California Independent
System Operator Corporation

Convergence Bidding:
Department of Market Monitoring Recommendations

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Introduction

Convergence bidding (also known as "virtual bidding") offers potential for improved market efficiency under the type of two-settlement energy market being implemented under MRTU. However, if not carefully designed, convergence bidding may also create the potential for market manipulation through exploiting market design or modeling flaws to the detriment of market efficiency and other participants. This paper provides recommendations of the California Independent System Operator (CAISO) Department of Market Monitoring (DMM) on some key market design, mitigation and monitoring issues relating to convergence bidding options being considered by the CAISO.

This paper builds upon DMM's initial analysis and recommendations which were provided in an October 24, 2005 whitepaper,[1] and numerous subsequent presentations made by DMM during the stakeholder process on convergence bidding.[2] This paper focuses on additional refinement of DMM's recommendations on some key issues of the market design, and mitigation and monitoring requirements of convergence bidding. Attachments to this report provide a summary of DMM's benchmarking of other ISOs, as well as illustrative examples of the Congestion Revenue Rights Settlement Rule, potential circumvention of Local Market Power Mitigation measures, and the potential concern with Seller's Choice Contracts.

As noted in previous DMM reports and presentations, the spatial granularity at which convergence bidding is implemented (i.e., at the Load Aggregation Point (LAP) or the pricing node level) represents the most important market design element relating to mitigation of potential adverse impacts or abuses of virtual bidding. Under a LAP-level virtual bidding design, both virtual demand and supply bids would only be allowed at the LAP level. Under this design, virtual supply bids are, in effect, negative virtual demand bids (i.e., they simply have the effect of reducing LAP demand bids). This option is most equivalent to the zonal model adopted in the New York ISO (NYISO), except that three LAPs exist in the CAISO market under MRTU, compared to eleven internal zones in the NYISO control area. Nodal virtual bidding would enable Market Participants to place virtual supply or demand bids at individual pricing nodes. While this design would require extensive enhancements to MRTU software, and may create potential gaming opportunities which necessitate much more significant mitigation and monitoring provisions, there may be additional efficiencies to be gained through a nodal convergence bidding design.

The remainder of this paper is divided into three parts, each evaluating both the LAP and nodal designs.

- The first section focuses on the potential benefits of convergence bidding with respect to specific objectives, including providing a hedging mechanism, increasing price convergence, and potentially improving forecast accuracy.

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[1] The October 24, 2005 DMM whitepaper on Convergence Bidding is available on the CAISO website at the following link: http://www.caiso.com/189b/189b787e6fbc0.pdf

[2] *DMM Comments and Recommendations on Convergence Bidding*, October 31, 2007, http://www.caiso.com/18a0/18a0b00f67110.pdf

DMM Comments and Recommendations on Convergence Bidding Design Options , August 10, 2007, http://www.caiso.com/1c33/1c33cc343d230.pdf

DMM Recommendations on Convergence Bidding, September 12, 2007, http://www.caiso.com/1c56/1c56ddb64d070.pdf

- The second section details the market mitigation measures in response to concerns under LAP and nodal convergence bidding. Again, specific issues are discussed in turn. Among the mitigation measures discussed are modifications to Local Market Power Mitigation, a settlement rule to deter the gaming of Congestion Revenue Rights, and the implementation of nodal position limits to dampen effects of virtual bidding strategies.

- The third section summarizes market monitoring requirements. While the potential benefits of nodal bidding are compelling, the concerns are much greater and the monitoring requirements more onerous.

The tables provided at the end of each of the following sections summarize DMM's research and recommendation, and also underscore the trade-offs between the two designs.

As noted in previous DMM whitepapers and presentations, DMM believes that implementing convergence bidding at a LAP level initially would capture many of the potential benefits of convergence bidding, while limiting the potential adverse effects of convergence bidding at a more granular level. However, this paper also outlines specific mitigation rules and monitoring requirements necessary to address the potential adverse impacts of nodal convergence in the event that the CAISO decides to start out with nodal convergence bidding. With these measures in place, DMM would support the implementation with nodal convergence bidding.

I. Potential Benefits from Convergence Bidding

This section summarizes DMM's assessment of the relative benefits of the LAP and nodal designs for convergence bidding under MRTU.

Price Convergence

One of the primary cited benefits of convergence bidding is to prevent the exercise of monopsony power in the day-ahead energy market by large buyers or LSEs at the LAPs by way of strategic load under-scheduling. The LAP-level convergence bidding design will certainly accomplish this by providing a mechanism for participants – including marketers and generators – to increase bid-in demand using virtual transactions in order to cause more supply to clear in the Day Ahead Market. Given that physical load bids of LSEs can only be placed at a LAP level and these load bids settle at the LAP level, LAP level convergence bidding would be just as effective as nodal convergence bidding in terms of providing other participants with a tool for off-setting any "under-scheduling" of load in the Day Ahead Integrated Forward Market (IFM) that may result from strategic, cost-minimizing bidding of loads by LSEs.

Meanwhile, two other sources of potential price divergence between day-ahead and real-time prices include:

- Modeling errors or inconsistencies in the Full Network Model (FNM) used in the IFM, compared to the Real Time Market software and conditions, and

- Any out-of-market dispatches or other reliability-related actions taken by the CAISO between the IFM and Real Time Markets.

These factors may create price divergences at a nodal level, which could not be resolved by LAP level convergence bidding. Thus, to the extent these factors do create price divergences under MRTU, the nodal design may provide greater price convergence at the nodal level and at the overall LAP level as well.

Mitigation of Supplier Market Power

A second and often cited potential benefit of convergence bidding is that it may mitigate market power of suppliers – particularly at individual supply nodes – in the Day Ahead Market by allowing other participants to submit virtual supply bids. At the same time, however, DMM notes that Convergence Bidding may also provide a tool by which market power can be exercised. For example, extensive illustrations of how nodal level convergence bidding might undermine the Local Market Power Mitigation (LMPM) provisions incorporated in MRTU are provided in Attachment A.

DMM believes that the potential for nodal convergence bidding to undermine the LMPM provisions of MRTU can be best mitigated by including physical and convergence supply and demand bids in the pre-IFM LMPM runs made to determine which supply units are subject to bid mitigation (i.e., instead of basing these pre-IFM LMPM runs on forecasted demand and physical supply bids only). A more detailed description of options and DMM recommendations for addressing this issue is provided in the second section of this report (II. Mitigation Measures**,** *Local Market Power Mitigation*, p. 9). However, as discussed later in the report, the opportunities for suppliers to undermine LMPM provisions or utilize convergence bidding for other gaming strategies that may be detrimental to the market may also be mitigated by the actions of other market participants if the convergence bidding market is deep and liquid. Thus, the extent to which convergence bidding ultimately contributes to or mitigates supplier market power depends on market rules, liquidity of the market, and other factors.

Elimination of Implicit Virtual Bids

Another potential benefit of convergence bidding is that it may reduce or eliminate the incentive for “implicit” virtual bidding through under- or over-scheduling of load or submitting bids or schedules from physical resources that, once accepted in the Day Ahead Market, are withdrawn in real-time.

Since actual load is required to schedule at the LAP level only, the LAP-level design should largely eliminate the incentives to engage in implicit convergence bidding through under- or over-scheduling of load. The LAP-level design should also help to reduce any implicit virtual bidding at individual supply nodes since there is likely to be a strong correlation between price convergence at the LAP level and at individual supply nodes.

Nodal convergence bidding would be highly effective in reducing implicit virtual bidding at individual supply nodes. However, as discussed in Attachment A, DMM notes that nodal convergences could also incent generators to take a virtual position in the Day Ahead Market (i.e., by placing virtual demand bids), and to then leverage that position by deviating from their generation schedules in order to raise the real-time price. Uninstructed deviation penalties and/or nodal position limits would help to deter this practice.

Increase in Market Liquidity

Virtual bidding may also provide the benefit of a general increase in market liquidity. Under the LAP design, all virtual supply and demand bids and all physical demand will form a single market at each LAP. These LAPs also correspond closely with generation trading hubs, which provides the opportunity to create significant liquidity at the LAP/trading hub level. In Eastern ISOs, much of the virtual trading activity reportedly occurs at their trading hubs despite the nodal design of those markets. This is because many of the bilateral contracts in the East source and sink at the trading hub, and those contracts are tied to the day-ahead price at the hub. Thus, the hubs become natural locations at which to place virtual bids to hedge a contract position. To the extent that most contracting is also done at a LAP or hub level in California, LAP-level convergence bidding may be comparable to a nodal design in terms of promoting market liquidity.

Nodal convergence bidding, on the other hand, may attract more purely financial players into California's market. In addition, it may incent more current participants to participate in the virtual market because the ability to place virtual bids at more targeted geographies may enable them to better tailor their use of virtual transactions. Again, many of the potential strategies for market manipulation under nodal convergence bidding can be quickly arbitraged away given a deep and liquid virtual market. Thus, market liquidity is not only a potential benefit of virtual bidding, but also a necessary attribute to ensure a healthy market under a nodal convergence bidding design.

Hedging and Scheduling Mechanisms for Generation Owners

Other frequently cited benefits of convergence bidding are that it provides generators with a mechanisn for:

- Hedging outage risks, and
- Offering and scheduling supply in the Day Ahead Market, while still being able to earn the real-time price if they believe this price will exceed the day-ahead price.

While limiting virtual demand bidding at the LAP level does not provide as targeted a mechanism for these purposes as nodal virtual demand bidding, LAP level virtual demand bidding could still enable generation owners to achieve some measure of a hedge. This is because, although the LAP price is a weighted average price of the nodal prices in that LAP and thus any change in a nodal price would have a "diluted" effect on the LAP price, that effect would, *ceteris paribus*, be in the same direction as the change in the LAP price. Similarly, to the extent that differences in day-ahead and real-time prices at a generator's node were comparable to differences in day-ahead and real-time prices at the LAP level, virtual bidding at a LAP level would be comparable to nodal virtual bidding in terms of providing generators with the ability to offer and schedule generating resources in the Day Ahead Market, while still earning the real-time price.

Meanwhile, a nodal convergence design provides a more precise instrument for accomplishing such hedging and scheduling incentives. Again, however, because nodal virtual bids would also enable a generation owner to take a virtual position in the day-ahead and leverage that position using uninstructed deviations (or unit outages), measures to deter such deviations or at least to dampen their effects would be required under a nodal virtual bidding design. An example of such a strategy is provided in Example 3 of Attachment A.

Conversion of Congestion Revenue Rights Hedge to the Real Time Price

Congestion Revenue Rights (CRRs) are settled based on prices in the Day Ahead IFM market. However, if the holder of a CRR wanted to utilize its CRRs as a hedge for difference in real-time prices between two locations, this could be accomplished by offsetting the CRR with a virtual transaction in the day-ahead which will then liquidate at the real-time price. Thus, with convergence bidding, a CRR could be used to hedge against day-ahead congestion *or* to hedge against real-time congestion.

LAP-level convergence bidding would be less effective in enabling participants to convert their congestion hedges to real-time. This is because virtual bids, which would only be submitted at LAPs under the LAP-level design, would be distributed across many nodes using Load Distribution Factors (LDFs) so it would not be possible for a participant to target the specific nodes for which it owns CRRs. Conversely, allowing convergence bidding at individual nodes would enable a participant to move the congestion hedge into real time.

While this aspect of convergence bidding may be seen as a benefit by some holders of CRRs, it may not be viewed as a significant overall benefit of nodal convergence bidding. Specifically, DMM notes that the desirability of allowing CRRs to be used to hedge real-time prices may be questionable from a policy and market design perspective, since this may undermine numerous aspects of the MRTU market rules that are designed to encourage reliance on the Day Ahead Market and reduce reliance on the Real Time Market.

In addition, while the ability to have a more targeted hedge using nodal virtual transactions may be a benefit to CRR holders in this situation, it must also be noted that nodal virtual bids could also be used to increase day-ahead congestion between specific nodes and thus increase the value of the CRR, as discussed later in this report. DMM recommends the implementation of the CRR settlement rule used by PJM Interconnection (PJM) and ISO New England (ISO-NE) under a nodal virtual bidding design.[3,4]

Table 1 provides a summary of the potential benefits of convergence bidding at both the LAP and nodal levels. Again, this highlights the trade-offs between the granular and aggregated convergence bidding designs.

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[3] PJM's Market Monitoring Unit applies the CRR settlement rule on a monthly basis, whereas ISO-NE appears to apply this rule on a less routine or even a case-by-case basis.

[4] For more detail on the settlement rule required for this option, see Attachment B.

Table 1: Potential Benefits of Convergence Bidding

	LAP Design	Nodal Design
Price Convergence at the LAP Level	Highly effective	Highly effective
Price Convergence at the Nodal Level	Highly effective, unless nodal prices diverge due to CAISO modeling deficiencies or out-of-market dispatches, etc.	Highly effective, but creates potential for gaming strategies that could create sporadic price divergences or increase overall prices.
Mitigation of Supplier Market Power	Effective on system level/limited effectiveness on local level	Effective on system and local level, assuming a deep and liquid virtual market
Deterrence of Implicit Virtual Bidding	Highly effective	Highly effective
Increase Market Liquidity	Effective	Highly effective
Provision of Hedging Mechanism for Generators	Limited effectiveness	Highly effective
Enables CRR Holders to Convert Their Hedge to the RT Price	Limited effectiveness	Highly effective

II. Mitigation Measures

This section describes the various market power mitigation measures that DMM recommends under LAP-level and nodal convergence bidding.

Settlement Rule for Congestion Revenue Rights

As discussed above, under nodal virtual bidding, DMM believes it would be important to implement a settlement rule that automatically limits revenues from CRRs that have been increased by the strategic use of convergence bids. DMM believes that while the settlement rule used by PJM and ISO-NE will mitigate much of the concern about use of virtual bids to mitigate gaming of CRRs, this rule is not a "silver bullet." In particular, the rule applies to virtual transactions at source and sink nodes and to "nearby nodes." These nearby nodes are defined as those that have a shift factor to the source or sink of .75 or greater. Participants submitting virtual transactions at nodes with a .74 shift factor are not subject to the rule but may nonetheless impact congestion and thus the value of the CRR. Another imperfection of the CRR settlement rule is that the value to which the CRR payment is mitigated in any hour is the average hourly price paid for the CRR. However, due to the inherent hour-to-hour variation of actual congestion over the time-span of a CRR, during many hours the average cost of the CRR is likely to significantly exceed the expected value of congestion (i.e., the congestion value that would occur in the absence of any strategic bidding to increase congestion). During these hours, an entity owning the CRR may benefit by increasing congestion up to the average cost of the CRR without triggering the CRR settlement rule. Additional details and an example are provided in Attachment B.

Position Limits

Under LAP convergence bidding, the ability of an individual participant to affect market prices through convergence bidding will be limited by the relatively large size of the market at a LAP level (i.e., including physical and convergence supply and demand bids). In addition, for many participants, credit and collateral requirements may provide *de facto* position limits that would be sufficient to limit an individual participant's ability to affect prices under the LAP design.

When nodal convergence bidding is considered, however, DMM recommends that position limits relative to nodal load or generation capacity be applied to each participant. For example, if a ten percent position limit were implemented, a node with 100 megawatts of generation capacity would have a limit of ten megawatts for each market participant for each hour. For load nodes, position limits could be based on metered loads during the previous year (e.g., the maximum or an average of specific hours). The benefit of such position limits would be to provide a controlled transition to nodal virtual bidding, and to prevent the exercise of market manipulation by way of outages or deviations. Additionally, position limits would limit the ability to use virtual transactions to undermine LMPM, to create infeasible schedules, and to impact congestion for the purpose of gaming CRRs. The primary drawback of position limits designed in this way is that it would prevent generation owners from fully hedging an outage. Given the possibility for manipulation, the inevitable unknown and learning under a new market design, and the uncertainty as to the market liquidity required to counter-balance such strategies, DMM recommends the inclusion of nodal position limits, at least initially, under the nodal convergence bidding design.

In particular, DMM recommends a nodal position limit of ten percent of that node's load or capacity. The limit would be applied to each participant. Thus, under a scenario in which four to six participants are placing virtual bids at a node, this would allow the volume of virtual bids equal to forty to sixty percent of the physical volume, which is roughly equivalent to the volume of virtual trading in other ISOs. These other markets are considered to be "deep and liquid" and thus able to self-correct in the event of market manipulation. In the case of fewer participants placing virtual bids – a case which would present market power or gaming concerns – a ten percent position limit would dampen the ability of a participant to move the nodal price. Additionally, a ten percent limit would enable a generation owner to utilize convergence demand bids to hedge significantly against the possibility of an outage, but would limit the ability to profit from such operational problems.

Bid Caps

Because virtual bids are based on the bidder's expectation of the difference between day-ahead and real-time prices, there is basis for establishing Default Energy Bids for virtual bids based on costs or virtual bids in previous time periods that could be used in market power mitigation (MPM). For this reason, applying MPM to virtual bidding is problematic. However, DMM recommends that virtual bids be subject to the same $500-$1,000 maximum bid cap that will be in effect for physical bids under MRTU.[5] Specifically, for the first year after the launch of MRTU, physical and virtual bids would be subject to the bid cap of $500. In the second year, the cap for physical and virtual bids would be raised to $750, and would move up to $1000 in the third year after the launch.

Local Market Power Mitigation

As illustrated in the examples provided in Attachment A, virtual bids at the nodal level can be used to undermine the LMPM process.

<u>Benchmarking</u>

The NYISO, PJM and ISO-NE all include virtual and physical supply and demand bids in their market power mitigation passes. The rationale for this is that since the virtual bids impact congestion and locational marginal prices during the actual Day Ahead Market, virtual bids should be included in the determination of which physical supply bids should be subject to market power mitigation provisions applied prior to the Day Ahead Market. However, in none of these ISOs are the virtual bids actually mitigated.

- In ISO-NE, virtual and physical demand clears against virtual and physical supply, and the evaluation on market power is done after the fact using a conduct and impact test.
- PJM includes virtual and physical supply and demand bids in their market power mitigation passes, but applies direct bid mitigation to physical bids only.
- The NYISO Day Ahead Market optimization includes multiple passes, the first of which includes all physical and virtual bids and thus renders an initial solution of prices and dispatch instructions. The Market Power Mitigation pass is applied to this initial solution, in which virtual and physical bids are included. Subsequent passes evaluate physical bids only against forecasted load, check for

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[5] MRTU Tariff, Section 39.6.1, available on the CAISO website at the following link: http://www.caiso.com/1798/1798ed7e313a0.pdf

satisfaction of local reliability requirements, apply automated market power mitigation to physical supply bids, and ultimately generate final dispatch instructions.

Options for LMPM under Virtual Bidding

When considering LMPM in the context of virtual bidding, the question is whether the virtual supply and demand bids should be excluded from the Pre-IFM and introduced only in the IFM pass, or if the virtual bids should be included in the Pre-IFM runs.

In the current MRTU design, the LMPM pass occurs prior to the IFM based on the CAISO load forecast.[6] This design may change, however, due to FERC's September 21 Order, which directed the CAISO to examine the issue of whether Pre-IFM LMPM should be based on total bid-in demand in future releases of MRTU.[7] In that case, the Pre-IFM LMPM runs would be made based on bid-in demand rather than forecasted demand.

Table 2 summarizes the inputs to the LMPM process under different scenarios. The first is the current MRTU design, which is followed by the possible scenario in which bid-in demand is included per FERC's September 21 Order. These first two items are presented for context for the subsequent two options which describe the potential inputs to LMPM under virtual bidding.

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[6] Currently the pool of resources that is passed to the IFM from the Pre-IFM contains only those resources that were selected in the Pre-IFM based on forecasted demand. However, since the actual IFM outcomes are based on bid-in demand (which may be different from and/or exceed the CAISO's demand forecast), the CAISO has determined that this restriction should be eliminated in order to broaden the pool of supply resources that may be used to meet bid-in demand. This restriction is evidently a simple "switch" which can be easily toggled to allow the entire pool of resources to be included in the IFM optimization. The CAISO has determined that this modification is appropriate under MRTU Release 1a even in the absence of convergence bidding. However, since convergence bidding would increase the potential for bid-in demand to exceed forecasted demand at both the LAP and nodal level, it is even more important to implement this modification prior to or in conjunction with convergence bidding.

[7] FERC Docket No. ER06-615-000 "Order Conditionally Accepting the California Independent System Operator's Electric Tariff Filing to Reflect Market Redesign and Technology Upgrade" September 21, 2006, Paragraph 1089, available on the CAISO website at the following link: http://www.caiso.com/1878/1878f9725ef80.pdf

- Current MRTU Design: In the initial launch of MRTU, the Pre-IFM evaluates bid-in supply against forecasted demand, first with only competitive constraints enforced, and then with all constraints enforced. The units committed in this second pass in order to relieve a non-competitive constraint are mitigated. The "clean bids" for the resources that are selected in this process, i.e., bids from resources selected in the competitive constraints pass and the mitigated bids for units committed in the all constraints pass, are then passed to the IFM.

- Potential Change to MRTU Design: FERC's September 21 Order directs the CAISO to examine the issue of whether Pre-IFM LMPM should be based on total bid-in demand in future releases of MRTU. This may constitute a major change to the Pre-IFM in that a second pass would be required. This is because the RMR component of the Pre-IFM may still need to be based on a pass against forecasted load whereas the LMPM component would be based on a pass against bid-in demand. The rationale for this change is that it would lessen the mitigation of supply bids.

- Option 1 under Virtual Bidding: In this option, mitigation is based on CAISO forecasted demand. This option closely parallels the current market design. Mitigation would exclude virtual bids altogether. The benefit of this approach is that it will continue to base mitigation solely on forecasted load and bid-in supply and thus the mitigation would not be impacted by the potential circumvention of LMPM using virtual demand bids as described in Attachment A, Example 1A.

- Option 2 under Virtual Bidding: In the second option, by contrast, mitigation is based on the inclusion of virtual bids and bid-in load. The LMPM examples in Attachment A illustrate the benefits that including bid-in demand in the LMPM pass can bring; in particular, competitively priced virtual supply can aid in checking market power by physical supply, as well as the effect of other virtual demand or supply bids that might be placed by participants aimed at increasing prices in the IFM or Real Time Markets. Under Option 2, the many participants in the market are collectively providing the forecast in the second option whereas the first option relies solely on the CAISO day-ahead forecast. In theory this could be a benefit of Option 2 since the unit commitment may be more efficient under this collectively determined "forecast." It is also conceivable, however, that the unit commitment could be less efficient and so this potential benefit should be carefully weighed. Finally, the second option respects the FERC directive to include bid-in demand in the IFM, and follows the same rationale as the Eastern ISOs.

DMM finds that both of these options are viable and the choice between the two options will largely depend on the underlying market design, implementation issues, and broader considerations beyond Convergence Bidding. If the CAISO implements the use of bid-in demand in the Pre-IFM, DMM recommends that Option 2 be implemented because it provides for greater checks against possible circumvention of the LMPM process, as illustrated in Attachment A.

Table 2: Inputs to Local Market Power Mitigation under Different Scenarios

	Forecasted Demand	Bid-In Demand	Physical Supply	Virtual Demand	Virtual Supply
Current MRTU Design	✓		✓		
Inclusion of Bid-In Demand		✓	✓		
Option 1 under Virtual Bidding	✓		✓		
Option 2 under Virtual Bidding		✓	✓	✓	✓

Uninstructed Deviation Penalties

By physically withholding all or part of a generating unit's scheduled supply in the Real Time Market, a generation owner could profit on a financial position taken in the Real Time Market through virtual demand bids. For example, a unit with a 100 MW day-ahead schedule could submit 200 MW of virtual demand bids. In real time, the owner could then fail to deliver his physical schedule, and the real-time price could be significantly higher as a result of this under-generation. Although the generator would have to buy the 100 MWh of undelivered energy back at this higher real-time price, the revenue from the 200 MWh virtual transaction would more than compensate for that loss.

This strategy hinges on the ability to affect the nodal price, reducing physical supply, and creating the need for the CAISO to dispatch higher cost bids in the Real Time Market. An example of another situation is depicted in further detail in Example 3 of Attachment A. As illustrated in this more detailed example, under real-time LMPM provisions, bid price mitigation is applied only to those units which the MRTU software forecasts will be dispatched based on forecasted demand. Thus, if resources deviate from their generation schedules or do not respond to dispatch instructions, the CAISO may dispatch units which have not been subject to bid price mitigation. This specific feature of current MRTU LMPM provisions may allow uninstructed deviations to create a significant increase in real-time prices.

Although the potential for uninstructed deviations to undermine the effectiveness of LMPM provisions exists even without convergence biding, DMM notes that convergence bidding at a nodal level could exacerbate this potential by providing a means for generators to leverage their ability to affect real-time prices to a much greater degree financially through virtual bidding. For this reason, under nodal virtual bidding, DMM believes that it is important to have relatively strict position limits (e.g., ten percent of load or generation at a node) for an initial period until greater experience with this potential issue is developed.

The CAISO's MRTU design provides for implementation of Uninstructed Deviation Penalties (UDP) should the CAISO determine that uninstructed deviations are creating significant detrimental impacts to system reliability or the CAISO markets. Given the uncertainty about the impact of uninstructed deviations under MRTU and the potential difficulties that may be associated with implementing the CAISO's current UDP provisions, DMM does not propose explicit uninstructed deviation penalties for the purpose of mitigating market power exercised using virtual transactions at this time. However, DMM notes that there may be other reasons (apart from concerns about the potential interactions between uninstructed deviations and virtual bidding) which may make it desirable to implement UDP or some other provisions to deter excessive uninstructed deviations. Thus, DMM recommends that the impacts of uninstructed deviations be assessed once MRTU is implemented, and actions be taken if necessary to address any observed detrimental reliability or market impacts which may include – but may not be limited to – the impact of uninstructed deviations on LMPM provisions.

Provisions to Address Potential Seller's Choice Contracts Concerns

Under MRTU, Inter-SC Trades (ISTs) are subject to physical validation procedures in the Day Ahead Market. This validation ensures that the generation and transmission capacity are present to accommodate the supply as scheduled. Seller's Choice Contracts allow the seller to choose the source node subject to the physical validation and at which the settlement of the contract will take place. The concern is that, because virtual transactions impact the Day Ahead Market outcome, the seller could use virtual transactions to place a schedule that would otherwise be infeasible. In this way, the seller can benefit from circumventing the physical validation process for ISTs. Attachment C to this paper provides an example of how this plays out in the settlement of the IST. LAP-level convergence bidding would avoid any foreseen problems with Seller's Choice Contracts, whereas nodal convergence bidding could result in manipulation. Currently there are approximately 9,900 MWh contracted under Seller's Choice Contracts. This will decrease to about 5,500 MWh in the year 2009, and all of the current Seller's Choice Contracts in California will expire in 2011.[8]

Limitation or Suspension of Convergence Bidding

As noted above, the Eastern ISOs generally do have provisions to limit or suspend convergence bidding for any particular SC or group of SCs that are determined to be utilizing convergence bidding in a way that is contributing to an "unwarranted divergence" between day-ahead and real-time prices. ISO-NE Market Monitoring has reportedly used this authority on rare occasions, whereas the NYISO has not. Additional detail is provided in Attachment D which contains the bulk of the results of benchmarking against other ISOs.

The Midwest ISO (MISO) Tariff, which has the most recently approved convergence bidding design, includes a more specific, formulaic approach to identification of behavior that may warrant limiting or suspending convergence bidding by individual participants. The MISO Tariff calls for the Market Monitor to calculate a rolling average of the difference between day-ahead and real-time prices to determine if that measure has exceeded ten percent. If so, and if the price divergence can be attributed to one or more market participants, then the Monitor has the discretion to suspend, for up to three months, the participant's

[8] This information was obtained from the California Energy Resources Scheduling (CERS) section of the California Department of Water Resources (CDWR) website: http://wwwcers.water.ca.gov/energy_contracts.cfm

ability to submit virtual bids. This suspension applies only to the nodes, or electrically similar nodes, at which the bids leading to the price divergence were placed.[9]

For the stability of the market and to protect other market participants, DMM believes it is important for the CAISO to have the authority to react quickly to any abuse of convergence bidding and therefore have an ability to quickly suspend an entity's ability to submit virtual bids if virtual bidding is found to:

- Detrimentally affect grid or market operations,
- Contribute to an unwarranted divergence in prices in the IFM and Real Time Market, or
- Otherwise distort competitive market outcomes.

Such behavior includes, but may not be limited to:

- Behavior that adversely affects the ability of the IFM to clear with the inclusion of virtual bids.
- Behavior that creates infeasible schedules which must be mitigated by out-of-market actions by Grid Operators.
- Virtual demand bidding behavior that reduces the effectiveness of Local Market Power Mitigation in the IFM (Example 1 of Appendix A).
- Virtual supply bidding behavior that reduces the effectiveness of Local Market Power Mitigation in the IFM (Example 2 of Appendix A).
- Potential instances of physical withholding of capacity in the Real Time Market to raise real-time prices in order to increase profits from virtual demand bids. Physical withholding may include unexplained or unjustified unit outages, deviations below energy schedules, and failure to respond to real-time dispatch instructions (Example 3 of Appendix A).

In the event that virtual bidding, either in general or by any particular participant or group of participants, was found to be detrimentally affecting grid or market operations, contributing to an unwarranted divergence in prices in the IFM and Real Time Market, or otherwise distorting competitive market outcomes, then the CAISO would have the authority to suspend virtual bidding in general or suspend or limit individual market participants' ability to submit virtual bids.

In the event the CAISO suspends or limits virtual bidding, either in general or for an individual market participant or group thereof, the CAISO would file supporting documentation with the FERC within ten business days of the suspension. The suspension or limitation would remain in effect for 90 calendar days unless the FERC directs otherwise.

With this approach, the CAIAO would be able to act promptly to limit or suspend any virtual bidding activity that was creating significant detrimental impacts. Within ten days, the CAISO would develop and file more detailed supporting documentation of the specific behavior and impacts leading to the limitation or suspension. This limitation would expire within ninety days or sooner unless expanded by FERC. Within

[9] Midwest ISO FERC Electric Tariff, Third Revised Volume No. 1, Section 65.5, pages 802-805

this 90 day period, FERC could consider documentation provided by the CAISO, as well as any information submitted by market participants subject to the limitations or suspension.

DMM recommends that the CAISO have this Tariff authority under both LAP and nodal convergence bidding. However, under the LAP design, DMM believes it would more likely be an operational issue, such as problems reaching a feasible solution, that would trigger suspension rather than market manipulation.

Table 3: Key Market Power Mitigation Rules

	LAP Design	Nodal Design
CRR Settlement Rule	Not required	Settlement rule as implemented in PJM and ISO-NE (see Attachment B)
Position Limits	Not required	Upon implementation of nodal design, 10% of load/capacity at each pricing node
Provisions to Deter Uninstructed Deviations	Not required	Not required, if 10% position limits adopted
Local Market Power Mitigation Modifications	Under both designs, DMM prefers LMPM based on physical and virtual bids.	
Provisions to Address Seller's Choice Concerns	Not required	Required
Ability to Limit or Suspend Trading	Recommended	Required

III. Monitoring Tools

Flagging of Convergence Bids

The DMM agrees that all virtual demand and supply bids should be explicitly identified or flagged so that they are distinguishable from physical bids. This is important for effective market monitoring and assessment of the impact of virtual bidding, and may have reliability implications as well.

Disclosure of Market Participant Affiliations

As is noted throughout this paper, the interactions between the various components of a market participant's portfolio are very important to monitor under nodal virtual bidding. Virtual trading, physical generation, load, CRRs, ISTs including Seller's Choice Contracts and others all play against one another in fairly complex ways in an LMP market. In order to effectively monitor the portfolio effects of a participant's market behavior, it is crucial to have information on all market participant affiliates.

Thus, DMM recommends that a specific requirement for SCs engaged in convergence bidding to report affiliations with other market participants or SCs be included under nodal convergence bidding.

Ability to Re-Run the Day Ahead Market

Under virtual bidding, it is vital that the CAISO market software include a routine, daily counterfactual run that calculates Day Ahead Market prices excluding convergence bids. DMM believes that in order to quickly identify and report potential market abuses to the FERC – or exercise any authority the CAISO may have to limit or suspend trading – it will be critical that DMM has the ability to routinely re-run the market with and without virtual bids to assess their impact on price convergence. Such routine assessments will require a highly automated set of modeling and monitoring tools.

In addition to examining price convergence, having the ability to calculate each individual virtual bidder's impact on prices, congestion and their net market profits is critical for monitoring. The ability to assess the consequences of virtual transactions on a participant's entire portfolio is required in order to safeguard against manipulations that on the surface would not seem problematic.[10]

Monitoring and Analysis of Real Time Impacts and Deviations

Although the majority of monitoring will be on the Day Ahead Market outcomes and the counterfactual outcomes without virtual bids, real-time impacts and deviations will also be monitored. The convergence of day-ahead and real-time prices will be analyzed, and potential impacts of uninstructed deviations will also be examined.

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[10] As an example, monitoring of the use of virtual bids to impact the value of CRRs will not be limited to an analysis of how often the rule is triggered. Rather, an analysis of how often the rule would have been triggered given different shift factor thresholds would be performed.