California ISO
Shaping a Renewed Future

California Independent
System Operator Corporation

November 16, 2011

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

Re: California Independent System Operator Corporation
Docket No. ER12-____-000
Amendments to Local Market Power Mitigation Tariff Provisions

Dear Secretary Bose:

The California Independent System Operator Corporation (CAISO)[1] submits this filing to amend its tariff to: (1) comply with the Commission's directive in its 2006 order to use bid-in rather than forecast demand in the local market power mitigation process in the day-ahead market within three years of implementation of the CAISO's nodal market design;[2] (2) improve the local market power mitigation process; and (3) add a new dynamic process for determining whether a transmission path is competitive or non-competitive as part of the day-ahead local market power mitigation process.[3] As described in more detail below, the new local market power process contained in this tariff amendment will improve the overall accuracy and efficiency of the CAISO's local market power mitigation.

The CAISO proposes an April 11, 2012 trading day effective date for the revisions set forth herein.[4] The CAISO respectfully requests that the Commission issue

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[1] The CAISO submits this filing pursuant to Section 205 of the Federal Power Act, 16 U.S.C. § 824d, and Section 35.13 of the Commission's regulations, 18 C.F.R. § 35.13. The CAISO is also sometimes referred to as the ISO. Capitalized terms not otherwise defined herein have the meanings set forth in Appendix A to the CAISO tariff and in this tariff amendment filing, and except where otherwise noted herein, references to section numbers are references to sections of the tariff.

[2] *California Independent System Operator Corp.*, 116 FERC ¶ 61,274, at P 1089 (2006).

[3] The revisions contained in this tariff amendment constitute the first stage in a planned two-stage process for enhancing the CAISO's local market power mitigation provisions. This two-stage process is discussed in further detail below.

[4] The CAISO is proposing an effective date of April 11, 2012. The CAISO selected April 11, 2012 rather than April 1, 2012 to be consistent with the CAISO's protocol for implementing

an order accepting the tariff revisions contained in this filing prior to March 1, 2012 in order to allow sufficient time to configure and test its systems in order to implement these improvements effective as of the April 11, 2012 trading day.

I. Background

A. The CAISO's Current Market Power Mitigation Process

The CAISO tariff includes provisions to mitigate the ability of suppliers to exercise local market power by unilaterally influencing the price of energy in the CAISO's markets. The CAISO performs local market power mitigation in the day-ahead for the day-ahead market and in the hour-ahead scheduling process, for both the hour-ahead scheduling process and the real-time market.[5] The current mitigation process analyzes supply bids in two pre-market processing runs that use the same resource optimization method as in the actual market runs, except that in the case of the market power mitigation run for the day-ahead market, resources are dispatched based on forecast demand rather than bid-in demand.[6]

The first market power mitigation processing run is the competitive constraints run, in which the CAISO's software clears supply against demand while enforcing only those transmission constraints that are pre-designated as competitive. The second run is the all constraints run, in which supply is cleared against demand while enforcing all modeled transmission constraints, which will also be enforced in the market run. The results of these two runs are compared for each resource. If the dispatch level produced through the all constraints run is greater than the dispatch level produced through the competitive constraints run, then the resource is considered to potentially have the ability to exercise local market power, in which case the entire portion of the resource's bid curve that is above the dispatch level in the competitive constraints run is mitigated to the lower of the resource's default energy bid or its market bid, but no lower than the resource's highest bid price that clears the competitive constraints run.[7]

Because the mitigation process for the hour-ahead scheduling process and the real-time market is run as part of the hour-ahead scheduling process, that process produces results for each 15-minute interval of the applicable hour, which means there

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complex software changes on or about the second Tuesday in the applicable month. The purpose is to regularize implementation of complex software implementation and avoid weekend implementations such as would occur if the CAISO were to implement on April 1, 2012, a Sunday.

[5] The mitigation process for the real-time market is performed as part of the CAISO's hour-ahead scheduling process. Both the hour-ahead scheduling process and the CAISO's five-minute real-time dispatch are conducted in "real-time," as that term is defined in Appendix A to the CAISO tariff.

[6] CAISO tariff, Section 31.2. The market power mitigation process is also sometimes called the market power mitigation – reliability requirement determination (MPM-RRD) process. *See id.*

[7] CAISO tariff, Sections 31.2.1, 31.2.2.

could be up to four mitigated bids for a resource in a trading hour. A single mitigated bid for the entire hour is calculated using the minimum bid price of the four bid curves at each bid quantity level. The bids are mitigated only for the bid quantities that are above the minimum quantity cleared in the competitive constraints run across all four 15-minute intervals.[8] The resulting mitigated bid curves are used to mitigate bids in the hour-ahead scheduling process and in the real-time market.

For purposes of this market power mitigation process, the determination of whether a transmission constraint is competitive or non-competitive is performed at a minimum on a seasonal basis, and more frequently if needed due to changes in system conditions, network topology, or market performance. The basic test for competitiveness is that a transmission constraint will be deemed competitive if no three unaffiliated suppliers are jointly pivotal in relieving congestion on that constraint. This competitive path assessment is performed assuming a variety of system conditions, and if an individual constraint fails the pivotal supplier criteria under any of these system conditions, it will be deemed uncompetitive until a subsequent assessment deems the constraint competitive.[9]

B. Commission Directives to Modify the Current Market Power Mitigation Process

In February 2006, the CAISO filed its new nodal market design for Commission acceptance. The CAISO proposed to implement the new market design in phases or "releases" that included release 1, which would go into effect at the start-up of the new CAISO market, and release 2, which would add new market design features to be implemented three years after start-up.[10] As part of release 1, the CAISO proposed to conduct the market power mitigation process for the day-ahead market based on the CAISO's forecast of demand, rather than on bid-in demand. The mitigation method was based on forecast demand rather than bid-in demand largely because technology limitations would have required a significant delay in the implementation of the new CAISO market if the CAISO were required to use bid-in demand at start-up. The CAISO stated that it would consider basing the market power mitigation process for the day-ahead market on bid-in demand in release 2.[11]

In an order issued in September 2006, the Commission conditionally authorized the CAISO's proposals:

> We agree with commenters that in the future the CAISO should use bid-in demand as the basis for market power mitigation in the day-ahead market. However, we are also cognizant of the CAISO's inability to

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[8] CAISO tariff, Section 33.4.

[9] CAISO tariff, Sections 39.7, 39.7.2.

[10] CAISO filing, Docket No. ER06-615-000, at 4-5, 95-96 (Feb. 9, 2006). The new CAISO market is also sometimes called the market redesign and technology upgrade or MRTU.

[11] *Id.* at 34-35, 95-96.

> institute this change in Release 1 without substantial delay of MRTU and its associated benefits. Accordingly, we conditionally accept the CAISO's proposal, subject to the CAISO instituting bid-in demand as the basis for applying market power mitigation in the pre-IFM runs no later than MRTU Release 2 to reduce the likelihood of over-mitigation of suppliers.[12]

On rehearing of the September 2006 order, the Commission affirmed its directive to the CAISO to use bid-in demand rather than forecast demand in its market power mitigation process for the day-ahead market within three years of new market start-up.[13] The new CAISO market was implemented in April 2009. Therefore, the CAISO is required to implement the use of bid-in demand rather than forecast demand in the day-ahead market power mitigation process effective April 2012.

C. The Stakeholder Process for this Tariff Amendment

On October 1, 2010, the CAISO established a stakeholder process to discuss changes to the market power mitigation provisions. The CAISO initially proposed two types of enhancements. First, the CAISO proposed to implement the use of bid-in demand rather than forecast demand in the market power mitigation process for the day-ahead market as required by the Commission's September 2006 order. Second, the CAISO proposed modifications to address other changes in the CAISO's evolving market. These changes included convergence bidding (sometimes also called virtual bidding), implemented in February 2011, and the addition of new demand response resources participating in the CAISO market.[14] The subsequent discussion in the stakeholder process led to the development of the entire set of proposed tariff revisions contained in this filing, including the development of a major improvement in the mitigation process that results in more accurate mitigation while reducing computation time. The reduction in computation time created the opportunity to develop a dynamic competitive path assessment, which will further improve the accuracy of local market power mitigation.

The stakeholder process has provided extensive opportunities for stakeholder participation and comment on the development of the market power mitigation enhancements. In addition to the portions of the stakeholder process conducted by the CAISO alone, other portions of the stakeholder process involved the CAISO's

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[12] *California Independent System Operator Corp.*, 116 FERC ¶ 61,274, at P 1089 (2006). *See also id.* at P 1373 (explaining that the CAISO expected to implement release 2 within three years of the release 1 implementation date).

[13] *California Independent System Operator Corp.*, 119 FERC ¶ 61,076, at PP 496, 662 (2007).

[14] *See* CAISO issue paper entitled "Local Market Power Mitigation Enhancements" (Sept. 29, 2010) at 1, 4-7. This CAISO document is available on the CAISO website at http://www.caiso.com/Documents/IssuePaper-LocalMarketPowerMitigationEnhancements29-Sep-2010.pdf. The reasons for the proposed tariff enhancements to address these new components of the CAISO market design are discussed further in Section II of this transmittal letter.

Department of Market Monitoring and the Market Surveillance Committee. The opportunities afforded by this stakeholder process have included a total of five meetings and conference calls and five additional opportunities for written stakeholder comments.[15] The proposed enhancements were presented to and approved by the CAISO Governing Board on July 14, 2011.[16]

Stakeholders generally supported the CAISO's proposed market power mitigation enhancements and the tariff revisions to implement them. As of this filing, the CAISO is not aware of any major objections to its proposal from parties that participated in the stakeholder process.[17]

II. Summary of Reasons for Revisions to CAISO's Local Market Power Mitigation Process and Primary Modifications

The CAISO is proposing modifications to its local market power mitigation (LMPM) process in order to meet four main objectives:

- comply with the Commission's order directing the CAISO to perform mitigation based on bid-in demand rather than forecast demand;
- account for virtual bidding and new demand response resources participating in the CAISO markets;
- improve the accuracy and efficiency of mitigation; and
- increase the frequency of determining the competitiveness of transmission constraints by incorporating a dynamic assessment of competitive path designations into the day-ahead LMPM process.

In order to meet these objectives, the CAISO is proposing several significant revisions to its market power mitigation process, to be implemented in April 2012:

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15 A list of key dates in the CAISO stakeholder process for the market power mitigation enhancements is provided in Attachment G to this filing. Materials related to the CAISO's part of the stakeholder process are available on the CAISO's website at http://www.caiso.com/2822/28229d8a4b370.html. Materials related to the Department of Market Monitoring's part of the stakeholder process are available on the CAISO's website at http://caiso.com/docs/2005/10/04/2005100412253314368.html. Materials related to the Market Surveillance Committee's part of the stakeholder process are available on the CAISO's website at http://www.caiso.com/docs/2000/09/14/200009141610025714.html.

16 Materials related to the CAISO Governing Board's approval are provided in Attachment H to this filing and are available on the CAISO's website at http://www.caiso.com/informed/Pages/BoardCommittees/BoardGovernorsMeetings.aspx.

17 The few concerns raised by stakeholders are discussed in Section III.D of this transmittal letter.

- The CAISO is amending its tariff to specify that the market power mitigation process will utilize bid-in demand in the day-ahead market. This satisfies the Commission's directive in the September 2006 order to utilize bid-in demand in the market power mitigation process for the day-ahead market.

- The CAISO's market power mitigation process will no longer be comprised of two separate processing runs. Instead, the CAISO's market power mitigation process will analyze the potential to exercise local market power and determine bid mitigation based on a single processing run that decomposes each resource's locational marginal price (LMP) into components relating to energy, losses, and competitive and non-competitive congestion components. Under this new method, which is known as the decomposition method, mitigation will be based on the non-competitive congestion component of each resource's LMP. This change reduces processing time while increasing the accuracy of the mitigation.

- The use of a single pass mitigation run also requires modifications concerning how reliability must-run (RMR) units are treated in the LMPM process. In addition, because of the use of bid-in demand and the implementation of convergence bidding, the market power mitigation process cannot be relied upon to commit RMR resources. Therefore, the CAISO will be relying on manual RMR commitments.[18]

- The CAISO is proposing to implement a dynamic competitive path assessment in the day-ahead market power mitigation process. By re-assessing the competitiveness of all transmission constraints in conjunction with each day-ahead market power mitigation run, use of a dynamic competitive path assessment by the CAISO will further increase the accuracy of the overall mitigation process.

III. Discussion of Tariff Changes to Revise the CAISO's Market Power Mitigation Process

A. Incorporation of Bid-In Demand in Day-Ahead Market Power Mitigation Process

As discussed above, in accordance with the Commission's September 2006 Order, the CAISO is proposing to modify its day-ahead market power mitigation process to use bid-in rather than forecast demand. In order to implement this change, the CAISO has modified Sections 27.4.1 and 31.2 of its tariff to specify that the CAISO will optimize resources to meet bid-in demand in the market power mitigation process associated with the day-ahead market utilizing the decomposition method.

B. Decomposition Method

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[18] Under the current tariff, the CAISO may issue manual RMR dispatches or rely on the automatic reliability requirements determination.

1. Description of the Decomposition Method

As with the CAISO's current method, the decomposition method will utilize the same resource optimization that is used in the CAISO's day-ahead market and hour-ahead scheduling process. However, the CAISO's proposed new market power mitigation method will streamline the existing two market runs (*i.e.*, the competitive constraints run and the all constraints run) into a single market run that enforces all modeled transmission constraints, which will also be enforced in the actual market run. This single pre-market run will produce results that indicate whether dispatches and prices are potentially impacted by market power. The CAISO will then decompose the LMP for each location into four components: (1) an energy component; (2) a loss component; (3) a competitive congestion component; and (4) a non-competitive congestion component.

Under the decomposition method, a positive non-competitive congestion component indicates the potential for local market power. The non-competitive congestion component of each LMP will be calculated as the sum over all non-competitive constraints of the product of the constraint shadow price and the corresponding shift factor. As explained in the testimony of Dr. Lin Xu, Senior Market Development Engineer for the CAISO, bids on behalf of any such resources will be mitigated to the higher of the resource's default energy bid, or the "competitive LMP" at the resource's location, which is the LMP established in the revised market power mitigation process minus the non-competitive congestion component thereof.[19]

In order for the non-competitive congestion component to be an accurate indicator of local market power, the reference bus that the shift factors are relative to should be at a location that is least susceptible to the exercise of local market power. As explained in the testimony of Dr. Xu, the CAISO has determined that the reference bus that best meets this criterion is the Midway 500 kV bus when flow on Path 26 is north to south and the Vincent 500 kV bus when flow on Path 26 is south to north.[20] In addition, Dr. Xu explains that the CAISO also considered using the load distributed slack reference bus, while the CAISO's Market Surveillance Committee is concerned that the load distributed slack reference bus may be impacted by local market power. This led to Dr. Xu's analysis to empirically prove that the Midway and Vincent busses would be a better choice for identifying local market power than the load distributed slack reference bus.[21]

2. Reasons for the Decomposition Method

The CAISO proposes to implement the decomposition method for several reasons. As explained in the attached testimony of Dr. Jeffrey D. McDonald, Manager, Market Analysis and Mitigation for the CAISO's Department of Market Monitoring (DMM), DMM determined that the implementation of virtual bidding (sometimes also

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[19] Direct Testimony of Lin Xu, Attachment C to this filing, at 8-9 (Xu Testimony).

[20] *Id*. at 9-10.

[21] *Id*. at 11-12.

called convergence bidding) and the integration of demand response resources in the CAISO's markets require modifications to the market power mitigation process in order to avoid undermining that process.[22] In this regard, the DMM identified two related concerns that the new decomposition method resolves.

The first concern noted by Dr. McDonald is that, by virtue of using bid-in demand to determine mitigation, the inclusion of virtual demand bids in the day-ahead market could result in an increased likelihood that unmitigated supply bids could determine LMPs. This can occur if a large amount of demand clears due to the addition of virtual demand bids, in which case unmitigated supply bids may be needed to meet this additional demand. This concern stems from the fact that, under the current market power mitigation approach, the amount of generation subject to mitigation is only that amount sufficient to meet projected physical demand. If additional demand clears due to the addition of virtual demand in the integrated forward market, without any modification to the current market power mitigation approach, then unmitigated supply bids will be cleared to meet demand in situations where generation is needed in areas subject to non-competitive transmission constraints.[23]

Dr. McDonald explains that the concern about market power mitigation being undermined by virtual demand bids could be addressed by including all demand and supply (virtual and physical) in the mitigation process. However, making that change would create a second concern: with the inclusion of virtual supply bids in the market run, it would be possible for a physical supply resource with a relatively low default energy bid to evade market power mitigation by being bid at a price above that of virtual supply bids in the same local area.[24] Under this scenario, the virtual supply bids could ultimately "crowd out" the physical supply, thus allowing unmitigated physical supply bids to enter the integrated forward market that would have otherwise been used to satisfy generation needs in a non-competitively transmission-constrained area and would have been mitigated during the run. Similar concerns arise with regard to bids from demand response resources.[25]

As discussed in the attached testimony of Dr. McDonald, the decomposition method will address these concerns by including consideration of virtual bids and demand response resources in the mitigation process, without actually mitigating the

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[22] Direct Testimony of Jeffrey D. McDonald, Attachment E to this filing, at 12-13 (McDonald Testimony). The CAISO integrated proxy demand resources into its markets on August 10, 2010. *See California Independent System Operator Corp.*, 132 FERC ¶ 61,045, at P 1 (2010). The CAISO implemented convergence bidding in its markets on February 1, 2011. *See California Independent System Operator Corp.*, 133 FERC ¶ 61,039, at P 1 (2010).

[23] McDonald Testimony at 13-14.

[24] Virtual bids do not have a reference price or a default energy bid associated with them. For this reason, virtual bids are not mitigated.

[25] McDonald Testimony at 14.

bids of such resources.[26] Because of the manner in which the decomposition method considers bids for mitigation, virtual bids and demand response bids can be included in this process without the need for any special treatment, and without the danger of allowing the exercise of market power. How this will occur in practice is demonstrated by the example set forth in the testimony of Dr. Xu.[27]

Also, Dr. McDonald explains in his testimony that, by streamlining the market power mitigation process from two runs down to a single market run, the decomposition method will reduce the amount of CAISO system resources and processing time required to perform market power mitigation. The reduction in the overall execution time for the market power mitigation process will permit the CAISO to include the dynamic competitive path assessment discussed below within the local market power mitigation application, in place of the existing pre-defined competitive path designations based on seasonal studies.[28] This streamlining will also provide the CAISO with more time to execute other market processes and to review market results and take corrective action if necessary.

In addition, the decomposition method provides increased accuracy in identifying units that have the potential to exercise market power. During the stakeholder process leading up to this filing, both Dr. Xu and Dr. McDonald conducted analyses using actual data in the CAISO's day-ahead market, comparing the mitigation results under the CAISO's current market power mitigation method with results using the decomposition method.[29] Both of their analyses revealed two significant improvements in mitigation accuracy realized by using the decomposition method. First, as compared with the CAISO's current approach, the decomposition method resulted in far fewer instances of mitigating resources that are not due to congestion on non-competitive constraints.[30] This increase in accuracy will be even more substantial when the decomposition method is coupled with the dynamic competitive path assessment process discussed below.[31]

In addition, the analyses conducted by Dr. Xu and Dr. McDonald both demonstrate that the decomposition method is better able to capture resources that

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[26] *Id.* at 16-17. *See also* "Local Market Power Mitigation Enhancements Draft Final Proposal" at 12-15 (May 6, 2011). This CAISO document is available on the CAISO website at http://www.caiso.com/Documents/DraftFinalProposal-LocalMarketPowerMitigationEnhancements.pdf.

[27] Xu Testimony at 15-17.

[28] McDonald Testimony at 15.

[29] Xu Testimony at 11-12, 17-18; McDonald Testimony at 19-20 and Appendix A thereto. Dr. Xu's analysis entitled "A Retrospective Analysis of Local Market Power Mitigation Enhancements," is included with this filing as Attachment F and is available on the CAISO website at http://www.caiso.com/Documents/ARetrospectiveAnalysis-LocalMarketPowerMitigationEnhancements.pdf.

[30] Xu Testimony at 18-19; McDonald Testimony at 20-24.

[31] Xu Testimony at 14; McDonald Testimony at 25-27.

engage in economic withholding. This is the case because, under the CAISO's current process, a resource that bids relatively high may not be committed in the all constraints run, and therefore, not subject to mitigation. The decomposition method, however, will consider all bids regardless of their dispatch levels, and mitigate them if they have a non-competitive congestion component greater than zero.

The accuracy realized by the decomposition method will be further increased when the CAISO implements additional changes to the real-time market power mitigation process targeted for implementation in the fourth quarter of 2012. As described above, in the CAISO's hour-ahead and real-time mitigation process, the CAISO creates a single hourly mitigated bid curve for each resource as part of the hour-ahead scheduling process. This bid curve is used in both the hour-ahead scheduling process and in the real-time market. As part of the future stage-two tariff amendment that it plans to become effective in the fourth quarter of 2012, the CAISO will maintain a singly hourly bid curve in the hour-ahead scheduling process but will create four mitigated bid curves – one for each 15-minute real-time unit commitment process – for use in the real-time market. The CAISO intends to implement this functionality in conjunction with the dynamic competitive path assessment for the real-time market.[32]

3. Changes to the Treatment of RMR Units under the Revised Market Power Mitigation Process

Under the CAISO's current tariff, RMR units are committed in the all constraints run based on RMR proxy bids. The change from forecast demand to bid-in demand means that RMR units could be under- or over-committed in the mitigation process. Accordingly, the CAISO intends to rely on manual RMR commitments to commit resources. In addition, use of a single pre-market local market mitigation process requires other modifications of how RMR units are treated.

Specifically, for RMR units operating under condition 1 of their contracts that submit bids into the CAISO's day-ahead market, the changes to the market power mitigation process mirror those for non-RMR units. That is, RMR units operating under condition 1 will have their bids analyzed for market power using the decomposition method described above. As with the current process, to the extent that such bids are identified for mitigation, mitigation will be based on the RMR unit's RMR proxy bids rather than default energy bids. With respect to RMR units operating under condition 2 and RMR units operating under condition 1 that do not submit bids into the CAISO's day-ahead market, to the extent that such units are needed for reliability purposes, they will no longer be automatically committed as part of the market power mitigation process. Under the CAISO's current process, RMR proxy bids for such RMR units are inserted into the all constraints processing run to determine the amount of energy required from these units. The CAISO is proposing to remove this automatic commitment process and, instead, to commit RMR units exclusively through manual RMR dispatches when needed.

4. Tariff Modifications to Implement the Decomposition Method

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32 See footnote 3, above.

a. Day-Ahead Market Power Mitigation Process

The CAISO proposes to modify Section 31.2 of the CAISO tariff to set forth the revised market power mitigation process for the day-ahead market. Revised Section 31.2 states that, after the market close of the day-ahead market, and after the CAISO has validated bids pursuant to Section 30.7 of the tariff, the CAISO will perform the market power mitigation process, which is a single market run that occurs prior to the market clearing run for the integrated forward market. Revised Section 31.2 goes on to explain that the day-ahead market power mitigation process determines which bids need to be mitigated in the integrated forward market and when RMR proxy bids should be considered in the integrated forward market for RMR units. The day-ahead market power mitigation process optimizes resources to meet demand reflected in demand bids, including export bids and virtual demand bids, and to procure one hundred percent of ancillary services requirements based on supply bids submitted to the day-ahead market. As revised, Section 31.2 also states that virtual bids and bids from demand response resources are considered in the market power mitigation process, but are not subject to bid mitigation.[33] Further, revised Section 31.2 states that bids from participating load resources that are not subject to bid mitigation will also be considered in the market power mitigation process.

Pursuant to revised Section 31.2.1, bid mitigation is determined by decomposing the congestion component of each LMP determined in the market power mitigation process into a component that represents congestion on competitive transmission constraints (the competitive congestion component) and a component that represents congestion on non-competitive transmission constraints (the non-competitive congestion component). The competitive congestion component of each LMP is calculated as the sum over all competitive transmission constraints of the product of the shift factor and the shadow price, and the non-competitive congestion component of each LMP is calculated as the sum over all non-competitive transmission constraints of the product of the shift factor and the shadow price. Revised Section 31.2.1 also specifies that the reference bus used in the market power mitigation process will be either: (1) the Midway 500 kV bus if Path 26 flow is from north to south; or (2) the Vincent 500 kV bus if Path 26 flow is from south to north.

Section 31.2.3 (renumbered from Section 31.2.2, which was deleted because the CAISO will no longer perform two mitigation runs) contains the day-ahead bid mitigation

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[33] The CAISO proposes several other tariff changes in conjunction with these revisions to Section 31.2 regarding virtual bids and bids from demand response resources. First, the CAISO proposes to define the new term *demand response resource* in Appendix A to the tariff as a resource, including but not limited to a proxy demand resource, providing demand response services; participating load is expressly not a demand response resource within the meaning of this definition. In addition, the CAISO proposes to delete existing language from Section 31.2 that states that virtual bids are excluded from the market power mitigation – reliability requirement determination process, and the CAISO proposes to delete existing language from Section 31.2 that states that bids on behalf of proxy demand resources, which are a type of demand response resource, are not mitigated and are not considered in the market power mitigation – reliability requirement determination process for the day-ahead market.

language for non-RMR units. As amended, this section provides that if the non-competitive congestion component of an LMP calculated in a market power mitigation process is greater than zero, then any resource at that location that is dispatched in that market power mitigation process is subject to local market power mitigation. Bids on behalf of any such resource, to the extent that they exceed the competitive LMP at the resource's location, will be mitigated to the higher of the resource's default energy bid, as specified in Section 39 of the tariff, or the competitive LMP at the resource's location. Section 31.2.3 also includes several changes necessary to conform the provisions relating to multi-stage generating resources to the new decomposition method, but does not otherwise change the treatment of such resources.

Day-ahead market power mitigation for RMR units is currently addressed in Section 31.2.2.1, which will be renumbered as Section 31.2.2. In that provision, the CAISO has deleted the language regarding the dispatch or non-dispatch of condition 1 and condition 2 RMR units in the competitive constraints run and the all constraints run. The CAISO has also revised Section 31.2.2 to state that, for purposes of the market power mitigation process, condition 1 RMR units will be treated like non-RMR units with respect to any capacity in excess of the maximum net dependable capacity specified in the RMR contract. Further, revised Section 31.2.2 states that, for up to the maximum net dependable capacity specified in the RMR contract for condition 1 RMR units, the portion of the market bid at and below the competitive LMP at the RMR unit's location will be retained in the integrated forward market.[34]

Revised Section 31.2.2 goes on to state that, to the extent that the non-competitive congestion component of an LMP calculated in the market power mitigation process is greater than zero, and that market power mitigation process dispatches a condition 1 RMR unit at a level such that some portion of its market bid exceeds the competitive LMP at the RMR unit's location, those bid prices above the competitive LMP will be set to the higher of the RMR proxy bid or the competitive LMP, and if a bid price is set to the level of the RMR proxy bid, any incremental dispatch of the resource based on the RMR proxy bid will be flagged as an RMR dispatch.

Revised Section 31.2.2 also states that condition 1 RMR units that have not submitted bids and condition 2 RMR units will not be considered in the market power mitigation unless the CAISO issues a manual RMR dispatch, in which case the dispatch level specified in the manual RMR dispatch will be protected in the market power mitigation. If a condition 2 RMR unit is issued a manual RMR dispatch by the CAISO, then RMR proxy bids for all of the unit's maximum net dependable capacity under the RMR contract will be considered in the market power mitigation. Any incremental dispatch based on RMR proxy bids will be flagged as an RMR dispatch in the day-ahead schedule and the resource will be considered to have received a dispatch notice pursuant to the RMR contract. For a condition 1 RMR unit that has submitted bids and has not been issued a manual RMR dispatch, to the extent that the non-competitive

[34] In conjunction with these revisions to Section 31.2.2 and other tariff revisions discussed below, the CAISO proposes to define the new term *competitive locational marginal price* in Appendix A to the tariff as a locational marginal price calculated in the market power mitigation process minus the congestion component relating to non-competitive transmission constraints, as calculated in accordance with Section 31.2.2.

congestion component of an LMP calculated in the market power mitigation process is greater than zero, and that market power mitigation process dispatches a condition 1 RMR unit at a level such that some portion of its market bid exceeds the competitive LMP at the RMR unit's location, the resource will be flagged as an RMR dispatch in the day-ahead market if the resource has a day-ahead schedule at a level higher than the dispatch level determined by the competitive LMP.

b. Market Power Mitigation Process for the Hour-Ahead Scheduling Process and the Real-Time Market

The CAISO proposes to revise Section 33.4 of the CAISO tariff, which addresses the market power mitigation run performed as part of the hour-ahead scheduling process for dispatches in both the hour-ahead scheduling process and the real-time market, to include provisions comparable to those that apply to the market power mitigation process for the day-ahead market. The reasons for the revisions to Section 33.4 are similar to the reasons for the tariff revisions for the day-ahead market described above.

Revised Section 33.4 states that bids on behalf of demand response resources are considered in the market power mitigation process but are not subject to bid mitigation.[35] The determination as to whether a bid is mitigated in the hour-ahead scheduling process and real-time market is made based on the non-competitive congestion component of each LMP for each 15-minute interval of the applicable trading hour, using the method set forth in Sections 31.2.2 and 31.2.3 of the tariff (discussed above). If a bid is mitigated in any of the four 15-minute intervals comprising a trading hour during the market power mitigation process for the hour-ahead scheduling process and real-time market, then based on the mitigated bids for each of the 15-minute intervals, a single mitigated bid that applies for the entire hour will be constructed for purposes of the hour-ahead scheduling process market optimization and all real-time market processes. The CAISO has retained an existing provision in Section 33.4 that states that a single mitigated bid for the entire trading hour is calculated using the minimum bid price of the four mitigated bid curves at each bid quantity level. This mitigated bid curve is used in both the hour-ahead scheduling process and the real-time market.

The CAISO also proposes to revise Section 33.4 to set forth the use of RMR proxy bids for condition 1 and condition 2 RMR units analogous to the changes for the day-ahead local market power mitigation process. Revised Section 33.4 specifies that both condition 1 and condition 2 RMR units may be issued manual RMR dispatches at any time to address local reliability needs or to resolve non-competitive transmission constraints.

c. Miscellaneous Revisions

In order to reflect the use of a single market run rather than the current two market runs, the CAISO proposes to delete the defined terms *all constraints run* and

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[35] In conjunction with these revisions, the CAISO also proposes to delete existing language in Section 33.4 that states that bids on behalf of proxy demand resources are not mitigated and are not considered in the market power mitigation for the hour-ahead scheduling process and real-time market.

competitive constraints run from Appendix A to the CAISO tariff. The CAISO also proposes to revise the following provisions to refer to the market power mitigation process instead of the market power mitigation – reliability requirement determination: Sections 27, 27.4.1, 31.2, 33, 33.1, 33.2, 33.4, 34.1, 34.2, 39.7.1.6, 39.8.1, 41.5.1 of the tariff, the definitions of the terms *CAISO markets processes*, *hour-ahead scheduling process*, *hour-ahead scheduling process bid*, *integrated forward market*, *manual reliability must-run dispatch*, and *market power mitigation – reliability requirement determination* set forth in Appendix A to the tariff, and Section B of Appendix C to the tariff.

C. Modifications to the Competitive Path Assessment Methodology

1. Implementation of Dynamic Competitive Path Assessment Methodology

The competitive path assessment is an analysis set forth in Section 39.7 of the CAISO tariff that is used to determine which transmission constraints are competitive and which are uncompetitive for purposes of the CAISO's market power mitigation process. Currently, the CAISO's Department of Market Monitoring performs each competitive path assessment for use in the day-ahead market, the hour-ahead scheduling process, and the real-time market on a quarterly basis through an off-line study using seasonal study data and considering a range of system conditions, unless the CAISO determines that more frequent competitive path assessments are needed. This quarterly path assessment is called a static or non-dynamic competitive path assessment.

The CAISO plans to transition to much more frequent (*i.e.*, dynamic) competitive path assessments that are performed by the CAISO's market software using the same time frames as the relevant market runs, rather than being pre-defined based on seasonal studies like the static competitive path assessments the CAISO currently performs. As Dr. McDonald explains in his testimony, doing so will improve the current market power mitigation process. Moving the competitive path assessment into the market software to capture the most up-to-date information about resource and system conditions will reduce the number of assumptions that must be made and will enhance the accuracy of the resulting competitive path assessments. Further, the dynamic competitive path assessment will be continually updated to capture the most accurate and up-to-date information for each individual transmission constraint.[36]

The CAISO will make this transition in two stages: as part of stage one, the CAISO will implement dynamic competitive path assessments for the day-ahead market in April 2012, and as part of stage two, the CAISO will implement dynamic competitive path assessments for the hour-ahead scheduling process and the real-time market in the fourth quarter of 2012 along with the real-time local market power mitigation changes.[37] The CAISO is proposing this staged approach for several reasons. First, as explained in the attached testimony of Dr. Khaled Abdul-Rahman, Director, Power Systems

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[36] McDonald Testimony at 18-19.

[37] See footnote 3, above.

Technology Development for the CAISO, the CAISO will not be able to implement a mitigation run as part of the 15-minute real-time unit commitment process, or perform the dynamic competitive path assessment as part of that process, until the fourth quarter of 2012. Implementing this functionality will require the CAISO's market software to accommodate increased demands within tighter time frames, which means that more numerous and complex software changes, as compared with the software changes needed to implement the modifications set forth in this amendment, will be required.[38] Moreover, these changes will significantly increase the volume of data transferred between the CAISO's systems and will therefore require major database structure redesigns.[39] In addition, the real-time local market power mitigation changes will require changes to the CAISO settlement system to incorporate the four mitigated bid curves. No changes to the settlements system are required for the changes proposed in this tariff amendment. Dr. Abdul-Rahman explains that the CAISO anticipates that it will require approximately six months after the implementation of the first stage of revisions in April 2012 in order to address these complexities.[40]

Therefore, the current proposal is to continue to use a single mitigated bid curve produced in the local market power mitigation process that is part of the hour-ahead scheduling process for both the hour-ahead scheduling process and the real-time market. Although the CAISO could feasibly implement a dynamic competitive path assessment as part of the hour-ahead scheduling process in April of 2012, doing so would create an unacceptable risk of under-mitigation in the real-time market. Dr. McDonald explains that in order for a dynamic competitive path assessment to be effective in real-time, the real-time market power mitigation process must be run more frequently than every hour, which the CAISO will not be able to do until the fourth quarter of 2012.[41] This is the case because the hour-ahead scheduling process, which is conducted once at the start of each hour, must rely on system information that becomes increasingly less current as the hour progresses. Further, under the dynamic competitive path assessment approach, paths will be deemed competitive by default. As a result, if the CAISO were to implement a dynamic competitive path assessment in the hour-ahead scheduling process prior to stage two, the relative inaccuracy of predicting local market power in real-time by applying the dynamic competitive path assessment in the hour-ahead scheduling process would be compounded by the fact that paths will be deemed competitive by default unless they are shown to be non-competitive.[42]

Dr. McDonald also explains that temporarily retaining the static competitive path assessment for the hour-ahead scheduling process will produce mitigation that will be appropriate and constitute a significant improvement in the accuracy of the mitigation

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38 Direct Testimony of Khaled Abdul-Rahman, Attachment D to this filing, at 7-9 (Abdul-Rahman Testimony).

39 *Id.* at 9-10.

40 *Id*. at 11-12.

41 McDonald Testimony at 29-33.

42 *Id*.

process as a result of the new decomposition method. Dr. McDonald bases this conclusion in part on the results of an analysis he performed demonstrating that retaining the static competitive path assessment in the hour-ahead scheduling process will still reduce the overall level of mitigation for the hour-ahead scheduling process and real-time market compared with the current approach. For these reasons, the CAISO concluded that the most reasonable solution was to retain the static competitive path assessment in the hour-ahead scheduling process during the interim period between stage one and stage two.

2. Tariff Revisions to Implement Stage One of the Dynamic Competitive Path Assessment

The CAISO proposes to revise Sections 39.7 and 39.7.2.1 of the tariff to implement stage one of the competitive path assessment methodology, described above. The CAISO also proposes to revise Section 39.7.2.2 of the tariff to revamp the criteria used to determine whether a transmission constraint is competitive or non-competitive. Revised Section 39.7.2.2 states that, for the day-ahead market, a transmission constraint will be competitive by default unless the CAISO designates the transmission constraint as non-competitive pursuant to the section. For the hour-ahead scheduling process and real-time market, a transmission constraint will be non-competitive by default unless the CAISO designates the transmission constraint as competitive pursuant to the section.

New Section 39.7.2.2(a) sets forth the criteria for the dynamic competitive path assessment, which will initially be employed for the day-ahead market only. The section states that, as part of the market power mitigation process associated with the day-ahead market, the CAISO will designate a transmission constraint for the day-ahead market as non-competitive when the fringe supply of counter-flow to the transmission constraint from all portfolios of suppliers that are not identified as potentially pivotal is less than the demand for counter-flow. Section 39.7.2.2(a) also sets forth what is meant by each component of the test for determining whether a transmission constraint for the day-ahead market should be designated as non-competitive – namely, fringe supply of counter-flow to the transmission constraint, portfolios of suppliers that are not identified as potentially pivotal, and demand for counter-flow.

Section 39.7.2.2(a) specifies that potentially pivotal suppliers are the three portfolios of net sellers that control the largest quantity of counter-flow supply to the transmission constraint. In this regard, the CAISO has also included provisions in Section 39.7.2.2(a) to specify what constitutes control of generation resources in the three identified portfolios. Direct ownership of a generating resource by a scheduling coordinator is not the only possible means of exercising control over the resource. Other possible means include control of a resource or virtual supply awards directly associated with a scheduling coordinator identification code associated with an affiliate of the scheduling coordinator, and also control of the resource by an affiliate pursuant to a resource control agreement.

In order to identify the affiliates and resource control agreements of each scheduling coordinator, the CAISO proposes to add new Sections 4.5.1.1.12 and 4.5.1.1.13 to its tariff. Section 4.5.1.1.12 states that each scheduling coordinator applicant will notify the CAISO of any affiliate that owns, controls, and/or schedules resources that may provide energy or ancillary services in the CAISO markets. Section 4.5.1.1.12 specifies that these requirements will continue to apply after a scheduling coordinator applicant becomes a scheduling coordinator. The CAISO has modeled these tariff provisions after the affiliate disclosure language applicable to convergence bidding entities set forth in existing Section 4.14.2.1 of the tariff.

Section 4.5.1.1.13 states that each scheduling coordinator applicant will register with the CAISO any resource it controls through a resource control agreement to which the scheduling coordinator applicant and/or any affiliate that satisfies the criteria set forth in Section 4.5.1.1.12 is a party. This requirement will continue to apply after a scheduling coordinator applicant becomes a scheduling coordinator. The applicable business practice manual sets forth the procedures for registering a resource controlled through a resource control agreement. The CAISO also proposes to define a *resource control agreement* in Appendix A to the tariff as an agreement that gives an entity bidding, scheduling, and/or operational control over a physical resource owned by or under contract to another entity, or otherwise directs the manner in which such a resource participates in the CAISO markets.

The CAISO proposes to specify, in renumbered Section 39.7.2.2(b) of the tariff, that the currently applicable tariff provisions regarding the determination of transmission constraints as competitive or non-competitive will apply solely to such determinations for the hour-ahead scheduling process and real-time market. As explained above, the CAISO will maintain the static competitive path assessment methodology for the hour-ahead scheduling process and real-time market until the stage-two tariff revisions to implement a dynamic competitive path assessment for those markets goes into effect in the fourth quarter of 2012.

The CAISO has revised Sections 39.7.2.3 and 39.8.1 of the tariff, which address candidate path identification and bid adder eligibility criteria, respectively, to delete outdated provisions regarding the already completed first assessment of competitive transmission constraints. The CAISO also proposes to revise Section 39.7.2.3, as well as Section 39.7.2.4 regarding the feasibility index, to specify that those tariff sections apply solely to assessments of competitive transmission constraints for the hour-ahead scheduling process and real-time market. Further, the CAISO proposes to modify Sections 39.7.2.2(b), 39.7.2.3, and 39.7.2.4 of the tariff to reference the defined term *transmission constraint*, which replaced the defined term *constraint* in a CAISO tariff amendment previously approved by the Commission.[43]

D. Issues Raised by Stakeholders

As mentioned in Section I.C, above, the CAISO is unaware of any major objections to its market power mitigation proposal from parties that participated in the stakeholder process. The CAISO knows of only two concerns of any significance that stakeholders have with the CAISO's final proposal.

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[43] *See California Independent System Operator Corp.*, 134 FERC ¶ 61,140, at P 14 (2011).

The first issue is that a few stakeholders did suggest that the CAISO consider adopting a mitigation threshold below which the CAISO's market power mitigation process would not flag a unit for mitigation. The CAISO has considered implementing such a threshold, but decided against doing so as part of this amendment because it lacks data sufficient to make an informed judgment as to whether such a threshold would improve mitigation accuracy, and if so, to what level the threshold should be set. The CAISO plans to revisit this issue after evaluating actual market data under the revised market power mitigation process set forth in this filing, including the implementation of a dynamic competitive path assessment. Specifically, the CAISO believes that it could provide such an analysis after it has six months of operational data, including a summer period, and estimates that it would take an additional two months to conduct the analysis and prepare a report. For the day-ahead market, this means that the CAISO will be able to produce this analysis by December of 2012. With respect to the real-time market, the CAISO plans to implement a dynamic competitive path assessment for the real-time market in the fall of 2012. Therefore, the CAISO will be able to produce the real-time mitigation threshold analysis in October 2013.

The second issue raised by stakeholders was whether the CAISO should maintain the current static competitive path assessment for the hour-ahead scheduling process and real-time market until the CAISO implements stage two of its market power mitigation proposal in the fourth quarter of 2012. As explained above, it is not feasible for the CAISO to implement a 15-minute market power mitigation run or dynamic competitive path assessment as part of such a run until the fourth quarter of 2012. Moreover, the CAISO believes it is appropriate not to implement a dynamic competitive path assessment for the hour-ahead scheduling process prior to stage two of its proposal because basing path competitiveness determinations for the real-time dispatch on an assessment performed in the hour-ahead scheduling process market run introduces a high risk of under-detection and under-mitigation of local market power. Therefore, it is appropriate to maintain the current static competitive path assessment for the hour-ahead scheduling process and real-time market until stage two is implemented.

IV. Effective Date and Request for Waiver

The CAISO requests that the Commission accept the tariff revisions contained in this filing to become effective as of trading day April 11, 2012. To implement as of the April 11 trading day, the CAISO must activate the day-ahead functionality on April 9 after the day-ahead market results for the April 10 trading day. This will allow the changes to be in effect on the April 10 running of the day-ahead market for the April 11 trading day. The CAISO will activate the hour-ahead and real-time functionality on April 10 after the hour-ahead scheduling process run for hour ending 24 for the April 10 trading day and before the hour-ahead scheduling process run for hour ending 1 for the April 11 trading day. To the extent necessary, the CAISO seeks waiver of the Commission's regulations to permit this effective date.[44] Good cause exists for the Commission to grant any necessary waiver. In addition, the April 11 effective date satisfies the directive in the Commission's September 2006 order that the CAISO employ bid-in demand rather than

[44] In particular, the CAISO requests waiver, pursuant to Section 35.11 of the Commission's regulations (18 C.F.R. § 35.11), of Section 35.3 of the Commission's regulations (18 C.F.R. § 35.3).

forecast demand in its market power mitigation process within three years of implementation of the new CAISO market.

In order to accommodate this requested effective date, the CAISO requests that the Commission issue an order accepting the tariff revisions on or before March 1, 2012. Issuance of a Commission order by this date is necessary to provide the CAISO with sufficient time to incorporate the new market power mitigation provisions into its systems and to test those modifications in order to ensure that they will operate properly when implemented in April 2012.

V. Communications

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

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VI. Service

The CAISO has served copies of this transmittal letter, and all attachments, on the California Public Utilities Commission, the California Energy Commission, and all parties with effective scheduling coordinator service agreements under the CAISO tariff. In addition, the CAISO is posting this transmittal letter and all attachments on the CAISO website.

VII. Attachments

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

Attachment A	Revised CAISO tariff sheets
Attachment B	CAISO tariff revisions shown in black-line format
Attachment C	Direct Testimony of Dr. Lin Xu, Senior Market Development Engineer for the CAISO
Attachment D	Direct Testimony of Khaled Abdul-Rahman, Director, Power Systems Technology Development for the CAISO

Attachment E	Direct Testimony of Dr. Jeffrey D. McDonald, Manager, Market Analysis and Mitigation for the Department of Market Monitoring of the CAISO
Attachment F	CAISO Analysis entitled “A Retrospective Analysis of Local Market Power Mitigation Enhancements”
Attachment G	List of key dates in the market power mitigation stakeholder process
Attachment H	CAISO Governing Board memorandum and resolution

VIII. Conclusion

For the foregoing reasons, the Commission should accept the proposed tariff revisions contained in the instant filing without modification, effective April 11, 2012. Please contact the undersigned with any questions regarding this matter.

Respectfully submitted,

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Attachment A – Clean Tariff

Local Market Power Mitigation
and
Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

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4.5.1.1.12 Generation Affiliate Disclosure Requirements

Each Scheduling Coordinator Applicant will notify the CAISO of any Affiliate that owns, controls, and/or schedules resources that may provide Energy or Ancillary Services in the CAISO Markets. The Scheduling Coordinator Applicant will provide the CAISO with information on each such Affiliate, including information concerning the corporate relationship of such Affiliate and the business purpose of such Affiliate. These requirements will continue to apply after a Scheduling Coordinator Applicant becomes a Scheduling Coordinator.

4.5.1.1.13 Resource Control Agreements

Each Scheduling Coordinator Applicant will register with the CAISO any resource it controls through a Resource Control Agreement to which the Scheduling Coordinator Applicant and/or any Affiliate that satisfies the criteria set forth in Section 4.5.1.1.12 is a party. This requirement will continue to apply after a Scheduling Coordinator Applicant becomes a Scheduling Coordinator. The applicable Business Practice Manual sets forth the procedures for registering a resource controlled through a Resource Control Agreement.

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4.5.1.2 Scheduling Coordinator's Ongoing Obligations After Certification

4.5.1.2.1 Scheduling Coordinator's Obligation to Report Changes

4.5.1.2.1.1 Obligation to Report a Change in Filed Information

Each Scheduling Coordinator has an ongoing obligation to inform the CAISO of any changes to any of the information submitted by it to the CAISO as part of the application process including, but not limited to, any changes to the information requested by the CAISO, any changes in its credit ratings, any changes regarding its Affiliates that satisfy the requirements of Section 4.5.1.1.12, and any changes regarding resources controlled through Resource Control Agreements that satisfy the requirements of Section 4.5.1.1.13. The applicable Business Practice Manual sets forth the procedures for changing the Scheduling Coordinator's information and the timing of notifying the CAISO of such changes.

* * *

27 CAISO Markets And Processes

In the Day-Ahead and Real-Time time frames the CAISO operates a series of procedures and markets that together comprise the CAISO Markets Processes. In the Day-Ahead time frame, the CAISO conducts the Market Power Mitigation (MPM) process, the Integrated Forward Market (IFM) and the Residual Unit Commitment (RUC) process. In the Real-Time time frame, the CAISO conducts the MPM process, the Hour-Ahead Scheduling Process (HASP), the Short-Term Unit Commitment (STUC), the Real-Time Unit Commitment (RTUC) and the five-minute Real-Time Dispatch (RTD). The CAISO Markets Processes utilize transmission and Security Constrained Unit Commitment and dispatch algorithms in conjunction with a Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 to optimally commit, schedule and Dispatch resources and determine marginal prices for Energy, Ancillary Services and RUC Capacity. Congestion Revenue Rights are available and entitle holders of such instruments to a stream of hourly payments or charges associated with revenue the CAISO collects or pays from the Marginal Cost of Congestion component of hourly Day-Ahead LMPs. Through the operation of the CAISO Markets Processes the CAISO develops Day-Ahead Schedules, Day-Ahead AS Awards and RUC Schedules, HASP Advisory Schedules, HASP Intertie Schedules and AS Awards, Real-Time AS Awards and Dispatch Instructions to ensure that sufficient supply resources are available in Real-Time to balance Supply and Demand and operate in accordance with Reliability Criteria.

* * *

27.4.1 Security Constrained Unit Commitment

The CAISO uses SCUC to run the MPM process associated with the DAM, the HASP, and the RTM. SCUC is conducted over multiple varying intervals to commit and schedule resources as follows: (1) in the Day-Ahead time frame, to meet Demand reflected in Bids submitted in the Day-Ahead Market and considered in the MPM process and IFM, and to procure AS in the IFM; (2) to meet the CAISO Forecast of CAISO Demand in the RUC, HASP, STUC and RTUC, and in the MPM process utilized in the HASP and RTM; and (3) to procure any incremental AS in the HASP and RTM. In the Day-Ahead MPM, IFM and RUC processes, the SCUC commits resources over the twenty-four (24) hourly intervals of the next Trading Day. In the RTUC, which runs every fifteen (15) minutes and commits resources for the RTM, the SCUC optimizes over a number of 15-minute intervals corresponding to the Trading Hours for which the Real-Time Markets have closed. The Trading Hours for which the Real-Time Markets have closed consist of (a) the Trading Hour in which the applicable run is conducted and (b) all the fifteen-minute intervals of the entire subsequent Trading Hour. In the HASP, which is a special run of the RTUC that runs once per hour, the SCUC schedules Non-Dynamic System Resources and exports for the applicable subsequent Trading Hour. In the STUC, which runs once an hour, the SCUC commits resources over the last fifteen (15) minutes of the imminent Trading Hour and the entire next four Trading Hours. The CAISO will commit Extremely Long Start Resources, for which commitment in the DAM does not provide sufficient time to Start-Up and be available to supply Energy during the next Trading Day as provided in Section 31.7.

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31.2 Day-Ahead MPM Process

After the Market Close of the DAM, and after the CAISO has validated the Bids pursuant to Section 30.7, the CAISO will perform the MPM process, which is a single market run that occurs prior to the IFM Market Clearing run. The Day-Ahead MPM process determines which Bids need to be mitigated in the IFM and when RMR Proxy Bids should be considered in the IFM for RMR Units. The Day-Ahead MPM process optimizes resources to meet Demand reflected in Demand Bids, including Export Bids and Virtual Demand Bids, and to procure, one hundred (100) percent of Ancillary Services requirements based on Supply Bids submitted to the DAM. Virtual Bids and Bids from Demand Response Resources are considered in the MPM process, but are not subject to Bid mitigation. Bids from Participating Load resources that are not subject to Bid mitigation will also be considered in the MPM process. The mitigated or unmitigated Bids and RMR Proxy Bids identified in the MPM process for all resources that cleared in the MPM are then passed to the IFM. The CAISO performs the MPM process for the DAM for the twenty-four (24) hours of the targeted Trading Day.

31.2.1 The Market Power Mitigation Process

The MPM process enforces all Transmission Constraints that are expected to be enforced in the relevant market and produces dispatch levels for all resources with submitted Bids and LMPs for all Locations.

Bid mitigation is determined by decomposing the Congestion component of each LMP determined in the MPM process into competitive Congestion and non-competitive Congestion components. The competitive Congestion component of each LMP is calculated as the sum of the product of the shift factor and the Shadow Price for all competitive Transmission Constraints and the non-competitive Congestion component of each LMP is calculated as the sum of the product of the shift factor and the Shadow Price for all non-competitive Transmission Constraints. The Reference Bus used in the MPM process will be either: (1) the Midway 500kV bus if Path 26 flow is from north to south; or (2) the Vincent 500kV bus if Path 26 flow is from south to north. The treatment of a particular Transmission Constraint as competitive or non-competitive for purposes of the MPM process is determined pursuant to Section 39.7.2.

31.2.2 Bid Mitigation for RMR Units

For purposes of the MPM process, Condition 1 RMR Units will be treated like non-RMR Units with respect to any capacity in excess of the Maximum Net Dependable Capacity specified in the RMR Contract. For up to the Maximum Net Dependable Capacity specified in the RMR Contract for Condition 1 RMR Units, the portion of the market Bid at and below the Competitive LMP at the RMR Unit's Location will be retained in the IFM. To the extent that the non-competitive Congestion component of an LMP calculated in the MPM process is greater than zero (0), and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, those Bid prices above the Competitive LMP will be set to the higher of the RMR Proxy Bid or the Competitive LMP. If any Bid prices are set to the level of the RMR Proxy Bid through this process, any incremental dispatch of the resource based on the RMR Proxy Bid will be flagged as an RMR Dispatch in the Day-Ahead Schedule and the resource shall be considered to have received a Dispatch Notice pursuant to the RMR Contract. Condition 1 RMR Units that have not submitted Bids and Condition 2 RMR Units will not be considered in the MPM unless the CAISO issues a manual RMR Dispatch, in which case the dispatch level specified in the manual RMR Dispatch will be protected in the MPM. If a Condition 2 RMR Unit is issued a Manual RMR Dispatch by the CAISO, then RMR Proxy Bids for all of the unit's Maximum Net Dependable Capacity under the RMR Contract will be considered in the MPM. Any incremental dispatch based on RMR Proxy Bids will be flagged as an RMR Dispatch in the Day-Ahead Schedule and the resource shall be considered to have received a Dispatch Notice pursuant to the

RMR Contract. For a Condition 1 RMR Unit that has submitted Bids and has not been issued a Manual RMR Dispatch, to the extent that the non-competitive Congestion component of an LMP calculated in the MPM process is greater than zero (0), and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, the resource will be flagged as an RMR dispatch in the Day-Ahead Market if the resource has a Day-Ahead Schedule at a level higher than the dispatch level determined by the Competitive LMP.

31.2.3 Bid Mitigation for Non-RMR Units

If the non-competitive Congestion component of an LMP calculated in an MPM process is greater than zero, then any resource at that Location that is dispatched in that MPM process is subject to Local Market Power Mitigation. Bids on behalf of any such resource, to the extent that they exceed the Competitive LMP at the resource's Location, will be mitigated to the higher of the resource's Default Energy Bid, as specified in Section 39, or the Competitive LMP at the resource's Location. To the extent a Multi-Stage Generating Resource is dispatched in the MPM process and the non-competitive Congestion component of the LMP calculated at the Multi-Stage Generating Resource's Location is greater than zero (0),for purposes of mitigation, all the MSG Configurations will be mitigated similarly and the CAISO will evaluate all submitted Energy Bids for all MSG Configurations based on the relevant Default Energy Bids for the applicable MSG Configuration. The CAISO will calculate the Default Energy Bids for Multi-Stage Generating Resources by submitted MSG Configuration. Any market Bids equal to or less than the Competitive LMP will be retained in the IFM .

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33 Hour-Ahead Scheduling Process (HASP)

The HASP is the hour-ahead process during the Real-Time which consists of the following activities. The HASP includes a special hourly run of the Real-Time Unit Commitment (RTUC), which is also one of the component processes of the RTM. The RTUC utilizes a SCUC optimization and runs every fifteen (15) minutes, as fully described in Section 34. This Section 33 describes the special features of the specific hourly HASP run of the RTUC. The HASP combines provisions for the CAISO to issue hourly pre-dispatch instructions to System Resources that submit Energy Bids to the RTM and for the procurement of Ancillary Services on an hourly basis from System Resources, with provisions for Scheduling Coordinators to self-schedule changes to their Day-Ahead Schedules as provided in Section 33.1, and submit Bids to export Energy at Scheduling Points. The HASP also performs the MPM procedure with respect to the Bids that will be used in the HASP optimization and in the RTM processes for the same Trading Hour.

33.1 Submission Of Bids For The HASP And RTM

Scheduling Coordinators may submit Bids, including Self-Schedules, for Supply that will be used for the HASP and the RTM processes starting from the time Day-Ahead Schedules have been posted until seventy-five (75) minutes prior to each applicable Trading Hour in the Real-Time. This includes Self-Schedules by Participating Load that is modeled using the Pumped-Storage Hydro Unit. Scheduling Coordinators may not submit Bids, including Self-Schedules, for CAISO Demand in the HASP and RTM. Scheduling Coordinators may submit Bids, including Self-Schedules, for exports at Scheduling Points in the HASP and RTM. The rules for submitted Bids specified in Section 30 apply to Bids submitted to the HASP and RTM. After the Market Close of the HASP and the RTM the CAISO performs a validation process consistent with the provisions set forth in Section 30.7 and the following additional rules. The CAISO will generate a Self-Schedule to cover any RUC Award or Day-Ahead Schedule in the absence of any Self-Schedule or Economic Bid components, or to fill in any gaps between any Self-Schedule Bid and any Economic Bid components to cover a RUC Award or Day-Ahead Schedule. Bids submitted to the HASP and the RTM to supply Energy and Ancillary Services will be considered in the various HASP and RTM processes, including the MPM process, the HASP optimization, the STUC, the RTUC and the RTD.

33.2 The HASP Optimization

After the Market Close for the HASP and RTM for the relevant Trading Hour, the Bids have been validated and the MPM process has been performed, the HASP optimization determines feasible but non-binding HASP Advisory Schedules for Generating Units for each fifteen-minute interval of the Trading Hour, as well as binding hourly HASP Intertie Schedules and binding hourly HASP AS Awards from Non-Dynamic System Resources for that Trading Hour. The HASP may also commit resources whose Start-Up Times are within the immediately following Trading Hour. The HASP, like the other runs of the RTUC, utilizes the same SCUC optimization and Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 as the IFM, with the Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 updated to reflect changes in system conditions as appropriate, to ensure that HASP Intertie Schedules are feasible. Instead of clearing against Demand Bids as in the IFM, the HASP clears Supply against the CAISO Forecast of CAISO Demand plus submitted Export Bids, to the extent the Export Bids are selected in the MPM process. The HASP optimization also factors in forecasted unscheduled flow at the Interties. The HASP optimization produces Settlement prices for hourly imports and exports to and from the CAISO Balancing Authority Area reflected in the HASP Intertie Schedule and for the HASP AS Awards for System Resources.

* * *

33.4 MPM For The HASP And The RTM

After the Market Close of the HASP and RTM, after the CAISO has validated the Bids pursuant to section 30.7, and prior to running the HASP optimization, the CAISO conducts the MPM process, the results of which will be utilized in the HASP optimization and all RTM processes for the Trading Hour. Bids on behalf of Demand Response Resources are considered in the MPM process but are not subject to Bid mitigation. The MPM process for the HASP and RTM produces results for each fifteen (15) minute interval of the Trading Hour and thus may produce up to four mitigated Bids for any given resource for the Trading Hour. The determination as to whether a Bid is mitigated in the HASP and RTM is made based on the non-competitive Congestion component of each LMP for each fifteen (15) minute interval of the applicable Trading Hour, using the methodology set forth in Sections 31.2.2 and 31.2.3 above. If a Bid is mitigated in any of the four fifteen (15) minute intervals comprising a Trading Hour during the MPM process for the HASP and RTM, then that Bid will be treated as mitigated for the entire Trading Hour for purposes of the HASP optimization and all RTM processes. A single mitigated Bid for the entire Trading Hour is calculated using the minimum Bid price of the four mitigated Bid curves at each Bid quantity level. For a Condition 1 RMR Unit, the use of RMR Proxy Bids is determined based on the non-competitive Congestion component of each LMP for each fifteen (15) minute interval of the applicable Trading Hour, using the methodology set forth in Section 31.2.2 above. If a Condition 2 RMR Unit is issued a Manual RMR Dispatch by the CAISO, then RMR Proxy Bids for all of the unit's Maximum Net Dependable

Capacity will be considered in the MPM process. For both Condition 1 and Condition 2 RMR Units, when mitigation is triggered, a single RMR Proxy Bid for the entire Trading Hour is calculated using the same methodology described above for non-RMR Units. For a Condition 1 RMR Unit that has submitted Bids and has not been issued a Manual RMR Dispatch, to the extent that the non-competitive Congestion component of an LMP calculated in the MPM process is greater than zero, and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, the resource will be flagged as an RMR dispatch if it is dispatched at a level higher than the dispatch level determined by the Competitive LMP. Both Condition 1 and Condition 2 RMR Units may be issued manual RMR dispatches at any time to address local reliability needs or to resolve non-competitive constraints.

* * *

34.1 Inputs To The Real-Time Market

The RTM utilizes results produced by the DAM and HASP for each Trading Hour of the Trading Day, including the combined commitments contained in the Day-Ahead Schedules, Day Ahead AS Awards, RUC Awards, HASP Intertie Schedules, HASP Self-Schedules, HASP Intertie AS Awards and the MPM that is run as part of the HASP to determine mitigated bids for each relevant Trading Hour. Virtual Bids and Virtual Awards are not used in the Real-Time Market. These results, plus the short-term Demand Forecast, Real-Time Energy Bids, Real-Time Ancillary Service Bids, updated Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6, State Estimator output, resource outage and de-rate information constitute the inputs to the RTM processes. Bids submitted in HASP for all Generating Units and Participating Load shall be used in the Real-Time Market.

34.2 Real-Time Unit Commitment

The Real-Time Unit Commitment (RTUC) process uses SCUC and is run every fifteen (15) minutes to: (1) make commitment decisions for Fast Start and Short Start Units having Start-Up Times within the applicable time periods described below in this section, and (2) procure required additional Ancillary Services and calculate ASMP used for settling procured Ancillary Service capacity for the next fifteen-minute Real-Time Ancillary Service interval. In any fifteen (15) minute RTUC interval that falls within a time period in which a Multi-Stage Generating Resource is transitioning from one MSG Configuration to another MSG Configuration, the CAISO: (1) will not award any incremental Ancillary Services; (2) will disqualify any Day-Ahead Ancillary Services Awards; (3) will disqualify Day-Ahead qualified Submissions to Self-Provide Ancillary Services Award, and (4) will disqualify Submissions to Self-Provide Ancillary Services in RTM. For Multi-Stage Generating Resources the RTUC will issue a binding Transition Instruction separately from the binding Start-Up or Shut Down instructions. The RTUC can also be run with the Contingency Flag activated, in which case the RTUC can commit Contingency Only Operating Reserves. If RTUC is run without the Contingency Flag activated, it cannot commit Contingency Only Operating Reserves. RTUC is run at the following time intervals: (1) at approximately 7.5 minutes prior to the next Trading Hour, in conjunction with the HASP run, for T-45 minutes to T+60 minutes; (2) at approximately 7.5 minutes into the current hour for T-30 minutes to T+60 minutes; (3) at approximately 22.5 minutes into the current hour for T-15 minutes to T+60 minutes; and (4) at approximately 37.5 minutes into the current hour for T to T+60 minutes where T is the beginning of the next Trade Hour. The HASP, described in Section 33, is a special RTUC run that is performed at approximately 7.5 minutes before each hour and has the additional responsibility of: (1) pre-dispatching Energy and awarding Ancillary Services for hourly dispatched System Resources for the Trading Hour that begins 67.5 minutes later, and (2) performing the necessary MPM for that Trading Hour. A Day-Ahead Schedule or RUC Schedule for an MSG Configuration that is later impacted by the resource's derate or outages, will be reconsidered in the RTUC process taking into consideration the impacts of the derate or outage on the available MSG Configurations.

* * *

39.7 Local Market Power Mitigation For Energy Bids

Local Market Power Mitigation is based on the assessment and designation of Transmission Constraints as competitive or non-competitive pursuant to Section 39.7.2. Prior to the effective date of this tariff provision, assessments will be performed for use in the DAM, HASP and the RTM at a minimum four (4) times per year and potentially more frequently if needed due to changes in system conditions, network topology, or market performance. Any changes in Transmission Constraints designations will be publicly noticed prior to making the change. Upon determination that an ad hoc assessment is warranted, the CAISO will notice Market Participants that such an assessment will be performed. As of the effective date of this tariff provision, these procedures will only apply to assessments and designations of Transmission Constraints as competitive or non-competitive used in the HASP and RTM, while assessments and designations of Transmission Constraints as competitive or non-competitive for the DAM will be made as part of each MPM run associated with the DAM. The determination whether a unit is being dispatched to relieve Congestion on a competitive or non-competitive Transmission Constraint is based on a preliminary market run that is performed prior to the actual pricing run of the market, as described in Sections 31 and 33 for the DAM and RTM, respectively.

* * *

39.7.1.6 Default Energy Bids for RMR Units

The available capacity in excess of the Maximum Net Dependable Capacity (MNDC) specified in the RMR Contract up to the maximum generation capacity (PMax) is subject to Local Market Power Mitigation. The Scheduling Coordinator for the RMR Unit must rank order its preferences between the Variable Cost Option, the LMP Option, and the Negotiated Rate Option, which shall be the default rank order if no rank order is specified by the Scheduling Coordinator. These preferences will be used to determine the Default Energy Bids for the capacity between the MNDC and PMax. RMR Proxy Bids for RMR Units based on contractually specified costs are used in lieu of Default Energy Bids for the contractual RMR Unit capacity between the minimum generating capacity (PMin) and the MNDC. The CAISO or Independent Entity will concatenate these two calculation methodologies (for calculating RMR Proxy Bids and Default Energy Bids for RMR Units) and will adjust them for monotonicity without lowering any price on either curve to create a single Energy Bid Curve to be used in the MPM processes as described in Sections 31 and 33 for the DAM and RTM, respectively. RMR Units are not eligible to receive a Bid Adder pursuant to Section 39.8 for contractual RMR Unit capacity between PMin and MNDC.

39.7.2 Competitive Path Designation

39.7.2.1 Timing of Assessments

For the DAM, the CAISO will make assessments and designations of whether Transmission Constraints are competitive or non-competitive as part of each MPM run associated with the DAM. Only binding Transmission Constraints determined by the Day-Ahead MPM process will be assessed in the DAM. For the HASP and RTM, the CAISO may perform additional competitive constraint assessments during the year if changes in transmission infrastructure, generation resources, or Load, in the CAISO Balancing Authority Area and adjacent Balancing Authority Areas suggest material changes in market conditions or if market outcomes are observed that are inconsistent with competitive market outcomes. The CAISO will calculate and post path designations for the HASP and RTM not less than four (4) times each year thereafter to provide timely seasonal path designations.

39.7.2.2 Criteria

For the DAM, a Transmission Constraint will be competitive by default unless the CAISO designates the Transmission Constraint as non-competitive pursuant to this Section 39.7.2.2. For the HASP and RTM, a Transmission Constraint will be non-competitive by default unless the CAISO designates the Transmission Constraint as competitive pursuant to this Section 39.7.2.2.

(a) Transmission Constraints for the DAM – As part of the MPM process associated with the DAM, the CAISO will designate a Transmission Constraint for the DAM as non-competitive when the fringe supply of counter-flow to the Transmission Constraint from all portfolios of suppliers that are not identified as potentially pivotal is less than the demand for counter-flow. For purposes of determining whether to designate a Transmission Constraint as non-competitive pursuant to this Section 39.7.2.2(a):

(i) Counter-flow to the Transmission Constraint means the delivery of Power from a resource to the system load distributed reference bus. If counter-flow to the Transmission Constraint is in the direction opposite to the market flow of Power to the Transmission Constraint, the counter-flow to the Transmission Constraint is calculated as shift factor multiplied by the resource’s scheduled Power. Otherwise, counter-flow to the Transmission Constraint is zero.

(ii) Fringe supply of counter-flow to the Transmission Constraint includes all available capacity from resources not controlled by the identified potentially pivotal suppliers and all Virtual Supply Awards not controlled by the identified potentially pivotal suppliers that provide counter-flow to the Transmission Constraint. Available capacity reflects the highest capacity of a resource's Energy Bid adjusted for Self-Provided Ancillary Services and derates.

(iii) Demand for counter-flow to the Transmission Constraint means all internal dispatched Supply and Virtual Supply Awards that provide counter-flow to the Transmission Constraint.

(iv) Potentially pivotal suppliers mean the three (3) portfolios of net sellers that control the largest quantity of counter-flow supply to the Transmission Constraint.

(v) Portfolio means the effective available generation capacity under the control of the Scheduling Coordinator and/or Affiliate determined pursuant to Section 4.5.1.1.12 and all effective Virtual Supply Awards of the Scheduling Coordinator and/or Affiliate. Effectiveness in supplying counter-flow is determined by scaling generation capacity and/or Virtual Supply Awards by the shift factor from that location to the Transmission Constraint being tested.

(vi) A portfolio of a net seller is any portfolio that is not a portfolio of a net buyer. A portfolio of a net buyer means a portfolio for which the average daily net value of Measured Demand minus Supply over a twelve (12) month period is positive. The average daily net value is determined for each portfolio by subtracting, for each Trading Day, Supply from Measured Demand and then averaging the daily value for all Trading Days over the twelve (12) month period. The CAISO will calculate whether portfolios are portfolios of net buyers in the third month of each calendar quarter and the calculations will go into effect at the start of the next calendar quarter. The twelve (12) month period used in this calculation will be the most recent twelve month (12) period for which data is available. The specific mathematical formula used to perform this calculation will be set forth in a Business Practice Manual.

(vii) In determining which Scheduling Coordinators and/or Affiliates control the resources in the three (3) identified portfolios, the CAISO will include resources and Virtual Supply Awards directly associated with all Scheduling Coordinator ID Codes associated with the Scheduling Coordinators and/or Affiliates, as well as all resources that the Scheduling Coordinators and/or Affiliates control pursuant to Resource Control Agreements registered with the CAISO as set forth Section 4.5.1.1.13. Resources identified pursuant to Resource Control Agreements will only be assigned to the portfolio of the Scheduling Coordinator that has control of the resource or whose Affiliate has control of the resource pursuant to the Resource Control Agreements.

(b) Transmission Constraints for the HASP and RTM – A Transmission Constraint for the HASP or RTM will be deemed competitive if no three (3) unaffiliated suppliers are jointly pivotal in relieving Congestion on that constraint. The determination of whether or not the pivotal supplier criteria for an individual Transmission Constraint for the HASP or RTM are violated will be assessed using the Feasibility Index described in Section 39.7.2.4. Assessment of competitiveness for the HASP or RTM will be performed assuming various system conditions potentially including but not limited to season, load, planned transmission and resource outages. If an individual Transmission Constraint for the HASP or RTM fails the pivotal supplier criteria under any of these system conditions, the Transmission Constraint will be deemed uncompetitive until a subsequent assessment deems the Transmission Constraint competitive. In general, a constraint for the HASP or RTM may be an individual transmission line or a collection of lines that create a distinct Transmission Constraint. For purposes of the competitive assessment for the HASP or RTM, the set of Transmission Constraints that will be included in the FNM are those modeled along with Transmission Constraints expected to be enforced in clearing the CAISO Markets.

39.7.2.3 Candidate Path Identification

Assessments of competitive Transmission Constraints for the HASP or RTM will consider all interfaces to neighboring Balancing Authority Areas and all inter-zonal interfaces that predate the effective date of this provision to be competitive, and no such interfaces will be included in the set of candidate Transmission Constraints for assessment. The set of candidate Transmission Constraints for the HASP or RTM will be reduced to those remaining Transmission Constraints that were congested or managed for Congestion in greater than five hundred (500) hours in the prior twelve (12) months.

39.7.2.4 Feasibility Index

For the HASP or RTM, the CAISO will perform a pivotal supplier test on all suppliers in the CAISO Balancing Authority Area for each path to be assessed using the Feasibility Index (FI). Suppliers will be considered in two groups: those suppliers with the largest portfolios will be considered in the preliminary simulations, and any additional suppliers who are likely to be pivotal given the competitive designations from the preliminary simulations. The FI requires solving the FNM having removed all internal resources of a supplier and modifying the candidate constraints of the FNM such that the flow limits of the set of candidate constraints can be exceeded with a penalty imposed for excess flow. The resulting solution to the FNM produces constraint flows that can be used to calculate the FI. The FI is calculated for each constraint as the proportion of the Transmission Constraint limit that is exceeded to solve the FNM without the specified supplier's supply. FI values less than zero indicate the supplier is pivotal in relieving Congestion on the specified Transmission Constraint. The process is repeated by removing the supply portfolio of two and three suppliers for paths with non-negative FI. If any three suppliers are jointly pivotal in relieving Congestion on a candidate path, as indicated by an FI value less than zero, the candidate path will be deemed uncompetitive. Otherwise, the candidate path will be deemed competitive. The portfolio of each supplier will be based on ownership information available to the CAISO, taking into account any material transfer of sufficient length that the transfer of control could have persistent impact on the relative shares of supply within the CAISO Balancing Authority Area. These transfers of control will be utilized in the assessment as provided to the CAISO by the supplier reflecting its triennial filing with FERC for market-based rate authority.

39.8.1 Bid Adder Eligibility Criteria

To receive a Bid Adder, a Generating Unit must: (i) have a Mitigation Frequency that is greater than eighty (80) percent in the previous twelve (12) months; and (ii) must not have a contract to be a Resource Adequacy Resource for its entire Net Qualifying Capacity, or be designated under the CPM for its entire Eligible Capacity, or be subject to an obligation to make capacity available under this CAISO Tariff. If a Generating Unit is designated under the CPM for a portion of its Eligible Capacity, the provisions of this section apply only to the portion of the capacity not designated. Scheduling Coordinators for Generating Units seeking to receive Bid Adders must further agree to be subject to the Frequently Mitigated Unit option for a Default Energy Bid. Run hours are those hours during which a Generating Unit has positive metered output. Generating Units that received RMR Dispatches and/or incremental Bids dispatched out of economic merit order to manage local Congestion in an hour prior to the effective date of this Section will have that hour counted as a mitigated hour in their Mitigation Frequency. After the first twelve (12) months from the effective date of this Section, the Mitigation Frequency will be based entirely on a Generating Unit being mitigated under the MPM procedures in Sections 31 and 33.

* * *

41.5.1 Day-Ahead And HASP RMR Dispatch

RMR Dispatches will be determined in accordance with the RMR Contract, the MPM process addressed in Sections 31 and 33 and through manual RMR Dispatch Notices to meet Applicable Reliability Criteria. The CAISO will notify Scheduling Coordinators for RMR Units of the amount and time of Energy requirements from specific RMR Units in the Trading Day prior to or at the same time as the Day-Ahead Schedules and AS and RUC Awards are published, to the extent that the CAISO is aware of such requirements, through an RMR Dispatch Notice or flagged RMR Dispatch in the IFM Day-Ahead Schedule. The CAISO may also issue RMR Dispatch Notices after Market Close of the DAM and through Dispatch Instructions flagged as RMR Dispatches in the Real-Time Market. The Energy to be delivered for each Trading Hour pursuant to the RMR Dispatch Notice an RMR Dispatch in the IFM or Real-Time shall be referred to as the RMR Energy. Scheduling Coordinators may submit Bids in the DAM or the HASP for RMR Units operating under Condition 1 of the RMR Contract in accordance with the bidding rules applicable to non-RMR Units. A Bid submitted in the DAM or the HASP for a Condition 1 RMR Unit shall be deemed to be a notice of intent to substitute a market transaction for the amount of MWh specified in each Bid for each Trading Hour pursuant to Section 5.2 of the RMR Contract. In the event the CAISO issues an RMR Dispatch Notice or an RMR Dispatch in the IFM or Real-Time Market for any Trading Hour, any MWh quantities cleared through the MPM shall be considered as a market transaction in accordance with the RMR Contract. RMR Units operating as Condition 2 RMR Units may not submit Bids until and unless the CAISO issues an RMR Dispatch Notice or issues an RMR Dispatch in the IFM, in which case a Condition 2 RMR Unit shall submit Bids in accordance with the RMR Contract in the next available market for the Trading Hours specified in the RMR Dispatch Notice or Day-Ahead Schedule.

* * *

Appendix A

Master Definitions Supplement

- [Not Used]

* * *

- CAISO Markets Processes

The MPM, IFM, RUC, STUC, RTUC, and RTD. HASP is an hourly run of the RTUC.

* * *

- [Not Used]

* * *

- Competitive LMP

An LMP calculated in the MPM process minus the Congestion component relating to non-competitive Transmission Constraints, as calculated in accordance with Section 31.2.2.

* * *

- Demand Response Resource

A resource, including but not limited to a Proxy Demand Resource, providing Demand Response Services. Participating Load is not a Demand Response Resource within the meaning of this definition.

* * *

- HASP Bid
A Bid received in HASP that can be used in the MPM conducted in HASP, the RTUC, STUC, or the RTD.

* * *

- Hour-Ahead Scheduling Process (HASP)
The process conducted by the CAISO beginning at seventy-five minutes prior to the Trading Hour through which the CAISO conducts the following activities: 1) accepts Bids for Supply of Energy, including imports, exports and Ancillary Services imports to be supplied during the next Trading Hour that apply to the MPM, RTUC, STUC, and RTD; 2) conducts the MPM on the Bids that apply to the RTUC, STUC, and RTD; and 3) conducts the RTUC for the hourly pre-dispatch of Energy and Ancillary Services.

* * *

- Integrated Forward Market (IFM)
The pricing run conducted by the CAISO using SCUC in the Day-Ahead Market, after the MPM process, which includes Unit Commitment, Ancillary Service procurement, Congestion Management and Energy procurement based on Supply and Demand Bids.

* * *

- Manual RMR Dispatch
An RMR Dispatch Notice issued by the CAISO other than as a result of the MPM process.

* * *

- MPM
Market Power Mitigation

* * *

- Resource Control Agreement
An agreement that gives an entity bidding, scheduling, and/or operational control over a physical resource owned by or under contract to another entity, or otherwise directs the manner in which such a resource participates in the ISO markets

* * *

Appendix C

Locational Marginal Price

* * *

B. The System Marginal Energy Cost Component of LMP

The SMEC shall be the same for each location throughout the system. SMEC is the sensitivity of the power balance constraint at the optimal solution. The power balance constraint ensures that the physical law of conservation of Energy (the sum of Generation and imports equals the sum of Demand, including exports and Transmission Losses) is accounted for in the network solution. For the designated reference location the CAISO will utilize a distributed Load Reference Bus for which constituent PNodes are weighted using the Reference Bus distribution factors. The Load distributed Reference Bus distribution factors are based on the Load Distribution Factors at each PNode that represents cleared Load in the Integrated Forward Market or forecast Load for MPM, RUC, HASP and RTM. In the Integrated Forward Market, in the event that the market is not able to clear based on the use of a distributed load Reference Bus, the CAISO will use a distributed generation Reference Bus for which the constituent nodes and the weights are determined economically within the running of the Integrated Forward Market based on available economic bids. In the event that the CAISO employs a distributed generation Reference Bus, it will notify Market Participants of which Integrated Forward Market runs required the use of this backstop mechanism. A distributed Load Reference Bus will be used for RUC, HASP and RTM regardless of whether a distributed Generation Reference Bus were used in the corresponding Integrated Forward Market run. Once the Reference Bus is selected, the System Marginal Energy Cost is the cost of economically providing the next increment of Energy at the distributed Reference Bus, based on submitted Bids.

* * *

Attachment B – Marked Tariff

Local Market Power Mitigation
and
Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

* * *

4.5.1.1.12 Generation Affiliate Disclosure Requirements

Each Scheduling Coordinator Applicant will notify the CAISO of any Affiliate that owns, controls, and/or schedules resources that may provide Energy or Ancillary Services in the CAISO Markets. The Scheduling Coordinator Applicant will provide the CAISO with information on each such Affiliate, including information concerning the corporate relationship of such Affiliate and the business purpose of such Affiliate. These requirements will continue to apply after a Scheduling Coordinator Applicant becomes a Scheduling Coordinator.

4.5.1.1.13 Resource Control Agreements

Each Scheduling Coordinator Applicant will register with the CAISO any resource it controls through a Resource Control Agreement to which the Scheduling Coordinator Applicant and/or any Affiliate that satisfies the criteria set forth in Section 4.5.1.1.12 is a party. This requirement will continue to apply after a Scheduling Coordinator Applicant becomes a Scheduling Coordinator. The applicable Business Practice Manual sets forth the procedures for registering a resource controlled through a Resource Control Agreement.

* * *

4.5.1.2 Scheduling Coordinator's Ongoing Obligations After Certification

4.5.1.2.1 Scheduling Coordinator's Obligation to Report Changes

4.5.1.2.1.1 Obligation to Report a Change in Filed Information

Each Scheduling Coordinator has an ongoing obligation to inform the CAISO of any changes to any of the information submitted by it to the CAISO as part of the application process~~,~~ including, but not limited to, any changes to the ~~additional~~ information requested by the CAISO, any ~~and including but not limited to~~ changes in its credit ratings, any changes regarding its Affiliates that satisfy the requirements of Section 4.5.1.1.12, and any changes regarding resources controlled through Resource Control Agreements that satisfy the requirements of Section 4.5.1.1.13.~~.~~ The applicable Business Practice Manual sets forth the procedures for changing the Scheduling Coordinator's information and the timing of notifying the CAISO of such changes.

* * *

27 CAISO Markets And Processes

In the Day-Ahead and Real-Time time frames the CAISO operates a series of procedures and markets that together comprise the CAISO Markets Processes. In the Day-Ahead time frame, the CAISO conducts the Market Power Mitigation (MPM) process, the~~MPM-RRD, an~~ Integrated Forward Market (IFM) and the Residual Unit Commitment (RUC) process. In the Real-Time time frame, the CAISO conducts the MPM process~~Market Power Mitigation and Reliability Requirement Determination~~, the Hour-Ahead Scheduling Process (HASP), the Short-Term Unit Commitment (STUC), the Real-Time Unit Commitment (RTUC) and the five-minute Real-Time Dispatch (RTD). The CAISO Markets Processes utilize transmission and Security Constrained Unit Commitment and dispatch algorithms in conjunction with a Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 to optimally commit, schedule and Dispatch resources and determine marginal prices for Energy, Ancillary Services and RUC Capacity. Congestion Revenue Rights are available and entitle holders of such instruments to a stream of hourly payments or charges associated with revenue the CAISO collects or pays from the Marginal Cost of Congestion component of hourly Day-Ahead LMPs. Through the operation of the CAISO Markets Processes the CAISO develops Day-Ahead Schedules, Day-Ahead AS Awards and RUC Schedules, ~~-~~HASP Advisory Schedules, HASP Intertie Schedules and AS Awards, Real-Time AS Awards and Dispatch Instructions to ensure that sufficient supply resources are available in Real-Time to balance Supply and Demand and operate in accordance with Reliability Criteria.

* * *

27.4.1 Security Constrained Unit Commitment

The CAISO uses SCUC to run the MPM process~~-RRD processes~~ associated with the DAM, the HASP, and the RTM. SCUC is conducted over multiple varying intervals to commit and schedule resources as follows: (1) in the Day-Ahead time frame, ~~and~~ to meet Demand reflected in~~for which~~ Bids ~~have been~~ submitted in the Day-Ahead Market and considered in the MPM process and IFM, and to procure AS in the IFM; (2)~~, and~~ to meet the CAISO Forecast of CAISO Demand in the ~~MPM-RRD,~~ RUC, HASP, STUC and RTUC, and in the MPM process utilized in the HASP and RTM; and (3) to procure any incremental AS in the HASP and RTM.~~.~~ In the Day-Ahead MPM~~-RRD~~, IFM and RUC processes, the SCUC commits resources over the twenty-four (24) hourly intervals of the next Trading Day. In the RTUC, which runs every fifteen (15) minutes and commits resources for the RTM, the SCUC optimizes over a number of 15-minute intervals corresponding to the Trading Hours for which the Real-Time Markets have closed. The Trading Hours for which the Real-Time Markets have closed consist of (a) the Trading Hour in which the applicable run is conducted and (b) all the fifteen-minute intervals of the entire subsequent Trading Hour. In the HASP, which is a special run of the RTUC that runs once per hour, the SCUC schedules Non-Dynamic System Resources and exports for the applicable subsequent Trading Hour. In the STUC, which runs once an hour, the SCUC commits resources over the last fifteen (15) minutes of the imminent Trading Hour and the entire next four Trading Hours. The CAISO will commit Extremely Long Start Resources, for which commitment in the DAM does not provide sufficient time to Start-Up and be available to supply Energy during the next Trading Day as provided in Section 31.7.

* * *

31.2 Day-Ahead MPM Process~~RRD~~

After the Market Close of the DAM, and after the CAISO has validated the Bids pursuant to Section 30.7, the CAISO will perform the MPM process, which is ~~-RRD procedures in~~ a single market run~~series of processing runs~~ that occurs~~occur~~ prior to the IFM Market Clearing run. The Day-Ahead MPM process determines which Bids need to be mitigated in the IFM and when~~. The RRD process is the automated process for determining~~ RMR Proxy Bids should be considered in the IFM~~Generation requirements~~ for RMR Units. The Day-Ahead MPM ~~The MPM-RRD process optimizes resources using the same optimization used in the IFM, but instead of using Demand Bids as in the IFM the MPM-RRD~~ process optimizes resources to meet Demand reflected in~~one hundred percent of the CAISO~~ Demand Bids, including~~Forecast and Export Bids to the extent the~~ Export Bids ~~are selected in the MPM-RRD process,~~ and Virtual Demand Bids, and to procure,~~meet~~ one hundred (100) percent of Ancillary Services requirements based on Supply Bids submitted to the DAM. Virtual Bids and Bids ~~are excluded~~ from ~~the MPM-RRD process. Bids on behalf of Proxy~~ Demand Response Resources are considered in the MPM process, but are not subject to Bid mitigation. Bids from Participating Load resources that ~~mitigated and~~ are not subject to Bid mitigation will also be considered in the MPM~~-RRD process. Virtual Bids are excluded from the MPM-RRD~~ process. The mitigated or unmitigated Bids and RMR Proxy Bids ~~Bid~~ identified in the MPM~~-RRD~~ process for all resources that cleared in the MPM~~-RRD~~ are then passed to the

IFM. The CAISO performs the MPM process ~~RRD~~ for the DAM for the twenty-four (24) hours of the targeted Trading Day.

31.2.1 The ~~Reliability And~~ Market Power Mitigation ~~Runs~~Process

The MPM process enforces all Transmission Constraints that are expected to be enforced in the relevant market and produces dispatch levels for all resources with submitted Bids and LMPs for all Locations. Bid mitigation is determined by decomposing the Congestion component of each LMP determined in the MPM process into competitive Congestion and non-competitive Congestion components. The competitive Congestion component of each LMP is calculated as the sum of the product of the shift factor and the Shadow Price for all competitive Transmission Constraints and the non-competitive Congestion component of each LMP is calculated as the sum of the product of the shift factor and the Shadow Price for all non-competitive Transmission Constraints. The Reference Bus used in the MPM process will be either: (1) the Midway 500kV bus if Path 26 flow is from north to south; or (2) the Vincent 500kV bus if Path 26 flow is from south to north. The treatment of a particular Transmission Constraint as competitive or non-competitive for purposes of the MPM process is determined pursuant to Section 39.7.2.

~~The first run of the MPM-RRD procedures is the Competitive Constraints Run (CCR), in which only limits on transmission lines pre-designated as competitive are enforced. The only RMR Units considered in the CCR are Condition 1 RMR Units that have provided market Bids for the DAM and Condition 2 RMR Units when obligated to submit a Bid pursuant to an RMR Contract. The second run is the All Constraints Run (ACR), during which all Transmission Constraints that are expected to be enforced in the Integrated Forward Market are enforced. All RMR Units, Condition 1 and Condition 2, are considered in the ACR.~~

~~**31.2.2 Bid Mitigation for RMR Units**~~

~~The CAISO shall compare the resource dispatch levels derived from CCR and ACR and will mitigate Bids as follows.~~

31.2.2.~~1~~ Bid Mitigation for RMR Units

~~For a Condition 1 RMR Unit that is dispatched in the CCR, the Bid used in the ACR for the entire portion of the unit's Energy Bid Curve above the CCR dispatch level and below the Maximum Net Dependable Capacity specified in the RMR Contract will be set to the lower of the RMR Proxy Bid, or the DAM Bid, but~~

~~not lower than the unit's highest Bid price that cleared the CCR. If a Condition 1 RMR Unit is dispatched in the CCR and receives a greater dispatch in the ACR, the entire portion of the unit's Energy Bid Curve above the CCR dispatch level and below the Maximum Net Dependable Capacity specified in the RMR Contract, will be set to the lower of the RMR Proxy Bid or the DAM Bid, but not lower than the unit's highest Bid price that cleared the CCR for purposes of being considered in the IFM.~~For purposes of the MPM process ~~RRD~~, Condition 1 RMR Units will be treated like non-RMR Units with respect to any capacity in excess of the Maximum Net Dependable Capacity specified in the RMR Contract. For up to the Maximum Net Dependable Capacity specified in the RMR Contract for Condition 1 RMR Units, the portion of the market Bid at and below the Competitive LMP at the RMR Unit's Location ~~CCR dispatch level~~ will be retained in the IFM. To the extent that the non-competitive Congestion component of an LMP calculated in the MPM process ~~For Condition 2 RMR Units and for Condition 1 RMR Units that either did not submit DAM Bids or submitted DAM Bids but were not dispatched in the CCR, the CAISO will use the RMR Proxy Bid in the ACR to determine the Energy required from RMR Units for each Trading Hour. If the dispatch level produced through the ACR for a Condition 1 RMR Unit is not greater than the dispatch level produced through CCR, the unit's original, unmitigated DAM Bid will be retained in its entirety. For a Condition 1 RMR Unit, if the dispatch level produced through the ACR is greater than the dispatch level produced through the CCR, and for a Condition 2 RMR Unit that~~ is greater than zero (0), and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, those Bid prices above the Competitive LMP will be set to the higher of the RMR Proxy Bid or the Competitive LMP. If any Bid prices are set to the level of the RMR Proxy Bid through this process, any incremental dispatch of the resource based on the RMR Proxy Bid ~~dispatched through the ACR, the resource~~ will be flagged as an RMR Dispatch in the Day-Ahead Schedule and the resource shall be considered to have received~~shall constitute~~ a Dispatch Notice pursuant to the RMR Contract. Condition 1 RMR Units that have not submitted Bids and Condition 2 RMR Units will not be considered in the MPM unless the CAISO issues a manual RMR Dispatch, in which case the dispatch level specified in the manual RMR Dispatch will be protected in the MPM. If a Condition 2 RMR Unit is issued a Manual RMR Dispatch by the CAISO, then RMR Proxy Bids for all of the unit's Maximum Net Dependable Capacity under the RMR Contract will be considered in the MPM.

Any incremental dispatch based on RMR Proxy Bids will be flagged as an RMR Dispatch in the Day-Ahead Schedule and the resource shall be considered to have received a Dispatch Notice pursuant to the RMR Contract. For a Condition 1 RMR Unit that has submitted Bids and has not been issued a Manual RMR Dispatch, to the extent that the non-competitive Congestion component of an LMP calculated in the MPM process is greater than zero (0), and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, the resource will be flagged as an RMR dispatch in the Day-Ahead Market if the resource has a Day-Ahead Schedule at a level higher than the dispatch level determined by the Competitive LMP

31.2.~~2.2~~3 Bid Mitigation for Non-RMR Units

If the non-competitive Congestion component of an LMP calculated in an MPM process is greater than zero, then any resource at that Location that is dispatched in that MPM process ~~If the dispatch level produced through the ACR is greater than the dispatch level produced through CCR, then the resource~~ is subject to Local Market Power Mitigation. Bids on behalf of any such resource, to the extent that they exceed the Competitive LMP at the resource's Location, ~~, in which case the entire portion of the unit's Energy Bid Curve that is above the CCR dispatch level~~ will be mitigated to the higher ~~lower~~ of the resource's Default Energy Bid, as specified in Section 39, or the Competitive LMP at the resource's Location. To the extent a Multi-Stage Generating Resource is dispatched in the MPM process and the non-competitive Congestion component of the LMP calculated at the Multi-Stage Generating Resource's Location ~~DAM Bid, but no lower than the unit's highest Bid price that cleared the CCR. To the extent a Multi-Stage Generating Resource's MWh dispatch level produced in in the All Constraints Run~~ is greater than zero (0), ~~the MWhs dispatch level produced in the Competitive Constraints Run,~~ for purposes of mitigation, all the MSG Configurations will be mitigated similarly and the CAISO will evaluate all submitted Energy Bids for all MSG Configurations based on the relevant Default Energy Bids for the applicable MSG Configuration. The CAISO will calculate the Default Energy Bids for Multi-Stage Generating Resources by submitted MSG Configuration. Any market Bids equal to or less than the Competitive LMP will be retained in the IFM~~When the ACR dispatch level is higher than the CCR level, the market Bid at and below the CCR dispatch level will be the resource retained in the IFM. If the dispatch level produced~~

~~through the ACR is not greater than the dispatch level produced through the CCR, the unit's original, unmitigated DAM Bid will be retained in its entirety~~.

* * *

33 Hour-Ahead Scheduling Process (HASP)

The HASP is the hour-ahead process during the Real-Time which consists of the following activities. The HASP includes a special hourly run of the Real-Time Unit Commitment (RTUC), which is also one of the component processes of the RTM. The RTUC utilizes a SCUC optimization and runs every fifteen (15) minutes, as fully described in Section 34. This Section 33 describes the special features of the specific hourly HASP run of the RTUC. The HASP combines provisions for the CAISO to issue hourly pre-dispatch instructions to System Resources that submit Energy Bids to the RTM and for the procurement of Ancillary Services on an hourly basis from System Resources, with provisions for Scheduling Coordinators to self-schedule changes to their Day-Ahead Schedules as provided in Section 33.1, and submit Bids to export Energy at Scheduling Points. The HASP also performs the MPM~~-RRD~~ procedure with respect to the Bids that will be used in the HASP optimization and in the RTM processes for the same Trading Hour.

33.1 Submission Of Bids For The HASP And RTM

Scheduling Coordinators may submit Bids, including Self-Schedules, for Supply that will be used for the HASP and the RTM processes starting from the time Day-Ahead Schedules have been posted until seventy-five (75) minutes prior to each applicable Trading Hour in the Real-Time. This includes Self-Schedules by Participating Load that is modeled using the Pumped-Storage Hydro Unit. Scheduling Coordinators may not submit Bids, including Self-Schedules, for CAISO Demand in the HASP and RTM. Scheduling Coordinators may submit Bids, including Self-Schedules, for exports at Scheduling Points in the HASP and RTM. The rules for submitted Bids specified in Section 30 apply to Bids submitted to the HASP and RTM. After the Market Close of the HASP and the RTM the CAISO performs a validation process consistent with the provisions set forth in Section 30.7 and the following additional rules. The CAISO will generate a Self-Schedule to cover any RUC Award or Day-Ahead Schedule in the absence of any Self-Schedule or Economic Bid components, or to fill in any gaps between any Self-Schedule Bid and any Economic Bid components to cover a RUC Award or Day-Ahead Schedule. Bids submitted to the HASP and the RTM to supply Energy and Ancillary Services will be considered in the various HASP and RTM processes, including the MPM~~-RRD~~ process, the HASP optimization, the STUC, the RTUC and the RTD.

33.2 The HASP Optimization

After the Market Close for the HASP and RTM for the relevant Trading Hour, the Bids have been validated and the MPM~~-RRD~~ process has been performed, the HASP optimization determines feasible but non-binding HASP Advisory Schedules for Generating Units for each fifteen-minute interval of the Trading Hour, as well as binding hourly HASP Intertie Schedules and binding hourly HASP AS Awards from Non-Dynamic System Resources for that Trading Hour. The HASP may also commit resources whose Start-Up Times are within the immediately following Trading Hour.~~its Time Horizon.~~ The HASP, like the other runs of the RTUC, utilizes the same SCUC optimization and Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 as the IFM, with the Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6 updated to reflect changes in system conditions as appropriate, to ensure that HASP Intertie Schedules are feasible. Instead of clearing against Demand Bids as in the IFM, the HASP clears Supply against the CAISO Forecast of CAISO Demand plus submitted Export Bids, to the extent the Export Bids are selected in the MPM~~-RRD~~ process. The HASP optimization also factors in forecasted unscheduled flow at the Interties. The HASP optimization produces Settlement prices for hourly imports and exports to and from the CAISO Balancing Authority Area reflected in the HASP Intertie Schedule and for the HASP AS Awards for System Resources.

* * *

33.4 MPM For The HASP And The RTM

After the Market Close of the HASP and RTM, after the CAISO has validated the Bids pursuant to section 30.7, and prior to running the HASP optimization, the CAISO conducts the MPM~~-RRD~~ process, the results of which will be utilized in the HASP optimization and all RTM processes for the Trading Hour. Bids on behalf of ~~the Proxy~~ Demand Response Resources are ~~not mitigated and are not~~ considered in the MPM~~-RRD~~ process but are not subject to Bid mitigation.~~.~~ The MPM~~-RRD~~ process for the HASP and RTM produces results for each fifteen (15) minute interval of the Trading Hour and thus may produce up to four mitigated Bids for any given resource for the Trading Hour. The determination as to whether a Bid is mitigated in the HASP and RTM is made based on the non-competitive Congestion component of each LMP for each fifteen (15) minute interval of the applicable Trading Hour, using the methodology set forth in Sections 31.2.2 and 31.2.3 above. If a Bid is mitigated in any of the four fifteen (15) minute intervals comprising a Trading Hour during the MPM process for the HASP and RTM, then that Bid will be treated as mitigated for the entire Trading Hour for purposes of the HASP optimization and all RTM processes. A single mitigated Bid for the entire Trading Hour is calculated using the minimum Bid price of the four mitigated Bid curves at each Bid quantity level. For a Condition 1 RMR Unit, the use of RMR Proxy Bids is determined based on the non-competitive Congestion component of each LMP for each fifteen (15) minute interval of the applicable Trading Hour, using the methodology set forth in Section 31.2.2 above. If a Condition 2 RMR Unit is issued a Manual RMR Dispatch by the CAISO, then RMR Proxy Bids for all of the unit's Maximum Net Dependable Capacity will be considered in the MPM process. For both Condition 1 and Condition 2 RMR Units, when mitigation is triggered, a single RMR Proxy Bid for the entire Trading Hour is calculated using the same methodology described above for non-RMR Units. For a Condition 1 RMR Unit that has submitted Bids and has not been issued a Manual RMR Dispatch, to the extent that the non-competitive Congestion component of an LMP calculated in the MPM process is greater than zero, and that MPM process dispatches a Condition 1 RMR Unit at a level such that some portion of its market Bid exceeds the Competitive LMP at the RMR Unit's Location, the resource will be flagged as an RMR dispatch if it is dispatched at a level higher than the dispatch level determined by the Competitive LMP. Both Condition 1 and Condition 2 RMR Units may be issued manual RMR dispatches at any time to address local reliability needs or to resolve non-competitive constraints~~The Bids are mitigated only for the Bid quantities that are above the minimum quantity cleared in the CCR across all four fifteen-minute intervals. For a Condition 1 RMR Unit, if the dispatch level produced through the ACR is greater than the dispatch level produced through the CCR, and for a Condition 2 RMR Unit that is dispatched through the ACR, the resource will be flagged as an RMR Dispatch in the RTM and shall constitute a Dispatch notice pursuant to the RMR Contract~~.

* * *

34.1 Inputs To The Real-Time Market

The RTM utilizes results produced by the DAM and HASP for each Trading Hour of the Trading Day, including the combined commitments contained in the Day-Ahead Schedules, Day Ahead AS Awards, RUC Awards, HASP Intertie Schedules, HASP Self-Schedules, HASP Intertie AS Awards and the MPM~~-RRD~~ that is run as part of the HASP to determine~~ reliability needs and~~ mitigated bids for each relevant Trading Hour. Virtual Bids and Virtual Awards are not used in the Real-Time Market. These results, plus the short-term Demand Forecast, Real-Time Energy Bids, Real-Time Ancillary Service Bids, updated Base Market Model adjusted as described in Sections 27.5.1 and 27.5.6, State Estimator output, resource outage and de-rate information constitute the inputs to the RTM processes. Bids submitted in HASP for all Generating Units and Participating Load shall be used in the Real-Time Market.

34.2 Real-Time Unit Commitment

The Real-Time Unit Commitment (RTUC) process uses SCUC and is run every fifteen (15) minutes to: (1) make commitment decisions for Fast Start and Short Start Units having Start-Up Times within the applicable time periods described below in this section, and (2) procure required additional Ancillary Services and calculate ASMP used for settling procured Ancillary Service capacity for the next fifteen-minute Real-Time Ancillary Service interval. In any fifteen (15) minute RTUC interval that falls within a time period in which a Multi-Stage Generating Resource is transitioning from one MSG Configuration to another MSG Configuration, the CAISO: (1) will not award any incremental Ancillary Services; (2) will disqualify any Day-Ahead Ancillary Services Awards; (3) will disqualify Day-Ahead qualified Submissions to Self-Provide Ancillary Services Award, and (4) will disqualify Submissions to Self-Provide Ancillary Services in RTM. For Multi-Stage Generating Resources the RTUC will issue a binding Transition Instruction separately from the binding Start-Up or Shut Down instructions. The RTUC can also be run with the Contingency Flag activated, in which case the RTUC can commit Contingency Only Operating Reserves. If RTUC is run without the Contingency Flag activated, it cannot commit Contingency Only Operating Reserves. RTUC is run at the following time intervals: (1) at approximately 7.5 minutes prior to the next Trading Hour, in conjunction with the HASP run, for T-45 minutes to T+60 minutes; (2) at approximately 7.5 minutes into the current hour for T-30 minutes to T+60 minutes; (3) at approximately

22.5 minutes into the current hour for T-15 minutes to T+60 minutes; and (4) at approximately 37.5 minutes into the current hour for T to T+60 minutes where T is the beginning of the next Trade Hour. The HASP, described in Section 33, is a special RTUC run that is performed at approximately 7.5 minutes before each hour and has the additional responsibility of: (1) pre-dispatching Energy and awarding Ancillary Services for hourly dispatched System Resources for the Trading Hour that begins 67.5 minutes later, and (2) performing the necessary MPM~~-RRD~~ for that Trading Hour. A Day-Ahead Schedule or RUC Schedule for an MSG Configuration that is later impacted by the resource's derate or outages, will be reconsidered in the RTUC process taking into consideration the impacts of the derate or outage on the available MSG Configurations.

* * *

39.7 Local Market Power Mitigation For Energy Bids

Local Market Power Mitigation is based on the~~a periodic~~ assessment and designation of Transmission Constraints as competitive or non-competitive pursuant to Section 39.7.2. Prior to the effective date of this tariff provision, assessments~~. Such periodic assessment~~ will be performed for use in the DAM, HASP and the RTM at a minimum four (4) times per year~~on an annual basis~~ and potentially more frequently if needed due to changes in system conditions, network topology, or market performance. Any changes in Transmission Constraints designations will be publicly noticed prior to making the change. Upon determination that an ad hoc assessment is warranted, the CAISO will notice Market Participants that such an assessment will be performed. As of the effective date of this tariff provision, these procedures will only apply to assessments and designations of Transmission Constraints as competitive or non-competitive used in the HASP and RTM, while assessments and designations of Transmission Constraints as competitive or non-competitive for the DAM will be made as part of each MPM run associated with the DAM. The determination whether a unit is being dispatched to relieve Congestion on a competitive or non-competitive Transmission Constraint is based on a~~two~~ preliminary market run~~runs~~ that is~~are~~ performed prior to the actual pricing run of the market, as~~and are~~ described in Sections 31 and 33 for the DAM and RTM, respectively.

* * *

39.7.1.6 Default Energy Bids for RMR Units

The available capacity in excess of the Maximum Net Dependable Capacity (MNDC) specified in the RMR Contract up to the maximum generation capacity (PMax) is subject to Local Market Power Mitigation. The Scheduling Coordinator for the RMR Unit must rank order its preferences between the Variable Cost Option, the LMP Option, and the Negotiated Rate Option, which shall be the default rank order if no rank order is specified by the Scheduling Coordinator. These preferences will be used to determine the Default Energy Bids for the capacity between the MNDC and PMax. RMR Proxy Bids for RMR Units based on contractually specified costs are used in lieu of Default Energy Bids for the contractual RMR Unit capacity between the minimum generating capacity (PMin) and the MNDC. The CAISO or Independent Entity will concatenate these two calculation methodologies (for calculating RMR Proxy Bids and Default Energy Bids for RMR Units) and will adjust them for monotonicity without lowering any price on either curve to create a single Energy Bid Curve to be used in the MPM~~-RRD~~ processes as described in Sections 31 and 33 for the DAM and RTM, respectively. RMR Units are not eligible to receive a Bid Adder pursuant to Section 39.8 for contractual RMR Unit capacity between PMin and MNDC.

39.7.2 Competitive Path Designation

39.7.2.1 Timing of Assessments

For the DAM, the ~~The~~ CAISO will make assessments and designations ~~complete the first assessment~~ of whether ~~competitiveness of~~ Transmission Constraints are competitive or non-competitive as part of each MPM run associated with~~prior to the effective date of this provision. Constraint designations resulting from~~ the DAM. Only binding Transmission Constraints determined by the Day-Ahead MPM process~~first assessment~~ will be assessed~~applied~~ in the DAM.

For the HASP and RTM, the~~MPM-RRD mechanism on the day this CAISO Tariff becomes effective and will not be changed until a subsequent assessment has been performed. The~~ CAISO may perform additional competitive constraint assessments during the year if changes in transmission infrastructure, generation resources, or Load, in the CAISO Balancing Authority Area and adjacent Balancing Authority Areas suggest material changes in market conditions or if market outcomes are observed that are inconsistent with competitive market outcomes. The CAISO will calculate and post path designations for the HASP and RTM~~not less than once prior to the effective date of this tariff provision and~~ not less than four (4) times each year thereafter to provide timely seasonal path designations.

39.7.2.2 Criteria

For the DAM, a~~A~~ Transmission Constraint will be competitive by default unless the CAISO designates the Transmission Constraint as non-competitive pursuant to this Section 39.7.2.2. For the HASP and RTM, a Transmission Constraint will be non-competitive by default unless the CAISO designates the Transmission Constraint as competitive pursuant to this Section 39.7.2.2.

(a) Transmission Constraints for the DAM – As part of the MPM process associated with the DAM, the CAISO will designate a Transmission Constraint for the DAM as non-competitive when the fringe supply of counter-flow to the Transmission Constraint from all portfolios of suppliers that are not identified as potentially pivotal is less than the demand for counter-flow. For purposes of determining whether to designate a Transmission Constraint as non-competitive pursuant to this Section 39.7.2.2(a):

(i) Counter-flow to the Transmission Constraint means the delivery of Power from a resource to the system load distributed reference bus. If counter-flow to the Transmission Constraint is in the direction opposite to the market flow of Power to the Transmission Constraint, the counter-flow to the Transmission Constraint is calculated as shift factor multiplied by the resource's scheduled Power. Otherwise, counter-flow to the Transmission Constraint is zero.

(ii) Fringe supply of counter-flow to the Transmission Constraint includes all available capacity from resources not controlled by the identified potentially pivotal suppliers and all Virtual Supply Awards not controlled by the identified potentially pivotal suppliers that provide counter-flow to the Transmission Constraint. Available capacity reflects the highest capacity of a resource's Energy Bid adjusted for Self-Provided Ancillary Services and derates.

(iii) Demand for counter-flow to the Transmission Constraint means all internal dispatched Supply and Virtual Supply Awards that provide counter-flow to the Transmission Constraint.

(iv) Potentially pivotal suppliers mean the three (3) portfolios of net sellers that control the largest quantity of counter-flow supply to the Transmission Constraint.

(v) Portfolio means the effective available generation capacity under the control of the Scheduling Coordinator and/or Affiliate determined pursuant to Section 4.5.1.1.12 and all effective Virtual Supply Awards of the Scheduling Coordinator and/or Affiliate. Effectiveness in supplying counter-flow is determined by scaling generation capacity and/or Virtual Supply Awards by the shift factor from that location to the Transmission Constraint being tested.

(vi) A portfolio of a net seller is any portfolio that is not a portfolio of a net buyer. A portfolio of a net buyer means a portfolio for which the average daily net value of Measured Demand minus Supply over a twelve (12) month period is positive. The average daily net value is determined for each portfolio by subtracting, for each Trading Day, Supply from Measured Demand and then averaging the daily value for all Trading Days over the twelve (12) month period. The CAISO will calculate whether portfolios are portfolios of net buyers in the third month of each calendar quarter and the calculations will go into effect at the start of the next calendar quarter. The twelve (12) month period used in this calculation will be the most recent twelve month (12) period for which data is available. The specific mathematical formula used to perform this calculation will be set forth in a Business Practice Manual.

(vii) In determining which Scheduling Coordinators and/or Affiliates control the resources in the three (3) identified portfolios, the CAISO will include resources and Virtual Supply Awards directly associated with all Scheduling Coordinator ID Codes associated with the Scheduling Coordinators and/or Affiliates, as well as all resources that the Scheduling Coordinators and/or Affiliates control pursuant to Resource Control Agreements registered with the CAISO as set forth Section 4.5.1.1.13. Resources identified pursuant to Resource Control Agreements will only be assigned to the portfolio of the Scheduling Coordinator that has control of the resource or whose Affiliate has control of the resource pursuant to the Resource Control Agreements.

(b) Transmission Constraints for the HASP and RTM – A Transmission Constraint for the HASP or RTM will be deemed competitive if no three (3) unaffiliated suppliers are jointly pivotal in relieving Congestion~~congestion~~ on that constraint. The determination of whether or not the pivotal supplier criteria for an individual Transmission Constraint for the HASP or RTM~~constraint~~ are violated will be assessed using the Feasibility Index described in Section 39.7.2.4. Assessment of competitiveness for the HASP or RTM will be performed assuming various system conditions potentially including but not limited to season, load, planned transmission and resource outages. If an individual Transmission Constraint for the HASP or RTM ~~constraint~~ fails the pivotal supplier criteria under any of these system conditions, the Transmission Constraint~~constraint~~ will be deemed uncompetitive ~~for the entire year under all system conditions~~ until a subsequent assessment deems the Transmission Constraint~~constraint~~ competitive. In general, a constraint for the HASP or RTM may be an individual transmission line or a collection of lines that create a distinct Transmission Constraint. For purposes of the competitive assessment for the HASP or RTM, the set of Transmission Constraints~~constraints~~ that will be included in the FNM~~network model~~ are those modeled along with Transmission Constraints~~transmission limits~~ expected to be enforced in clearing the CAISO Markets.

39.7.2.3 Candidate Path Identification

Assessments~~The first assessment~~ of competitive Transmission Constraints for the HASP or RTM~~constraints will be determined prior to the effective date of this provision and~~ will consider all interfaces to neighboring Balancing Authority Areas and all inter-zonal interfaces ~~for zones~~ that predate~~existed prior to~~ the effective date of this provision to be competitive, and no such~~. The set of candidate constraints that will be evaluated for competitiveness in the initial assessment will be limited to intra-zonal constraints for zones that existed prior to the effective date of this provision, that were managed for Congestion in Real-Time in greater than five hundred (500) hours in the most recent twelve (12)-month period. The Congestion frequency threshold of five-hundred (500) hours for designation of~~

~~competitive constraint candidates will be based on the combination of real-time intra-zonal congestion hours that pre-dated the effective date of this provision, and congestion in IFM and Real-Time markets after the effective date of this provision for the twelve (12) months of historical data. Subsequent assessments will again consider all pre-existing~~ interfaces will~~to neighboring Balancing Authority Areas and all inter-zonal interfaces to be competitive and will not~~ be included in the set of candidate Transmission Constraints~~constraints~~ for assessment. The set of candidate Transmission Constraints for the HASP or RTM~~constraints~~ will be ~~further~~ reduced to those remaining Transmission Constraints~~constraints~~ that were congested or managed for Congestion~~congestion~~ in greater than five hundred (500) hours in the prior twelve (12) months.

39.7.2.4 Feasibility Index

For the HASP or RTM, the~~The~~ CAISO will perform a pivotal supplier test on all suppliers in the CAISO Balancing Authority Area for each path to be assessed using the Feasibility Index (FI). Suppliers will be considered in two groups: those suppliers with the largest portfolios will be considered in the preliminary simulations, and any additional suppliers who are likely to be pivotal given the competitive designations from the preliminary simulations. The FI requires solving the FNM~~network model~~ having removed all internal resources of a supplier and modifying the candidate constraints of the FNM~~network model~~ such that the flow limits of the set of candidate constraints can be exceeded with a penalty imposed for excess flow. The resulting solution to the FNM~~network model~~ produces constraint flows that can be used to calculate the FI. The FI is calculated for each constraint as the proportion of the Transmission Constraint~~constraint~~ limit that is exceeded to solve the FNM without the specified supplier's supply. FI values less than zero indicate the supplier is pivotal in relieving Congestion on the specified Transmission Constraint.~~constraint.~~ The process is repeated by removing the supply portfolio of two and three suppliers for paths with non-negative FI. If any three suppliers are jointly pivotal in relieving Congestion~~congestion~~ on a candidate path, as indicated by an FI value less than zero, the candidate path will be deemed uncompetitive. Otherwise, the candidate path will be deemed competitive. The portfolio of each supplier will be based on ownership information available to the CAISO, taking into account any material transfer of sufficient length that the transfer of control could have persistent impact on the relative shares of supply within the CAISO Balancing Authority Area. These transfers of control will be utilized in the assessment as provided to the CAISO by the supplier reflecting its triennial filing with FERC for market-based rate authority.

* * *

39.8.1 Bid Adder Eligibility Criteria

To receive a Bid Adder, a Generating Unit must: (i) have a Mitigation Frequency that is greater than eighty (80) percent ~~(80%)~~ in the previous twelve (12) months; and (ii) must not have a contract to be a Resource Adequacy Resource for its entire Net Qualifying Capacity, or be designated under the CPM for its entire Eligible Capacity, or be subject to an obligation to make capacity available under this CAISO Tariff. If a Generating Unit is designated under the CPM for a portion of its Eligible Capacity, the provisions of this section apply only to the portion of the capacity not designated. Scheduling Coordinators for Generating Units seeking to receive Bid Adders must further agree to be subject to the Frequently Mitigated Unit option for a Default Energy Bid. Run hours are those hours during which a Generating Unit has positive metered output. ~~During the first twelve (12) months after the effective date of this Section, the Mitigation Frequency will be based on a rolling twelve (12)-month combination of RMR Dispatches and incremental Bids dispatched out of economic merit order to manage local Congestion from the period prior to the effective date of this Section, which will serve as a proxy for being subject to Local Market Power Mitigation, and a Generating Unit's Local Market Power Mitigation frequency after the effective date of this Section.~~ Generating Units that received RMR Dispatches and/or incremental Bids dispatched out of economic merit order to manage local Congestion in an hour prior to the effective date of this Section will have that hour counted as a mitigated hour in their Mitigation Frequency. After the first twelve (12) months from the effective date of this Section, the Mitigation Frequency will be based entirely on a Generating Unit being mitigated under the MPM ~~RRD~~ procedures in Sections 31 and 33.

* * *

41.5.1 Day-Ahead And HASP RMR Dispatch

RMR Dispatches will be determined in accordance with the RMR Contract, the MPM ~~RRD~~ process addressed in Sections 31 and 33 and through manual RMR Dispatch Notices to meet Applicable Reliability Criteria.

The CAISO will notify Scheduling Coordinators for RMR Units of the amount and time of Energy requirements from specific RMR Units in the Trading Day prior to or at the same time as the Day-Ahead Schedules and AS and RUC Awards are published, to the extent that the CAISO is aware of such requirements, through an RMR Dispatch Notice or flagged RMR Dispatch in the IFM Day-Ahead Schedule. The CAISO may also issue RMR Dispatch Notices after Market Close of the DAM and through Dispatch Instructions flagged as RMR Dispatches in the Real-Time Market. The Energy to be delivered for each Trading Hour pursuant to the RMR Dispatch Notice an RMR Dispatch in the IFM or Real-Time shall be referred to as the RMR Energy. Scheduling Coordinators may submit Bids in the DAM or the HASP for RMR Units operating under Condition 1 of the RMR Contract in accordance with the bidding rules applicable to non-RMR Units. A Bid submitted in the DAM or the HASP for a Condition 1 RMR Unit shall be deemed to be a notice of intent to substitute a market transaction for the amount of MWh specified in each Bid for each Trading Hour pursuant to Section 5.2 of the RMR Contract. In the event the CAISO issues an RMR Dispatch Notice or an RMR Dispatch in the IFM or Real-Time Market for any Trading Hour, any MWh quantities cleared through ~~Competitive Constraints Run of~~ the MPM~~-RRD~~ shall be considered as a market transaction in accordance with the RMR Contract. RMR Units operating as Condition 2 RMR Units may not submit Bids until and unless the CAISO issues an RMR Dispatch Notice or issues an RMR Dispatch in the IFM, in which case a Condition 2 RMR Unit shall submit Bids in accordance with the RMR Contract in the next available market for the Trading Hours specified in the RMR Dispatch Notice or Day-Ahead Schedule.

* * *

Appendix A

Master Definitions Supplement

- ~~All Constraints Run~~ [Not Used]

~~The second optimization run of the MPM-RRD process through which all Transmission Constraints that are expected to be enforced in the market-clearing processes (IFM, RUC, STUC, RTUC and RTD) are enforced.~~

* * *

- CAISO Markets Processes

The MPM~~-RRD~~, IFM, RUC, STUC, RTUC, and RTD. HASP is an hourly run of the RTUC.

* * *

~~**- Competitive Constraints Run**~~**[Not Used]**

~~The first optimization run of the MPM-RRD process through which only pre-designated competitive constraints are enforced.~~

* * *

- Competitive LMP

An LMP calculated in the MPM process minus the Congestion component relating to non-competitive Transmission Constraints, as calculated in accordance with Section 31.2.2.

* * *

- Demand Response Resource

A resource, including but not limited to a Proxy Demand Resource, providing Demand Response Services. Participating Load is not a Demand Response Resource within the meaning of this definition.

* * *

- HASP Bid

A Bid received in HASP that can be used in the MPM~~-RRD~~ conducted in HASP, the RTUC, STUC, or the RTD.

* * *

- Hour-Ahead Scheduling Process (HASP)

The process conducted by the CAISO beginning at seventy-five minutes prior to the Trading Hour through which the CAISO conducts the following activities: 1) accepts Bids for Supply of Energy, including imports, exports and Ancillary Services imports to be supplied during the next Trading Hour that apply to the MPM~~-RRD~~, RTUC, STUC, and RTD; 2) conducts the MPM~~-RRD~~ on the Bids that apply to the RTUC, STUC, and RTD; and 3) conducts the RTUC for the hourly pre-dispatch of Energy and Ancillary Services.

* * *

- Integrated Forward Market (IFM)

The pricing run conducted by the CAISO using SCUC in the Day-Ahead Market, after the MPM~~-RRD~~ process, which includes Unit Commitment, Ancillary Service procurement, Congestion Management and Energy procurement based on Supply and Demand Bids.

* * *

- Manual RMR Dispatch

An RMR Dispatch Notice issued by the CAISO other than as a result of the MPM~~-RRD~~ process.

* * *

- MPM

~~-~~Market Power Mitigation~~-Reliability Requirement Determination~~

* * *

- Resource Control Agreement

An agreement that gives an entity bidding, scheduling, and/or operational control over a physical resource owned by or under contract to another entity, or otherwise directs the manner in which such a resource participates in the ISO markets

* * *

Appendix C

Locational Marginal Price

B. The System Marginal Energy Cost Component of LMP

The SMEC shall be the same for each location throughout the system. SMEC is the sensitivity of the power balance constraint at the optimal solution. The power balance constraint ensures that the physical law of conservation of Energy (the sum of Generation and imports equals the sum of Demand, including exports and Transmission Losses) is accounted for in the network solution. For the designated reference location the CAISO will utilize a distributed Load Reference Bus for which constituent PNodes are weighted using the Reference Bus distribution factors. The Load distributed Reference Bus distribution factors are based on the Load Distribution Factors at each PNode that represents cleared Load in the Integrated Forward Market or forecast Load for MPM~~-RRD~~, RUC, HASP and RTM. In the Integrated Forward Market, in the event that the market is not able to clear based on the use of a distributed load Reference Bus, the CAISO will use a distributed generation Reference Bus for which the constituent nodes and the weights are determined economically within the running of the Integrated Forward Market based on available economic bids. In the event that the CAISO employs a distributed generation Reference Bus, it will notify Market Participants of which Integrated Forward Market runs required the use of this backstop mechanism. A distributed Load Reference Bus will be used for~~ MPM-RRD,~~ RUC, HASP and RTM regardless of whether a distributed Generation Reference Bus were used in the corresponding Integrated Forward Market run. Once the Reference Bus is selected, the System Marginal Energy Cost is the cost of economically providing the next increment of Energy at the distributed Reference Bus, based on submitted Bids.

* * *

Attachment C–Direct Testimony of Lin Xu

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	))	**Docket No. ER12-____-000**

DIRECT TESTIMONY OF
LIN XU
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR CORPORATION

Q. Please state your name, title, and business address.

A. My name is Lin Xu. I am a Senior Market Development Engineer with the California Independent System Operator Corporation (CAISO). My business address is 250 Outcropping Way, Folsom, CA 95630.

Q. What are your duties and responsibilities at the CAISO?

A. I work in the Department of Market Analysis and Development. My duties and responsibilities include designing and improving market products and features, supporting policy development, performing in-depth engineering and economic analysis, and recommending solutions to improve market efficiency and grid reliability.

Q. Please describe your educational and professional background.

A. I received Ph.D. in Electrical Engineering – Energy Systems from the University of Texas at Austin in 2009, and an M.S.E degree and a B.S.

degree both in Electrical Engineering from Tianjin University, Tianjin, China in 2003 and 2000 respectively. From 2007 to 2008, I was a full time employee with the Electric Reliability Council of Texas (ERCOT). I was involved in ERCOT nodal market design and testing, as well as regional transmission planning. In 2008, I joined the CAISO's Department of Market Monitoring, where I worked as a key analyst focused on monitoring local market power. In 2010, I transferred to the Department of Market Analysis and Development and became involved in various projects related to market design and enhancements and engineering and economic analyses.

My experiences in analyzing strategic behaviors and market power in electricity markets can be traced back to my Ph.D. studies. I have worked on several research projects related to market power sponsored by the National Science Foundation and the Power Systems Engineering Research Center. My Ph.D. dissertation topic is about analyzing strategic behaviors in electricity markets considering the impacts of transmission constraints.

Q. **Please briefly describe your role in developing the proposed modifications to the local market power mitigation provisions of the CAISO's tariff.**

A. I am a key member of the CAISO's market power mitigation enhancements team, and the inventor of the locational marginal price (LMP) decomposition method for local market power mitigation. I have supported the development of the tariff provisions as a subject matter expert.

Q. **As you testify, will you be using any specialized terms?**

A. Yes. Unless otherwise indicated, any capitalized terms I use have the meanings set forth in the Master Definitions Supplement, Appendix A of the CAISO tariff.

Q. **What is the purpose of your testimony?**

A. In my testimony, I will discuss proposed revisions to the CAISO's Local Market Power Mitigation ("LMPM") process. Specifically, my testimony will focus on the CAISO's proposed new method for identifying and mitigating local market power. My testimony will begin with a brief overview of the CAISO's current LMPM process and a summary of the reasons why the CAISO is proposing revisions to this process. I will then explain the CAISO's new method for analyzing and mitigating bids, and discuss the advantages offered by this new method and why this method will best satisfy the objectives for the revisions to the LMPM process.

I. <u>Overview of the CAISO's Currently Proposed and Future Tariff Revisions</u>

Q. Please briefly describe the CAISO's current LMPM process.

A. The CAISO's local market power mitigation process is designed to identify and mitigate the circumstances under which a supply resource can exercise local market power, meaning that it could potentially manipulate the energy price in its local area by economically withholding supply. In its current design, the CAISO runs its automated LMPM process before the day-ahead market and as part of the hour-ahead scheduling process for real-time markets. In the day-ahead process, although the market run dispatches resources based on bid-in demand, the LMPM run determines the dispatch level of resources based on forecasted demand. In contrast, all real-time markets and processes dispatch resources against forecasted demand, and so does the real-time LMPM run performed in the hour ahead scheduling process.

The CAISO's current LMPM process consists of two market optimization runs. Each of the two runs uses the same market optimization engine as in the actual market run. The first LMPM run is the competitive constraints run, in which the market optimization engine clears supply against demand while enforcing only those transmission constraints that are pre-designated as competitive. The second run is the all constraints run, in which supply is cleared against demand while enforcing all modeled transmission constraints. The dispatch levels of these two runs are compared for each resource. If the dispatch level produced through the all constraints run is greater than the dispatch level produced through the competitive constraints run, then the resource is considered to potentially have the ability to exercise local market power, in which case the entire portion of the resource's bid curve that is above the dispatch level in the competitive constraints run is mitigated to the lower of the resource's default energy bid and its market bid, but no lower than the resource's highest bid price that is cleared in the competitive constraints run.

Q. **Why is the CAISO proposing to modify this process?**

A. The reasons for modifying the CAISO's current LMPM process are discussed in detail in the direct testimony of my colleague Dr. Jeffrey McDonald, which is Attachment E to this filing. However, in order to provide context for my testimony, I will provide a brief summary of the primary reasons for modifying the CAISO's method. They are: 1) to comply with FERC's order of September 2006 in which it directed the CAISO to modify its day-ahead LMPM process by April 2012 in order to perform bid mitigation based on bid-in rather than forecasted demand; 2) to account for the implementation of convergence bidding and new demand response products; 3) to improve the accuracy of mitigation in both the day-ahead and real-time markets; and 4) to incorporate into the LMPM process the ability to perform a more frequent study of competitive/non-competitive transmission paths, known as a dynamic competitive path assessment (CPA).

II. <u>CAISO's Revised LMPM Process</u>

Q. What are the main differences between the CAISO's current and revised LMPM process?

A. There are several main differences between the CAISO's current and revised LMPM process:

1) In accordance with FERC's September 2006 order on the CAISO's new market design, the CAISO's revised day-ahead LMPM process will be based on bid-in demand.

2) The CAISO's LMPM process will employ a single market optimization run in which all modeled transmission constraints are enforced. Under this new method, which is known as the decomposition method, each resource's LMP is decomposed into four components: the energy component, the loss component, the competitive congestion component and the non-competitive congestion component. Local market power identification will be

based on the non-competitive congestion component of each resource's LMP.

3) The CAISO will no longer rely on the LMPM process to commit Reliability Must-Run (RMR) units that do not bid into the market. Instead, operators will manually commit these units if they are needed for local reliability reasons. Once committed by operators, their RMR proxy bids will be considered in the LMPM run. For all Condition 1 RMR units that bid into the market, their bids will be considered in the LMPM process, and will possibly be mitigated based on their RMR proxy bids.

4) The CAISO is proposing to implement a dynamic process, called the dynamic CPA, for determining which transmission paths are competitive or non-competitive. The CAISO is proposing to introduce the dynamic CPA for the day-ahead LMPM process as part of this tariff amendment, and to add functionality for dynamic CPA as part of the real-time LMPM process later in 2012. This issue is discussed in the testimony of Dr. McDonald.

Q. Please explain in more detail how the CAISO's proposed new decomposition method will operate.

A. The CAISO's proposed new LMPM method will consist of a single market optimization run in which all modeled transmission constraints are enforced. As with the CAISO's current method, the revised LMPM process will utilize the same market optimization engine as used in the CAISO's markets. In order to identify potential local market power, each LMP in the market will be decomposed into four components: (1) the energy component; (2) the loss component; (3) the competitive congestion component; and (4) the non-competitive congestion component.

Under the decomposition method, a positive non-competitive congestion component indicates the potential of local market power. The non-competitive congestion component of each LMP will be calculated as the sum over all non-competitive constraints of the product of the constraint shadow price and the corresponding shift factor. In order for the non-competitive congestion component to be an accurate indicator of local market power, the reference bus that these shift factors are relative to should be at a location that is least susceptible to the exercise of local market power. Based on the CAISO transmission network topology and studies that the CAISO has performed, the CAISO proposes to select as the reference bus the Midway 500kV bus when flow on Path 26 is north to south and the Vincent 500kV bus when flow on Path 26 is south to north. I will explain this selection in more detail below.

Every resource with a positive non-competitive congestion component is subject to mitigation. Bids from any such resources will be mitigated downward to the higher of the resource's Default Energy Bid, or the "competitive LMP" at the resource's location, which is the LMP established in the LMPM run minus the non-competitive congestion component thereof.

The decomposition method will consider both convergence bids (also known as virtual bids) and demand response bids in the LMPM run, although it will not actually mitigate these types of bids. As I will explain below, convergence bids and demand response bids require no special treatment under the decomposition method, which addresses the two concerns discussed in Dr. McDonald's testimony relating to the treatment of convergence and demand response bids under the current LMPM process.

Q. Why did the CAISO select the Midway and Vincent buses as the reference buses to use in the revised LMPM process?

A. In order for the LMP non-competitive congestion component to be an accurate indicator of local market power, and therefore, ensure the most precise mitigation assessment, the reference bus used in the decomposition method should be at a location on the system that is least influenced by local market power. This is because under the decomposition method, local market power on the grid will be measured relative to this reference bus. The Midway and Vincent 500kV buses are excellent choices because they are located on the backbone of the

CAISO's transmission system near the center of the California transmission grid with sufficient generation and roughly half the system load on each side. Therefore, these buses are very competitive locations, and are least likely to be impacted by the exercise of local market power.

Q. Why is the CAISO proposing to switch the reference bus between the Midway bus and the Vincent bus according to the direction of flow on path 26?

A. Under normal operating conditions, path 26 is a competitive transmission constraint. Under these circumstances, either the Midway 500kV bus or the Vincent 500kV bus is a competitive location, and can be used as the reference bus in the decomposition method. However, when path 26 is de-rated due to a planned or forced outage, it might be designated as a non-competitive constraint. In this case, the receiving end of path 26 flow is located behind a non-competitive constraint, and may be influenced by local market power. Under this circumstance, only the bus on the sending end of path 26 flow qualifies as competitive and should be used as the reference bus in the LMPM process. Therefore, the CAISO proposes to switch the reference bus used in the LMPM process between Midway and Vincent according to the direction of flow on path 26 in order to ensure that the reference bus always represents a competitive location.

Q. Did you consider using a load distributed slack reference bus instead of the Midway and Vincent buses?

A. Yes. However, the CAISO's Market Surveillance Committee expressed the concern that the load distributed slack bus may be affected by local market power if a local area has a positive load distribution factor such that the price in the local area, which is already inflated by the exercise of market power, is aggregated into the load distributed slack bus LMP. I did an analysis using two months of actual data in the CAISO's day-ahead market and compared the mitigation results under the CAISO's current LMPM process and the results from the revised process that I have discussed herein. It showed that compared with the distributed slack bus, the Midway and Vincent 500kV buses have lower LMPs and thus produce higher non-competitive congestion components for every resource. These higher non-competitive congestion components relative to the Midway and Vincent 500kV buses allow local market power to be identified more accurately than do those relative to the load distributed slack bus. On average the non-competitive congestion component was $1.42/MWh higher when using the Vincent or Midway bus as opposed to using a load distributed slack bus. This means that the load distributed slack bus may have been affected by local market power in the amount of $1.42/MWh. Therefore, I concluded that using the Midway or Vincent bus was a better choice for the reference bus in the LMP decomposition than the load distributed slack bus. My full analysis of this issue can be found in the study entitled “A Retrospective Analysis of Local Market Power Mitigation Enhancements,” which is included with this filing as Attachment F.

Q. Is it possible that another location might emerge as a better choice for the reference bus in the future?

A. The choice of reference bus depends on system topology. Therefore, if the CAISO’s system topology were to change significantly, it is possible that a location other than Midway/Vincent might become a better choice for the reference bus to use in the LMPM process. However, given the central location of the Midway and Vincent buses, I do not expect such a change in topology to occur in the near future. Moreover, if such a change was to occur, it would be as a result of substantial modifications to the CAISO’s transmission grid, which means that the CAISO would have sufficient notice such that it would be able to file an amendment to its tariff to change the reference bus in the LMPM process to go into effect in conjunction with the topology change necessitating such amendment.

Q. Please explain the changes that the CAISO is proposing to the LMPM process with respect to RMR units.

A. For RMR units operating under Condition 1 of their contract that submit bids into the CAISO’s day-ahead market, the changes to the LMPM process mirror those for non-RMR units. That is, RMR units operating under Condition 1 will have their bids analyzed for market power using the decomposition method that I described above. As with the current process, if such bids are identified for mitigation, mitigation will be based on the RMR units' RMR proxy bids rather than default energy bids.

With respect to RMR units operating under Condition 2 and RMR units operating under Condition 1 that do not submit bids into the CAISO's day-ahead market, to the extent that such units are needed for local reliability purposes, they will be manually committed by CAISO operators, and only then will their RMR proxy bids will be considered in the LMPM process. In contrast, under the CAISO's current LMPM process, RMR proxy bids for such RMR units are inserted into the all constraints run to determine the amount of energy required from these units.

There are three reasons why the CAISO is proposing to rely on a manual RMR commitment process. First, the use of bid-in rather than forecasted demand and the implementation of convergence bidding in the day-ahead LMPM process mean that the automated process cannot be relied upon to commit RMR resources at the level necessary to meet reliability needs and address non-competitive transmission constraints. The automated process could under- or over-commit RMR resources when bid-in demand and convergence bids clear at a different level than the CAISO's load forecast. Second, some reliability needs are not modeled in the CAISO's market optimization, so manually committing RMR resources is often necessary, even in today's LMPM process. Third, due to the significant reduction in RMR units over the past several years, the CAISO has concluded that there are no practical obstacles to using a manual process to commit RMR units. Indeed, as of 2011, only one unit is operating under an RMR contract.

III. Benefits of New LMPM Process

Q. What are the main benefits associated with the revisions to the CAISO's LMPM process that you discussed above?

A. There are four main benefits to the modifications to the CAISO's LMPM process that I discussed above:

1) The revised process complies with FERC's directive that the day-ahead market power mitigation process be based on bid-in demand.

2) The decomposition method appropriately accounts for the impact of convergence bidding.

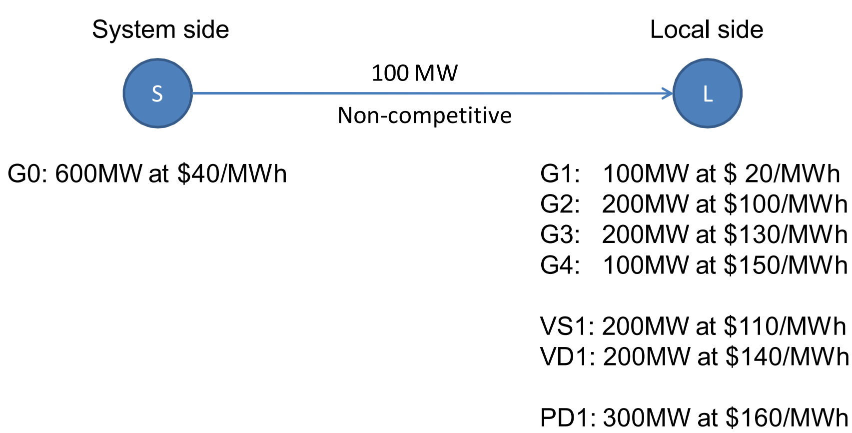
3) The decomposition method is more targeted. When combined with the new dynamic CPA enhancement, the decomposition method will produce more accurate local market power mitigation results.

4) Because it requires only one market optimization run, the revised LMPM process will be more efficient, thereby providing more time for the market runs and associated processes. More importantly, the time savings

enables competitive and non-competitive paths to be assessed dynamically.

Q. Please illustrate how the decomposition method will better account for the implementation of convergence bidding.

A. As explained in the testimony of Dr. McDonald, including convergence bids in the current LMPM process may result in the dispatch of unmitigated bids to meet supply needs in non-competitive areas. This problem will be resolved by the decomposition method, which will consider virtual bids in the LMPM process without actually mitigating them. This can best be illustrated by an example:



In this example "S" represents the system side of a constraint, which has sufficient competition, and "L" is a local constrained area (load pocket), which may be vulnerable to the exercise of local market power. L is connected to S by a 100 MW capacity flowgate "S-L". The "S" side has 30,000 MW total cleared demand at $40/MWh. In addition, 600 MW of supply at $40/MWh from G0 is still available. Because of the “S-L” constraint, only 100 MW can reach the “L” side. The “L” side has 300 MW of physical bid-in demand (PD1) at $160/MWh and 200 MW of virtual demand (VD1) at $140/MWh. On the “L” side, there are four generators G1, G2, G3 and G4 and virtual supply VS1. For simplicity, ignore loss in the example.

The table below lists the outcome under the current LMPM process. If both physical and virtual supply and demand are considered in both the competitive constraints and all constraints run, G3 and G4 are able to bypass market mitigation because virtual supply VS1 undercuts (”crowds out”) G3 and G4.

Supply	**CC run**	**AC run**	**CC LMP**	**AC LMP**	**DEB**	**LMPM**	**Mitigated Bid**
G0	400 MW	100 MW	$40	$40	$30	N	$40
G1	100 MW	100 MW	$40	$110	$10	N	$20
G2	0 MW	200 MW	$40	$110	$30	Y	$40
G3	0 MW	0 MW	$40	$110	$60	N	$130
G4	0 MW	0 MW	$40	$110	$70	N	$150
VS1	0 MW	100 MW	$40	$110	N/A	N	$110

The next table illustrates the outcome under the revised LMPM process, using the decomposition method:

Supply	Schedule	LMP	EC	CC	LC	NC	Unmitigated Bid	DEB	LMPM	Mitigated Bid
G0	100 MW	$40	$40	$0	$0	$0	$40	$30	N	$40
G1	100 MW	$110	$40	$0	$0	$70	$20	$10	Y	$20
G2	200 MW	$110	$40	$0	$0	$70	$100	$30	Y	$40
G3	0 MW	$110	$40	$0	$0	$70	$130	$60	Y	$60
G4	0 MW	$110	$40	$0	$0	$70	$150	$70	Y	$70
VS1	100 MW	$110	$40	$0	$0	$70	$110	N/A	N	$110

EC: LMP energy component CC: LMP competitive congestion component
LC: LMP loss component NC: LMP non-competitive congestion component

As shown, G1, G2, G3 and G4 in the local constrained area are all subject to mitigation due to the fact that the non-competitive component of their LMP (NC) is greater than zero, and none of these units are able to escape mitigation due to the inclusion of VS1 in the LMPM process.

Q. Please explain why you believe the decomposition method will be more accurate than the current mitigation method.

A. As I mentioned above, as part of the process that led up to the filing of the current tariff amendment, I conducted an analysis, using two months of actual data in the CAISO's day ahead market, comparing the mitigation results under the CAISO's current LMPM process and the results from the revised process that I have discussed herein. As reported therein, there are two significant improvements in mitigation accuracy realized under the decomposition method. First, the decomposition method will eliminate the issue of mitigating resources that are not due to congestion on non-competitive constraints, which has been observed with the CAISO's current approach.

In addition, the decomposition method is better able to capture resources that engage in economic withholding. This is the case because, under the CAISO's current process, a resource that bids relatively high may not be committed in the all constraints run, and therefore, not subject to mitigation. The decomposition method, however, will consider all bids regardless of their dispatch levels, and mitigate them if they have a positive non-competitive congestion component. In my analysis, I found that the new method identified an average of approximately seven units that appeared to be economically withholding a portion of their capacity, while the current method only identified an average of 1.6 units (which were also captured under the new method).

Q. Why has the CAISO elected to use the decomposition method instead of mitigating for each individual transmission constraint?

A. The CAISO believes that the decomposition method is preferable to an approach that mitigates resources based on each individual transmission constraint because the decomposition method captures overall market signals of competitiveness or non-competitiveness. For example, consider a generation pocket inside a load pocket constrained by a transmission line deemed non-competitive. As long as the resources in the generation pocket do not have a positive LMP non-competitive component, they will not be mitigated under the decomposition method even they have negative shift factors to the load pocket constraint. This is because the overall effect of the non-competitive constraints is to lower their LMPs below the reference bus LMP, which is deemed to be free of local market power.

However, the resources in such a generation pocket would be mitigated under an individual constraint analysis approach, which is not appropriate. The decomposition method is therefore preferable because it avoids over-mitigation under these types of conditions.

Q. Did the CAISO consider including a tolerance threshold for the non-competitive congestion component below which a resource would not be subject to mitigation?

A. The CAISO considered implementing such a threshold, but decided against doing so at present without sufficient empirical data to make an informed judgment as to whether such a threshold would improve mitigation accuracy, and if so, what level the threshold should be set at. The CAISO plans to re-visit this issue after evaluating actual market data under the revised LMPM process, including the implementation of a dynamic CPA. Specifically, the CAISO believes that it could provide such an analysis within eight months of implementation. For the day-ahead market, this means that the CAISO will be able to prepare this analysis by December of 2012. With respect to the real-time market, however, because the CAISO does not plan to implement dynamic CPA for the real-time market until the fall of 2012, and the CAISO believes that it is important to have data from a summer period, it will not be able to complete the real-time mitigation threshold analysis until October 2013.

Q. Thank you. I have no further questions.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	))	Docket No. ER12-____-000

DECLARATION OF WITNESS

I, Lin Xu, declare under penalty of perjury that the statements contained in the Direct Testimony of Lin Xu on behalf of the California Independent System Operator Corporation in this proceeding are true and correct to the best of my knowledge, information, and belief.

Executed on this 15th day of November, 2011.

Lin Xu

Attachment D–Direct Testimony of Khaled Abdul-Rahman

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	**)** **)**	**Docket No. ER12-____-000**

DIRECT TESTIMONY OF
KHALED ABDUL-RAHMAN
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR CORPORATION

Q. Please state your name, title, and business address.

A. My name is Khaled Abdul-Rahman.I am employed as Director, Power Systems Technology Development for the California Independent System Operator Corporation (CAISO). My business address is 250 Outcropping Way, Folsom, CA 95630.

Q. Please describe your educational and professional background.

A. I received my Ph.D. in Power Systems in 1993 from the Illinois Institute of Technology (IIT) in Chicago, Illinois. Since then, I have worked in the electric power system industry in the U.S. focusing primarily on large-scale optimization software development and deployment of production systems. My career includes working for different energy management system, electricity market, and information technology software vendors, and various consulting companies.In July 2009, I began work for the CAISO as the Principal for Power Systems Technology Architecture and

Development, and in July 2010 I became the Director of the Power Systems Technology Development group at the CAISO.

Q. What are your duties and responsibilities at the CAISO?

A. My current responsibilities include design, implementation, testing, deployment, and analyzing results of all market applications for the CAISO's day-ahead and real-time markets. I have worked on many projects requiring deep optimization knowledge and full understanding of market design rules.

Q. Please briefly describe your role in the enhancement of the market power mitigation provisions of the CAISO tariff.

A. My primary role in this process has been to developa feasible method for implementing, within the CAISO's current market timelines,improvements to the CAISO's market power mitigation functionality. Specifically, I have worked closely with the CAISO's software vendor developing business requirements to integrate theuseof bid-in demand instead of forecast demand in the day-ahead mitigation process, add a dynamic competitive path assessment process, and include in the market power mitigation function all applicable new market enhancements that have been introduced over several years since the go-live date of the CAISO's locational marginal pricing (LMP) markets in April 2009.

Q. As you testify, will you be using any specialized terms?

A. Yes. Unless otherwise indicated, any capitalized terms I use have the meanings set forth in the Master Definitions Supplement, Appendix A of theCAISO tariff.

Q. What is the purpose of your testimony?

A. In my testimony,I will discuss why it is necessary and appropriate for the CAISO to implement improvements to the local market power mitigation (LMPM) processin two stages. In the first stage, which will take place in April 2012, the CAISO will implement an improved LMPM process in the day-aheadand the hour-ahead scheduling process (HASP). The ISO will also institute a dynamic competitive path assessment for the day-ahead LMPM process only, while temporarily retaining the current “static” competitive path assessment in the LMPM process in the HASP. Bids mitigated in the LMPM process that is run in the HASP will be used in both the HASP and the real-time market as today. In the second stage, which is targeted for the fourth quarter of 2012, the CAISO will implement four additional mitigation runs—one run in each 15-minute real-time unit commitment process--and also institute a dynamic competitive path assessment in both the HASP LMPM run and the other 15-minute LMPM runs as part of thereal-time unit commitment process. As I will explain, the CAISO must employ this two-stage approach due to the complexity involved in implementing the software changes necessary for the stage two components.

Q. Please briefly summarize the CAISO's current local market power mitigation process.

A. The CAISO currently performs the LMPM in conjunction with both its day-aheadintegrated forward market and HASP. The day-ahead LMPM process mitigates bids for use in the integrated forward market. The LMPM process performed as part of the HASP mitigates bids that are then used in both the HASP and real-time market. It does this by creating a single mitigated bid curve for each mitigated resource for all four 15-minutereal-time unit commitment intervals during the applicable hour. The current LMPM processdetermines mitigation based on a comparison of each resource's dispatch level in two consecutive runs of the market application: one that takes into account only competitive transmission constraints and one that includes all transmission constraints.Resources with higher dispatch levels in the all constraints (AC) run compared to their corresponding dispatch levels in the competitive constraints (CC) run are subject to mitigation.

Q. How does the CAISO determine which transmission constraints are competitive?

A. The CAISO makes this determination in a process known as the competitive path assessment.Currently, the CAISO's Department of Market Monitoring performs each competitive path assessment for use in the day-ahead market and the HASP on a quarterly basis through an off-line study using seasonal data and considering a range of system conditions, although the CAISO could conduct more frequent competitive path assessments ifneeded. This performance on a quarterly basis is called a static or non-dynamic competitive path assessment.

Q. What changes to the local market power mitigation process does the CAISO propose in the tariff amendment?

A. The CAISO plans two major improvements to its local market power mitigation process. First, the CAISO plans to adopt a more streamlined and accurate methodology for analyzing and mitigating bids that relies on a "decomposition" of each resource's location-specific locational marginal price. A detailed discussion of this revised methodology, known as the locational marginal price decomposition method (decomposition method), is set forth in the testimony of Dr. Xu.

In addition, the CAISO proposes to transition to much more frequent (*i.e.*, dynamic) competitive path assessments that are performed in the CAISO's market software, rather than being pre-defined based on offline seasonal studies like the static competitive path assessments the CAISO currently performs. A more detailed discussion of the features of the dynamic competitive path assessment iscontained in the testimony of Dr. McDonald.

Q. How and when does the CAISO propose to implement these improvements?

A. The CAISO proposes to implement these improvementsin two stages. In the first stage, the CAISO will implement the decomposition method in the LMPM performed in conjunction with the day-ahead market and HASP. The CAISO will also implement a dynamic competitive path assessment as part of the day-ahead LMPM process only. Pursuant to this dynamic competitive path assessment, the market software will determine whether transmission constraints are competitive or non-competitive as part of each LMPM run associated with the day-ahead integrated forward market. For the LMPM process performed in conjunction with the HASP, the CAISO will continue to utilize the current static competitive path designation. The tariff revisions regarding the stage one improvementswill go into effect in April 2012.

Several months after stage one,the CAISO plans to file a second tariff amendment, targeted to become effective in the fourth quarter of 2012, to implement further improvements to its LMPM process. These future improvements will be twofold. First, the CAISO will execute the LMPM process prior to each of the four 15-minute real-time unit commitment runs that are executed for each trading hour. This may result in four separate mitigated bid curves which will be used to mitigate bids in the real-time market.Second, the CAISO will incorporate the dynamic competitive path assessment in the HASP LMPM run as well as for each 15-minute LMPM run in the real-time unit commitment process.

Q. Why does the CAISO propose to use this two-stage approach?

A. The CAISO proposes to employ this two-stage approach in order to accommodate development of the new market power mitigation functionality and to minimize implementation risks involved in applying the dynamic competitive path assessment in conjunction with the implementation of LMPM in each of the 15-minute real-time unit commitment runs that I described above.Due to the number and complexity of changes needed to the CAISO's software in order to implement the real-time LMPM process and to integrate the dynamic competitive path assessment into that process, the CAISO and its market software vendor concluded that it would be impossible to implement the 15-minute mitigation run and dynamic competitive path assessment for the real-time market within the April 2012 time frame.

Q. Please explain further the reasons for employing the two-stage approach.

A. The first stage of the CAISO's approach involves the implementation of the new LMPM methodology in the day-ahead as well as the HASP (for use in the HASP and real-time market)along with implementation of the dynamic competitive path assessment in the LMPM for the day-ahead market. The day-ahead market uses hourly bids in the mitigation process and the dynamic competitive path assessment will be included within the existing hourly time-frame.The added complexity of integrating thedynamic competitive path assessment as part of this process creates a software performance riskwith respect to the ability of the software to meet the market timeline. However, because thisfirst stage only affects the day-ahead market, which has a three-hour timeline to publish results, the performance risk is relatively low compared to the timelines for implementation in the real-time. Therefore, although the CAISO will need several months to perform software upgrades and test those upgrades in order to integrate the dynamic competitive path assessment into the day-ahead market, the CAISO will be able to implement this functionality by April 2012, the month in which it is required by FERC to modify its day-ahead mitigation process to use bid-in rather than forecast demand.

In contrast, the market timelines for hour-ahead and real-time transactions are substantiallyshorter than the day-ahead market timeline, so mitigation of these transactions must be performed on a much tighter schedule. As I explained above, stage two, which is targeted for implementation in the fourth quarter of 2012, involves adding the LMPM process toevery 15-minutereal-time unit commitment process,thereby creating four mitigated bid curves, one for each 15-minute interval for each trading hour. These four mitigated bid curves will be used in the CAISO's real-time imbalance market (which normally issues five-minute dispatches), while a single mitigated bid curve will continue to be utilized in the HASP. In addition to the creation of the four separate mitigated bid curves, the CAISO will also be implementing the dynamic competitive path assessment in the HASPand the real-time market in the fourth quarter of 2012. These changes require the CAISO's market software to accomplish more within far less time as compared to the day-ahead time-frame. These tighter timeframes and increased computational demandsmean that more numerous and complex software changes, as compared with the software changesfor theday-ahead market,will be needed in order to change the real-time software infrastructure from processing mitigated bids that are fixed throughout the hour to a new infrastructure that will also process mitigated bids on a 15-minute basis and integrate into this process the dynamic competitive path assessment.

Running the new LMPM process four times and creating four separate mitigated bid curves will also significantly increase the volume of data transferredfrom the real-time market system to the market quality system, which is the system responsible for preparing and sending market data to the CAISO's settlement system. Furthermore, having four mitigated bid curves will require theintroductionof major database structure redesign changes to accommodate the 15-minuteprocessing I have described, in place of the current design structure of the hourly based database. Implementing 15-minute LMPM also requires changes to the CAISO settlement system in order to incorporate the four mitigated bid curves. These changes are not necessary in stage one because the CAISO will continue to perform mitigation in the same current timeframes until stage two.

Q. Are there other challenges associated with implementing the CAISO's stage two market power mitigation improvements?

A. Yes. Implementing the dynamic path assessment in real-time instead of the current static method, regardless of whether the dynamic path assessment is executed on an hourly or a 15-minute mitigation basis, introduces other challenges to real-time operation due to the current design of the process associated with the issuance of real-time manual exceptional dispatch instructions to resources needed to address transmission reliability concerns. The current process calls for each CAISO operator to enter a special code or type of manual exceptional dispatch instruction into the CAISO's systems as part of the manual exceptional dispatch instruction which is then usedfor settlement purposes.The tool theoperator uses to enter such instruction types requires the operator's upfront knowledge of the transmission path designation, i.e.competitive or non-competitive, prior to entering the manual exceptional dispatch instruction, in order to mitigate reliability concernsregardingthe transmission path and ensure correct settlement and cost allocation. The current tools used by the operators were built based on the assumption of static path designations and therefore it is possible for anoperator to know the path designation before entering the instruction. However, in order to implement dynamic path assessment in real-time, these tools will need to be redesigned and the operators will need to undergo training after the redesign occurs. The CAISO expects it will take a couple of monthsfor all of the operators to complete this training.

Q. **How much time does the CAISO anticipate will be needed to address the complexities you describe?**

A. The CAISO anticipates that it will require approximately six months after implementation of the stage one improvementsto deploy the further improvements planned for stage two. Because stage one will be implemented in the second quarter of 2012, the CAISO anticipates that stage two will be ready to go into effect in the fourth quarter of 2012. Of course, the CAISO will have to file a further tariff amendment to implement stage two.

Q. Is it possible to implement the dynamic competitive path assessment as part of the HASP mitigation run before the CAISO expands its real-time mitigation to include a mitigation run as part of the 15-minute real-time unit commitment process?

A. As stated above, implementing the dynamic path assessment in real-time instead of the current static method, regardless of whether the dynamic path assessment is executed on an hourly or a 15-minute mitigation basis, introduces challenges to real-time operation relating to the issuance of real-time manual exceptional dispatch instructions. Apart from the impact of implementing the dynamic path assessmentin the HASP on the current manual exceptional dispatch process, thesoftware change to include dynamic path assessment in HASP can technically be accomplished after the first stage butbefore the proposed second stage, which would include integrating the dynamic competitive path assessment into the mitigation process that will be run as part of the 15-minute real-time unit commitment process. The HASP produces hourly mitigated bids that do not require major real-time infrastructure changes compared to the required changes to accommodate the 15-minute mitigated bids. However, the information available in the HASP for predicting congestion in the real-time dispatch and for predicting system and resource conditions is less accurate than the information available in the 15-minutereal-time unit commitment run. As explained in Dr. McDonald's testimony, this has implications for the accuracy of the mitigation applied in the HASP as compared with the mitigation applied in the four15-minutereal-time unit commitment processes. In particular, the fact that the dynamic competitive path assessment process assumes that paths are competitive unless found to be otherwise means that there is a substantial risk of under-mitigation if real-time transactions are only mitigated based on the single mitigated bid curve produced in the HASP.Dr. McDonald addresses this concern in greater detail in his testimony.

Q. Thank you. I have no further questions.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	))	Docket No. ER12-____-000

DECLARATION OF WITNESS

I, Khaled Abdul-Rahman, declare under penalty of perjury that the statements contained in the Direct Testimony of Khaled Abdul-Rahman on behalf of the California Independent System Operator Corporation in this proceeding are true and correct to the best of my knowledge, information, and belief.

Executed on this 15th day of November, 2011.

K.H. AbdulRahman

Khaled Abdul-Rahman

Attachment E–Direct Testimony of Jeffrey D. McDonald

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	**)** **)**	**Docket No. ER12-____-000**

DIRECT TESTIMONY OF
JEFFREY D. MCDONALD
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM
OPERATOR CORPORATION

Q. Please state your name, title, and business address.

A. My name is Jeffrey D. McDonald. I am employed as Manager, Market Analysis and Mitigation for the Department of Market Monitoring (DMM) of the California Independent System Operator Corporation (CAISO). My business address is 250 Outcropping Way, Folsom, CA 95630.

Q. Please describe your educational and professional background.

A. I have three degrees in applied economics: a Bachelor of Science from the University of California, Davis (1990), a Master of Science from the University of Massachusetts, Amherst (1992), and a Doctorate of Philosophy from the University of California, Davis (2002).

I began working at the CAISO in June, 2000, as a market analyst in the DMM. From December 2005 through January 2010, I was the Manager of Market Monitoring and Reporting in DMM. I have been Manager of

Market Analysis and Mitigation in DMM since February 2010. During this time I served several functions ranging from monitoring and reporting on market outcomes, designing and performing analysis of specific market issues, investigating market participant behavior, and contributing to market design enhancement efforts.

Q. What are your duties and responsibilities at the CAISO?

A. I manage a team of five market analysts in the Market Analysis and Mitigation group within DMM. My primary functions in this role are to monitor for and investigate instances of potential market manipulation and to contribute to the CAISO's broader market design initiatives.

Q. Please briefly describe your role in the enhancement of the market power mitigation provisions of the CAISO tariff.

A. As Manager of Market Analysis and Mitigation, issues relating to market power and related mitigation measures fall within my group. Two relevant activities I perform are monitoring for the exercise of local market power and analyzing the competitiveness of specific transmission constraints four times each year. As the CAISO began its initiative to incorporate bid-in demand into the market power mitigation process pursuant to the Commission's September 2006 order, I became involved in that process to help address potential inefficiencies and market manipulation opportunities that may arise from making this change. I have been involved in both internal efforts and public meetings to determine appropriate changes to the market power mitigation process. There are two key elements to this process: determining if specific transmission paths create the opportunity to exercise local market power when they are congested, and assessing appropriate resource-level mitigation when this occurs. I have been involved in the design of both elements, but have focused more on the former rather than the latter. In this role I have combined historical observation from the work my group has performed using the existing market power mitigation methodology with additional empirical analysis to evaluate how best to improve the accuracy of identifying where local market power can be exercised . In this process I have reviewed and discussed elements of the proposed methodology assessing transmission path competitiveness with staff internal to the CAISO and with members of the CAISO's Market Surveillance Committee, and have worked with stakeholders.

Q. As you testify, will you be using any specialized terms?

A. Yes. Unless otherwise indicated, any capitalized terms I use have the meanings set forth in the Master Definitions Supplement, Appendix A of the CAISO tariff.

Q. What is the purpose of your testimony?

A. I will address three topics in my testimony. First, in order to provide helpful background information for my later testimony, I will provide a brief overview of the revisions to the CAISO's current local market power mitigation (LMPM) process that the CAISO proposes in this tariff amendment, and the future tariff revisions that the CAISO plans to make regarding the LMPM process. As I explain, the CAISO is proposing to implement the revisions to its LMPM process in two stages.

Second, I will discuss the reasons for the CAISO's proposal to modify the existing local market power mitigation provisions in its tariff. As I will explain, there are four primary reasons for modifying the tariff provisions: (1) to comply with FERC's order directing the CAISO to perform mitigation based on bid-in demand rather than forecast demand; (2) to reflect the implementation of virtual bidding and new demand response resources in the CAISO markets; (3) to improve the accuracy of identifying resources for which mitigation should apply; and (4) to improve the accuracy of identifying where local market power may exist through a more "dynamic" assessment of competitive path designations into the LMPM process as compared to the current relatively static assessment of competitive paths.

Third, I will discuss how the CAISO's proposal to modify its methodology for mitigating market power in all CAISO markets, in combination with the use of a new dynamic competitive path assessment in the day-ahead market beginning in April 2012 while continuing the existing “static” competitive path assessment for the hour-ahead scheduling process (HASP) and the real-time market until the fourth quarter of 2012, will result in a mitigation of bids that is significantly more accurate than the current LMPM process employed by the CAISO.

I. Overview of the CAISO’s Two-Stage Approach to LMPM Revisions

Q. Please briefly describe the CAISO’s current approach to market power mitigation.

A. There are two distinct processes that comprise the broader LMPM process: determining which transmission constraints (sometimes also called paths) do not have a competitive supply of counter-flow, and identifying which resources the market will dispatch to supply counter-flow to relieve congestion on uncompetitive transmission constraints.

Q. Please describe the first of these two LMPM processes.

A. The process of determining which transmission constraints do not have a competitive supply of counter-flow is referred to as the competitive path assessment. This determination is made four times a year through an analysis of the sufficiency of supply of counter-flow for internal transmission constraints that have been congested (or have been managed for congestion) in over 500 hours in the most recent 12 months. The study is performed by staff in my group and assesses path competitiveness by simulating the sufficiency of supply for counter-flow to congested constraints when capacity from the three largest potentially pivotal suppliers is withheld from the market.

The test for supply sufficiency, and thus competitiveness, is done for each candidate transmission constraint. If the market simulation used for this study is able to arrive at a solution without the withheld capacity while respecting the limits of the tested transmission constraint, then the test for that constraint under those test conditions is passed. If the market simulation must violate the tested transmission constraint to solve, or cannot reach a solution, then the test for that constraint under those test conditions is failed. This test is run for various load and hydro conditions based on historical observation. If a tested constraint fails the supply sufficiency test under any of the test conditions, then that constraint is deemed uncompetitive. Transmission constraints that do not exceed the threshold of 500 hours of congestion in the most recent 12 months are not tested and are deemed uncompetitive by default. These determinations are made four times a year and are static in the sense that they apply until a subsequent study is performed.

The current approach for assessing path competitiveness is performed outside of the execution of the CAISO's market process and the results are used in the market execution process to facilitate identifying and mitigating for local market power.

Q. Please describe how the CAISO uses the assessment of competitive transmission paths in its local market power mitigation process.

A. Under the CAISO's current market mitigation process, the CAISO performs two pre-market runs prior to both the day-ahead market and HASP. The first run, known as the competitive constraints run, clears the market with only competitive constraints enforced in the full network model. The resulting dispatch level reflects a competitive market outcome absent any impacts from the exercise of local market power. By not enforcing the uncompetitive transmission constraint limits, this set of constraints is not able to bind and create a circumstance where local market power exists.

The second run, known as the all constraints run, applies all transmission constraints in the full network mode. The dispatch level from the all constraints run is compared with the dispatch level from the competitive constraints run. Generating resources that were dispatched upward in the all constraints run relative to their competitive constraints run dispatch level are presumed to be dispatched upward to manage congestion on an uncompetitive constraint and as such are deemed to have local market power. Bid mitigation is applied to the set of resources that have an all constraints run dispatch level greater than their competitive constraints run dispatch level.

This process is applied in the day-ahead market for use in the integrated forward market (IFM), and in the HASP for use in both the HASP and the real-time market.

Q. Please briefly describe the approach the CAISO proposes in this proceeding to improve local market power mitigation under its tariff.

A. The CAISO proposes to implement revisions to its market power mitigation process in two stages, which I will refer to throughout my testimony as Stage 1 and Stage 2.

Q. Please describe Stage 1.

A. Stage 1 will be implemented pursuant to the tariff revisions contained in this tariff amendment and will be effective for the April 11, 2012 trading day. In Stage 1, the CAISO proposes two main modifications to its local market power mitigation process. First, the CAISO's procedures for identifying and mitigating resources with the potential to exercise market power will be streamlined from the current two runs (competitive constraints run and all constraints run) that rely on a change in dispatch levels to trigger mitigation down to a single pre-market run that optimizes resources using all submitted bids for supply and demand, enforces all transmission constraints that are expected to be enforced in the relevant market, and uses the impact of binding uncompetitive constraints on the price at the locations of individual generating resources as a trigger for bid mitigation. The trigger for bid mitigation under this process will be based on a "decomposition" of the congestion component of each locational marginal price determined in the single pre-market run process into competitive and non-competitive components. A resource at a location with a non-competitive congestion component of the locational marginal price will be subject to mitigation. A floor will be applied to bid price mitigation. The mitigated bid price floor will be the greater of the resource's default energy bid or the calculated competitive price for that interval.

In Stage 1, the CAISO will employ this locational marginal price decomposition method in the market power mitigation runs performed for the day-ahead market and the HASP (which determines which bids are mitigated in both the HASP and the real-time market). My colleague Dr. Lin Xu provides testimony in this proceeding that gives a further description of how the market power mitigation process will operate using the decomposition method.

In addition, Stage 1 will include modifications to the tariff provisions regarding the competitive path assessment, which is used to determine which transmission constraints are competitive and which are uncompetitive for purposes of the market power mitigation process. Specifically, the CAISO will begin a transition to much more frequent (*i.e.*, dynamic) competitive path assessments that are performed by the CAISO's market software using the same time frames as the relevant market runs, rather than being pre-defined based on historical seasonal studies. In Stage 1, the CAISO will implement a dynamic competitive path assessment for the market power mitigation process associated with the day-ahead market only. Pursuant to this dynamic competitive path assessment, the market software will determine whether transmission constraints are competitive or non-competitive as part of each local market power mitigation run associated with the day-ahead market, and each binding transmission constraint in the market power run will be assessed for competitiveness (rather than the current approach where untested constraints are deemed non-competitive by default). The CAISO will retain the currently effective (*i.e.*, static) competitive path assessment procedures to determine which paths are competitive or non-competitive for the market power mitigation process executed in the HASP.

Q. **Please describe Stage 2.**

A. Stage 2 will be implemented pursuant to a future CAISO tariff amendment, which the ISO plans to file in order to become effective in the fourth quarter of 2012. In Stage 2, the CAISO will broaden the scope of the modifications made as part of Stage 1. First, the CAISO will adopt a more granular real-time mitigation assessment. Currently, the mitigation process run as part of the HASP creates a single mitigated bid curve for each mitigated resource, which is then used in the HASP as well as in all of the real-time processes during the applicable hour. In Stage 2, the CAISO proposes to implement an additional mitigation assessment as part of each 15-minute real-time unit commitment process using the decomposition method I described above. This means that for resources bidding into the real-time market, the CAISO will create a separate mitigated bid curve for those resources for each 15-minute interval which will be used to mitigate bids in each real-time market application. Also, in Stage 2, the CAISO will implement a dynamic competitive path assessment for the HASP and the real-time unit commitment process, meaning that the competitiveness or non-competitiveness of transmission paths will be re-assessed in conjunction with each mitigation run in both the HASP and each of the four hourly real-time unit commitment runs.

Q. Why does the CAISO propose to make the tariff revisions in these two stages?

A. I will explain in detail below the reasons behind this staged implementation.

II. <u>Reasons for the CAISO's Revisions to Its Local Market Power Mitigation Process</u>

Q. Why does the CAISO propose to modify its existing local market power mitigation process in this proceeding?

A. The CAISO proposes the modifications contained in its tariff amendment in this proceeding for four reasons. I will discuss each of those reasons in turn.

Q. What is the first reason for the modifications to the CAISO's existing local market power mitigation process?

A. The first reason is that, in September 2006, the Commission directed the CAISO to use bid-in demand rather than forecast demand in its local market power mitigation process for the day-ahead market within three years of the CAISO's new market start-up. The CAISO initiated a stakeholder process to develop the policy changes needed to satisfy the Commission's directive. The CAISO's tariff amendment satisfies this requirement because the revised LMPM process uses bid-in demand.

Q. What is the second reason for the modifications to the CAISO's existing market power mitigation?

A. The second reason is that the CAISO's Department of Market Monitoring determined that, with the implementation of virtual bidding (also referred to as convergence bidding) in the CAISO markets in February 2011 and proxy demand resources (a new type of demand response resource) in the CAISO's markets in August 2010, modifications to the LMPM process were needed to prevent virtual bids and bids from proxy demand resources as well as other demand response resources from undermining the effectiveness of market power mitigation. In this regard, the Department of Market Monitoring identified two related concerns.

Q. What were those two concerns?

A. The first concern was that including virtual demand bids in the existing LMPM process increases the likelihood that supply bids not subject to mitigation could determine the locational marginal prices. This can occur if the amount of demand that clears in the market run is greater than the forecast demand which is cleared in the mitigation run. This can happen as a result of the addition of virtual demand bids in the market run. In this case, the market may dispatch additional supply bids under uncompetitive conditions that were not detected or mitigated for in the market power run. Under the current local market power mitigation approach, the amount of generation subject to mitigation is only that amount which is sufficient to meet projected physical demand. If additional demand clears due to the addition of virtual demand in the integrated forward market, without any modification to the current local market power mitigation approach, unmitigated supply bids may be cleared to meet demand in situations where generation is needed in areas subject to non-competitive transmission constraints.

The concern about local market power mitigation being undermined by virtual demand bids could be addressed by including all demand and supply (virtual and physical) in the LMPM process. However, making that change creates a second concern: with the inclusion of virtual supply bids in the LMPM run, it would be possible for a physical supply resource with a relatively low default energy bid to evade market power mitigation by being bid at a price above that of virtual supply bids in the same local area. Virtual bids do not have a reference price, or a default energy bid. For this reason, they are not mitigated. Under this scenario, the virtual supply bids could ultimately “crowd out” the physical supply, thus allowing unmitigated physical supply bids to enter the integrated forward market which would have otherwise been used to satisfy generation needs in a non-competitively transmission constrained area and which would have been mitigated during the run.

The same concern about crowding out physical supply bids also arises from the implementation of proxy demand resources and other demand response resources such as reliability demand response resources in the CAISO’s markets, because the CAISO has no means to develop a default energy bid for demand response resources.

I explain below how the CAISO's proposed revisions to its LMPM methodology resolve these concerns.

Q. What is the third reason for the modifications to the CAISO's existing market power mitigation?

A. The third reason is that the CAISO determined that a new approach, such as the decomposition method, could reduce the overall mitigation process execution time while improving the accuracy of the mitigation.

Q. What is the fourth and final reason for the modifications to the CAISO's existing local market power mitigation?

A. The fourth reason is related to the third reason I have just described. The CAISO determined that reducing the overall mitigation process execution time would allow the CAISO to implement a dynamic competitive path assessment within the market application, in place of the current static competitive path assessment. Later on in my testimony I discuss the benefits of using a dynamic competitive path assessment.

III. <u>The CAISO's Proposed Stage 1 Revisions Will Significantly Improve the Local Market Power Mitigation Process</u>

Q. How will the CAISO's proposed Stage 1 revisions to its LMPM process improve that process?

A. The revisions to the LMPM process that the CAISO proposes to adopt as part of its Stage 1 implementation will improve that process in three main ways. First, the CAISO's proposed revisions will remove the opportunity for virtual bids and demand response bids to undermine the market power mitigation process. Second, the proposed revisions will improve the efficiency of the execution of the CAISO's market power mitigation process thus allowing for the integration of a dynamic competitive path assessment. And third, the CAISO's proposed revisions will substantially improve the accuracy of the mitigation process, eliminating instances of over-mitigation. I have quantified these improvements through a study, the results of which I will discuss below.

A. <u>Concerns Regarding Virtual Bids and Bids from Demand Response Resources</u>

Q. How will the CAISO's proposed LMPM revisions address the concerns you discussed above with respect to virtual bids and demand response bids?

A. The CAISO proposes to modify its tariff to state that virtual bids and bids from demand response resources are considered in the LMPM, but are not subject to bid mitigation. Moreover, the CAISO's proposed decomposition method will utilize a single processing run that determines mitigation based on the impact of congestion on uncompetitive constraints on the locational marginal price of each resource. The proposed mitigation trigger depends explicitly on the impact of local market power on the locational marginal price of each resource and not on a comparison of dispatch levels between the competitive constraints run and the all constraints run. As such, the opportunity for virtual bids or demand response bids to "crowd out" physical generation bids and circumvent local market power mitigation is eliminated.

Virtual bids and demand response bids are, however, accounted for in both the determination of transmission path competitiveness and the impact of congested uncompetitive constraints on the locational marginal price at each generation resource's location. The dynamic competitive path assessment explicitly accounts for cleared virtual bids and demand response bids in determining whether there is a competitive supply of counter-flow on binding transmission constraints. Further, the proposed mitigation trigger under the decomposition method relies on the prices generated by the local market power mitigation market run which considers virtual bids and demand response bids.

A numerical example of how the CAISO's revised market power mitigation methodology will address the concerns regarding virtual and demand bids is set forth in Dr. Xu's testimony.

B. Improvements in Efficiency

Q. Please explain how the CAISO's revised local market power mitigation process under Stage 1 will improve efficiency and allow for the implementation of a dynamic competitive path assessment.

A. Streamlining the market power mitigation process in Stage 1 from two runs down to a single run will reduce the amount of CAISO system resources and processing time required to perform market power mitigation. The reduction in the overall execution time for the LMPM process will permit the CAISO to include the dynamic competitive path assessment within the market application, in place of the existing, pre-defined competitive path assessments based on seasonal studies. Issues relating to software development, implementation, and efficiencies are discussed in more detail in Dr. Abdul-Rahman's testimony.

Q. Why is this significant?

A. The current approach of performing the competitive path assessment on a quarterly basis and then using the results in the market execution requires the CAISO to employ a number of assumptions regarding resource and system conditions. Moving the competitive path assessment into the market software to capture the most up-to-date information about resource and system conditions will improve the quality of the information used in making the assessments, will reduce the number of assumptions that must be made, and will enhance the accuracy of the resulting competitive path assessments and thereby the overall accuracy of mitigation decisions. Further, the dynamic competitive path assessment will be continually updated.

C. <u>Improvements in Mitigation Accuracy</u>

Q. How have you determined that the CAISO's proposed Stage 1 revisions to its LMPM process will improve the accuracy of that process?

A. As part of the process of preparing this amendment, I conducted an analysis using data for the three-month period from July through September of 2011, in which I evaluated and compared the current and proposed Stage 1 mitigation approaches for the day-ahead market to separately estimate (i) the impact on mitigation of implementing the decomposition method (without also implementing the dynamic competitive path assessment for the day-ahead market), as well as (ii) the impact on mitigation of implementing the decomposition method in tandem with the dynamic competitive path assessment for the day-ahead market. My analysis indicates that the use of the decomposition method, both independently and in tandem with the use of the dynamic competitive path assessment for the day-ahead market in Stage 1, will result in significantly more accurate mitigation and will likely mitigate less frequently for the day-ahead market than is currently the case. I will refer to the results of this analysis in the context of my explanations regarding the specific accuracy improvements that will be realized by implementing the proposed Stage 1 revisions to the CAISO's market power mitigation process. Details regarding this analysis are contained in Appendix A to my testimony.

Q. You mentioned that one of the benefits of the CAISO's revised LMPM process was that it will eliminate instances of over-mitigation. Please explain what you mean when you refer to over-mitigation.

A. The current LMPM process, as briefly described earlier in my testimony, identifies and mitigates for local market power through comparison of dispatch levels from market runs with and without uncompetitive transmission constraints applied in the model. The appeal of this approach is that it focuses mitigation on resources that have local market power and are anticipated to be leveraged by the market to manage the congestion that created the local market power. This approach relies heavily on an underlying assumption that any increase in dispatch in the all constraints run (compared to the dispatch from the competitive constraints run) is indicative of local market power due to the need to manage congestion on an uncompetitive constraint in the all constraints run that was not applied in the competitive constraints run.

But that underlying assumption is not always valid. I have observed mitigation of generation resources that do not appear to be associated with, or effective in managing congestion on, binding uncompetitive transmission constraints, and therefore do not appear to have local market power.[1] This type of mitigation of resources is what I refer to as "over-mitigation". Stated another way, I define a resource as appropriately mitigated based on whether or not that resource had a shift factor to a binding uncompetitive constraint that indicates the resource could be effective in supplying counter-flow to that constraint. If a unit was mitigated even though it could not effectively supply counter-flow to any binding uncompetitive constraint in the hour it was mitigated, then I consider this to be a case of over-mitigation.[2] I have observed that over-mitigation occurs both in hours where there is a binding uncompetitive constraint and hours where there is not.

Q. Have you estimated the degree of over-mitigation that could occur under the CAISO's current local market power mitigation process?

A. Yes. In the analysis that I mentioned above, I found that approximately 94 percent of the mitigation that occurred in the day-ahead market during the period that I analyzed under the current approach met my definition of over-

[1] This definition may over-state over-mitigation in cases where the market software observed congestion on an uncompetitive constraint and, as part of its iterative process, increases the dispatch of effective resources to a point where the congestion no longer exists. In this case, the incremental dispatch of effective resources was made under uncompetitive conditions; however the uncompetitive constraint is no longer binding, creating the appearance of over-mitigation.

[2] Dr. Xu also discusses the concept of over-mitigation in his testimony, although his definition of over-mitigation is somewhat different than mine. Dr. Xu's definition of over-mitigation refers to those instances in which mitigation occurs despite the fact that the relevant non-competitive transmission constraint is not binding. My definition of over-mitigation accounts for such instances, and also looks at whether a particular resource would be effective in managing congestion on binding non-competitive constraints.

mitigation. That is to say, 94 percent of the time that a unit was flagged for mitigation, that unit was not effective in providing counter-flow to relieve congestion on binding uncompetitive constraints in the mitigation run. The very high percentage of instances of over-mitigation identified in my analysis raises a concern with respect to the accuracy of the CAISO's current mitigation process. While inaccuracy is a concern, both the current and proposed bid mitigation mechanisms include a mitigation floor that limits the extent to which a resource's bid price can be mitigated. In both cases, the bid price will not be mitigated below the higher of a calculated competitive price or the resource's default energy bid. This limits the likelihood that market prices resulting from over-mitigation will not reflect at least the resource's marginal cost.

Q. How does the CAISO's revised local market power mitigation methodology as proposed in this proceeding address the issue of over-mitigation?

A. By using the impact of a binding uncompetitive transmission constraint on price at the generator location to trigger mitigation, the proposed decomposition method limits bid mitigation to only those resources whose locational marginal price is increased as a result of uncompetitive conditions created by congestion. This thereby limits bid mitigation to only those resources that have and potentially could benefit from exercising local market power created by the binding uncompetitive transmission constraint and eliminates the over-mitigation observed under the current LMPM process. Also, by eliminating these instances of over-mitigation, the decomposition method will reduce the overall frequency of mitigation compared to the current approach.

Q. Is this outcome borne out in your analysis?

A. Yes. When I analyzed the same time period using the decomposition method (along with the current static competitive path assessment) to detect and mitigate market power, I observed two effects on the frequency of mitigation. First, there was an increase in the frequency of mitigation resulting from the broader set of resources identified as having local market power with the decomposition method. Where the current approach may have only dispatched a subset of resources effective in supplying counter-flow on a binding uncompetitive constraint, the decomposition method will address such instances by mitigating all such effective resources provided their locational marginal price is positively impacted by the congestion. Second, all of the over-mitigation that occurred under the current approach was eliminated. The net effect on mitigation frequency from the decrease resulting from eliminating over-mitigation and the increase from the broader set of resources associated with and mitigated for each binding uncompetitive constraint resulted in a net reduction in the frequency of mitigation of 13 percent in the day-ahead market and over 40 percent in the real-time market. Further, the accuracy of mitigation was greatly improved as all mitigation triggered by the decomposition method was directly attributable to uncompetitive conditions detected in the mitigation run.

Q. Please explain further what you mean by under-mitigation and how the CAISO's revisions would address this concern.

A. Under the current approach, the all constraints run may only dispatch a subset of effective resources to manage congestion on an uncompetitive constraint. Because mitigation under the current approach is based on the difference in dispatch levels between the all constraints run and the competitive constraints run, if a resource is not dispatched in the all constraints run, it will not be mitigated, even if it can provide counter-flow on a non-competitive constraint. For example, there may be ten resources that are effective in providing counter-flow on an uncompetitive constraint to manage congestion. Under the current approach, if only three of these resources were dispatched in the mitigation run to meet demand, then only these three resources would be mitigated. Under the decomposition method, however, all resources that have local market power, that is to say their location-specific locational marginal price is increased as a result of local market power (binding non-competitive constraints), will be mitigated. This eliminates the possibility of under-mitigation due to selecting a subset of supply resources under uncompetitive local conditions in the market power run when a different subset may be dispatched in the actual market run.

Q. Did your analysis look at the impact of implementing the dynamic competitive path designation in the day-ahead market?

A. Yes. I estimated for the same period the change in path designations in the day-ahead market that would result from applying a dynamic competitive path assessment and compared those with the designations that resulted from the current approach. The results of this analysis indicate a shift of 13 percent of binding constraint hours from uncompetitive to competitive when applying the dynamic competitive path assessment approach in the day-ahead market, which will result in a lower frequency of mitigation compared with application of the current approach. I consider this difference to represent an improvement in accuracy, and it is likely due to two facts: (1) the dynamic competitive path assessment uses more current load, resource, and transmission information in its assessment compared to the static competitive path assessment; and (2) the dynamic competitive path assessment assesses all binding constraints, as opposed to the static competitive path assessment which uses a default non-competitive designation for less frequently binding constraints.

Q. What did your analysis demonstrate with respect to the impact of combining the decomposition method with the dynamic competitive path assessment in the day-ahead market mitigation process?

A. My results indicate that for the July – September 2011 study period, implementing both the decomposition method and dynamic competitive path assessment in the day-ahead market would have resulted in a significant decrease in the frequency of mitigation. Specifically, I observed the following: a 23 percent reduction in mitigation attributable to the proposed decomposition method alone (eliminating instances of over-mitigation outweighed the increase in mitigation associated with the broader set of resources that will be mitigated for a specific constraint under the new approach), and a reduction in mitigation resulting from a shift of 13 percent of binding constraints from non-competitive to competitive (due to application of the proposed dynamic competitive path assessment).

There is an additional factor that I anticipate will also improve the accuracy of local market power mitigation in the day-ahead market. The ability for the mitigation run to accurately predict congestion in the market run should improve with the addition of bid-in demand, convergence bids, and demand response in the mitigation run. For the study period, the day-ahead mitigation run under-predicted roughly 80 percent of congestion that occurred in the subsequent integrated forward market run on internal lines. This represents an opportunity for under-mitigation as undetected congestion will not trigger mitigation. Further, the mitigation run predicted congestion on internal lines in excess of what was observed by 10 percent. This represents an opportunity for over-mitigation as mitigation may be triggered in the mitigation run in response to congestion that did not actually occur in the market run. Including bid-in demand and all virtual bids, and clearing the market power mitigation run based on bid-in demand, will allow the market power mitigation run to more closely match inputs used in the actual market run.

IV. Using a Static Competitive Path Assessment in Conjunction with the Decomposition Method in HASP for Stage 1 Is the Best Solution in Light of the Need for Staged Implementation

Q. Why is the CAISO proposing to limit the dynamic competitive path assessment to the day-ahead mitigation process in Stage 1?

A. As I noted above, the CAISO is planning to implement a mitigation run performed as part of each 15-minute real-time unit commitment run that will be used for mitigation in each of the real-time market applications. However, as explained in the testimony of my colleague, Dr. Abdul-Rahman, because of the added complexity associated with conducting a mitigation process during every 15-minute interval, the CAISO cannot implement this functionality until Stage 2, which the CAISO plans for the fourth quarter of 2012. In addition, implementation of the dynamic competitive path assessment in the HASP is deferred to Stage 2 due to concerns regarding the ability of HASP to accurately predict local market power in the 5-minute real-time market.

Q. Will the CAISO's retention of the static competitive path assessment in the HASP until Stage 2 result in appropriate mitigation during the interim period?

A. Yes. Temporarily retaining the static competitive path assessment in the HASP until Stage 2 will produce mitigation that will be appropriate and will be an improvement compared to today's approach as a result of implementing the decomposition method. All of the benefits associated with this methodology that I discussed above will apply to the mitigation run in the HASP. I have performed an analysis to evaluate the impact on mitigation of using the decomposition method in conjunction with the current static competitive path assessment. My analysis indicates that employing this interim "mixed" approach until Stage 2 will reduce the overall level of mitigation for the HASP and real-time market compared with the current approach. This reduction reflects a more targeted and accurate mitigation of resources identified as having local market power under the current path assessment methodology while retaining the more conservative competitive path designations until a more accurate dynamic assessment can be implemented in conjunction with the real-time unit commitment process in Stage 2.

In particular, I evaluated the impact of implementing the proposed decomposition method while retaining the static competitive path assessment in HASP on the frequency of mitigation compared to what the current mitigation approach produced for the period from July 1 through September 30 of 2011. My results indicate that the decomposition method would have resulted in a decrease of about 48 percent in the frequency of mitigation (unit-hours of mitigation) in the real-time market during that period. The increase in mitigation resulting from applying the broader-reaching decomposition method when non-competitive constraints are binding is more than made up for by the reduction in mitigation achieved due to the elimination of over-mitigation under the decomposition method. Given my observation, I view using the current competitive path assessment methodology along with the decomposition method in the HASP in the interim as a significant improvement in accuracy and therefore an appropriate interim solution until stage 2.

Q. Even if the CAISO is unable to implement a dynamic competitive path assessment on a 15-minute basis until Stage 2, couldn't the CAISO implement the dynamic competitive path assessment as part of its HASP in Stage 1?

A. Technically, yes. However, doing so would lead to increased likelihood of circumstances where local market power was not identified and mitigated for the five-minute real-time market. The HASP market process is sufficiently removed from the five-minute real-time market that it can produce significantly different outcomes. I have observed that the local market power mitigation process in the HASP can significantly under-predict congestion that occurs on internal constraints in the real-time market. My analysis indicated an under-prediction rate of about 45 percent, which suggests the HASP mitigation run outcomes often do not reflect conditions seen in the real-time market. Under-predicting congestion in the local market power mitigation run can result in under-mitigation if the observed congestion creates local market power. In fact, when the HASP mitigation run does accurately predict congestion in the real-time market, application of the dynamic competitive path approach results in significant under-identification of local market power (22 percent accurate) compared to application of the current competitive path assessment approach (89 percent accurate).

Deferring implementation of the dynamic path assessment until Stage 2 is prudent given the improved mitigation accuracy of applying the decomposition method alone in the HASP, the potential for under-mitigation with the dynamic competitive path assessment and decomposition methods applied in the HASP only, and the greatly improved accuracy of applying the mitigation process in the real-time unit commitment process (discussed below).

Q. Please explain in further detail why the LMPM process needs to run more frequently than on an hourly basis in order to implement a

dynamic competitive path assessment for mitigation of real-time transactions.

A. In real-time, the primary mitigation concern is alleviating market power in the real-time market where internal resources are dispatched every five minutes (in the economic dispatch mode of the real-time market) based on their submitted bids and may have the opportunity to exercise local market power. In general, local market power is created by congestion on a constraint for which there is an uncompetitive supply of counter-flow to manage that congestion. The HASP, which is conducted once for the start of each hour, is less accurate in predicting congestion in the real-time market relative to subsequent market runs conducted on a 15-minute basis because it utilizes less current system information regarding resource and transmission availability, load ramping, power flow, and actual resource performance than subsequent market runs. Because the accuracy of *ex ante* identification and mitigation of local market power hinges on accurate prediction of congestion and accurate accounting of the conditions that impact local market power in the applicable market, it is important to base mitigation on a market run that best reflects these conditions. Consequently, implementing the dynamic competitive path assessment as part of the HASP in Stage 1 would lead to much less accurate mitigation results for real-time transactions than would implementing the dynamic competitive path assessment as part of the HASP and real-time unit commitment process in Stage 2.

Q. To illustrate the explanation you have just provided, have you analyzed the relative accuracy of predicting local market power across different markets in the real-time?

A. Yes. Details of that analysis are provided in Appendix A to my testimony. To summarize, I calculated the relative accuracy of predicting local market power in the real-time market by applying the dynamic competitive path assessment in the HASP and in each 15-minute real-time unit commitment run for the period July 1, 2011, through September 30, 2011, which is the study period on which I focused. I also calculated the competitive path assessment for the real-time market as a baseline for assessing accuracy of the other designations. My analysis indicates that calculating path competitiveness in the HASP for application of market power mitigation in the real-time market is considerably less accurate than calculating path competitiveness in each of the fifteen-minute real-time unit commitment runs. Assessing market power for real-time transactions in the HASP has approximately a 65 percent accuracy rate over these three months, whereas the accuracy rate for assessing market power in the real-time unit commitment runs is approximately 86 percent. While general accuracy is a concern, the ability of the dynamic competitive path assessment to accurately predict when there is local market power in the real-time market is of even greater concern since there will not be a subsequent opportunity to identify and mitigate for this local market power.

My analysis demonstrates that basing path competitiveness determinations for the real-time market on an assessment performed in the HASP market run introduces a high risk of under-detection and under-mitigation of local market power in the real-time market. The under-prediction is about 240 percent higher compared with performing a dynamic competitive path assessment in a subsequent real-time unit commitment run.

Q. Please summarize your analysis.

A. It is my assessment that use of the decomposition method and the dynamic competitive path assessment for the day-ahead market in Stage 1 will result in more accurate and less frequent mitigation compared with the current approach. Use of the decomposition method along with the static competitive path assessment for the HASP process and real-time market for the interim period until Stage 2 will also result in more accurate and less frequent mitigation, largely due to the reduction in over-mitigation inherent in the current LMPM process. Putting these two pieces of information together, I conclude that the CAISO's proposal will constitute an improvement over the currently effective market power mitigation process.

Q. Thank you. I have no further questions.

Appendix A to Direct Testimony of Jeffrey D. McDonald

Analysis of Dynamic Competitive Path Assessment and LMPM via Locational Marginal Price Decomposition

Contents

1 Overview

The analyses discussed below were performed to assess the impact of the local market power mitigation (LMPM) enhancements that the CAISO proposes in this proceeding and to supplement the discussion of those enhancements contained in the Direct Testimony of Jeffrey D. McDonald submitted in this proceeding.[1]

To perform the analyses, the proposed dynamic competitive path assessment approach and an approximation of the proposed locational marginal price "decomposition" methodology(decomposition methodology) for resource bid mitigation under the LMPM enhancements were applied to historical market outcomes for both the day-ahead and real-time markets. The analyses focus specifically on the three-month period from July 1, 2011, through September 30, 2011. The analyses indicate the following:

1. Analysis of the impact of implementing the dynamic competitive path assessment for the day-ahead market in stage one of the LMPM enhancements indicates that it will likely reduce the frequency that binding constraints are uncompetitive and ultimately reduce the frequency of mitigation.

[1] The specific components of the LMPM enhancements and the reasons the CAISO proposes them are discussed in Dr. McDonald's testimony and in the other documents submitted by the CAISO in this proceeding. The discussion in this analysis below presumes familiarity with those documents.

2. Analysis of the impacts on local market power mitigation in the day-ahead market due to implementation of the CAISO's proposed decomposition methodology to trigger mitigation indicates a net reduction in mitigation frequency.

3. Analysis of the impact of implementing the dynamic competitive path assessment in the hour-ahead scheduling process (HASP) without also implementing the dynamic competitive path assessment and LMPM enhancements on a 15-minute basis in the real-time unit commitment indicates that doing so would introduce additional risk of under-mitigation in cases where local market power exists in the real-time market (five-minute dispatches in standard operation of the real-time market).

4. Analysis of the impact on path designationaccuracy that results from implementing the dynamic competitive path assessmentin only the HASP versus implementing a dynamic competitive path assessment on a 15-minute basisin the real-time unit commitment indicates that accuracy is significantly greater if implementation occurs on a 15-minute basis.

5. Analysis of the impacts on local market power mitigation in the day-ahead market and the HASP due to implementation of the CAISO's proposed LMPM enhancements (ignoring the impacts of the CAISO's proposed transition from the static competitive path assessment to the dynamic competitive path assessment) indicates that the LMPM enhancements will have significant benefits for the frequency and costs of local market power mitigation.

2 Analyses Regardingthe Dynamic Competitive Path Assessment

2.1 Overview of the Static Competitive Path Assessment and Dynamic Competitive Path Assessment

The CAISO currently employs a static competitive path assessment in all of the markets it operates. In stage one of its proposed LMPM enhancements, which will go into effect in April 2012, the CAISO will implement improvements in how it applies LMPM procedures to resources with the potential to exercise local market power in the day-ahead market and the HASP, and will implement as part of these improved procedures a new dynamic competitive path assessmentin the day-ahead market only. In stage two of the proposed LMPM enhancements, which the CAISO anticipates will go into effect in the fourth quarter of 2012, the CAISO will further enhance its LMPM procedures by adding an additional mitigation run as part of its 15-minute real-time unit commitment process, and implementing a dynamic competitive path assessment for the HASP and eachreal-time unit commitment process.[2]

Both the current static competitive path assessment and the proposed dynamic competitive path assessment use a form of pivotal supplier test to evaluate the competitiveness of transmission constraints (sometimes also called paths). However, the approach taken in evaluating the competitiveness of transmission constraints differs considerably under the static competitive path assessment as compared with the dynamic competitive path assessment.

[2] The mitigation process for the HASP and real-time market is performed as part of the HASP.

The following is a high-level comparison of the static competitive path assessment and dynamic competitive path assessment:

Static Competitive Path Assessment	Dynamic Competitive Path Assessment
Analysis and path determinations are based primarily on historical information, with resulting designations applied going forward (one to four months forward).	Analysis and path determinations are performed in-line with the market software using resource, transmission, and load information that is also used by the market software in thesubject dispatchinterval.
Based on simulation that uses hourly schedules for a 24-hour optimization (similar to the day-ahead market).	Based on dispatch interval length for which the assessment is being done. More accurately reflects resource ramp limitations than does the static competitive path assessment.
Withholds all capacity in portfolio of potentially pivotal suppliers.	Adjusts capacity withholding to reflect the interval-specific ramp-limited quantity that could have been withheld (short of full unit outage).
Pivotal suppliers are evaluated and withdrawn from supply on a system-wide basis.	Pivotal suppliers and calculations of the residual supply index are specific to each constraint being evaluated.
Default designation of "uncompetitive" if constraint is not tested.	Tests all binding constraints that are not permanently deemed competitive.

A more detailed description of the current static competitive path assessment can be found on the CAISO website in the CAISO Business Practice Manual for Market Operations (particularly in Attachment C of that document), and in the Department of Market Monitoring (DMM) paper entitled "Competitive Path Assessment for MRTU - Final Results for MRTU Go-Live."[3]More detail on the dynamic competitive path assessment is set forth in the CAISO's final policy proposal paper on the topic.[4]

[3] This DMM methodology paper is available at http://www.caiso.com/2365/23659ca314f0.pdf. Recent DMM papers presenting path determinations are available at http://www.caiso.com/Documents/Competitive%20path%20assessments%20for%202011

[4] "Revised Draft Final Proposal – Dynamic Competitive Path Assessment," available at http://www.caiso.com/Documents/RevisedDraftFinalProposal-DynamicCompetitivePathAssessment.pdf.

2.2 Assessing *ex ante*Path Designations

Analysis of the Impact of Using Static Competitive Path Assessment vs. Dynamic Competitive Path Assessment for the Day-Ahead Market in Stage One

Theanalysis reflected in Table 1 belowcompares the path designations that have occurred with the current static competitive path assessmentwith those that would have been made using the dynamic competitive path assessment for the day-ahead market. In order to make this comparison, the analysis examined the percentages of competitive and uncompetitive designations under the static competitive path assessmentapproach and under the dynamic competitive path assessmentapproach with regard to the common benchmark of all binding eligible constraints in the integrated forward market .[5]

Table 1 shows that using the static competitive path assessment for the day-ahead market results in designation of 53 percent of the paths as competitive and 47 percent of the paths as non-competitive, whereas using the dynamic competitive path assessmentfor the day-ahead market results in designation of 66 percent of the paths as competitive and 34 percent of the paths as non-competitive. Use of the dynamic competitive path assessment results in a 13 percent increase in designation of paths as competitive (*i.e.*, 66 percent versus 53 percent) and a corresponding 13 percent decrease in designation of paths as non-competitive (*i.e.*, 34 percent versus 47 percent). Because local market power mitigation is triggered only for non-competitive paths, it follows that use of the dynamic competitive path assessmentlikewise results in a 13 percent decrease in instances where local market power mitigation is triggered.

Table 1 Comparison of Path Designations from Static Competitive Path Assessment and Dynamic Competitive Path Assessment in the Day-Ahead Market

		Dynamic CPA		
		Competitive	Non-competitive	***Total***
Static CPA	Competitive	23%	30%	***53%***
	Non-competitive	43%	4%	***47%***
	Total	***66%***	***34%***	

Table 1 also shows that, almost 75 percent of the time,using the static competitive path assessmentfor the day-ahead market results in designation of paths that differs from the designation of paths using the dynamic competitive path assessment for the day-ahead market. Specifically, both of those approaches

[5] The analysis uses the integrated forward market as the common benchmark for the analysis because of the difference in inputs between the LMPM run and the actual market run (*i.e.*, the integrated forward market). The LMPM run clears forecast load against physical supply and exports and *excludes* virtual bids. The integrated forward market, on the other hand, clears bid-in physical and virtual demand against all bid-in supply and exports – thus, it *includes* virtual bids. Because the dynamic competitive path assessment will account for virtual bids, it is necessary to use the integrated forward market as the common benchmark for the analysis. Performing the dynamic competitive path assessment for the LMPM run and comparing the resulting path designations to those produced by performing the dynamic competitive path assessment for the integrated forward market would result in an invalid comparison.

agree as to the competitiveness of 23 percent of paths and the non-competitiveness of 4 percent of paths – a total of 27 percent agreement. Conversely, however, there is disagreement between the approaches as to the competiveness or non-competitiveness of paths a total of 73 percent of the time.[6]Using the dynamic competitive path assessment approach rather than the static competitive path assessment approach makes a dramatic difference in which paths are designated as competitive or non-competitive.

Analysis of the Accuracy of Using Dynamic Competitive Path Assessment for the HASP Alone vs. Using Dynamic Competitive Path Assessment for the HASP and Real-Time Unit Commitmentin Stage Two

The first comparison of path designation accuracy, in Table 1 above, is between using the static competitive path assessment in the HASP and using the dynamic competitive path assessment in the HASP, without subsequent application of LMPM in the real-time unit commitment. (In fact, however, the CAISO plans to subsequently apply the LMPM in the real-time unit commitment in Q 4 of 2012.) The purpose of the comparison shown in Table 2, below, is to assess the risk of under-mitigation associated with implementing the dynamic competitive path assessment in the HASP in stage one without application of LMPM in the real-time unit commitment.

In this regard, it is important to note that the outcomes of the LMPM conducted in theHASP often do not closely reflect the outcomes ultimately observed in the five-minute real-time market,which is where the CAISOis most focused on achieving accurate LMPM in the real-time market. Accurate prediction of the congestion that can create local market power is critical to accurate application of LMPM. The HASP market does not accurately predict congestion in the real-time market. Analysis of the data for the study period indicates that the LMPM run in the HASP under-predicted congestion in the real-time marketin 45 percent of hours where real-time congestion occurred. The HASP LMPM correctly predicted congestion in 21 percent of hours where real-time congestion occurred, and over-predicted congestion in 35 percent of hours reviewed. These results suggest the HASP mitigation run outcomes often do not reflect conditions seen in the real-time market. Under-prediction of congestion can lead to instances of under-mitigation, and *vice versa* for over-prediction of congestion. Both of these cases are the function of mismatch in market outcomes and do not speak directly to the relative accuracy of the static and dynamic competitive path assessments. The instances where the HASP LMPM run correctly predicted congestion in the real-time market are useful for comparing the relative accuracy of the static and dynamic competitive path assessments when used in the HASP alone.

When the HASP mitigation run does accurately predict congestion in the real-time market, application of the dynamic competitive path approach results in significant under-identification of local market power (22 percent accurate) compared with application of the current competitive path assessment approach (89 percent accurate). This result indicates that the dynamic competitive path assessment, when applied in the HASP alone, presents an additional risk of under-mitigation. This is likely due to the fact that the HASP market is sufficiently removed in time from the real-time market runs that even when congestion is accurately predicted, the conditions reflected in the HASP and the calculations that produce the path designations do not reflect conditions observed in the real-time market where the mitigation is targeted. The static competitive path assessment uses a default designation of non-competitive for non-tested constraints. Although imprecise, this default designation appears to predict uncompetitive conditions in the real-time market better than the dynamic competitive path assessment when applied in the HASP only.

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[6] *I.e.*, the 30 percent and 43 percent figures shown in Table 1 add up to 73 percent.

The analysis reflected in Table 2 below compares the difference in accuracy in path designation between implementing a dynamic competitive path assessment in the HASP only and implementing a dynamic competitive path assessment as part of a mitigation run performed every 15 minutes in conjunction with the CAISO's real-time unit commitmentprocess. The purpose of this comparison is to evaluate the gain in accuracy when implementing the LMPM process in the real-time unit commitment in stage two.

In Table 2, the impact on path designation accuracy due to implementing the dynamic competitive path assessment for only the HASP is shown in the row titled "HASP," and the impact on path designation accuracy due to implementing the dynamic competitive path assessmenton a 15-minute basis in the real-time unit commitmentis shown in the row titled "RTUC." The percentages in both rows were calculated with regard to the common benchmark ofpath determinations resulting from application of the dynamic competitive path assessment in the real-timemarketThe figures in Table 2 represent the percentages of dispatch intervals for which the analysis indicates correct and incorrect path designations for competitive and non-competitive paths in any LMPM run with a binding constraint. For example, the analysis indicates that,for 63 percent of the dispatch intervals studied, implementing the dynamic competitive path assessmentin the HASP only results in correct designations of competitive pathswhere there was a binding constraint in either a HASP or a real-time marketrun.Table 2 omits dispatch intervals for which there were no binding constraints in either a HASPor a real-time unit commitment run. In those cases, there is no risk of local market power arising and no path designation produced.

Table 2 Accuracy of Dynamic Competitive Path Assessment in HASP Relative to Real-Time Unit Commitment

			Competitiveness As Measured in RTD w/ DCPA		
			Competitive	Uncompetitive	All
Designation Accuracy w/DCPA	HASP	Correct	63.0%	1.9%	64.9%
		Incorrect	5.8%	28.9%	34.7%
	RTUC	Correct	75.1%	11.0%	86.1%
		Incorrect	5.6%	8.5%	14.1%

Table 2 shows that implementing the dynamic competitive path assessment on a 15-minute basis results in significantly more accurate path designations than implementing the dynamic competitive path assessment in the HASP only. Overall, performing the dynamic competitive path assessment in the real-time unit commitment results in 86.1 percent of path designations being assessed correctly versus 64.9 percent when the dynamic competitive path assessment is run in the HASP only – an improvement of approximately 21 percent. This improvement in accuracy stems from better prediction of real-time market congestion and more current information used in the residual supply index calculations.

It is also important to recognize that limits that establish the floor to which a bid price can be mitigated limit the potential damage from over-mitigating resources. There is no such limit that applies when under-mitigation occurs. Applying the dynamic competitive path assessment approach in the real-time unit commitment run results in a decrease in instances where an uncompetitive path is falsely deemed competitive from 28.9 percent to 8.5 percent, which is a very significant improvement in reducing under-identification of local market power.

3 Analysis Regarding the LMPM Enhancements (Other than the Dynamic Competitive Path Assessment)

3.1 Existing and Proposed Mitigation Rules

The current local market power mitigation mechanism assesses and mitigates local market power in two pre-market LMPM runs in the day-ahead market and the HASP. The first of the two LMPM runs clears the market with only competitive constraints enforced in the full network model (competitive constraintsrun). The resulting dispatch reflects a competitive market outcome absent any impacts from the exercise of local market power. By not enforcing the uncompetitive transmission constraint limits, this set of constraints is not able to bind and create a circumstance where local market power exists.

The second of the two LMPM runs (all constraintsrun) applies all transmission constraints in the full network model. The dispatch from the all constraints run is compared to the dispatch from the competitive constraints run. Generating resources that were dispatched upward in the all constraints run relative to their competitive constraints run dispatch are presumed to be dispatched upward to manage congestion on an uncompetitive constraint and as such are deemed to have local market power. Bid mitigation is applied to the set of resources that have an all constraints run dispatch greater than their competitive constraints run dispatch. Bid prices are mitigated to a resource-specific reference price curve (default energy bid) but not below the bid price of the resource’s highest priced bid segment dispatched in the competitive constraints run.

The proposed revised LMPM methodology, known as the decomposition methodology,will apply mitigation to all resources that have a positive non-competitive congestion component in their locational marginal prices that is attributed to a binding uncompetitive constraint. This process uses the relationship between the generation resource and the binding constraints (the shift factor), the shadow price on binding constraints, and the competitive / uncompetitive designations of binding constraints to decompose the congestion component of eachlocational marginal price into parts attributable to competitive and uncompetitive binding constraints. If a resource has a positive congestion price component that is attributable to a binding uncompetitive constraint, the resource will be subject to mitigation. Bid prices will be mitigated to the higher of the resource’sdefault energy bid or a calculated competitive baseline price.

3.2 Methodology for Comparison of Current and Proposed LMPM

This analysis estimates which resources would be mitigated under the proposed decomposition methodology. Conceptually, within a dispatch interval, any resource that can provide counter-flow to a binding uncompetitive constraint and has a positive congestion component in itslocational marginal price is identified as a mitigated resource under the revised LMPM rules. This analysis only identifies the resources that would have been mitigated under the proposed decomposition methodology and does not evaluate the impact on their bid curves. This measure is useful in comparing the frequency and accuracy of resources mitigated under the two methodologies.

An additional adjustment is performed to make the estimate of the number of resources mitigated under the proposed decomposition methodology comparable to the count of effectively mitigated resources observed under the current LMPM approach. As described above, the measure of observed mitigated units discounts resources that were not dispatched in the market run for which the mitigation applied or did not have their bid price lowered at the point of market dispatch as a result of mitigation. A large portion of resources identified as being subject to mitigation (because of all constraints run dispatch being greater thancompetitive constraints run dispatch) are discounted due to no effective impact on their bid curve. About 70 percent of mitigated resources in the day-ahead market and 66 percent of mitigated resources in the real-time market had no effective impact on their bid curves resulting from mitigation.

This analysis does not construct mitigated bid curves for resources expected to be mitigated under the proposed LMPM and hence no determination can be made whether the mitigation would have impacted the resource (*i.e.*, the mitigation lowered the bid price of the resource at the point of market dispatch). The high proportion of observed mitigation that did not effectively impact the bid curve suggests that many resources bid at or below their default energy bids and are not effectively impacted by mitigation. The proportion of zero bid price impact for the day-ahead and real-time markets is applied to the estimated set of resources that would have been mitigated under the proposed approach. This is reasonable given the observed impact of mitigation on bid prices and allows for a more direct comparison to assess changes in mitigation frequency under the two approaches.

By using the impact of a binding uncompetitive transmission constraint on price at the generator location to trigger mitigation, the proposed decomposition methodology limits bid mitigation to only resources whose locational marginal price is increased as a result of uncompetitive conditions created by congestion. This thereby limits bid mitigation to only those resources that have and potentially could benefit from exercising local market power created by the binding uncompetitive transmission constraint and eliminates over-mitigationeffectsobserved with the current LMPM procedures.[7] The determination of whether a resource was over-mitigated in the analysis rests on whether or not that resource had a shift factor to a binding uncompetitive constraint that indicates that the resource could be effective in supplying counter-flow to that constraint. If a resource was mitigated and was not effective on any binding uncompetitive constraint in the hour in which it was mitigated, then that resource was deemed to be over-mitigated.[8]

3.3 Results of Comparison of Current and Proposed LMPM

The analysis reflected in Table 3 below evaluatesvarious impactson local market power mitigation in the day-ahead market and the HASP due to implementationof the CAISO's proposed LMPM enhancements, ignoring for purposes of this analysis the impacts of the CAISO's proposed transition from the static competitive path assessmentto the dynamic competitive path assessment.

[7] The over-mitigation issue associated with the current LMPM methodology is addressed in some detail in the testimony of Dr. McDonald.

[8] One caveat to this measure is the potential that the pre-market mitigation runs, as they iterate to an optimal solution, may have dispatched up and/or committed resources (relative to their output level in the competitive constraints run) and completely resolved congestion on the uncompetitive constraint. In this circumstance, the mitigation would be appropriate despite the fact that the uncompetitive constraint for which the dispatch was made is no longer binding. The way that over-mitigation is measured here would falsely identify this mitigation as over-mitigation. Therefore, the over-mitigation figures presented below reflect an upper bound and may actually be lower.

The first row in Table 3 shows the percentages of hours in the day-ahead market and the HASPin which bid mitigation occurs. The second row in Table 3 shows the percentage of hours in the study period in which bid mitigation occurs and there is no binding uncompetitive constraint that could trigger mitigation.

The third row in Table 3 shows the decrease in the percentage of resource-hours during which over-mitigation occurs under the decomposition methodology. The over-mitigation rate in both the day-ahead and real-time market was very high under the current approach. The proposed LMPM approach using the decomposition methodologywill eliminate this type of mitigationby mitigating only those resources whose locational marginal price was increased as a result of a binding uncompetitive constraint. Thus, based on the statistics in Table 3, application of the decomposition methodology would have reduced the frequency of mitigation by 94 percent in the day-ahead market and by 93 percent in the HASP.

As described in the CAISO's filing in this proceeding, the proposed LMPM approach will also apply mitigation to a broader set of resources that have local market power as a result of a binding uncompetitive constraint, some of which are not mitigated by the current LMPMprocess. The fourth row in Table 3 shows the percentage increase in mitigation frequency resulting from applying mitigation to the broader set of resources that have local market power. This effect will increase the frequency of mitigation by 81 percent in the day-ahead market and by 46 percent in the HASP.

The net effect of applying the proposed decomposition methodology for mitigation (with no changes to the path assessment approach) is the sum of the effects of eliminating the over-mitigation and increasing the number of resources accurately mitigated specifically for local market power created by a binding uncompetitive constraint.[9]As shown in the fifth row in Table 3, this net effect reduces the frequency of mitigation by 13 percent in the day-ahead market and by 48 percent in the HASP.

Thesixth, seventh, and eighth rows in Table 3provide some statistics on the set of mitigated resources that were observed under the current LMPM approach during the study period. As shown in the sixth row, the average dispatch differential that triggered mitigation was between 32 MW and 40 MW. The seventh row indicates that the average decrease in bid price at the point of market dispatch resulting from the current mitigation was $3.69/MWh for the day-ahead market and $9.15/MWh for the HASP (including mitigated resources that had a $0 impact on their bid curves). The eighth and final row shows that 70 percent of the mitigated resources in the day-ahead market and 66 percent of the mitigated resources in the HASP had no decrease in their bid prices at the point of market dispatch as a result of bid mitigation.

[9] Both the over-mitigation rate and the broader pool of mitigated resource rate are expressed in the analysis as a percentage of the observed resource-hours of mitigation. Since they share the same basis, they are additive.

Table 3 Impact of New LMPM on the Frequency of Mitigation

	Day Ahead	HASP
Percent of hours with bid mitigation	32%	68%
Percent of hours with bid mitigation and no binding uncompetitive constraint	25%	50%
Percent of mitigated resources that were unintended	94%	93%
Percent increase in mitigated resource hours from new LMPM	81%	46%
Net change in resource mitigation hours (eliminate unintended, add increase from new LMPM)	-13%	-48%
Average increase in MPM dispatch that triggered mitigation	40	32
Average decrease in bid price from mitigation (measured at market dispatch)	-$3.69	-$9.15
Percent of resource mitigation hours where there was no effective change in bid price	70%	66%

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

California Independent System Operator Corporation	))	Docket No. ER12-____-000

DECLARATION OF WITNESS

I, Jeffrey D. McDonald, declare under penalty of perjury that the statements contained in the Direct Testimony of Jeffrey D. McDonald on behalf of the California Independent System Operator Corporation in this proceeding are true and correct to the best of my knowledge, information, and belief.

Executed on this 15th day of November, 2011.

Jeffrey D. McDonald

Attachment F – CAISO Analysis entitled "A Retrospective Analysis of Local Market Power Mitigation Enhancements"

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

A Retrospective Analysis of Local Market Power Mitigation Enhancements

Lin Xu, PhD

Market Analysis and Development,

California Independent System Operator

May 9, 2011

A Retrospective Analysis of Local Market Power Mitigation Enhancements

1. INTRODUCTION

The ISO proposed a new Local Market Power Mitigation (LMPM) methodology to

- To meet the requirements for bid in demand outlined in the September 21, 2006 FERC order[1] and
- To incorporate changes needed due to the implementation of convergence (virtual) bidding and new demand response products.[2]

Compared with the current LMPM approach, the new LMPM has several other benefits. The current LMPM process has two runs – the competitive constraints (CC) run and the all constraints (AC) run. Each one of these runs uses system resources and processing time. The new proposal, streamlines the process into one run, providing the opportunity in the future to run the mitigation process more frequently in the real time and thus providing more precision in the mitigation decisions. In addition, this proposal is fully compatible with the future direction of the ISO to implement a dynamic, or inline, competitive path assessment (CPA). What this means is that each time the mitigation is run, the competitive path assessment is performed. Again, this provides more accurate information for the system to make mitigation decisions. As a parallel process, Department of Market Monitoring (DMM) proposed to change the current seasonal CPA into a dynamic CPA.

The performance of overall market power mitigation will be impacted by both the LMPM methodology change and the dynamic CPA change. Stakeholders have requested the ISO to perform analysis to address the impacts in responding to the ISO's LMPM enhancements straw proposal.[3]. A comprehensive analysis road map is illustrated in Figure 1 to assess these two changes. The analysis to address the change from current CPA to dynamic CPA was performed by DMM, and is discussed in DMM's 2010 annual report. The focus of this paper is to address the change from current LMPM to the new LMPM methodology under the current CPA designation. A similar analysis could be performed to address both changes together if a dynamic CPA study for 2011 using the AC results can be prepared. When the dynamic CPA results are available, the ISO can use them as input to address both the LMPM and CPA changes together, to further the analysis roadmap.

[1].The webpage containing the September 21, 2006 FERC Order can be found at: http://www.caiso.com/1bbd/1bbd7bf91bcd0.pdf .

[2] The webpage containing all the documents related to convergence bidding can be found at http://caiso.com/1807/1807996f7020.html ; demand response at http://caiso.com/1893/1893e350393b0.html

[3] The LMPM enhancements straw proposal can be found at http://www.caiso.com/2b45/2b45ceff66c70.pdf

This paper reports a retrospective analysis of the ISO's new LMPM approach based on current CPA. The proposed new LMPM approach is applied to historical markets to compare its results with the current mitigation approach under the same seasonal CPA designation. The objective of this is to provide better understanding of the new LMPM approach.

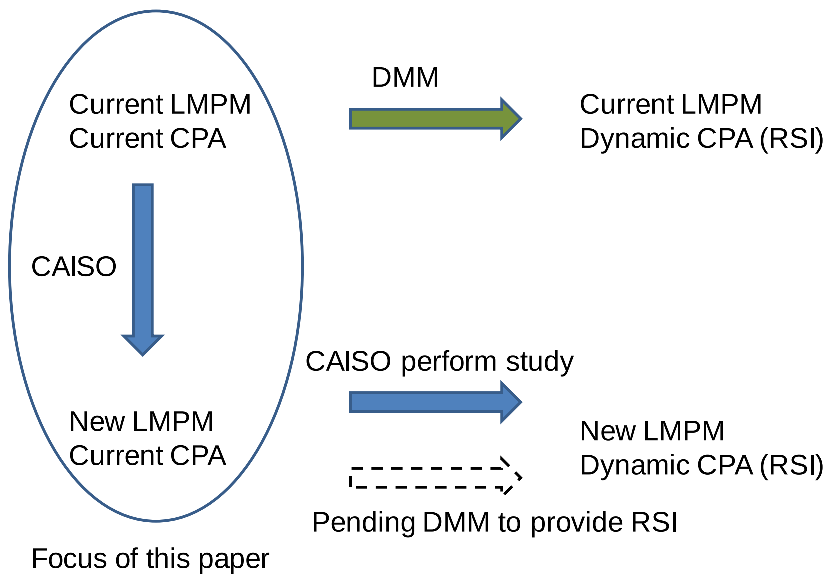

FIGURE 1: ANALYSIS ROAD MAP TO ASSESS NEW LMPM AND DYNAMIC RSI

2. DATA AND METHOD

The analysis in this paper is based on two months of actual day-ahead market data, February and March of 2011. For this period of time, the shift factor data was provided to the ISO as part of the convergence bidding release. Because shift factor data is a crucial input, the first step of this analysis is to validate the shift factors in terms of data quality. It was found that there were two days within these two months that the shift factor data was incomplete in the ISO historical data store. These two days have been excluded from the analysis. The remaining 57 days will be referred to as the study period. The study data set consists of 57 days of data from the study period.

The ISO's preferred mitigation reference bus is the Midway 500 KV bus if path 26 flow is from north to south, and the Vincent 500 KV bus if the path 26 flow is south to north. Unless mentioned otherwise, the default reference bus will be either the Midway or Vincent 500 KV bus. There will be a comparison of using either Midway or Vincent reference bus versus using the load distributed slack bus as the mitigation reference bus in section 3.1.

The first step in the new LMPM method is to run the all constraints (AC) run. Given the mitigation reference bus, the analysis finds the binding constraints in AC run, and decomposes the locational marginal price (LMP) for every location *i* as follows:

$$LMP_i = LMP_i^{EC} + LMP_i^{LC} + LMP_i^{CC} + LMP_i^{NC}$$

Where:

LMP_i^{EC} = the energy component of LMP_i ,

LMP_i^{LC} = the loss component of LMP_i ,

LMP_i^{CC}= the congestion component of LMP_i due to the competitive constraints and;

LMP_i^{NC}= the congestion component of LMP_i *due to* the non-competitive constraints.

The ISO has a shift factor effectiveness threshold of 0.02, which means that any shift factor with absolute values less than 0.02 will not be considered in the decomposition.

Every unit with $LMP_i^{NC} > 0$ will be flagged for mitigation.

The LMP without the non-competitive congestion component, $LMP_i^{CMP} = LMP_i^{EC} + LMP_i^{LC} + LMP_i^{CC}$, is referred as the competitive LMP_i, and will be used as a mitigation price floor.

3. ANALYSIS

3.1 MITIGATION HOURS

In our study period, there are 175 hours with at least one non-competitive constraint binding in the day-ahead AC run. The non-competitive constraints and congested hours are listed in Table 1. The new mitigation will be applied to these 175 hours.

Constraint	Type	Congested Hours
SDGE_PCT_UF_IMP_BG	Flowgate	109
SLIC 1417897_IV_CB_7022_OUT_NG	Nomogram	15
36957_MCSN TP1_230_36961_MOCCASIN_230_BR_1 _1	Flowgate	13
32228_PLACER _115_32238_BELL PGE_115_BR_1 _1	Flowgate	10
SLIC 1446790 EGL_SLV_FLTN SOL-1	Nomogram	9
SLIC 1368530_SDGE_IV_CB_7022	Nomogram	6
SSONGS_BG	Flowgate	6
SLIC 1434491_Moorpark_Pardee_NG	Nomogram	5
22716_SANLUSRY_230_24131_S.ONOFRE_230_BR_3 _1	Flowgate	2

TABLE 1: BINDING NON-COMPEPTITIVE CONSTRAINTS IN DAY-AHEAD MARKET POWER MITIGATION ALL-CONSTRAINT RUN

In contrast, the current LMPM was triggered[4] in 644 hours out of total of 1,367 hours. Among them, 163 hours overlap with the non-competitive constraint binding hours. The comparison of mitigation hours is illustrated in Figure 2. There 481 hours when the current mitigation identifies units for mitigation without any non-competitive constraint binding. In other words, the current LMPM produces false positive mitigation results 75% (=481/644) of time. We stress that this analysis only benchmarks the LMPM, but not the CPA. Therefore, the "false positive" and "false negative" discussed in the paper only involve the incorrect results of the LMPM, but not the CPA.[5]

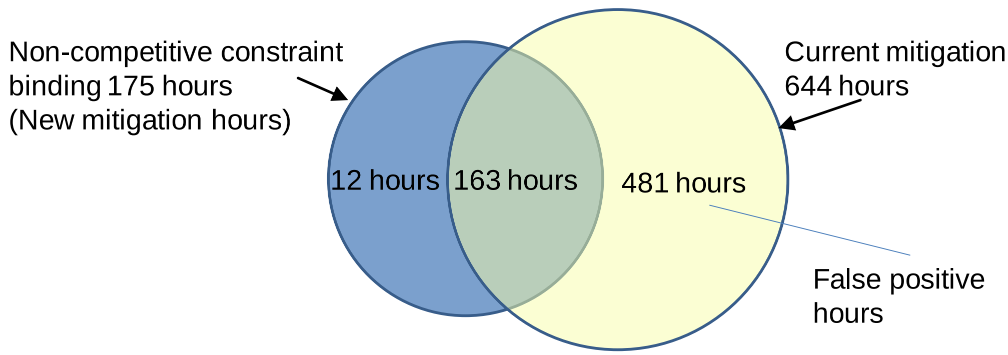

FIGURE 2: NEW MITIGATION HOURS VS CURRENT MITIGATION HOURS

3.2 NUMBER OF UNITS MITIGATED

Now let's focus on the 175 hours with non-competitive constraint binding. Within these 175 hours, the new LMPM flags 35.6 units per hour (including different configurations from MSG units) as candidates for exercising local market power. As illustrated in Figure 3, among these 35.6 units, 4.8 units are unavailable for dispatch due to outages; 11.6 units choose to self schedule; 11.8 units already bid under their default energy bids (DEB); and 0.1 units bid below the competitive LMP. Although the new LMPM flags those units, mitigation applied to those units will not result in any market impact.

The remaining 7.2 units are economically withholding some portion of their capacities, and their bids will be changed by the new LMPM. These economic withholding units are further divided into two categories: severe economic withholding and moderate economic withholding. Severe withholding refers to the units that bid more than $200 above its DEB for at least one segment, and moderate withholding refers to the units that bid within $200 of their DEBs. A large portion of these economic withholding units are not committed in the AC run. The economic withholding units could possibly cause market impact if their bids are mitigated and awarded, unless there are other constraints, such as minimum offline time, that prevent the market optimization from

[4] The current LMPM is considered triggered if a resource is dispatched in the "all constraint" (AC) run greater than the resource is dispatched in the "competitive constraint" (CC) run.

[5] The "false positive" and "false negative" have different meanings in DMM's reports. DMM uses "false positive" and "false negative" to mean if a constraint is deemed non-competitive correctly in the context of CPA benchmarking.

committing these units. However, due to the complexity of the market optimization, it is difficult to determine if a mitigated unit can change market outcome without rerunning market optimization with mitigated bid. Rerunning every market to perform this impact test was not feasible due to the limited amount of time to perform the analysis, and was not considered within the scope of this analysis.

In contrast, the current mitigation only flags 1.6 units per hour, half of which overlaps with the units identified in the new LMPM approach, and the other half are false positives. For example, in hour ending 15 on March 27 2011, SDGE_PCT_UF_IMP_BG was binding in AC run with \$26/MWh shadow price, and the current LMPM flagged two units for mitigation. One was in the SDGE area, and was also flagged by the new approach. The other unit was in the PG&E area, and is a false positive, because mitigating a PG&E unit would not help alleviate market power in SDGE.[6] In this hour, the new LMPM identifies 42 units in SDGE, 3 units having severe economic withholding, and 6 units having moderate economic withholding.

On the other hand, it is difficult to determine if a unit is a false negative for the current approach, because of the difficulty in determining if a mitigated unit will have market impact. In theory, the true false negatives should be a subset of the economic withholding units under the new LMPM approach. However, the current LMPM approach was not able to flag any economic withholding units identified by the new LMPM approach in the study period.

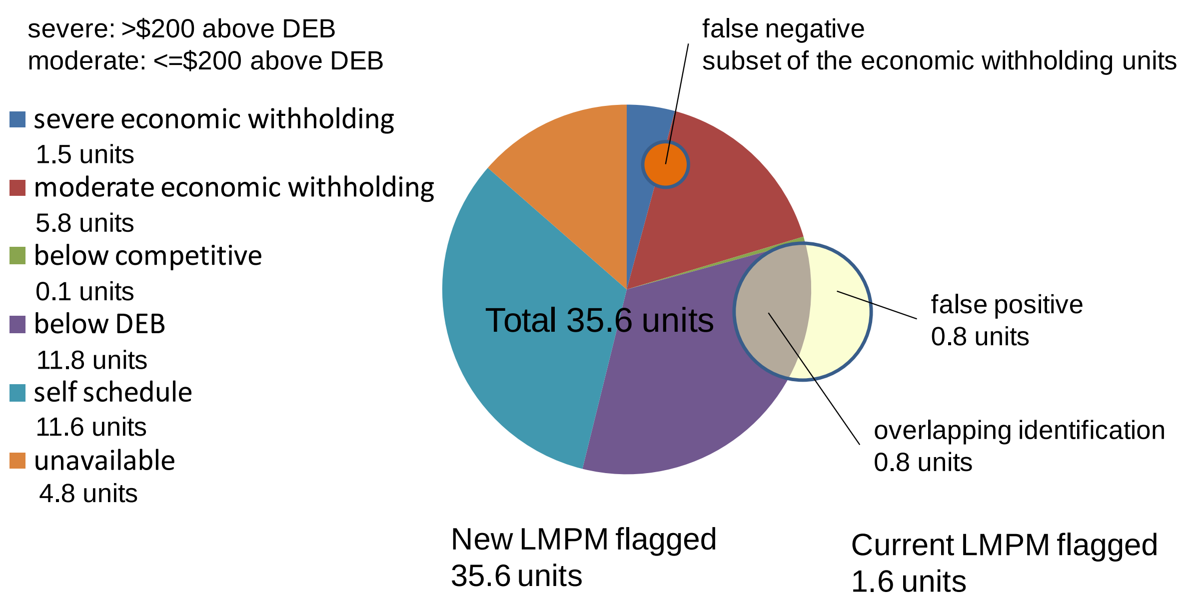

FIGURE 3: NEW LMPM VS CURRENT LMPM IN NON-COMPEPETITIVE CONSTRAINT BINDING HOURS

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[6] These spurious "false positives" under the current LMPM approach could possibly be caused by modeling differences between the CC run and AC run. This issue may be alleviated by protecting the CC run schedules with negative penalty prices. However, looking forward, when bid-in demands and virtual bids are used in the LMPM process, it is unclear how to properly set the penalty level. Increasing the protection level may cause bid-in demands and virtual bids to be redispatched before the physical bids in the downward direction, which may produce unexpected results, such as dispatching down a DLAP load in order to alleviate local congestion.

3.2 REFERENCE BUS CHOICE

Using the Midway or Vincent 500KV bus as the LMPM reference bus always identifies more units for mitigation than using the distributed slack bus as summarized in Table 2. In the study period, the LMP non-competitive constraint congestion component with respect to the Midway or Vincent 500KV bus is always greater than or equal to the LMP non-competitive constraint congestion component with respect to the load distributed slack bus for every hour and every resource. The average LMP non-competitive constraint congestion component with respect to the Midway or Vincent 500KV bus is $12.79/MWh, and the average LMP non-competitive constraint congestion component with respect to the load distributed slack bus is $11.37/MWh. On average, the LMP non-competitive constraint congestion component with respect to the Midway or Vincent 500KV bus is $1.42/MWh higher than the LMP non-competitive constraint congestion component with respect to the distributed slack bus. In other words, the load distributed slack bus may have been affected by local market power by $1.42/MWh. The load distributed slack bus will be affected by local market power if a local area has a positive load distribution factor such that the inflated price of the local area will be aggregated into the load distributed slack bus LMP. Therefore, the Midway or Vincent 500KV bus is a better choice than the load distributed slack bus for the purpose of market power mitigation.

	Number of Units Flagged Per Hour	
Categories	Midway or Vincent 500KV Bus	Load Distributed Slack Bus
severe economic withholding	1.5	1.5
moderate economic withholding	5.8	5.6
below competitive	0.1	0.1
below DEB	11.8	11.7
self schedule	11.6	11.4
unavailable	4.8	4.8
Total	35.6	35.1

TABLE 2: REFERENCE BUS IMPACTS ON NUM OF UNITS IDENTIFIED FOR MITIGATION

3.3 MITIGATION THRESHOLD

The LMPM market power flag, $LMP_i^{NC} > 0$, is a zero tolerance flag. In practice, a small positive tolerance may produce more robust and reasonable results. One way to achieve small positive tolerance is to set a positive mitigation threshold, *thres*>0, and mitigate units if $LMP_i^{NC} > thres$. The mitigation threshold impact on mitigation is illustrated in Figure 4. As the mitigation threshold increases, the num of mitigated units monotonically decreases.

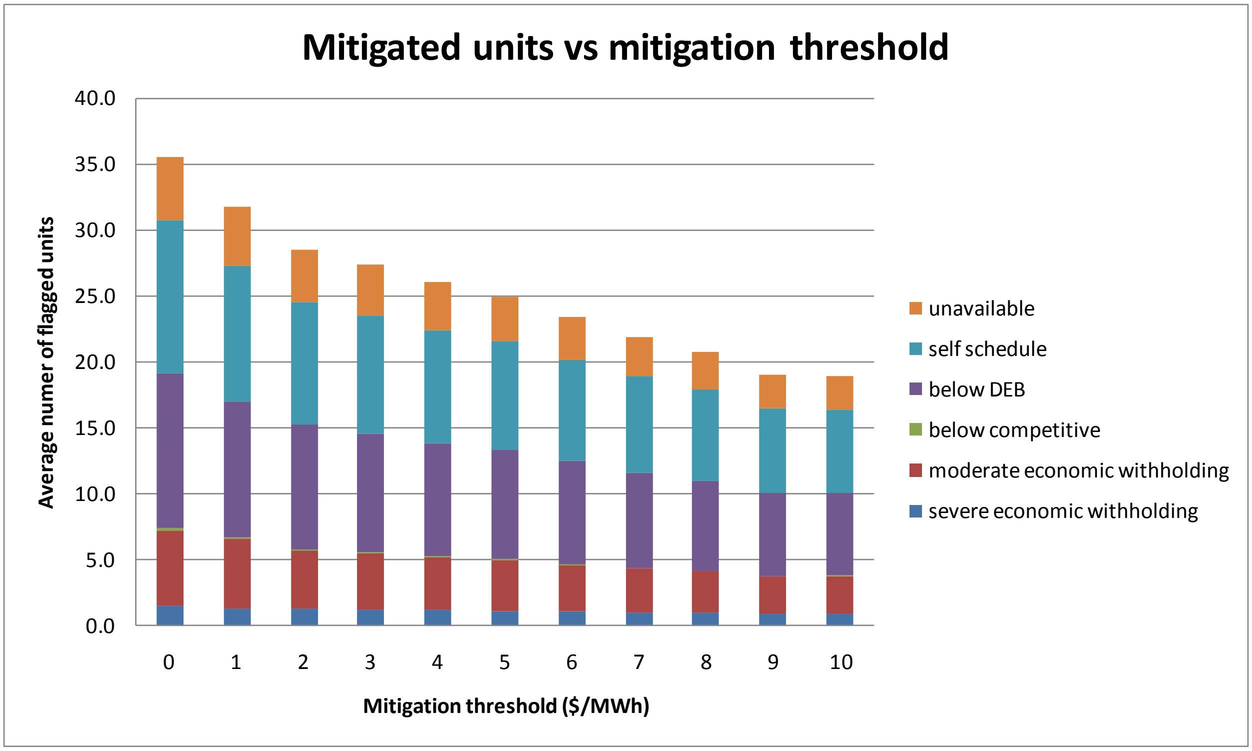

FIGURE 4: POSITIVE MITIGATION THRESHOLD IMPACTS ON NUMBER OF UNITS MITIGATED

4. SUMMARY

This analysis performed on the day-ahead market from February to March 2011 is to address the impact of the LMPM methodology change. In this analysis, the new LMPM results were compared with the current LMPM results. Given the same set of non-competitive constraints, the new LMPM tends to flag more units for mitigation. One major reason for this is that the current LMPM is designed to filter out the outage units, the self schedule units, uncommitted units, etc., while the new LMPM provides a more thorough examination without filtering out these units. Mitigating these units will not result in any market impact under the new LMPM approach. The economic withholding units that need mitigation are about 7 units per hour per constraint. However, the current LMPM fails to identify any of them.

Another reason for relatively frequent mitigation in the new LMPM is that the current CPA designation methodology is very conservative. The current LMPM is a less discerning approach, and thus it is coupled with a very conservative CPA. The new LMPM is a more discerning approach and better situated to accommodate a more accurate CPA methodology. With the desire to move to a more accurate dynamic CPA replacing the current CPA, the new LMPM is a better fit and fully compatible with the desired direction than the current LMPM method.

The analysis also compared the reference bus choice. In contrast with the load distributed slack bus, the Midway or Vincent 500 KV bus is less impacted by local market power, and is a better choice as a reference for local market power mitigation purpose.

Another part of the analysis sheds light on mitigation tolerance. The LMPM proposal currently employs a zero tolerance approach, while in practice a small tolerance may be more robust. The analysis illustrates the impact of a non-zero mitigation threshold, and may be viewed as a sensitivity analysis of the mitigation tolerance.

Some stakeholders proposed to test local market power based on shift factor to each individual binding non-competitive constraint. This alternative approach and the ISO's proposal will produce different results only when there are multiple simultaneously binding looped non-competitive constraints. In our study period, there was exactly one non-competitive constraint binding in each of these 175 hours, so using individual shift factor to test local market power will produce exactly the same results as the ISO proposed approach. We will report our findings on this in future analysis if looped non-competitive constraints congestion is observed in our market.

Attachment G – List of key dates in the market power mitigation stakeholder process

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

ATTACHMENT G

List of Key Dates in Stakeholder Process for Local Market Power Mitigation Enhancements Tariff Amendment

Date	Event/Due Date
October 1, 2010	CAISO announces launch of new stakeholder process regarding local market power mitigation enhancements and issues paper entitled "Local Market Power Mitigation Enhancements Issue Paper"
October 8, 2010	CAISO Market Surveillance Committee hosts meeting that includes discussion of CAISO paper issued on October 1, CAISO presentation entitled "Local Market Power Mitigation Enhancements Briefing," and CAISO Market Surveillance Committee presentation entitled "Changes to Local Market Power Mitigation Due to Addition of Bid-in Demand and Convergence Bidding"
October 15, 2010	Due date for written stakeholder comments on matters discussed at October 8 meeting
March 18, 2011	CAISO issues paper entitled "Local Market Power Mitigation Enhancements Straw Proposal," and CAISO Department of Market Monitoring issues paper entitled "Proposed Modifications to Methodology for Competitive Path Designations for Local Market Power Mitigation"
March 25, 2011	CAISO hosts stakeholder conference call that includes discussion of CAISO paper and CAISO Department of Market Monitoring paper issued on March 18, and CAISO presentation entitled "Local Market Power Mitigation Enhancements"
April 1, 2011	Due date for written stakeholder comments on matters discussed on March 25 conference call
May 6, 2011	CAISO issues paper entitled "Local Market Power Mitigation Enhancements Draft Final Proposal"
May 9, 2011	CAISO issues paper entitled "A Retrospective Analysis of Local Market Power Mitigation Enhancements"
May 13, 2011	CAISO hosts stakeholder meeting that includes discussion of CAISO paper issued on May 6 and CAISO presentation entitled "Local Market Power Mitigation Enhancements"
May 23, 2011	CAISO Department of Market Monitoring issues paper entitled "Draft Final Proposal – Dynamic Competitive Path Assessment"; due date for written stakeholder comments on CAISO paper issued on May 6
June 23, 2011	CAISO issues paper entitled "Addendum to the Retrospective Analysis of Local Market Power Mitigation

Date	Event/Due Date
	Enhancements”
July 5, 2011	CAISO Department of Market Monitoring issues paper entitled “Revised Draft Final proposal – Dynamic Competitive Path Assessment”
July 6, 2011	CAISO hosts stakeholder conference call that includes discussion of CAISO papers issued on May 9 and June 23, CAISO presentation entitled “Discussion of Addendum to the Retrospective Analysis,” and CAISO Department of Market Monitoring presentation entitled “Dynamic Competitive Path Assessment”; CAISO Market Surveillance Committee issues paper entitled “Final Opinion on Local Market Power Mitigation and Dynamic Competitive Path Assessment”; Keith Casey, Vice President, Market & Infrastructure Development for the CAISO, provides memorandum to the CAISO Governing Board entitled “Decision on Local Market Power Mitigation Enhancements”
July 14, 2011	CAISO Governing Board Authorizes filing of tariff amendment to implement local market power mitigation enhancements
July 15, 2011	CAISO issues draft tariff language to implement local market power mitigation enhancements
July 22, 2011	Due date for written stakeholder comments on draft tariff language issued on July 15
August 4, 2011	CAISO hosts stakeholder conference call to discuss draft tariff language issued on July 15
August 26, 2011	CAISO issues revised draft tariff language to implement local market power mitigation enhancements and paper entitled “Local Market Power Mitigation Enhancements – Stakeholder Comments”
September 2, 2011	Due date for written stakeholder comments on revised draft tariff language issued on August 26
September 13, 2011	CAISO hosts stakeholder conference call to discuss revised draft tariff language and paper issued on August 26
October 28, 2011	CAISO issues further revised draft tariff language to implement local market power mitigation enhancements

Attachment H – CAISO Governing Board memorandum and resolution

Local Market Power Mitigation

and

Dynamic Competitive Path Assessment Tariff Amendment

California Independent System Operator Corporation

Fifth Replacement FERC Electric Tariff

November 16, 2011

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President, Market & Infrastructure Development

Date: July 6, 2011

Re: **Decision on Local Market Power Mitigation Enhancements**

This memorandum requires Board action.

EXECUTIVE SUMMARY

The California Independent System Operator Corporation includes market power mitigation provisions in its market design to ensure that no market participant has the ability to unilaterally influence the price of energy. This memorandum describes proposed changes to the local market power mitigation rules set forth in the ISO tariff and requests ISO Board of Governors approval for a necessary filing with the Federal Energy Regulatory Commission. These changes would:

- Meet the requirement set forth in the September 21, 2006 FERC order to base the market power mitigation on *bid-in demand* rather than the current practice of using *forecast demand;*

- Incorporate design elements to reflect the implementation of convergence (virtual) bidding and new demand response resources;[1]

- Improve the accuracy of bid mitigation in both the day-ahead and real-time markets; and

- Incorporate *dynamic competitive/non-competitive path designation* into the LMPM process in place of the current practice of using a more static seasonal designation.

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[1] The webpage containing all the documents related to convergence bidding can be found at http://caiso.com/1807/1807996f7020.html ; demand response at http://caiso.com/1893/1893e350393b0.html

Requirement to use bid-in demand

In 2003, as part of its new market design filing with FERC, the ISO filed proposed new local market power mitigation measures. The ISO needed these measures to mitigate the potential exercise of local market power in transmission-constrained areas under the new market design. In the day-ahead market, the mitigation was based on forecast demand rather than the demand that was bid into the market. The mitigation was based on forecast demand at that time to address technology limitations and to determine requirements for *reliability must-run resources*[2] based on forecast demand. FERC issued an order that approved the proposal, but required the ISO to transition from using forecast demand to bid-in demand as the basis for applying market power mitigation no later than three years after the new market start up. Based on that order, the ISO must implement this change by April 2012. Approval of this enhancement will ensure that the ISO meets the FERC requirement.

Convergence bidding and demand response

Since the inception of the new market in April 2009, the ISO has implemented additional functionality to allow demand response resources to participate in the market and to allow market participants to take financial positions through convergence bidding. Currently, the ISO excludes consideration of convergence (or virtual) bids and demand response bids from the market power mitigation process because, under the current design, these bids could potentially undermine the local market power mitigation process. Management's proposed changes to the methodology for mitigating market power incorporates consideration of convergence bidding and demand response in a manner that does not undermine the effectiveness of the mitigation.

Dynamic competitive path assessment

The Department of Market Monitoring currently uses a seasonal competitive path assessment to determine whether specific transmission paths are competitive or non-competitive. A transmission path is deemed non-competitive if fewer than three resources can relieve congestion on that path. The ISO is proposing to move from a seasonal assessment to a dynamic competitive/non-competitive path assessment each time the mitigation process is executed. The proposed changes include assessing transmission path competitiveness within the market software. Doing so will allow the ISO to run the path assessment and mitigation measures prior to each 15-minute real-time, pre dispatch run to determine the set of mitigated and unmitigated bids for the 5-minute real time market. To accommodate development time for the new functionality and to minimize implementation risks, the dynamic path assessment and associated bid mitigation changes will be implemented in two

[2] A reliability must-run resource is a generator that the ISO determines to be needed on line to meet reliability requirements. This includes (1) generation needed to meet NERC/WECC reliability requirements (2) generation needed to meet load in constrained areas, and (3) generation needed to provide voltage support. In 2011, there is only one resource designated as reliability must run.

phases. Additional background and discussion of this issue is provided in DMM's board memo.

Mitigation execution time and frequency in real-time

By implementing the proposed enhancements to the local market power mitigation process, the ISO can reduce the overall mitigation process execution time. This will allow the ISO to accommodate the proposed dynamic competitive path assessment, and run the mitigation process in sync with this assessment. The proposed mitigation method is more targeted to those resources that are identified as having local market power and therefore is more accurate. In addition, when real-time mitigation is ultimately implemented, the improvements from using more current market and system information will result in more accurate mitigation.

Management proposes the following motion:

> ***Moved, that the ISO Board of Governors approves the proposed tariff change regarding the enhancements to local market power mitigation, as detailed in the memorandum dated July 6, 2011, and;***
>
> ***Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.***

DISCUSSION AND ANALYSIS

Background

The current automated market power mitigation process has one main purpose: to determine the circumstances where a supply resource can exercise local market power, meaning that it could potentially manipulate the price in its local area by controlling supply. In its current design, the ISO runs its local market power mitigation process before the day-ahead market and as part of the hour-ahead scheduling process for the real-time market. Each of these processes results in a bid curve[3] that is then considered in the market runs. In the day-ahead timeframe, for example, scheduling coordinators submit bids and self schedules, which are validated by the ISO before beginning the local market power mitigation process. The bids are evaluated for market power in two passes. In the first pass, the *competitive constraints run*, the software uses the competitive transmission paths to clear supply against forecast demand. Transmission paths are deemed competitive if there are three or more suppliers that are able to resolve a constraint on the path. The results are then used in the second pass, the *all constraints run*. In this pass the

[3] A bid curve represents MWh output levels and associated prices at which a supplier is willing to supply energy.

software uses a network model that has all transmission constraints enforced (not just those deemed competitive) and clears supply against forecast demand. Any resource that has an increase in its dispatch level between the competitive constraints run and the all constraints run potentially has the ability to exercise local market power and, as a result, its bids will be mitigated. Mitigation means that the software will modify these resources' energy bid curves to the lower of their default energy bids[4] or their day-ahead market bids. The resulting mitigated bid curves are then used in the applicable market run.

As mentioned above, the current local market power mitigation process uses a forecast of internal demand rather than submitted demand bids. In its 2006 order, FERC recognized that the ISO was unable to implement its current local market power mitigation provisions with bid-in demand at the start of the new market. They directed the ISO to revise its process to use bid-in demand within three years of the new market start up to reduce the likelihood of over-mitigation on suppliers.

In considering how to comply with this requirement, the ISO has examined how virtual bids should be evaluated in the local market power mitigation process. Although the ISO is not proposing to mitigate virtual bids, the implementation of virtual bidding triggers two concerns with the current process. First, bid-in demand will include virtual demand bids in the local market power mitigation process, so there is an increased likelihood that the unmitigated supply bids could determine the locational marginal prices. That is, if a large amount of demand clears due to the addition of virtual demand bids, then unmitigated supply bids may be needed to meet this additional demand. Similarly, since virtual supply bids do not have default energy bids associated with them, a virtual supply bid can potentially "crowd out" a physical supply bid, which has higher bid prices but lower default energy bids than the virtual supply bid. A physical resource can systematically bypass local market power mitigation in this way. To address this issue, the ISO has proposed a market power mitigation enhancement that is able to identify the physical resource for mitigation without mitigating the virtual bid.

There are additional benefits the ISO will be able to incorporate with the proposed changes to the local market power mitigation measures. As mentioned above, the current process has two pre-market passes – the competitive constraints run and the all constraints run. Each of these market runs uses ISO system resources and processing time. The proposed enhancement would streamline the process into one market run, and reduce the overall mitigation process execution time. This would allow the ISO to accommodate a dynamic competitive path assessment. The bid mitigation process will be executed in sync with the dynamic competitive path assessment which will provide more accurate information for the system to make mitigation decisions.

[4] The ISO maintains default energy bids for all generating units that are calculated using a variety of methods designed to reflect a reasonable competitive bid for each generating unit. These default energy bids are used in the local market power mitigation procedures.

Both the current and proposed mitigation processes require a distinction between competitive and non-competitive transmission paths in order to identify local market power and apply targeted mitigation. When a transmission path becomes congested, there will generally be a change in prices on either side of that path, with prices on the congested side being higher. A transmission path is competitive if there is adequate supply of generation that can provide congestion relief. Currently, the Department of Market Monitoring performs the competitive path assessments four times a year through an off-line study that considers a range of system conditions that may be faced when the resulting path designations are used for mitigation.

Performing the competitive path assessment months prior to using the results in the market execution involves a high degree of unknown circumstances that require employing assumptions to overcome. Moving the competitive path assessment into the market software so that it captures the most up to date information about resource and system conditions reduces the number of assumptions that must be made and improves the accuracy of the resulting competitive assessment.

Local market power mitigation enhancements proposal

Locational marginal price decomposition methodology

Management's proposal uses a new mechanism to determine which bids to mitigate in the local market power mitigation process that is called *locational marginal price decomposition*. The locational marginal price is the cost of serving the next increment of demand at a specific location and is made up of three components: energy, losses and congestion. The locational market price decomposition methodology separates the congestion component into two parts, including the congestion due to constraints on competitive transmission paths and congestion due to constraints on non-competitive transmission paths. This is important because if congestion occurs on non-competitive transmission paths, some resources could have local market power and require mitigation.

The locational market price decomposition methodology considers both physical and virtual bids. When a resource provides a bid into the market, the non-competitive congestion component of the locational market price at that resource's location is evaluated. If a physical resource has potential for local market power due to non-competitive congestion, its bid is mitigated in the market run. However, as with the current methodology, virtual bids will not actually be mitigated under the locational market price decomposition methodology.

Reliability must-run dispatch

Since the local market power mitigation enhancements will require the use of bid-in demand rather than forecast demand, the current mitigation process cannot be relied on to dispatch reliability must-run resources at the level necessary to meet reliability needs and to address non-competitive constraints.

Due to the dramatic reduction of reliability must-run units in 2011, the ISO has concluded that the most efficient solution to this problem from both process and resource perspectives is to provide for manual reliability must-run dispatch. Under this proposal, if ISO operators believe that a reliability must-run unit needs to be committed they will issue a manual reliability must-run dispatch.

Dynamic competitive path assessment methodology

The dynamic competitive path assessment will test each binding constraint in the associated market run to evaluate competitiveness. This test, known as *the pivotal supplier test*, involves removing the three largest suppliers (defined in terms of amount of congestion relief capabilities) and testing to see whether the remaining supply can relieve congestion on the transmission path in question. If the remaining supply cannot relieve the congestion, the three largest suppliers are considered "pivotal" (i.e., needed for congestion relief on that path) and the path is deemed non-competitive. The residual supply calculations will take into account the most current resource and system conditions, the effectiveness of each resource to relieve congestion on the path, the impact of convergence bids on the ability to exercise market power, and changes in operational and bidding control of physical resources within each portfolio.

Dynamic competitive path assessment implementation schedule

The proposed dynamic competitive path assessment is to be implemented in two phases because of the complexity surrounding the implementation of the real-time changes. The first phase will be implemented in the Spring of 2012 along with the local market power mitigation enhancements and will include a dynamic competitive path assessment in the day-ahead market only. For the day-ahead market, a transmission path will be determined to be non-competitive only if it fails the pivotal supplier test, rather than by default. Because the dynamic competitive path assessment will not be applied in the real-time market in the first phase, the current approach using static path assessments will be applied in the real-time market. Under the static path designation approach, each transmission path is deemed non-competitive by default unless it is tested and passes the current seasonal pivotal supplier test.

The second phase will be implemented before the end of 2012 and will add two dynamic competitive path assessments in the real-time market; one in the hour-ahead scheduling process and a second in the 15-minute pre-dispatch process.

> **Hour-ahead scheduling process** - The static seasonal path designations used in the hour-ahead scheduling process will be replaced with competitive path designations generated by a dynamic assessment performed in the hour-ahead scheduling process. Under the dynamic assessment approach, each path will be considered competitive unless it is tested and fails the pivotal supplier test. Bid mitigation resulting from this run will be applied to all subsequent market runs until the 5-minute real time market dispatch. This includes the financially binding intertie dispatch for energy and ancillary services from the hour-ahead scheduling process, as well as subsequent short term unit commitment and real-time procurement of ancillary services from internal resources.

> **15-Minute pre-dispatch process** - There will be an additional dynamic competitive path assessment applied in each 15-minute real-time pre-dispatch run just prior to the 5-minute real-time market dispatch. It is this additional assessment and mitigation that provides the additional accuracy in the real-time mitigation process since they are evaluated very close to the 5-minute real-time market where market power would be exercised. As with the hour-ahead process, a transmission path will be considered competitive unless it is tested and fails the pivotal supplier test. The proposed local market power mitigation also will be applied after this market run and utilize the more current competitive path designations. All real time bids will be re-evaluated at this stage. Bid mitigation resulting from this run will be applied to the balance of the trade hour starting with the 15-minute period for which the mitigation run applies.

Market Surveillance Committee opinion

The Market Surveillance Committee supports Management's proposal. The opinion of the Market Surveillance Committee is attached.

POSITIONS OF THE PARTIES

Stakeholders generally support the proposal; however, there were requests for additional information and examples describing how the locational marginal price decomposition methodology works in practice. Additional studies were provided to enable stakeholders to evaluate the proposal in more detail.

Some stakeholders urged the ISO to commit to implementing the dynamic competitive path assessment in parallel with the local market power mitigation enhancements. The driver for implementing this proposal is the September 21, 2006 FERC order requiring the use of bid-in demand by April 2012. However, the ISO has committed to implementing the dynamic competitive path assessment simultaneously if possible, or as soon as possible thereafter if it is not possible to implement the changes simultaneously.

Some stakeholders have argued that the current phased approach for implementing the dynamic competitive path assessment will result in a higher number of non-competitive paths and more mitigation. Based on staff analysis, Management believes the current phased implementation plan for a dynamic competitive path assessment, coupled with the enhanced local market power mitigation based on locational market price decomposition, will produce more accurate and less frequent bid mitigation than the current mitigation procedures. Therefore, we recommend this approach over deferring both mitigation changes until they can be implemented simultaneously.

Additional information regarding stakeholder comments is provided in the attached stakeholder matrix.

MANAGEMENT RECOMMENDATION

Management recommends that the Board approve the policy to implement enhancements to local market power mitigation and modify tariff provisions as outlined in this memorandum and authorize Management to make all necessary and appropriate filings with FERC to implement the proposed tariff change.

Board of Governors **July 13-14, 2011** **Decision on Local Market Power Mitigation Enhancements**

<u>Motion</u>

Moved, that the ISO Board of Governors approves the proposed tariff change regarding the enhancements to local market power mitigation, as detailed in the memorandum dated July 6, 2011; and

Moved, that the ISO Board of Governors directs ISO Management to report back in Q1 2012 on testing results and the implementation status so the Board can assess whether any changes to the schedule are warranted; and

Moved, that the ISO Board of Governors authorizes Management to make all necessary and appropriate filings with the Federal Energy Regulatory Commission to implement the proposed tariff change.

Moved: Bhagwat Second: Foster

Board Action: **Passed**	Vote Count: **4-0-0**
Bhagwat	Y
Foster	Y
Galiteva	Y
Maullin	Y

Motion Number: 2011-07-G4