DRAFT

Working White Paper on Design Criteria for Convergence Bidding

Prepared by
Alan G. Isemonger and Farrokh A. Rahimi
Department of Market and Product Development, CAISO

For Initial Discussion at
CAISO Stakeholder Meeting
CAISO, Folsom, CA
July 18-19, 2006

TABLE OF CONTENTS

Introduction 3
Process Clarification 3
Elements of Convergence Bidding Design 4
(1) Explicit vs. Implicit 4
(2) Deterrence of Implicit Virtual Bidding 4
(3) Spatial Granularity (Nodal vs. Zonal) 5
(4) LDFs 5
(5) Market Power Mitigation 6
(6) Pricing and Unit Commitment 6
(7) Bid Price-Quantity Pairs 6
(8) Credit and Collateral 7
8(A) Collateral Requirements 7
8(B) Proxy Clearing Price for Collateral Calculation 7
(9) Cost Allocation 7
9(A) Unit Commitment Costs from the IFM and RUC 8
9(B) Ancillary Service Cost Allocation 8
(10) Other Design Elements 9
Draft Proposals 9
NY-style 9
PJM-style 9
CAISO Candidate Models? 9
Evaluation Criteria 9
Stakeholder Input 10
Final CAISO Proposed Design 10
Conclusion 10
Reading List 10
General Documents 10
FERC Decisions 11
Appendix One: Hedging By Physical Generators 12
Protecting a Generation Offer 12
Congestion Hedging 12

Introduction

On June 14th 2006 the CAISO hosted a tutorial on Convergence Bidding[1] for the benefit of both CAISO Board members and interested market participants at which the concept of virtual bidding was thoroughly explored[2]. In a recent compliance filing (http://www.caiso.com/17ba/17bac4f62ab80.pdf) the CAISO undertook to present a Convergence Bidding proposal to the CAISO Board of Governors before the end of summer 2006, for the board to vote on before the end of the year. This white paper is pursuant to that commitment.

Process Clarification

This white paper is prepared as a Draft Work In Progress and represents the first iteration of a Convergence Bidding design proposal for the CAISO. The purpose of this initial document is to identify the design framework in terms of different design elements that must be worked out to arrive at a complete and comprehensive Convergence Bidding design compatible with the rest of the MRTU design, responsive to the needs of the market participants, and in line with reliable and efficient market operation. The document will detail both the nature of the design elements and the choices that face the CAISO, and will be used to gather feedback from market participants regarding the design framework. For some design elements the document will state possible choices, but these will have to be developed further and analyzed to determine a consistent comprehensive set. The designs adopted in other ISOs and FERC precedence in that context will be used as guides to augment the possible choices for each design element. Some of the design issues have been effectively decided by FERC precedent concerning Convergence Bidding designs at the eastern ISOs. The nature of credit and collateral policies is a good example of a design element for which there is extensive guidance in the FERC record. Among other design elements the spatial granularity of virtual bids is most significant. The choices for the CAISO to make regarding this design element are whether to allow nodal virtual bidding as PJM, ISO-NE and MISO do, only allow virtual bidding at the zonal level like the NYISO, or perhaps some hybrid. Other significant design elements address issues related to safeguards against unintended consequences, opportunities for the exercise of market power, effects on other markets, such as the CRR market etc. The work to complete the design process will involve the following:

(1) Identify all issues and concerns related to different aspects of virtual bidding and complete the initial list of the design elements stated in this first draft.

[1] The terms Convergence Bidding and Virtual Bidding will be used interchangeably in this document. Unless otherwise specified both terms will refer to Explicit Virtual Bidding. Any intended reference to Implicit Virtual Bidding will be clearly stated.
[2] Documents from this tutorial are available at: http://www.caiso.com/docs/2005/06/09/2005060910374912494.html

(2) Identify different choices to address the requirements for each design element. The choices may be based on other ISO designs, FERC precedence, stakeholder input, and consideration of other MRTU design elements. Some choices are already stated in this first draft for some design elements, but they are not complete.

(3) Work out the evaluation criteria to assess the different choices for each design element. These criteria may be a subset of the Ranking Criteria being worked out in a separate but related stakeholder process, or may include criteria specific to each design element. A tentative list of criteria is stated in this first draft; the list will be expanded and modified as needed in subsequent iterations of this white paper.

(4) Evaluate the choices formulated for each design element in (2) against the criteria agreed upon in (3) to come up with the best option for each design element.

(5) The combination of the choices for various design elements will guide the recommended design. However, because of the interdependence of different design elements, the ultimate choice for each design determined in (4) may be adjusted for an overall consistent design. At this stage the Convergence Bidding design will be ready for presentation to the Board at the September Board meeting.

(6) Apply the full set of the Ranking Criteria (currently the subject of the July 18 afternoon stakeholder meeting) to the completed design and identify costs, benefits, and risks for the Board's consideration and vote at the December 2006 Board meeting.

Elements of Convergence Bidding Design

(1) Explicit vs. Implicit

By definition the design must be based on Explicit Virtual Bidding, that is, virtual bids must be submitted with an indication (a flag) that identifies them as virtual rather than physical. By submitting a virtual bid, the participant bids to take a forward financial position that will be liquidated in real time. Submission of virtual bids will only occur in the Day-ahead Market (DAM). If accepted in IFM, such bids will be liquidated as price takers in the RTM. Virtual supply that is accepted in DA will require the seller to buy that same quantity of supply back in the RT market. Virtual demand that is accepted in DA will require the buyer to sell that same quantity of demand back in the RT market. Virtual bidding provisions apply only to Energy Bids. No provision are contemplated for explicit virtual bidding for Ancillary Services or other products in CAISO's markets.

(2) Deterrence of Implicit Virtual Bidding

Implementation of Explicit Virtual Bidding reduces, but does not necessarily eliminate Implicit Virtual Bidding. The experience at the NYISO substantiates this. It shows that the incentive to engage in IVB decreases with the implementation of EVB, but does not disappear. In particular, participants engage in IVB to circumvent the onerous credit and collateral requirements that are often imposed on virtual bidding at startup. At the NYISO these credit and collateral requirements have gradually eased, as they have at other ISOs. The NYISO continues to monitor physical schedules for IVB. Measure by the CAISO to deter IVB should be considered.

(3) <u>Spatial Granularity (Nodal vs. Zonal)</u>

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. Both PJM and the NYISO allow bidding at the zonal level. Indeed most of the virtual bidding in PJM is at the zonal level. As both the NYISO and PJM allow trading at the zonal level and the majority of the trading occurs at the zonal level 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. Even if one decides to only allow zonal virtual bidding the question remains, which zones?

Another elated question with the zonal design is what distribution factors to use to establish the relationship between virtual bids and nodal prices. 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, 9) 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 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 board presentation and material from that document is reproduced in Appendix One. The PJM model has better functionality than the NYISO model, and this may be part of the reason why subsequent implementations at the ISO-NE and MISO have followed the PJM nodal model as opposed to the NYISO zonal model.

Certainly this issue of nodal vs. zonal, and if zonal then which zones, is an extremely important design characteristic.

(4) <u>LDFs</u>

Experience in the eastern ISOs indicates that whether one opts for a zonal or a nodal model the majority of the trading will occur at the hubs. In PJM almost all the trading occurs at the hubs even though nodal bidding is allowed. In all the eastern ISOs 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. Possible options are to use real-time LDFs (that are generally different from DA LDFs), use the same LDFs in real-time that were used in DA, or use fixed LDFs in both DA and RT similar to hub 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.

(6) Pricing and Unit Commitment

Virtual bidding, to be meaningful, must be allowed to affect market clearing and price formation in the DA energy market. Therefore virtual bids will be included in the running of the IFM and will, as a result, also affect unit commitment in the IFM. Virtual bidding will not affect the unit commitment in the RUC process as RUC concerns itself solely with ensuring that enough physical supply is committed to serve the forecast physical load. However, to the extent virtual supply bids are accepted in the IFM, the need for system-wide RUC capacity may increase, and to the extent virtual demand bids compensate for otherwise under-scheduled load in the IFM, the need for system-wide RUC capacity may decrease. Having said that, the impact of VB on local RUC capacity will depend on the other design features of VB, particularly, the geographical granularity (zonal, pocket, nodal, or other) permitted under the VB design.

(7) Bid Price-Quantity Pairs

Both PJM and the NYISO insist that all load bids are price capped, meaning that virtual demand cannot act as a price taker in the DAM. This is another somewhat technical issue that is worth considering. Bids in the NYISO are limited to three price quantity pairs (NYISO, 2005, 7-75). The CAISO's physical design allows for ten price quantity pairs (eleven data points). The choices for CAISO in this context are: (1) whether to allow price taker virtual bids, and if so, under what conditions, and (2) whether to restrict the number of virtual bid segments compared to actual bid segments. A hybrid approach may also be possible if both nodal and zonal (LASP or hub) virtual bids are considered as candidate design options under the third design element stated above (Nodal vs Zonal). For example, it may be possible to allow price taker virtual bids only at the nodal level, but disallow price taker virtual bids (i.e., require price-quantity bids) at the zonal (LAP or hub) level.

(8) Credit and Collateral

Regarding credit and collateral issues the ISO intends to be guided by the opinions expressed by FERC concerning credit and collateral issues as they pertain to virtual bidding. The following design elements seem important.

8(A) Collateral Requirements

To engage in virtual trades participants have to post collateral as they do for other aspects of the CAISO markets (e.g. the CRR markets). FERC has previously ruled on the credit and collateral policies of the NYISO (Docket No.ER05-941-000 , see Issuance of July 1st 2005) as well as separate rulings at PJM (see PJM, 104 FERC ¶ 61,309 at P 23-24 where FERC rejects a proposed four-day collateral requirement); and the Midwest ISO, (see MISO 108 FERC ¶ 61,163 at P 447-48 where FERC rejects a proposed six-day collateral requirement). It appears that when virtual trading first began in the eastern ISOs it was common to constrain it with credit requirements. As this concern proved unfounded the ISOs have moved to more conventional credit requirements under FERC orders. The CAISO can either follow the same path that the eastern ISOs followed, namely constrain and then liberalize under FERC orders, or simply jump straight to the end point which appears to be a one or two day collateral requirement. Another compromise position would be to constrain the initial release, but document a fairly rapid liberalization at predefined dates thereafter.

8(B) Proxy Clearing Price for Collateral Calculation

To calculate the collateral requirements the CAISO has to multiply the quantity virtually bid by a proposed proxy clearing price. FERC has recently required the eastern ISO to replace their initial calculation methodology, such as the NYISO's reference price which is presumed to be the 97th percentile of the highest actual price experienced in the market over a three month period, with something more realistic. In its MISO decision FERC ordered MISO justify the 97% rule (see MISO, Docket No. ER04-691-004, p.107). The MISO subsequently moved to a 50th percentile rule.

(9) Cost Allocation

The issue of cost allocation can hardly be over-emphasized. This issue has recently come to the fore due to a recent FERC MISO decision (see Docket No.ER04-691-065, " Order Requiring Refunds, And Conditionally Accepting In Part, And Rejecting In Part Tariff Sheets" Issued April 25, 2006). Briefly in this case the MISO tariff assessed the Revenue Sufficiency Guarantee (RSG, similar in concept to Bid Cost Recovery for Energy and A/S bids under MRTU) to the sum of real-time load for the day, the resource uninstructed deviation quantities, and all virtual supply offers. The MISO did not implement the third part of this cost allocation (to virtual supply) and its Business Practices Manuals and tariff training materials both stated that virtual supply offers would not be included in the RSG charge calculation. Thus the MISO tariff and the BPM/training materials contradicted one another, and it appears that the MISO believed that the BPM formulation was the appropriate policy regarding uplift, and the failure to correct the tariff was an oversight of some sort. Using the filed rate doctrine as the basis for its argument FERC ordered the MISO (paras 26-30) to recalculate the RSG charges and issue refunds where necessary. Turning to the prospective treatment of RSG allocation FERC instructed the MISO to make sure that virtual supply is allocated an appropriate share of the RSG payments (paras 48-49) as the virtual supply can cause RAC (Reliability Assessment Commitment – similar to Residual Unit Commitment under MRTU) costs. Clearly FERC is of the opinion that RUC-type costs should be assessed to virtual supply.

9(A) Unit Commitment Costs from the IFM and RUC

There is also a fair level of complexity in the allocation of the uplift charges at both the NYISO and at PJM[3]. PJM appears to allocate uplift from the DAM solution to DAM demand (actual and virtual) and real-time uplift is allocated to any entity causing an uninstructed deviation from the DA solution (which implies that virtual demand and supply share in this cost allocation). It should be pointed out that virtual demand increases unit commitment in the IFM and decreases commitment in RUC, whereas virtual supply (negative load) does just the opposite, it decreases unit commitment in the IFM and increases commitment in RUC. Using basic cost causation this suggests that virtual demand should pay a share of the IFM commitment costs similar to physical demand, whereas virtual supply should pay a share of the RUC commitment costs comparable to the allocation to metered load that was not scheduled in the DA IFM. Such a design would conform to the principles of cost causation as well as the FERC MISO decision mentioned above.

9(B) Ancillary Service Cost Allocation

In the eastern ISOs the reserve cost allocation differs between the PJM and NYISO model. PJM allocates DAM reserve costs to all demand, both actual and virtual, whereas the NYISO allocates reserves costs to actual withdrawals. Neither makes mention of regulation costs. Although there is some choice over how AS costs are allocated the CAISO believes that the MRTU procurement methodology again gives a good indication as to how AS costs might be allocated. Under the MRTU design the procurement of Ancillary Services will be based on the CAISO forecast of CAISO demand, not on the IFM result. Thus virtual demand will not cause incremental procurement of AS and virtual supply will not create a real AS obligation. This might suggest that AS costs should be allocated to physical loads as occurs at the NYISO. However, it should be

[3] See Technical Bulleting No. 82 at: (http://www.nyiso.com/public/documents/tech_bulletins/index.jsp?sort=name&order=descending&maxDisplay=149&=undefined

pointed out that under MRTU A/S costs are allocated in two Tiers. Tier 1 is allocated based on Obligation net of self provision. However, there are Tier 2 (neutrality) cost allocations under MRTU which result from discrepancies between CAISO procurement and SC Obligations. Whether or not virtual bids should be allocated part of the A/S neutrality cost must be discussed.

(10) <u>Other Design Elements</u>

[Purposefully left open to account for stakeholder input for this iteration of the white paper]

Draft Proposals

The choice of a different option for each of the design elements stated above determines a different overall design for Convergence Bidding. Thus thee can in principle be a large number of designs by mixing and matching different choices for each design element. A lot of these combinations may not necessarily be meaningful. It is expected that a few combinations of the design elements will emerge as competing candidate solutions for the overall design. The existing designs used at other ISOs may provide the direction for such viable candidate combinations. The following are sample choices.

<u>NY-style</u>

[Purposefully left incomplete for this iteration of the white paper]
The NYISO model only allows virtual bidding at the zonal level, not at the nodal level. Hedging for physical generating units is poor in this model.

<u>PJM-style</u>

[Purposefully left incomplete for this iteration of the white paper]
Under the PJM design participants can bid at any node for which there is a calculated price. This seems to include the inter-tie scheduling points. Nearly all virtual bidding is at the hubs, and there are some restrictions on bidding supply and demand at the same bus. Physical hedging functionality is complete in this model.

<u>CAISO Candidate Models?</u>

[Purposefully left incomplete for this iteration of the white paper]

Evaluation Criteria

The evaluation criteria used to assess the proposed designs should include a number of different measures including;

1. Consistency with Previously Approved Designs: There are many advantages to implementing a previously approved design, such as the NYISO or PJM design. The main advantages are the fact that the design is tried and tested so that, in the absence of significant differences in the host system, the design should work. Whilst the CAISO market architecture is obviously different to

that in the NYISO and PJM these are still fundamentally similar systems[4]. In addition previously approved designs face much lower regulatory risk as FERC has already approved the functionality elsewhere.

2. Level of functionality: Obviously the CAISO would like to maximize the functionality of the proposed design so that market participants have more rather than less functionality.
3. Simplicity; the best designs are often clean, simple and easy to implement.
4. Market Efficiency
5. Market Power Mitigation Concerns
6. Other Criteria: [Purposefully left open to account for stakeholder input for this iteration of the white paper]

Option	Consistency	Level of Functionality	Simplicity	Market Efficiency	MPM	Other
NYISO						
PJM						
CAISO1						
CAISO2						

Stakeholder Input

[Purposefully left open to account for stakeholder input for this iteration of the white paper]

Final CAISO Proposed Design

[Purposefully left incomplete for this iteration of the white paper]

Conclusion

[Purposefully left incomplete for this iteration of the white paper]

Reading List

General Documents

CAISO Tutorial Documents available at: http://www.caiso.com/docs/2005/06/09/2005060910374912494.html

[4] In some ways the CAISO architecture is closer to the NYISO design, e.g. both have DA markets for reserves and HASP and the NYISO's BME are similar, but in others it is closer to the PJM design, e.g. in PJM bid-in demand clears against bid-in supply to set the DA prices and quantities, followed by a reliability run, a structure that is very close to the MRTU design. At the NYISO the Day-Ahead market solution includes units required to support reliability.

Hogan, W.W. (2006, May 25) “Revenue Sufficiency Guarantees And Cost Allocation” Available at http://ksghome.harvard.edu/~whogan/Hogan_RSG_052506.pdf Published May 25, 2006

NYISO (2002) “State of the Market”. Available at: http://www.nyiso.com/public/documents/studies_reports/market_advisor_reports.jsp

NYISO (2005) “NYISO Market Participant User’s Guide”. Available at: http://www.nyiso.com/public/webdocs/documents/guides/mpug_mnl.pdf

NYISO Technical Bulletin No. 82 at: http://www.nyiso.com/public/documents/tech_bulletins/index.jsp?sort=name&order=descending&maxDisplay=149&=undefined

PJM Guide to Generation Offers and Schedules p.61, available at: http://www.pjm.com/etools/downloads/emkt/guide-generation-schedules-offers-v3.pdf

FERC Decisions

Midwest ISO Collateral Requirements see FERC 108 FERC ¶ 61,163 at P 447-48

Midwest ISO 97% rule see FERC Docket No. ER04-691-004, p.107

Midwest ISO Cost Allocation see Docket No.ER04-691-065, “ Order Requiring Refunds, And Conditionally Accepting In Part, And Rejecting In Part Tariff Sheets” Issued April 25, 2006

NYISO Collateral Requirements, see FERC Docket No.ER05-941-000, Issuance of July 1st 2005

PJM Collateral Requirements, see FERC 104 FERC ¶ 61,309 at P 23-24

Appendix One: Hedging By Physical Generators[5]

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 (100MW*$60= $6000 from DA) + (10MW*[$70-$60]=$100 from virtual) = $6100 Total
2. RTM closes lower than $60, say $50, in which case Marketer X receives (100MW*$60= $6000 from DA) + (10MW*[$50-$60]=-$100 from virtual) = $5900 Total

Unit produces 90MW in RT

3. RTM closes higher than $60, say $70, in which case Marketer X receives (100MW*$60=$6000 from DA) - (10MW*$70=$700 – due to RT under delivery) + (10MW*$70-$60=$100 due to the virtual) = $5400 Total
4. RTM closes lower than $60, say $50, in which case Marketer X receives (100MW*$60=$6000 from DA) - (10MW*$50=$500 – due to under delivery) + (10MW*$50-$60=-$100 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

[5] 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:

Charges & Credits	Calculation	Total
Transmission Congestion Charge	50 MW * ($21-$14)	$ 350 charge
Dec Bid (Charge)	50 MW * $14	$ 700 charge
Inc Offer (Credit)	50 MW * $21	-$ 1,050 credit
Net Position		$ 0