Working White Paper\textsuperscript{1} on Design Criteria for Convergence Bidding

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For Review and Discussion at
Convergence Bidding Work Group Conference Call
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\textsuperscript{1} This version of the paper includes a Straw Proposal on three core elements of the Convergence Bidding design: spacial granularity, load distribution factors, and market power mitigation provisions. Since there is no change in the text for other design features, this version abbreviates those sections.
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Introduction
[No Change from August 17 in this version.]

Process Clarification
[No Change from August 17 in this version.]

Elements of Convergence Bidding Design

1) **Explicit vs. Implicit**
[No Change from August 17 in this version.]

2) **Deterrence of Implicit Virtual Bidding**
[No Change from August 17 in this version.]

3) **Spatial Granularity (Nodal vs. Zonal)**

The nodal versus zonal debate has often been cast in the NY-style vs. PJM-style design of Convergence Bidding. Such a characterization risks over-simplifying the nature of the choices that the CAISO faces.

PJM allows virtual trades at every node or group of nodes for which it publishes a price. Thus the PJM nodal approach encompasses the zonal approach and, in practice, market participants in PJM seem to virtually bid at hubs at least three times more frequently than nodes.

The NYISO only allows virtual bidding at the zonal level, but does allow generators to bid at their own specific connection node. Thus, at both the NYISO and PJM most of the virtual bidding occurs at the zonal level.

Perhaps a better way to phrase this design question is simply how deep one should push the level of spatial disaggregation at which one allows virtual trading. Another related issue is whether the same or different spatial granularity should apply to virtual supply and virtual demand. Even if one decides to only allow zonal virtual bidding the question remains, which zones?

The Zonal Design

The NYISO has a zonal design in which virtual trades (for both virtual supply and virtual demand) are limited to demand zones with the exception of physical generators who can bid at their own node. In the MRTU design the equivalent would be limiting virtual trades (for both virtual supply and virtual demand) to the three LAPs, as well as allowing those entities with sub-LAPs (e.g. MSSs) to bid (for both virtual supply and virtual demand) at their sub-LAP level.

For convergence in pricing it is best if the zones are uniform and do not contain constrained pockets where the pattern between DA and RT prices differs. This was the experience of the NYISO (2002) where the load pockets within the 138kV zone were disparate. The Market Advisor recommended a re-evaluation of the load pocket modeling as well as virtual trading at the load pocket level to improve price convergence.
Allowing virtual bidding at the sub LAP level as well as load pocket level would be one level of disaggregation greater than zonal. A further level of disaggregation would bring one to the nodal level. Another issue with the zonal implementation is that some of the hedging benefits that physical generators like are absent. These benefits were explained in the June 13 2006 Board tutorial presentation and the relevant material from that document is reproduced in Appendix 1.

The Nodal Design

The nodal design is conceptually fairly simple in that virtual bids (for both virtual demand and virtual supply) are accepted at all pricing points for which the ISO posts a public price, so it includes LAPs and Hubs. Bidding at the nodal level is not limited to specific market participants within PJM. The drawback of the PJM approach is that the greater level of functionality also introduces a greater risk of market manipulation. To mitigate this both PJM and the subsequent implementations in the ISO-NE and MISO have rules to prevent the gaming of CRR revenues. The nodal model allows for better price convergence as price convergence can potentially occur at the nodal level not just at the zonal level. In addition nodal bidding allows generators to physically hedge their production by scheduling DA but exposing their output either to the RT price should they so desire. It is also possible to hedge congestion using the nodal framework. (An example is provided in Appendix 1.)

It should be noted that bidding at the nodal level inherently offers more functionality and better convergence than a zonal model. The real issue here is the magnitude of the risk introduced by the nodal design and whether or not that risk can be mitigated. A related key issue that warrants consideration is the impact of the granularity of virtual bidding upon the seller’s choice settlement features of MRTU.

Discussion

- In discussion of the NYISO model some market participants indicated that the market advisor to the NYISO had brought up potential market power concerns due to the fact that bidding at the nodal level is limited to generators only. Those participants supported nodal bidding for all participants. In contrast SCE supported the elimination of all nodal bidding to eliminate this market power problem and to prevent market participants from taking advantage of “knife-edge” (sic) solutions. According to SCE eliminating bidding at the nodal level would concentrate liquidity at the LAPs and benefit the ISO generally.

- SCE further notes that LAP-level bidding is consistent with the MRTU design and bidding philosophy in that, under MRTU, load bids at the LAP. Thus, SCE comments, “limiting VB to the LAPs allows virtual load and physical load to participate on an even footing. Moreover, the CAISO should be able to integrate ‘negative virtual demand’ bids (equivalent to virtual supply) by simply treating negative demand as a reduction to LAP-level load.”
• SCE further emphasizes that virtual bids should not be allowed at any individual load nodes, generation nodes or interties.

• PG&E generally suggests “cautious roll-out” which “would include initially limiting convergence bidding to trading hubs or LAPs ... subject to further review and relaxation of limits as the market progressed.”

• Williams Power Company comments that NYISO’s experience suggests that the more granular the application of virtual bidding, the more effective the price convergence is. Williams also seeks a better understanding of the implications for allowing nodal virtual bids when load is bidding on a LAP basis.

• WPTF comments that virtual bidding should be allowed at trading hubs and LAPs, and that allowing virtual bids at generating nodes would provide additional means of price convergence and hedging for generators. WPTF urged the CAISO to consider potential costs that might be incurred if virtual bidding were allowed at the generating nodes.

• EPIC comments that nodal bidding allows the market the greatest flexibility, hedging ability and price transparency, whereas a zonal approach constrains the hedging ability and flexibility and compromises the price signals sent to the market. EPIC points out that nodes provide many more points for bidding and more opportunities to resolve congestion over smaller areas. EPIC further comments that nodal bidding provides more information to the ISO on the location of congestion, provides a better opportunity for hedging CRRs and helps to ensure price convergence at a nodal level.

**Formulation of Options for Further Discussion**

The CAISO seeks further input and discussion from stakeholders. For the purposes of framing additional discussion, the CAISO offers the following options for spatial granularity of virtual bids:

- **Option 1**: Zonal virtual bidding (using EZ Gen hubs and/or LAPs)
  - Sub-option 1a: LAPs for both virtual supply and virtual demand
  - Sub-option 1b: EZ Gen hubs for both virtual supply and virtual demand
  - Sub-option 1c: EZ Gen Hubs for virtual supply and LAPs for virtual demand

- **Option 2**: Nodal virtual bidding
Option 3: Nodal bidding for virtual supply and LAP bidding for virtual demand (or more generally, virtual bidding consistent with physical bidding)

Option 4: Other (such as sub-LAPs commensurate with tiered CRR nominations or step 3 of the LAP clearing problem mitigation)

**CAISO’s Straw Proposal: Option 1, sub-option 1a**

The CAISO proposes virtual bidding at the LAP level as the initial design for convergence bidding (within the proposed “MRTU Release 1A.”)

However, the CAISO anticipates strong consideration of virtual bidding at the nodal level (Option 2) to be incorporated at a later time, possibly within “MRTU Release 2.”

**Straw Proposal Rationale**

The CAISO offers the following reasons for proposing virtual bidding at the LAP for the initial implementation of convergence bidding:

1) **LAP-level virtual bidding is Appropriately Cautious**

   Instituting convergence bidding at this high level of granularity allows market participants, state and federal regulators and the CAISO’s market monitors time to gain experience with the practice within the newly redesigned California markets.

2) **Reduces the Likelihood of Underscheduling**

   Option 1 will help prevent under scheduling of load by providing a mechanism for participants – including marketers and generators – to gain from underscheduling. Options 2 and 3 do not appear to provide any significant additional benefits than Options 1 in this respect.

3) **Mitigates Supplier Market Power**

   An 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. However, under the MRTU local market power mitigation design, virtual bidding at individual supply nodes may actually exacerbate local market power, depending on whether virtual supply bids are considered in the local market power mitigation procedures or not. If they are considered but are also exempt from mitigation, virtual supply bids might be used to undermine the local market power mitigation procedures.

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2 For example, under the local market power mitigation procedures, only resources that are dispatched up to relieve congestion on non-competitive transmission paths are subject to
Alternatively, if they are excluded from the local market power mitigation procedures, their exclusion could result in inaccurate bid mitigation of physical generator bids since ultimately all bids (virtual and physical) are considered in the day-ahead energy market. Given these complexities and potential for nodal virtual bids to undermine local market power mitigation procedures, the CAISO’s Department of Market Monitoring believes limiting virtual bids to LAPs, as an initial design approach, is prudent.

4) Helps Reduce or Eliminate 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 overscheduling of load. Since actual load is required to be scheduled at the LAP level only, Option 1 should largely eliminate the incentives to engage in implicit convergence bidding through under or over scheduling of load.

Options 2 and 3 do not appear to provide any significant additional benefits than Options 1 in this respect.

5) Increases Market Liquidity
Another potential market benefit of virtual bidding is a general increase in market liquidity. Again, Option 1 seems to allow significant benefits from increased market liquidity. Under this option, all virtual supply and demand bids and all physical demand will form a single market at each LAP.

Options 2 and 3 do not appear to provide any significant additional benefits than Options 1 in this respect, since it is unclear that the volume of virtual bids at individual nodes would be so significant as to create a highly liquid market at a nodal level.

6) Option 1 (LAP only) is preferable to Option 2 (full nodal) for the initial implementation of convergence bidding when considering “Seller’s Choice contracts.”
The CAISO believes the continued existence of “Seller’s Choice contracts” raises significant and complicated issues for a design that permits virtual bidding at the nodal level, but not for a design that limits virtual bidding to LAPs.
Seller’s Choice settlement allows handoff (physical Inter-SC Trade) at generation nodes up to the level of accepted physical supply at the node. Virtual bidding at a node can influence both the nodal supply clearing quantity and the nodal LMP. Any measures against potential gaming of nodal prices and quantities would require consensus of the Settlement parties, and can entail a laborious process. With the time frame suggested in the straw proposal for potential expansion of virtual bidding, LAP level virtual bidding (which does not impact Seller’s Choice settlement) would prevail while significant volumes of State Contracts exist.

Under the MRTU design, the CAISO will be instituting measures like physical Inter-SC Trades (ISTs) to ensure that parties with “Seller’s choice” contracts can settle schedules that allow a hand-off point at nodes tied to the physical point, and where the MW quantity does not exceed its contractual amount.

With virtual bidding at the nodal level, an entity could theoretically choose a large amount of generation that is then offset by virtual bidding at that node, in effect playing with the LMPs to create a potentially large profit opportunity.

Thus the CAISO is concerned that allowing virtual bidding at a nodal level may un-do the Inter-SC Trade design established to address the incompatibility of pre-existing seller’s choice contracts and an LMP market design.

The CAISO notes that many and perhaps most of these “Seller’s choice contracts” will no longer be in effect in 2009, approximately 14 months after the scheduled implementation of MRTU.

7) **Option 1 (LAP only) is preferable to Option 3 (nodal for supply, LAPs for demand) that doesn’t give equal ability to supply and demand.**

Option 3 allows virtual bidding to mirror the rules for the settlement of physical bids: load settles at the LAP, supply at the node. However, Option 3 only captures benefits for one-half of the balance between supply and load.

If the Day Ahead price were higher than the Real Time price, then virtual supply bids at the node would be unable to capture the price difference except imperfectly through a portfolio of supply and demand bids.

For example, if a LSE SC bids 50 MW of uncompetitively low priced virtual supply at a node to depress the LMP at that node\(^3\), the local supplier at that node would not be able to bid 50 MW of nodal virtual demand to counter this action.

\(^3\) This may payoff for the LSE SC by either increasing CRR revenues, or even potentially lower the LMPs in the load nodes in the vicinity and thus lower the LAP price albeit by a small amount.
To get the benefits of virtual bidding for supply and load, each side should have the ability to capture price differences between the Day Ahead and Real Time for the same points. Supply and demand should have equal ability to mitigate the power of each other.

Virtual bids that restrict negative signs impact the equal ability to check virtual bidding. Supply cannot make negative bids at their location whereas load could gain by their nodal bids. Similarly, load’s inability to negatively bid at the LAP could be trumped by supply bids at the LAP.

Convergence bidding at the LAP for both virtual supply and virtual demand provides a check against the potential power of each side.

8) **Option 1 can be implemented without instituting complicated market monitoring measures.**

As explained within a separate White Paper prepared by the CAISO’s Department of Market Monitoring, convergence bidding at the LAPs does not require imposition of a “settlement rule” or other market rules to mitigate potential abuses.

As an additional point of clarification, this straw proposal would allow virtual bidding at the LAP only (Option 1a) and not at Trading Hubs (option 1b). The reason is that overlapping nodes between LAP and hubs would impose complicated design and software implications that could lead to unforeseen consequences. The market clearing process moves the entire LAP to respect relative LAP Load Distribution Factors (LDFs). If virtual bids were allowed at the hub level, then the hub level virtual quantities would have to be distributed to the hub nodes based on Hub distribution factors. At the nodes common to the LAP and the hub, the net sum of the nodal allocation from the LAP and the hub bids would have to be considered along with physical LAP level load bids in the congestion management and market-clearing process. This complication is substantially reduced with LAP only virtual bids since the same LDFs would be used for actual and physical demand bids.

The straw proposal does not accommodate Option 1c (EZ Gen Hubs for virtual supply and LAPs for virtual demand) since it involves differential treatment of virtual supply and demand, thus suffering from the same drawbacks of Option 3.

**(4) Load Distribution Factors (LDFs)**

Experience in the eastern ISOs indicates that virtual load bids and virtual supply bids utilize the same designated virtual nodes. Moreover, when virtual bids are
submitted to a LAP, the distribution factors used to distribute virtual bids are the same as the load distribution factors (LDFs) used to distribute physical load schedules and bids. Thus virtual load appears just like physical load on the network, and virtual supply is effectively negative virtual load.

The question to resolve in CAISO’s design is how to treat LDFs in real-time where virtual bids are liquidated.

**Discussion**

- WPTF comments that the same LDFs in RT as those used in the DA.
- Williams Power Company comments that the CAISO should use the same DA LDFs to liquidate the virtual positions in RT as it applies to distribute the virtual position on the DA market.
- SCE expressed the view that virtual bids should be like unto physical bids in every way possible. SCE was opposed to any special treatment for virtual bids.

**Formulation of Options for Further Discussion**

The CAISO seeks additional input into these options, or any other options proposed by stakeholders:

- Option 1: Use the same distribution factors for virtual and physical virtual bids in the relevant market (even though real-time LDFs are likely different from DA LDFs);
- Option 2: Use fixed LDFs in both DA and RT (from a distribution factors library);
- Option 3: Use DA physical distribution factors for both DA and RT virtual bids.

**Straw Proposal: Option 1**

The CAISO proposes using the same distribution factors for virtual and physical bids in the relevant market (even though real-time LDFs are likely different than day-ahead LDFs.)

**(5) Market Power Mitigation**

In the eastern ISOs virtual bids are traditionally not subject to LMPM procedures as they are not physical resources, but they are subject to the price caps. If the
CAISO were to implement a similar system then virtual bids would not be considered in the pre-IFM (i.e., CAISO's market power mitigation and local reliability determination process). Virtual supply and demand would only be considered in the DA IFM where virtual supply and demand bids are used in the same way as physical bids. Virtual supply and demand bids would then be ignored in RUC.

Concerning gaming opportunities both PJM and the ISO-NE have rules to prevent the gaming of congestion revenues using virtual bids. It would seem prudent to consider including this provision should the CAISO opt for a nodal design where this might be an issue.

The number of virtual bids and virtual bid segments allowed may be another issue that may be related to whether or not virtual bids are subject to market power mitigation. The higher the number of virtual bids or the bid segment per bid, the higher the opportunity for the so-called “Hockey stick bidding”, particularly in the absence of LMPM for virtual bids.

**Discussion**

- PG&E endorses a strong role for the CAISO’s Department of Market Monitoring in assessing the application of convergence bidding, particularly at the onset. Suggested safeguards include limits on the volume of total convergence biddings at each hub and limits on the volume that any one player could trade. PG&E also suggests tools such as monitoring:
  - Price dispersion and net position in convergence biddings of any single player;
  - Generator bidding, including under-scheduling and virtual purchases bidding, that inflates the price of a delivery point or price divergence between nodes;
  - Bids that impact holders of CRRs.

- SCE urges a detailed and effective monitoring program commensurate with the virtual bidding design. Specifically, SCE urges:
  - Tariff authority for the CAISO to suspend or revoke a participant’s right to utilize virtual bids.
  - Guidance on what is and what is not acceptable virtual bidding behavior.
  - Monitoring of the impact on prices, congestion and unit commitment/RUC from specific virtual bids.
  - Monitoring of virtual bids that are highly profitable or result in high or sustained losses.
  - Explicit rules for participants who hold CRRs.
LAP-only bidding to address concerns that virtual bids could “distort prices, dispatch or uplift charges away from those expected in a competitive market.”

- WPTF comments that virtual bids should be subject to the price caps but no other market power mitigation, which WPTF notes is the practice at other ISOs... WPTF emphasizes the CAISO should take steps to ensure that virtual bids cannot be used to take advantage of gaming opportunities.

- Williams Power Company supports the same mitigation as implemented in other ISOs, namely that virtual bids are subject to the price caps but no other market power mitigation. Williams also emphasizes the CAISO should take steps to ensure that virtual bids cannot be used to take advantage of gaming opportunities.

- EPIC commented that it was appropriate to have rules in place for virtual transactions and that the market monitor should have appropriate oversight as there are risks associated with CRR revenue manipulation as pointed out in the paper. EPIC indicated that as LMPs were not capped and it did not believe that bids should be capped either and that a trader should be able to bid any price.

**CAISO Recommendation**

For a discussion of Market Monitoring and Mitigation issues relevant to Convergence Bidding, please refer to the accompanying paper by the CAISO Department of Market Monitoring (DMM).

*(6) Pricing and Unit Commitment*
[No Change from August 17 in this version.]

*(7) Bid Price-Quantity Pairs*
[No Change from August 17 in this version.]

*(8) Credit and Collateral*
[No Change from August 17 in this version.]

**8(A) Collateral Requirements**
[No Change from August 17 in this version.]

**8(B) Proxy Clearing Price for Collateral Calculation**
[No Change from August 17 in this version.]

*(9) Cost Allocation*
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9(A)  **Unit Commitment Costs from the IFM and RUC**
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9(B)  **Ancillary Service Cost Allocation**
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(10)  **Other Design Elements**
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**Evaluation Criteria**
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**Stakeholder Input for Evaluation Criteria**
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**Final CAISO Proposed Design**
[No Change from August 17 in this version.]

**Conclusion**
[No Change from August 17 in this version.]

**Reading List**

*General Documents*
[No Change from August 17 in this version.]

*FERC Decisions*
[No Change from August 17 in this version.]
Appendix One: Hedging By Physical Generators

Protecting a Generation Offer

Marketer X is offering a generation resource that is good for 100 MW under normal circumstances. However, the unit on a particular day is having potential mechanical problems that may reduce the output of the unit by 10 MW for the next day. The situation is not critical enough that a partial de-rating of the unit is required, but the marketer is not one hundred percent confident that the unit will be able to produce 100 MW.

Marketer X bids in 100MW at $50, and a 10MW virtual demand bid (PJM dec) at $50.

Both bids clear at $60, thus Marketer X has a financially binding commitment for 100MW at $60 in the DAM, and has bought 10MW at $60 (i.e. has effectively bought back the last 10MW). This virtual will then be liquidated in real time.

There are four possible scenarios.

Unit produces 100MW in RT

1. RTM closes higher than $60, say $70, in which case Marketer X receives
   \[ 100\text{MW} \times \$60 = \$6000 \text{from DA} \] + \[ 10\text{MW} \times \[$70-$60\] = $100 \text{from virtual} \] = $6100 Total

2. RTM closes lower than $60, say $50, in which case Marketer X receives
   \[ 100\text{MW} \times \$60 = \$6000 \text{from DA} \] + \[ 10\text{MW} \times \[$50-$60\] =-$100 \text{from virtual} \] = $5900 Total

Unit produces 90MW in RT

3. RTM closes higher than $60, say $70, in which case Marketer X receives
   \[ 100\text{MW} \times \$60 = \$6000 \text{from DA} \] - \[ 10\text{MW} \times \$70 =$700 \text{— due to RT under delivery} \] + \[ 10\text{MW} \times \$70-$60 =$100 \text{ due to the virtual} \] = $5400 Total

4. RTM closes lower than $60, say $50, in which case Marketer X receives
   \[ 100\text{MW} \times \$60 = \$6000 \text{from DA} \] - \[ 10\text{MW} \times \$50 =$500 \text{— due to under delivery} \] + \[ 10\text{MW} \times \$50-$60 =-$100 \text{ due to the virtual} \] = $5400 Total

In this example Physical hedging allows the unit to contract in the DA for the RT price, rather than actually wait for the RTM. This exposes a portion of the output to the real-time price. This has the added reliability benefit of shifting the unit completely into the DAM. Without VB the unit owner would have to do this exercise physically by selling 90MW DA and then waiting for the RTM to bid in the last 10MW. By using VB to sell in the DA for the RT price the unit owner can schedule the entire unit in the DA, but pick up the RT price for the last 10MW.

Congestion Hedging

A generator (A) is offering to sell 50 MW at $15/MWh. An LSE (B) is looking to buy 50 at $20/MWh. A marketer picks up both deals and enters a bilateral transaction from point A to point B. The marketer is buying 50 MW from A at

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\[^4\text{Both of these examples are taken from the board presentation, but come originally from PJM (Guide to Generation Offers and Schedules p.61). Available at:}\] http://www.pjm.com/etools/downloads/emkt/guide-generation-schedules-offers-v3.pdf
$15/MWh and selling to B at $20/MWh and therefore, does not wish to pay more than $5/MWh in congestion charges. How does he/she cover the position? Answer: The marketer enters a 50 MW Dec bid at point B where the generator is located for $15/MWh so that this resembles a spot purchase. A 50 MW Inc offer is placed at point B for $20/MWh so that it resembles a spot sale. If LMPs from the Day-Ahead Market are $14/MWh at point A and $21/MWh at point B, the marketer is selling to the spot market at A and buying at B. As a result, the marketer knows his/her position by 16:00 on the day prior to the operating day and has time to make appropriate arrangements to respond to his/her resulting position. A summary of the charges is listed below:

<table>
<thead>
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<th>Charges &amp; Credits</th>
<th>Calculation</th>
<th>Total</th>
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</thead>
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