Memorandum

To: ISO Board of Governors

From: Benjamin F. Hobbs, Chair, ISO Market Surveillance Committee

Date: September 11, 2014

Re: **Briefing on MSC Activities from July 1, 2014 to September 8, 2014**

This memorandum does not require Board action.

1. Overview

Over the time period covered by this memorandum, the Market Surveillance Committee (MSC) finalized and adopted a formal opinion that was submitted to the Board of Governors at its July meeting. The opinion addressed local market power mitigation (LMPM) in the forthcoming energy imbalance market. The final opinion was adopted during a general session teleconference meeting on July 7, 2014, and was summarized in the Board memo on MSC activities submitted in July.

The MSC held a general session meeting at Folsom on August 22, 2014 in which the following topics were addressed:

- Proposed energy imbalance market benefit methodology
- Market power mitigation in the capacity procurement mechanism
- Flexible ramping product
- Commitment cost enhancements
- Load granularity refinements
- Recent experience with FERC Order 764 market design pricing and interchange

Individual MSC members interacted informally with staff and stakeholders on these initiatives. In addition, MSC members were also consulted by ISO staff during the development of the full network model tariff revisions filed on September 2, 2014 that address the accuracy metric to be used to evaluate the performance of the model and trigger implementation.

Finally, the MSC drafted a formal Opinion on the Commitment Cost Enhancements proposal that is to be considered during the September meeting of the Board of Governors. The final opinion was adopted during a general session teleconference meeting on September 8, 2014.

Section 2 of this memo summarizes the conclusions of the Opinion. Section 3 provides summaries of the issues discussed at the MSC general session meeting of August 22. Section 4 summarizes the MSC's evaluation of the accuracy metric proposed for evaluation of the full network model.

2. MSC Opinion on Commitment Cost Enhancements

The natural gas price volatility and spike events experienced in the winter of 2013-2014 made plain a limitation of the ISO's procedures for adapting its commitment cost estimates to changing gas prices. There is a clear and immediate need to revise the commitment cost estimation procedure to reduce lags in updating those costs and the potential inefficiencies that can result.

In response to this need, the ISO has developed the commitment cost enhancements proposal that is now before the Board. The elements of the proposal include:

- An increase in the proxy cost cap from 100% to 125% of estimated cost, based on a pair of prior day gas price indices, to provide more flexibility for commitment cost offers to reflect varying costs.
- Deferral of implementation of an opportunity cost estimation methodology for limited-use natural gas units, pending further refinement and review of the methodology.
- Retention of the registered cost option, which fixes the commitment cost caps for the month based on 150% of expected proxy cost for that period, on an interim basis for use-limited resources only. Non-use-limited resources will be required to use the proxy cost option, and the ISO intends to eliminate the registered cost option for all resources once the opportunity cost methodology can be implemented.
- Retention of the manual process for modifying gas prices based on a single same day gas index for the day-ahead market, triggered when a region's gas prices rises to 125% or more of the previous night's value. The proposal will also automatically switch units using the registered cost option to the proxy cost on the day of a price spike if the manually updated proxy cost is higher than the registered cost.

In summary, the MSC's Opinion offered the following recommendations.

- In general, the proposal for calculating commitment costs is reasonable from the standpoint of what can be implemented prior to this coming winter. Increasing the proxy cost calculation used to cap start-up and minimum-load offers to be 125% of the calculated cost will reduce the frequency and extent to which the offer prices of suppliers lacking market power will be mitigated below the supplier's incurred commitment costs. This change in the cap will reduce the likelihood of inefficient outcomes that could adversely impact electric or gas system reliability.

- In general, resources with significant use-limitations need to either implement use plans or manage their use through commitment cost offers. We strongly prefer using such offers for this purpose, since the timing of the system's need for the resources is becoming less predictable as renewable penetration increases. The ISO's goal of developing, testing, and implementing an opportunity cost calculation methodology for use-limited natural gas units is very important, and we encourage the ISO to do so, if possible prior to the summer of 2015, and, if not, prior to the winter of 2015-2016.
- Because it will not be possible to implement explicit calculation and inclusion of opportunity costs in the ISO's commitment cost estimates prior to the winter of 2014-2015, the ISO has proposed retention of the registered cost option for use-limited units. We have considered that option and a number of alternatives, and none is fully satisfactory from the point of view of being cost reflective, providing flexibility, and protecting against market power. We conclude that, as a temporary fix, allowing limited-use units a registered cost option based on 150% of the projected average proxy cost is an acceptable means of providing flexibility in the near term prior to implementation of the opportunity cost estimation methodology. However, an alternative approach is described below that in our view has advantages over the proposed temporary fix.
- While the retention of the registered cost option for use-limited units is acceptable, we have also defined another alternative that has some advantages. In this alternative, the registered cost option instead would be eliminated for all units, with offers of use-limited units being allowed a temporary adder on top of the 125% of the proxy cost, to cover possible opportunity costs.
- In the longer term, the ISO should continue to improve its methodology for including major maintenance costs in proxy commitment costs to better reflect costs, while continuing to ensure that only costs that vary with starts or hours of operation, not fixed costs, are included, and that the included costs are reflective of actual maintenance costs.
- Finally, we conclude that the various problems involved in estimating those costs for the purposed mitigation are inevitable and to a degree unavoidable when mitigating resources that possess locational market power, but the impact of errors in estimating these costs is magnified when start-up cost mitigation is applied to all units all the time without regard to whether they even potentially possess market power. This raises the question as to whether the mitigation of commitment costs within the ISO's local market power mitigation system can be limited to resources that potentially possess market power.

3. MSC general session meeting of August 22

MSC members and ISO staff made several formal presentations,[1] and members led discussions with staff and stakeholders during this meeting on six topics.

[11] Available from the MSC page, www.caiso.com/informed/Pages/BoardCommittees/MarketSurveillanceCommittee/Default.aspx

3.1 Proposed energy imbalance market benefit methodology

The ISO has been developing a method for after-the-fact quantification of the total economic benefits of the energy imbalance market, and the distribution of those benefits among balancing area authorities (BAAs). These benefits are anticipated to take several forms: trade among the BAAs in the real-time market that doesn't presently occur; increased participation by non-PacifiCorp resources in the real-time market in its BAAs; more efficient congestion management and meeting of load changes in real-time in the PacifiCorp BAAs; and reduced overall need for the flexibility product due to the ability to share flexible capacity among BAAs.

The MSC has been consulting with ISO staff on the general framework for calculating those EIM benefits. Conceptual issues include: how to represent the "but for" counterfactual of non-CAISO dispatch in the absence of the energy imbalance market; how to handle greenhouse gas emissions inside and outside of California in the calculations; and what prices to use to value energy and flexible ramping product transactions between BAAs.

During the MSC meeting, Dr. Lin Xu, Lead Market Development Engineer at the ISO, briefed the MSC on the proposed methodology, and presented an illustrative example. In general, the MSC believes that the after-the-fact benefit methodology has a solid conceptual footing. If the practical computational challenges of rerunning the market software to identify the counterfactual and compare it with actual 15 minute outcomes prove to not be a problem, then the result will be a useful tool for evaluating the benefits of the energy imbalance market. In addition, such a tool will be useful for assessing the benefits of expanding real-time markets throughout the west and for calculating competitive baseline prices for the purposes of monitoring market performance and identifying potential market power.

The MSC looks forward to continuing its consultation with ISO staff on the development of the methodology.

3.2 Market power mitigation in the capacity procurement mechanism

During this portion of the meeting, four presentations were made:

- Carrie Bentley, Senior Market Design and Policy Specialist at the ISO, who described the proposed competitive solicitation process, including the offer procedure, market power mitigation, and procedure to determine competitive solicitation process designation and payments.
- MSC Member Dr. James Bushnell, who summarized two roles for the mechanism: one to create a market when too few resources have been procured to meet a resource adequacy requirement, and the second to secure resources when extreme events or unanticipated constraints mean that capacity is needed even though adequacy requirements are met. Each role has different

implications for pricing, especially concerning whether a scarcity premium should be offered if there are too few resources to meet a requirement, and if local market power is a concern.

- MSC Member Dr. Shmuel Oren summarized lessons from the field of economics, especially experimental economics, regarding whether pay-as-bid or market clearing-based pricing can be expected to yield efficient outcomes (i.e., use of the least-cost resources) and minimum payments for consumers. For the general situation, experiments show that payments are no lower under pay-as-bid, but inefficiencies occur as bidders attempt to guess where the clearing price will be and then bid just under it. However in the competitive solicitation process, the market is likely to be thin and resources will have diverse attributes (such as their location relative to an unmodeled constraint that drives exceptional dispatch). As a result, Dr. Oren concluded that a pay-as-bid mechanism would be appropriate in this circumstance.
- Finally, Michael Castelhano, Market Monitoring Analyst for the ISO Department of Market Monitoring, reviewed design choices involved in configuring a market power mitigation scheme for the competitive solicitation process. He discussed the issues of market concentration tests (such as three pivotal suppliers), determination of what costs are relevant, and ISO review of bids that fail market power screens.

The MSC anticipates submitting a formal Opinion on market power mitigation in the capacity procurement mechanism at an appropriate time.

3.3 Flexible ramping product

Don Tretheway, Lead Market Design and Policy Specialist at the ISO, briefed the MSC on three sets of issues concerning the design of the flexible ramping product market: day-ahead bidding rules; the amounts of requirement to be specified day-ahead, in the fifteen minute market, and the 5 minute real-time dispatch market; and the parameterization of a demand curve that would allow requirements to be relaxed if the marginal costs of meeting them is high.

The MSC will submit a formal Opinion on the flexible ramping product at an appropriate time.

3.4 Commitment cost enhancements

This initiative is the subject of the formal Opinion discussed in Section 2, above.

MSC Member Dr. Scott Harvey made a presentation on short- and long-run issues in designing market power mitigation for commitment costs. He pointed out that there is no very good short-term solution to the problem of accommodating the desire to allow generators to offer commitment cost bids that reflect their opportunity costs, while protecting against market power as long as the ISO does not have a method of

estimating opportunity costs. He discussed design possibilities for a system that removes caps on commitment cost offers for generators that lack local market power, which he argued is desirable in the long term.

3.5 Load granularity refinements

Stephen Keehn, Senior Advisor for Infrastructure Policy at the ISO, made a presentation summarizing the recent Order by the Federal Energy Regulatory Commission that requires the ISO to either disaggregate the ISO's three load aggregation points or justify a waiver of that requirement based on additional analyses of the costs and benefits of disaggregation. The ISO will be estimating these benefits and costs over the next year in preparation for a filing no later than June 2015.

The MSC will consult with ISO staff on appropriate methods for quantifying those costs and benefits over the coming months.

3.6 Recent Experience with FERC Order 764 Market Design Pricing and Interchange

Dr. Harvey of the MSC made a presentation on price and interchange scheduling experience in the fifteen minute market that was started in May 2014 in response to FERC Order 764. This presentation lead to active discussion of a number issues, including the timing, persistence , and causes of gaps between hour-ahead prices and other prices; the lack of economic import offers in the hour-ahead market; and the high volatility of hour-ahead prices relative to fifteen and five minute prices.

Dr. Harvey reviewed several possible explanations of the observed price gaps, including operator actions, flexi-ramp constraints, forecast errors, and differences in congestion. He contrasted the ISO experience with experience in the PJM and NYISO markets with price convergence between real-time commitment and real-time dispatch, where prices have largely converged. Finally, Dr. Harvey reviewed possible reasons for decreases in economic offers in the hour-ahead market, including the possibility that (unlike the eastern ISOs) Western BAAs tend to charge for transmission on a per-MW basis rather than per-MWh basis, which penalizes 15 minute transactions. It was noted that in the weeks immediately preceding the MSC meeting, convergence in the ISO's markets had improved.

4. Full network model metrics

On July 31, 2014, the ISO's full network modeling enhancements filing was approved by the Federal Energy Regulatory Commission. The ISO was required to submit a compliance filing by Sept. 2 in which an accuracy metric and triggering mechanism was to be described. The ISO is also required to file a report on a pre-implementation analysis of the performance of the model before its implementation.

We have reviewed the definition of the accuracy metric as well as the first 10 days of the accuracy metric results. The ISO intends to publish an analysis of that metric prior to

implementation, with a decision to implement to be based both on that analysis and other information. According the ISO's Sept 2 filing to FERC, the accuracy metric will then be used as follows in the two years of implementation: the accuracy metric will be calculated daily, and if the rolling three week average of the metric is worse for the full network model than for the alternative of no day-ahead estimation of external unscheduled flows, then modeling of external unscheduled flow is to be suspended until the ISO passes the metric.

The accuracy metric that is proposed to be used is based on the absolute value of errors in estimated external unscheduled flows, totaled daily over all ties and hours. We believe that a suite of metrics should be used informally by the ISO to assess the performance of the model because they will provide a fuller picture of the performance of the model and, possibly, diagnostics of modeling problems that might arise that could be used to improve the model. As three examples, a metric based on the errors weighted by the shadow prices of the intertie constraints will provide an index of the economic impact of errors. A metric that weighs larger errors more (such as the root mean square error) would be useful, under the reasonable assumption that larger errors are of disproportionate importance. A metric that considers internal constraints would also be informative. In general, we believe that the ISO should routinely track such metrics on a daily basis

However, if a single accuracy metric is to be used, then the proposed accuracy metric is a reasonable one. Other metrics should be calculated and published in parallel to order to provide a more complete picture.

Our review of the accuracy metric results (aggregated across interties) that were provided to us shows that the total error resulting from using the full network model to represent external unscheduled flows in the day-ahead market (Scenario 1) is less for 12 of 14 days compared to doing no modeling of external unscheduled flow impacts (Scenario 2). If the days are treated as independent observations, the performance of the full network model is statistically significantly better than a 50:50 split at a 0.5% confidence level.[2]

This result for this very small sample indicates that the full network model has the potential to result in appreciably improved estimates of unscheduled flows, consistent with the expectation we expressed in our recent opinion “Opinion on Implementation of the Full Network Model”, adopted January 30, 2014. However, we cannot conclude on the basis of this analysis that the full network model will definitely be an improvement. This is because a larger sample of days under a wider range of conditions is needed, and because the Aug. 23, 2014 results reported to us require more analysis to understand whether they are the result of analysis or input error, or instead indicate a flaw in the model that needs

[2] The test used is the nonparametric binomial one-tailed test, using each day as one observation. The test is equivalent to asking: what is the chance that a fair coin would result in 12 or more heads out of 14 coin tosses? In theory, use of hourly data would provide more degrees of freedom and a more powerful nonparametric test, if the autocorrelation among hours was less than 1. However, for 13 out of 14 days, each and every one of the 24 hours within the day had the same result as the daily average, so the autocorrelation among hours is perfect and we cannot treat the hours as independent observations. Therefore, we can only consider the days as independent.

correction.[3] Therefore, we strongly support the ISO's plans for much more extensive analysis of a larger number of days before implementation.

We have also considered the issues raised by Powerex Corporation in its comments on the ISO metric methodology.[4] In its comments, Powerex expresses its preference for a regionally coordinated approach to modeling the western grid, involving other regional transmission providers in the West, and makes specific criticisms of the accuracy metric recommended by the ISO. The major criticisms are that the metric aggregates over all interties and does not consider the impact on the market.

We agree that the ideal would be a regionally coordinated approach, but none is within reach at this time and we believe that it is best if the ISO take the lead and proceed with developing a full network model on its own. If other regional transmission providers would then join in to cooperate on further development or refinement, we believe that this would be a welcome development. There is nothing in the ISO proposal that would preclude the ISO from participating in the development of a coordinated regional approach. The issue is simply that the ISO need not passively wait to change how it operates its transmission system, hoping for the development of a regional approach that may never happen.

Regarding Powerex's criticisms of the ISO's metric, we believe that comparing the loopflow forecast developed using the full network model to the current forecast of zero loopflow is a reasonable and appropriate summary metric. While the overall metric would be aggregated over all interties to provide a general measure, the ISO will also be reviewing the performance of the full network model on a tie by tie basis and making adjustments to improve forecasting on a tie by tie basis. As noted above, we would encourage the ISO to develop a suite of metrics for assessing the performance of the full network model and for identifying ways to improve it. No one metric will provide all the information needed for this process, but if it has to be based on a single metric, we believe that the ISO's metric is a useful and informative one for that purpose.

We do not believe it is worthwhile to delay implementation of the full network model pending the outcome of a much longer stakeholder process to consider all metrics; we think it is important to be testing it now and, if it performs well on the ISO's metric, begin using it in order to benefit the California market and, likely, all markets in West.

[3] Whereas for 12 out of 14 days, the FNM model errors were roughly half or less of the error that would result from using no model, for this one day, FNM model errors were reported to be several times as large as those from no model. This anomalous result might be the result of data input errors or other readily correctable errors and, if so, would be unrepresentative of the likely performance of the FNM.

[4] Powerex Corporation, "Motion for leave to answer and answer of Powerex Corp to the answer of the California Independent System Operator Corp.," Filed at the Federal Energy Regulatory Commission, Docket No. ER14-2017-, July 14, 2014.