Comments on Price Inconsistency Caused by Intertie Constraints Draft Final Proposal

Submitted By	Company or Entity	Date Submitted
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On April 27, 2011, the California Independent System Operator Corporation ("CAISO") issued a document entitled "Price Inconsistency Caused by Intertie Constraints". Powerex Corp. ("Powerex") submitted comments on May 11, and CAISO issued its revised proposal on May 18. Powerex is pleased to provide comments on the revised proposal.

Powerex believes that, in considering how to improve the implementation of convergence bidding, two overriding concepts must be borne in mind. First, the sole purpose of convergence bidding is to improve the efficiency of commitment and dispatch of physical resources in the CAISO markets. While participants who enter into virtual transactions may do so to manage their exposure to prices in the different markets, it is not the core purpose of convergence bidding – or CAISO in general – to provide a platform for market participants to execute risk management transactions. Second, market design changes must consider the real-world decisions and behaviors of market participants. Firms respond to price signals, and it would be folly to engage in any market design effort without careful consideration of such a response.

In these comments, we explain the detrimental price signals that would likely arise under CAISO's preferred "Option A", and the likely impact of participants responding to those price signals. We also describe how, when there is physical congestion, virtual bids on the interties do not affect the commitment of physical resources, and therefore do not contribute to improved dispatch of physical resources.

Powerex believes that significant additional stakeholder discussion would be beneficial. We propose three possible alternatives that merit consideration: (1) suspension of virtual bidding on an intertie for the hours when the physical scheduling constraint is binding; (2) treat intertie convergence bids like physical bids for purposes of determining the LMP, but add a feasibility run to ensure feasible physical schedules; and (3) intertie convergence bids settle only against the energy component of LMP, and neither create nor eliminate congestion on the interties.

Background

As explained in the initial and revised documents, there are instances in which physical export (import) awards on the interties clear despite a locational marginal price ("LMP") that are higher (lower) than the bid price. These "bid inconsistency" outcomes are indicative of the manner in which LMPs are calculated on the interties. Specifically, the CAISO algorithms respect two constraints on the intertie: the net physical awards must not exceed the scheduling limit of the intertie; and (b) the net physical plus virtual awards must not exceed the scheduling limit. The two constraints imply virtual and physical shadow prices which will generally be different. The current algorithm utilizes both shadow prices to determine which intertie bids clear the market, but only one of those shadow prices – the one associated with the physical+virtual limit – is used to calculate the LMP at which all the cleared bids settle. Under certain circumstances, this results in physical awards that are not consistent with their bids.

CAISO supports, and plans to seek approval to implement, its so-called "Option A." This option would result in two LMPs at each intertie: one that is applicable to virtual awards, and one that is applicable to physical awards. CAISO explains that this option reflects the mathematical reality that different constraints imply different shadow prices, and that it would resolve the bid inconsistency problem. CAISO opposes the second option in the initial proposal due to the potential to cause revenue neutrality problems and that it is prone to manipulation.

Option A Outcomes under different scenarios

Under Option A, the LMP for virtual awards (LMP*V) will differ from the LMP for physical awards (LMP*P) whenever the physical scheduling constraint is binding. Since virtual schedules cannot provide counterflow transmission capacity for physical schedules but physical schedules do provide counterflow transmission capacity for virtual schedules, the LMP*V will always be greater than or equal to the LMP*P when the physical import limit is binding and less than or equal to the LMP*P when the physical export limit is binding.

Consider an intertie with a 100 MW bi-directional scheduling limit on which 200 MW of import bids are submitted at a price of $20/MWh. The system LMP is $80/MWh. In this simple example, CAISO would accept 100 MW of imports; the physical import constraint would be binding with a shadow price of $60/MWh, and the LMP *P would be $20/MWh. This example is shown in the Example 1 below. The physical scheduling constraint is binding, denoted by the red box.

Example 1. Only physical imports

	Bids		Awards	
	Qty. (MW)	Price ($/MWh)	Qty. (MW)	LMP ($/MWh)
Physical bids				
Imports	200	$20	100	$20
Exports				
Virtual bids				
Imports				
Exports				
Gen	1,500	$80	900	$80
Load	1,000	$500	1,000	$80

We next consider the calculation of the LMP applicable to virtual bids. This depends on the quantity, price, and direction of virtual bids, so we explore the outcome under several alternative scenarios.

First, we consider in Example 2 the impact of virtual imports priced at $30/MWh:

Example 2. Physical and virtual imports

Scheduling Limit: 100 MW

	Bids		Awards	
	Qty. (MW)	Price ($/MWh)	Qty. (MW)	LMP ($/MWh)
Physical bids				
Imports	200	$20	100	$20
Exports	0	$0		
Virtual bids				
Imports	100	$30	0	$30
Exports				
Gen	1,500	$80	900	$80
Load	1,000	$500	1,000	$80

This causes the physical+virtual limit to be binding, with a shadow price of $50/MWh, and hence LMP*V is $30/MWh. The physical limit is still binding, though the physical shadow price now differs from the

virtual shadow price by $10/MWhand therefore LMP*P is $20/MWh. While no virtual bids clear the market, they nevertheless result in a different price for virtual and physical awards.

Next, we consider in Example 3 the impact of virtual imports priced below the physical imports:

Example 3. Virtual imports displace physical imports

Scheduling Limit: 100 MW

	Bids		Awards	
	Qty. (MW)	Price ($/MWh)	Qty. (MW)	LMP ($/MWh)
Physical bids				
Imports	200	$20	0	$10
Exports	0	$0		
Virtual bids				
Imports	200	$10	100	$10
Exports				
Gen	1,500	$80	900	$80
Load	1,000	$500	1,000	$80

This causes the physical+virtual limit to be binding, with a shadow price of $70 and hence an LMP*V of $10/MWh. The LMP*P is also $10/MWh; relaxing the physical scheduling constraint would not change the outcome, since no physical imports could be accepted without violating the physical+virtual constraint. The black box indicates that the physical constraint is not binding.

The above examples demonstrate that virtual imports can lead to LMP*V>=LMP*P, but never to LMP*V<LMP*P.

We next examine scenarios involving virtual exports, beginning with Example 4 the case of virtual exports willing to pay more than the system LMP:

Example 4. Virtual exports and physical imports

	Bids		Awards	
	Qty. (MW)	Price ($/MWh)	Qty. (MW)	LMP ($/MWh)
Physical bids				
Imports	200	$20	100	$20
Exports				
Virtual bids				
Imports				
Exports	100	$100	100	$80
Gen	1,500	$80	1,000	$80
Load	1,000	$500	1,000	$80

The virtual+physical limit is not binding, as the net of physical and virtual awards is less than the scheduling limit of 100 MW. Hence LMP*V is the same as the system LMP: $80/MWh. The physical limit is binding, however, as the net physical award is at the scheduling limit. The shadow price is $60/MWh, and hence LMP*P is $20/MWh.

If virtual exports bid less than $80/MWh, they could not be accepted unless there are virtual import bids also available:

Example 5. Physical imports and offsetting virtual bids

Scheduling Limit: 100 MW

	Bids		Awards	
	Qty. (MW)	Price ($/MWh)	Qty. (MW)	LMP ($/MWh)
Physical bids				
Imports	200	$20	100	$20
Exports	0	$0		
Virtual bids				
Imports	200	$30	100	$30
Exports	100	$50	100	$30
Gen	1,500	$80	900	$80
Load	1,000	$500	1,000	$80

Both the physical and the physical+virtual constraints are binding in the above Example 5.

When the physical import limit is binding the LMP*V>=LMP*P; there is no scenario where LMP*V<LMP*P. By extension, when the physical scheduling limit is binding in the export direction, LMP*V<=LMP*P. This is true because virtual counterschedules cannot clear physical schedules when the intertie is full.

Option A will produce confused price signals and inefficient behavior

Given that CAISO interties flow predominantly in the import direction for most of the year, LMP*V will, on average, exceed LMP*P. Importantly, this would be the case even when there is perfect price convergence between LMP*P in the Integrated Forward Market ("IFM") and the LMP in the Hour Ahead Scheduling Process ("HASP"). Despite the perfect price convergence, market participants would still have a financial incentive to submit virtual import bids, since the price they expect to be paid on average in the IFM (*i.e.,* LMP*V) is higher than the price they expect to pay in the HASP.

Thus, even when there is no average divergence between IFM and HASP, -- and hence no improvement to be achieved in the commitment and dispatch of physical resources -- there nevertheless exists an incentive for market participants to submit virtual import bids. As a practical matter, participants will often submit price-taker virtual import bids for the desired award quantity to simply "play the averages".

The increase in price-taking virtual import bids will result in two possible outcomes. First, to the extent there are virtual export bids, virtual import bids can be accepted while maintaining a higher LMP*V than LMP*P. This implies that the physical+virtual scheduling constraint is not binding. Second, if price-taking virtual import bids are sufficient in quantity to make the physical+virtual scheduling constraint binding, the virtual imports will displace physical imports. In this outcome, LMP*V will fall to LMP*P. Since physical import bids will be at a range of offer prices, moreover, LMP*P will also fall.

The second outcome – in which LMP*V is equal to a (depressed) LMP*P price – is not profitable to the virtual importer. However, behavior may only change if it becomes unprofitable *on average* over the timeframe relevant to the evaluation of the rational economic behavior being pursued. So long as there are still hours in which the first outcome – in which LMP*V is higher than LMP*P, and consequently higher than the HASP LMP –the rational economic behavior of price-taking virtual imports can remain profitable on average.

The physical dispatch of the system is not improved by this behavior. Indeed, since there was average price convergence already, there was no room for improvement to begin with. The increase in price-taker virtual imports, responding to the incentives that would exist under Option A, actually undermine the efficiency of the physical dispatch by shifting the commitment of physical resources out of the IFM and into HASP or RTD. Thus, an efficient physical dispatch is undermined.

In short, while Option A may lead to a mathematically correct outcome in a single hour, it sends a price signal encouraging the submission of virtual bids which cause price divergence. Thus Option A is fatally

flawed and inconsistent with the primary purpose of virtual bidding – to improve the efficiency of commitment and dispatch of physical resources in the CAISO markets.

Powerex believes further unintended consequences may occur from a unique market design which bifurcates prices between virtual and physical imports at the same location. Powerex strongly believes that continued stakeholder discussion is necessary to develop an alternative rule for convergence bidding on the interties.

Alternative Option 1: when the physical scheduling constraint is binding on an intertie, suspend virtual bidding on the intertie for the specific hours of occurrence

Under this alternative, all virtual bids are suspended if the physical scheduling constraint is binding. This ensures a single LMP which is "mathematically correct"; dual LMPs can arise only when the physical constraint is binding. By eliminating the outcomes in which LMP*V exceeds LMP*P (for net import flows), the incentive to enter into virtual imports will reflect the expected spread between LMP*P and the HASP price, which is the desired incentive. Virtual imports will still be able to displace physical imports (if they are offered at a lower price); it is just that this behavior will not be distorted by outcomes in which virtual imports enjoy a higher price than physical imports.

Alternative Option 2: treat virtual bids as physical, with a feasibility pass to ensure feasible physical schedules

Under this alternative rule, virtual and physical bids are evaluated simultaneously, and only the physical+virtual scheduling limit is enforced. This results in a single LMP at the interties, and permits virtual awards to both relieve and to exacerbate congestion in the pricing run, restoring congestion symmetry of virtual bids. The requirement that net physical schedules be feasible is ensured through an additional feasibility pass. The feasibility pass begins by curtailing the excess portion of least economic initial physical awards, and setting the quantity flows on the affected interties at the physical scheduling limit. The market is then re-optimized with intertie awards and LMPs fixed from the pricing run, resulting in the additional internal unit commitments (or de-commitments) necessary to balance the excess physical flows that were eliminated on the intertie.

This alternative permits convergence bids to participate fully in the price formation process while resulting in feasible physical schedules. It will, however, lead to bid inconsistency where physical awards are curtailed in the feasibility pass. By definition, the physical imports would have been economic relative to the LMP, but would not result in a final award. This type of bid inconsistency is one of lost opportunity, however, rather than one of outright financial loss, as under the current approach.

Additional stakeholder discussion is necessary to explore issues such as the practicality of additional optimization runs.

Alternative Option 3: intertie virtual bids do not affect intertie congestion

Under this alternative, intertie virtual bids are ignored from the evaluation of congestion; they neither cause congestion nor relieve it. In other words, the physical + virtual scheduling constraint is not enforced under this alternative rule, only the physical scheduling limit is binding.

This approach reflects the two potential impacts of convergence bids: the relationship between IFM and HASP congestion costs, and the relationship between the IFM and HASP energy costs. Under this rule, convergence bids on interties would affect the latter, but not the former. At present, virtual schedules can only exacerbate congestion but cannot relieve it. It has become evident that this congestion asymmetry of virtual schedules is the core of the challenge of appropriately accommodating virtual bidding activity on the interties.

This rule eliminates intertie convergence bids from having a role in congestion costs altogether. The rule preserves the effect of convergence bids on the energy component of the LMP. Virtual exports still result in the commitment of additional internal physical resources, while virtual imports still result in reducing the quantity of committed physical resources. The principal difference is that, under this rule, virtual imports would no longer result in a reduction of physical resources *on that intertie.*

Different variations need discussion. The CAISO should consider whether to model all intertie virtual bids at the system reference bus – in which case all intertie bids are effectively the same; or there may be an

ability tomodel them as being on the “downstream” side of an interface, thus avoiding intertie congestion. This option may be the most preferred approach as it directly eliminates the intertie congestion asymmetry issue.

Conclusion

Given the problems with CAISO’s “Option A” and the complexity of evaluating alternatives to the current approach, Powerex believes additional stakeholder consultation is necessary. We therefore renew our recommendation that the CAISO suspend virtual bidding on the interties for a period of up to six months, while this consultation takes place. If the CAISO does not move to suspend convergence bidding on the interties, Powerex recommends continuing with the existing approach while a better approach is thoroughly developed.