Attachment B -- Example of Congestion Revenue Rights Settlement Rule

Under nodal convergence bidding, DMM strongly recommends that the settlement rule implemented in the eastern ISOs to help deter the gaming of CRRs using virtual transactions be implemented in the CAISO market. The specific language in the PJM Tariff limiting a participant's CRR payments in cases where the participant's virtual bids may have otherwise increased CRR payments reads as follows:

> 5.2 Transmission Congestion Credit Calculation.
>
> (b) If a holder of a Financial Transmission Right between specified delivery and receipt busses acquired the Financial Transmission Right in a Financial Transmission Rights Auction (the procedures for which are set forth in Part 7 of this Schedule 1) and (i) had an Increment Bid and/or Decrement Bid that was accepted by the Office of the Interconnection for an applicable hour in the Day-ahead Energy Market for delivery or receipt at or near delivery or receipt busses of the Financial Transmission Right; and (ii) the result of the acceptance of such Increment Bid or Decrement Bid is that the difference in locational marginal prices in the Day-ahead Energy Market between such delivery and receipt busses is greater than the difference in locational marginal prices between such delivery and receipt busses in the Real Time Energy Market, then the Market Participant shall not receive any Transmission Congestion Credit, associated with such Financial Transmission Right in such hour, in excess of one divided by the number of hours in the applicable month multiplied by the amount that the Market Participant paid for the Financial Transmission Right in the Financial Transmission Rights Auction.

PJM extends the CRR settlement rule described above to busses "nearby" the delivery or receipt busses specified by the CRR. The Tariff defines busses that are "at or near" each FTR delivery or receipt Location as follows:

> [a] Location shall be considered at or near the FTR delivery or receipt Location if seventy-five % or more of the energy injected or withdrawn at that Location and which is withdrawn or injected at another Location is reflected in the constrained path between the subject FTR delivery and receipt Locations that were acquired in the FTR Auction

The ISO-NE Tariff incorporates virtually the same language.

DMM staff found this Tariff language ambiguous,[1] and sought to clarify how it is actually applied. The following example demonstrates how DMM believes this settlement rule used by PJM and also adopted by ISO-NE is applied.

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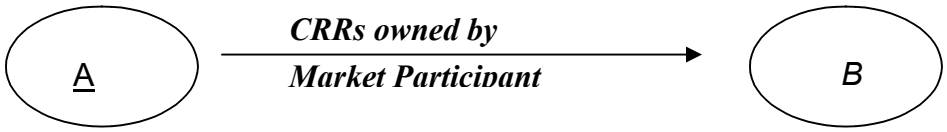
[1] For example, the requirement that "the result of the acceptance of such Increment Bid or Decrement Bid is that the difference in locational marginal prices in the Day-ahead Energy Market between such delivery and receipt busses is greater than the difference in locational marginal prices between such delivery and receipt busses in the Real-time Energy Market" seems to imply that some analysis must be done to determine the impact of the participant's virtual bids on the day-ahead and real-time price at both nodes. However, DMM does not believe that, in practice, such analysis is done.

Example 1: Congestion Revenue Credit Calculation

In this example, the transmission congestion occurs from Zone A to Zone B, so the Participant owning CRRs from Zone A to Zone B will receive the difference between the Locational Marginal Prices (LMPs) at those two zones. Increasing congestion will increase the price at Zone B, so Market Participants might try to create congestion by bidding convergence demand at B, or convergence supply at A.

Figure B1 - Two-Node Example



The settlement rule adopted by PJM and ISO-NE to address such situations essentially consists of three steps, which are described below.

1. If the participant has an accepted inc bid (convergence supply bid) at A or an accepted dec bid (convergence demand bid) at B, then a potential adjustment to participant's Congestion Revenue Rights (CRR) payments (also called Financial Transmission Rights (FTR)) would be based on Steps 2 and 3 described below.

2. A test of whether the difference between the Market Clearing Prices (MCPs) in the two zones in the Day Ahead Market is greater than the difference between the MCPs in real time,[2] which can be expressed as:

$$\text{Is } (MCP_{DA,B} - MCP_{DA,A}) \text{ greater than } (MCP_{RT,B} - MCP_{RT,A})?$$

   If this condition is not true, no adjustment is made, as depicted in Cases A and B in Table A-1. If this condition is true, an adjustment is made to limit the CRR revenues received by the participant, as described in Step 3 below. Case C in Table A-1shows a case in which this condition is true. In this scenario, the Participant's accepted inc bid at A or accepted dec bid at B may have contributed to a $10 price differential between points A and B. Without a settlement rule, the Participant would collect $10 of congestion revenue[3] for each MW of CRRs owned, while the RT market results show that only a $5/MW differential between Nodes A and B.

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[2] While this doesn't necessarily mean that gaming of CRRs using convergence trading occurred, it is as good a measure as can be obtained without rerunning the market without convergence bids. Note that rerunning the market would show the day-ahead results without convergence trades, but these results would still have to be compared to the RT market that ran after the DA market including convergence trades. For this and other reasons, even rerunning the DA market would produce an imperfect test of the gaming of CRRs using convergence bidding.

[3] For simplicity, we assume the marginal loss component of the LMPs at A and B are the same and therefore the price differential is assumed to reflect only congestion.

Table B1 - Summary of Settlement Scenarios

Case	Day Ahead Market			Real Time Market			CRR Settlement Adjustment
	MCP at Zone B	MCP at Zone A	MCP_B – MCP_A	MCP at Zone B	MCP at Zone A	MCP_B – MCP_A	
A	$50	$45	$5	$50	$45	$5	None
B.	$50	$45	$5	$55	$45	$10	None
C.	$55	$45	$10	$50	$45	$5	See 3. below

Note: All prices are per MWh.

3. In Case C, the following adjustment would be made as part of the settlement process:

$$CRR = (DA_B - DA_A)*Q_{CRR} - Q_{CRR}*[(DA_B - DA_A) - avg(P_{CRR})]$$

where Q_{CRR} is the quantity in MWh of CRRs owned along the path from Node A to Node B, and the average CRR price (P_{CRR}) is the price the Participant paid for the monthly CRR divided by the number of hours in the month.[4]

For example, if a participant's monthly CRR of a 100 MW cost $600, and there were 720 hours in the month, the following would be the revenue calculations for the CRRs in the above three scenarios:

a. ($50 - $45)*100 = $500

b. ($50 - $45)*100 = $500

c. ($55 - $45)*100 – 100*[($55 - $45) - $600/720]

= $1,000 – $917 (payment on CRRs – adjustment)

= $83

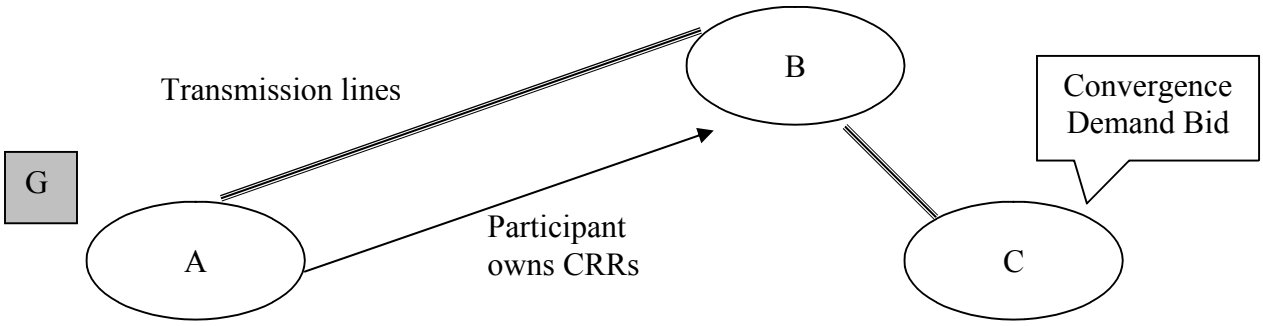
Definition of "Nearby" Nodes:

In a nodal virtual bidding scenario, it is important to consider that congestion might occur between Nodes A and B if the Participant strategically places convergence bids at nearby nodes. For example, say a Participant owning CRRs from Node A to Node B places a convergence demand bid (also known as a dec bid) at Node C. Depending on the transmission system and the location of generating plants, congestion may well be increased between Nodes A and B.

[4] Note that, in the event that the difference between the MCPs is less than the average hourly price of the CRRs, no adjustment would be made.

Below is a diagram of a situation in which a node, Node C, is isolated such that a convergence demand bid at Node C can only be met by additional generation from Node A, which will increase flows on the path between Nodes A and B. In this case, convergence demand bids at Node C could create congestion between Nodes A and B, thereby increasing the difference between the MCPs at Nodes A and B, and increasing CRR revenues.

Figure B2 - Three-Node Example



In order to deter this sort of gaming, PJM extends the CRR settlement rule described above to busses "nearby" the delivery or receipt busses specified by the CRR. PJM Market Monitoring staff has clarified that busses that are "nearby" the delivery or receipt busses are identified based on "Shift Factors" or "Power Transfer Distribution Factors" (PTDFs).

Specifically, if there is congestion between a CRR's source and sink, and the owner of those Rights places a virtual supply bid on the low priced or unconstrained side, it is then paired with another location where a withdrawal occurred (by the CRR owner or any market participant). This reference location is the withdrawal location with the minimum Shift Factor. If the difference between the Shift Factor at the location of the virtual supply bid and the Shift Factor of the reference location is greater than or equal to +/- 75%, the location is considered near the constraint.

For example, if a virtual supply bid is placed at Node A, which has a 20% Shift Factor, and a withdrawal occurred in Node C, which has a the lowest Shift Factor of -55%, then difference between the two is 75%. This would trigger the application of the above-described settlement rule.

Conversely, if a virtual demand bid is placed on the high priced or constrained side, it is paired with the location with the maximum Shift Factor where an injection occurred (again, by the CRR owner or any other market participant). If the difference between the Shift Factor at the bid location and the Shift Factor at the reference injection location is greater than or equal to +/- 75%, the location is considered near the constraint. For example, if a virtual demand bid is placed at Node C, which has a -55% Shift Factor, and an injection occurred at Node A, which has the maximum Shift Factor of 20%, the difference between the two is -75%. Again, this would trigger the application of the above-described settlement rule.