in" sources in addition to one other source. Sources shown are as follows:

- Bid-based: lower of mean or median of unit's accepted bids.
- Consultative-based: cost-based justification by unit's owner to Potomac.
- MCP-based: mean of zonal MCP for unit's location in lowest-priced 25 percent of hours unit was scheduled
- "Fill-in" indicates a missing reference price, filled in by setting the price equal to that in the previous step (Step 1).
- "Peak" indicates an off-peak hour, in which no inherent reference price exists, so the corresponding reference price from a peak hour was used.
- "Adjusted" or "Adjusted for monotonicity" indicates that the underlying reference price would have violated the monotonic non-decreasing rule for reference prices. The level used is equal to that in the previous step (Step 1).

on the evenings of November 20 and December 16.[5] The total cumulative cost of all such spikes was approximately $1.4 million, with a relatively high average interval procurement of 218 MWh, at an average price of $119/MWh. This cost is approximately $624,000 (or $54/MWh) greater than if the same volume had been procured in those intervals at the average peak-hour price during the quarter of $64/MWh. All of the spikes occurred in SP15, usually with the real-time market split between congestion zones due to congestion on Path 15 or Path 26, and most can be attributed to import limitations during high loads as specified in the Southern California Import Transmission (SCIT) Nomogram.[6]

There were two spikes in the price of incremental real-time imbalance energy on December 13 and 16. On December 13, rapidly increasing loads leading to the evening peak forced operators to dispatch deep into the BEEP stack between 5:00 and 6:00 p.m. This caused prices to stay above $100/MWh for eight intervals, peaking at $139/MWh. On December 16, with the Midway-Vincent 500 kV Line 1 already scheduled out, a storm blew down several towers supporting the Midway-Vincent 500 kV Line 3, curtailing Path 26 to 500 MW. This outage required splitting the BEEP Stack between Northern and Southern California, causing prices in Southern California to spike for five hours, peaking at $140.54/MWh.

The BEEP MCP was set by one particular thermal peaking resource in 29 intervals between November and December during which the MCP was at least $100/MWh. While this high-cost unit's bids routinely were high enough to cause the MCP to rise to that level, its reference price was sufficiently high that the bids remained below the AMP Conduct Test thresholds.

On January 13, ISO operators dispatched incremental energy to meet the sharp rise in load between 6:00 and 7:00 p.m. The SCIT nomogram constrained import supply into Southern California on this day. During the early-evening load increase, the real-time market-clearing price in SP15 was at least $115.55/MWh for seven intervals, and peaked at $119/MWh. Most of the units dispatched by the ISO during this time possessed high ramp rates needed to meet the steep load increase. The MCP was set this hour by a peaking unit that had also set the price during several spikes in December.

On January 25, at 5:34 p.m. a major generating unit in NP15 was unexpectedly forced out of service. ISO operators responded by incrementing several resources, causing the MCP to spike to $100/MWh for the next four intervals. The resource that set the MCP in intervals 1 and 2 (between 6:00 and 6:20 p.m.), had a reference price below $5/MWh, which would place it in a position to fail the conduct test whenever it bids $15/MWh or greater and AMP is applied[7]. However, due to an unusual time sequence of events, AMP was not applied in these hours. AMP only runs if the hour-ahead prediction of the BEEP MCP exceeds $91.87/MWh. In this case, the contingency caused a sudden supply shock and consequential price spike in the middle of the hour – well after the time

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[5] For this analysis, DMA has defined a price spike as an incremental MCP above $100/MWh.

[6] This nomogram effectively is a limit on the amount of electricity that can be imported into Southern California at any given time.

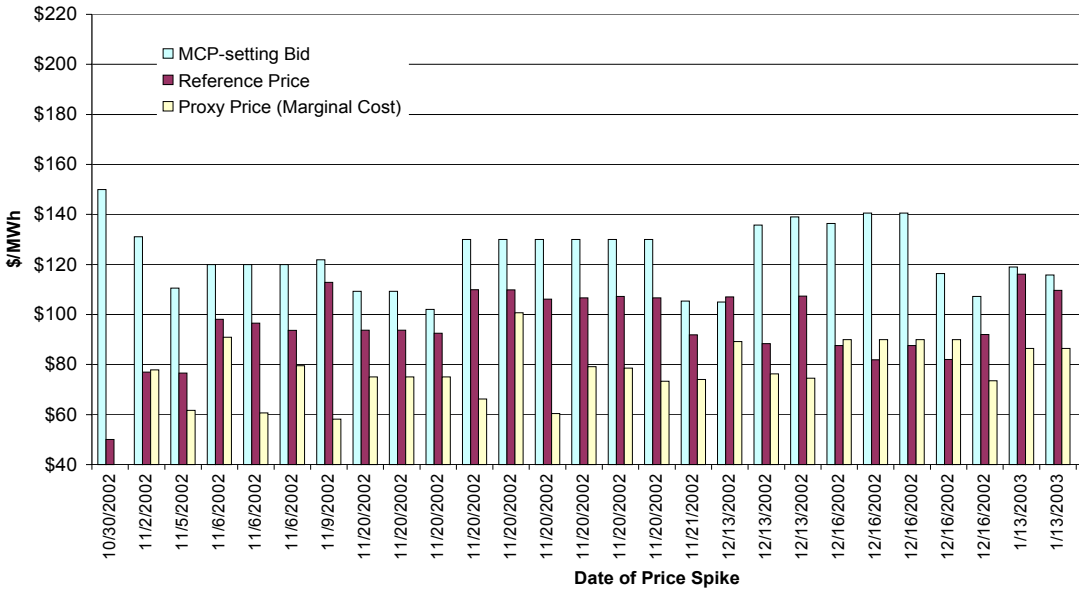
[7] The ISO does not apply AMP to bids at or below $25/MWh. So, while a $15/MWh bid from this resource would technically fail the conduct test, the ISO would not mitigate this resource's bid until it exceeded $25/MWh.

the ISO would have run AMP. Thus, the MCP-setting resource was not subjected to the conduct test. Had AMP been applied automatically with no price screen at the beginning of each hour, the units selling during intervals 1 and 2 would have been subject to AMP mitigation.

Given the generous Conduct Test thresholds, none of the bids that set the price during spikes in the period studied in this report failed the AMP Conduct Test. The lower AMP Conduct threshold levels of $50/MWh or 100% above the reference level initially recommended by the ISO in its May 1, 2002 MD02 filing would have caused the MCP-setting bid to fail the conduct test in at least two instances. The bids setting the MCP during the spikes on November 2 and December 16 offered energy at prices greater than $50/MWh above the unit's reference curve, but not high enough to trigger the existing threshold of $100/MWh or 200% above the reference curve. In at least three instances, a cost-based rather than a bid-based conduct threshold would have caused the MCP-setting bid to fail the conduct test. During spikes on November 2, November 9 and December 16, the MCP was at least $50/MWh or 100% above the marginal cost curves (used to create proxy bids for units subject to the Must-Offer Requirement) of those bidders setting the MCP.

The following chart compares MCP-setting bids during price spikes with reference prices and marginal costs associated with the bids that set the MCP.

Figure 7. MCP-Setting Bids vs. Corresponding Reference Levels And Marginal Costs during Price Spikes, Oct. 30, 2002, through Jan. 31, 2003



IV. Predictive Dispatch

The ISO runs AMP when the predicted imbalance energy price exceeds $91.87/MWh. Predicting the imbalance price requires the ISO to predict the amount of imbalance energy it must dispatch in each interval for the next hour. Though the ISO makes every effort to accurately predict the imbalance energy requirement, several factors – some of which are within the ISO's responsibility, while some of which are not - make doing so a challenge. These factors are:

- **Load forecast error.** Load forecasts, which, at their best, can only be as good as weather forecasts, are not perfect.

- **Shape of the imbalance energy supply curve.** The aggregate imbalance energy supply curve is not a straight upward-sloping line. In general, the aggregate supply curve is a curve marked by a sharp "knee", below which the price increases slowly, then beyond which the price increases sharply. Below the knee, a small error in the forecast imbalance energy requirement may have a small effect on predicted price. Beyond the knee, a small error in the forecast imbalance energy requirement may have a large effect on the predicted price.

- **Declined dispatch instructions.** When the ISO predicts the imbalance energy price by forecasting how much imbalance energy it must dispatch, the ISO assumes that all imbalance energy bids dispatched will be delivered. Actually, a significant amount of imbalance energy bids dispatched in real-time are declined, which means that the ISO must dispatch bids for more than the required imbalance energy just to produce the required imbalance energy. Not accounting for declined dispatch instructions tends to reduce the forecast price.

- **Deviations from Final Hour-Ahead schedules.** The ISO assumes that all suppliers are operating at the levels specified in their Final Hour-Ahead Schedules when the ISO forecasts the imbalance energy requirement. If they are not, the amount that suppliers are deviating from Final Hour-Ahead Schedules, either positive or negative, will contribute to any other errors in the forecast imbalance energy requirement.

The net effect of all these factors is that the ISO cannot predict either the imbalance energy requirement or the imbalance energy price with perfect certainty. Consequently, if the ISO overestimates the imbalance energy requirement, the ISO may apply AMP in hours in which the imbalance energy price does not exceed $91.87/MWh; if the ISO underestimates the imbalance energy requirement, the ISO may not apply AMP in hours in which the imbalance energy price exceeds $91.87/MWh.

The ISO is investigating ways to increase the accuracy of the imbalance energy forecast, such as accounting for an average amount of declined dispatch instructions, running AMP closer to real-time (it currently runs AMP 53 minutes prior to the operating hour), and improving the load

forecasts. Since AMP is a market power mitigation tool, the ISO is greatly concerned about failing to run AMP in hours in which it should have been run and believes the prudent approach would be to eliminate the price screen and apply AMP in all hours. The ISO believes that the overly generous conduct and impact thresholds more than protect suppliers from any undue mitigation that might occur when AMP is run in hours in which the imbalance energy price turned out to be below $91.87/MWh.

While these issues may suggest that AMP should not be applied based on predicted dispatch, but on actual dispatch, such an approach is problematic. First, the ISO's systems cannot change from unmitigated bids to mitigated bids once the hour has begun. Second, running the AMP takes enough time and computational power that doing so in real-time would interfere with the real-time dispatch systems. Consequently, the ISO must apply AMP based on predictive dispatch.

V. Summary

All of these factors indicate that AMP has not yet been effectively tested to determine whether it is an effective means of market power mitigation during periods in which suppliers have the ability to exercise market power. Relatively mild temperatures in the western region have kept loads at moderate levels. Moderate loads, combined with more than adequate supply and positive trends in scheduling deviations, resulted in fundamental market conditions during the report period that limited suppliers' ability to exercise market power. Certain units consistently failed the conduct test, but they were seldom or never dispatched by ISO due to ramp rate limitations. Price spikes were frequent, but AMP conduct test thresholds are sufficiently generous such that price setters have ample latitude to bid successfully at prices well above their reference levels and marginal costs.

That notwithstanding, future quarterly reports on AMP may help to provide a clearer picture of the mitigating efficacy of AMP. Natural gas and electricity hub prices recently spiked, causing a series of price spikes in the ISO real-time market. Furthermore, unseasonably warm weather in the Pacific Northwest has resulted in a minimal snow pack, indicating that supplies of hydro-based imports into California in the spring and summer of 2003 may be well below normal. If hydro conditions do not improve, supply conditions this summer could be tight, making the market generally less competitive and establishing conditions that may provide a more appropriate test of the effectiveness of AMP as a market power mitigation tool.