Congestion Revenue Right Settlements Rule

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Revision History

Date	Version	Description	Author
2015-07-31	1.0	First draft	Guillermo Bautista Alderete
2017-03-09	2.0	Added Addendum	Rahul Kalaskar

Note: *The purpose of this market issues bulletin is to provide information to market participants concerning market issues as that term is described in Attachment G to the Business Practice Manual for Market Operations.*

Contents

Executive Summary

The ISO implemented convergence bidding, also known as virtual bidding, on February 1, 2011. The congestion revenue right (CRR) settlements rule was implemented as part of the same initiative. The purpose of the CRR settlements rule (also known as claw back rule) is to provide a targeted way of limiting CRR payments to entities that can increase the value of congestion revenue rights through the use of virtual bids. The ISO included all flow-based constraints, namely transmission corridors, lines, transformers and nomograms, as well as schedule-based constraints, like interties, in the CRR settlement rule. Although the ISO intended to include nodal megawatt limit constraints (nodal constraints) as part of the CRR settlements rule, these were not included in the initial implementation or in any subsequent upgrade until September 10, 2014. Following a market participant inquiry, the ISO investigated market outcomes in August 2014 and determined that the nodal constraint had not been included among the constraints in the CRR settlement rule. Through different investigations related to the CRR settlements rule, it was found that the Spring 2014 release implemented on May 1, 2014 significantly disrupted the overall functionality of the CRR settlement rule, which resulted in incorrect outcomes. These issues have been generally addressed since May 2015. This market issues bulletin provides a description and an impact assessment of not having implemented the nodal constraint functionality in the CRR settlement rule and the ISO's plans for resettling the CRR settlement rule as of May 1, 2014.

Background and Scope

The objective of this document is to describe the issues that have impacted the expected functioning of the congestion revenue right (CRR) settlement rule, as well as provide an impact assessment. As per the tariff section 11.2.4.6 and attachment F of the Business Practice Manual (BPM) for Market Operations, the ISO will adjust the CRRs revenues to CRR holders if their virtual awards in the Integrated Forward Market (IFM) increase their CRR payment. The ISO implemented this rule on February 1, 2011 for the various types of transmission constraints, namely interties, transmission corridors, flowgates, and nomograms but not for nodal constraints, even though nodal constraints were identified as in scope in the design documents. Nodal constraints are utilized in the market when an alternating current cannot be achieved as described in ISO tariff section 30.10 and consistent with the definition of "Transmission Constraint" in Appendix A of the ISO tariff.

When a nodal constraint is deployed in the market, it can limit the amount of power injections or withdrawals at certain locations, and can bind and create congestion; such congestion will have a direct impact on the pricing locations that are within the nodal constraint. Unlike any other transmission constraint, nodal constraints are dynamically created by the market application to bound excessive power injections or withdrawals in certain locations that may be causing or contributing to the inability to achieve an alternating current solution in the day-ahead market.

During the investigation of certain market outcomes, in August 2014, the ISO came to the conclusion that nodal constraints were not being accounted for in the CRR settlements rule. The ISO informed the market through a market notice[1] and a market update call about the fact the CRR settlement rule was not evaluating nodal constraints.

The ISO concluded that existing tariff language in effect during August 2014 in section 11.2.4.6 already authorized the ISO to include nodal constraints in the CRR revenue adjustment calculations because nodal constraints are included in the definition of Transmission Constraints. This was consistent with the intent of the CRR settlement rule, which is to capture any constraint that impacts the congestion component of locational marginal prices.   The events of August 2014 and the findings that the CRR settlements rule was not being applied to nodal constraints raised questions among market participants concerning whether the nodal constraints should be included in the rule.

In an abundance of caution, the ISO filed the proposed language on September 2, 2014 to reinforce that the CRR settlement rule specified in section 11.2.4.6 includes nodal constraints to achieve an alternating current solution in the day-ahead market pursuant to tariff section 30.10.   The ISO requested that the Commission permit the September 2 tariff filing to go into effect as of September 2.

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[1] A market notice was posted on August 2014 and is available at
http://www.caiso.com/Documents/ApplicationofCRRSettlementRuletoNodalConstraints.htm

On October 31, 2014, the Commission issued an order accepting the ISO's filing as of the requested effective date[2].

In the September 2, 2014 filing, the ISO also indicated that it would evaluate the impact of the absence of nodal constraints on participants' settlements outcome, through its existing Market Issues process described in Appendix G of the ISO's Business Practice Manual for Market Operations. The ISO also indicated that it would seek further authorization from FERC if the ISO proposes to apply the nodal constraint for any period prior to September 2, 2014.

Timeline Associated With This Market Issue

The following timeline is provided to ease the understanding the different dates and events impacting the issue of nodal group constraints not evaluated in the CRR settlements rule[3].

1. CRR settlement rule was implemented on February 1, 2011; this process was not evaluating nodal constraint effect since this implementation day through September 10, 2014 when the fix was implemented.
2. The ISO filed a tariff clarification due to the delay in implementation to ensure that the ISO had the authority to include the nodal constraint in the CRR settlements rule. Per this filing, the ISO will recalculate the CRR settlements rule for trading dates within the schedule settlements runs of September 2, 2014 through September 10, 2014.
3. Based on the previous items, the impact analysis for the nodal group constraint issue encompasses the period of February 1, 2011 through September 1, 2014.
4. The CRR settlements rule was significantly disrupted as of May 1, 2014 when the Spring release was implemented. This impacted all constraints, not just nodal constraints. This issue was resolved by May 1, 2015.
5. As of May 1, 2015, the CRR settlements rule as a whole, including the evaluation of nodal constraints, has been working as designed.
6. Prior to May 1, 2014 the nodal constraint impact is comparatively low and the settlements impact would correspondingly be low.

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[2] *Cal. Indep. Sys. Operator Corp.*, 149 FERC ¶ 61,093 (2014).

[3] The dates in this bulletin refer to the dates when the events happened, such as a fix implemented in the software. These dates, however, are different to the trading dates subject to settlements. For instance, a fix to include the nodal constraint was deployed on September 10. With the current cycles for settlements calculations, the CRR settlement rule with the fix in place will have the settlements for the T+3B for September 9, 2015, for the T+12B the trade date will be August 27 and for the T+55B the trade date will be June 4.

7. Given this timeline, the ISO is expecting to file a request at the commission to apply the CRR settlements evaluation to nodal constraints for the period of May 1, 2014 through September 1, 2014 shortly after publication of this market issues bulletin.

8. Furthermore, due to the issues arising since May 1, 2014, the ISO will be resettling the CRR settlements rule in its entirety, including the evaluation of nodal constraints, for the period of May 1, 2014 through May 1, 2015.

Virtual Bids and Nodal Constraints

Virtual bids are financial bids submitted only in the integrated forward market (IFM); they are settled at the IFM prices and automatically liquidated with the opposite position at the simple average of the four applicable Fifteen Minute Market (FMM) prices[4]. The integrated forward market considers both physical and virtual bids during the market clearing process; from a power injection standpoint, virtual bids have the same treatment and impact on the transmission system. Thus, it is possible that the combination of physical and virtual bids may cause excessive power injections at certain locations that result in direct current solutions for the power flows used in the integrated forward market. In order to ensure AC convergence, the IFM enforces nodal constraints on a locational basis to limit the amount of power injections at a particular location or set of locations and applies to both physical and virtual bids[5]. These nodal constraints are enforced only when an AC solution is not attainable in IFM. The process of determining whether to enforce nodal group constraints is shared between the Security Constrained Unit Commitment (SCUC) module and the Transmission Network Analysis (TNA) module. The TNA module identifies the locations where nodal constraints will be enforced and the SCUC includes the appropriate constraints in the optimization formulation. Nodal constraints are defined in section 30.10 of the ISO tariff, which provides that, if and when it is impracticable to achieve an alternating current power flow solution without the initial enforcement of nodal constraints, the ISO will enforce nodal constraints. The Commission accepted sections 11.2.4.6 and 30.10 effective February 1, 2011, pursuant to the ISO tariff amendment to implement convergence bidding in the ISO markets.[6]

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Figure 1 shows the daily count of occurrences of congestion on the nodal constraints for the period of February 1, 2011 until March 31, 2015. The nodal constraints are not enforced every day, which implies that they were not required to obtain an AC solution in the IFM market for those days. The number of

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[4] Market Operations BPM- Section 2.5.2.4 for Convergence bidding

[5] Market Operations BPM- Section 3.1.11 Nodal group constraints.

[6] *Cal. Indep. Sys. Operator Corp.*, 133 FERC ¶ 61,039, at PP 19-21, 153-59, 202-03, *order on reh'g and compliance filing*, 134 FERC ¶ 61,070, at PP 106-08, 111 (2011). In 2014, the Commission accepted revisions to section 11.2.4.6 filed by the ISO and found that the revisions did not change the methodology for adjusting the revenue from congestion revenue rights. *Cal. Indep. Sys. Operator Corp.*, 146 FERC ¶ 61,204, at P 100 (2014).

days on which the nodal constraints bound increased from 116 in 2012 to 187 in 2014. At the same time, the total count of binding nodal group constraints also increased from 11,557 in 2012 to 20,514 in 2014.

Figure 1: Average Daily Count of binding nodal constraints
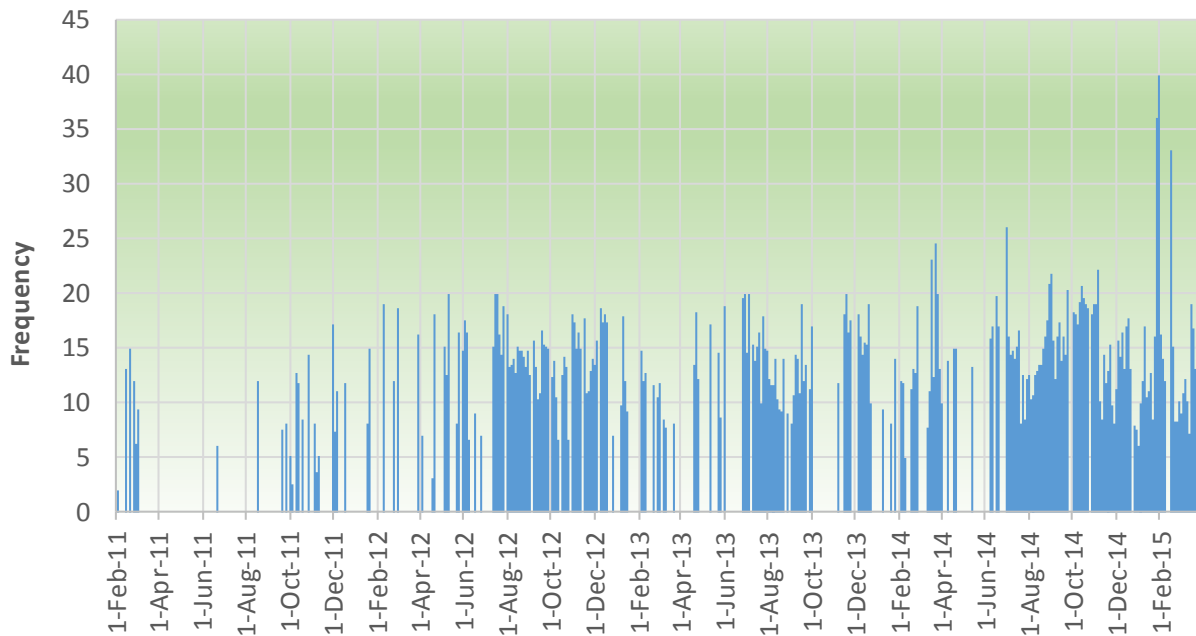
Figure 2: Monthly IFM congestion rents
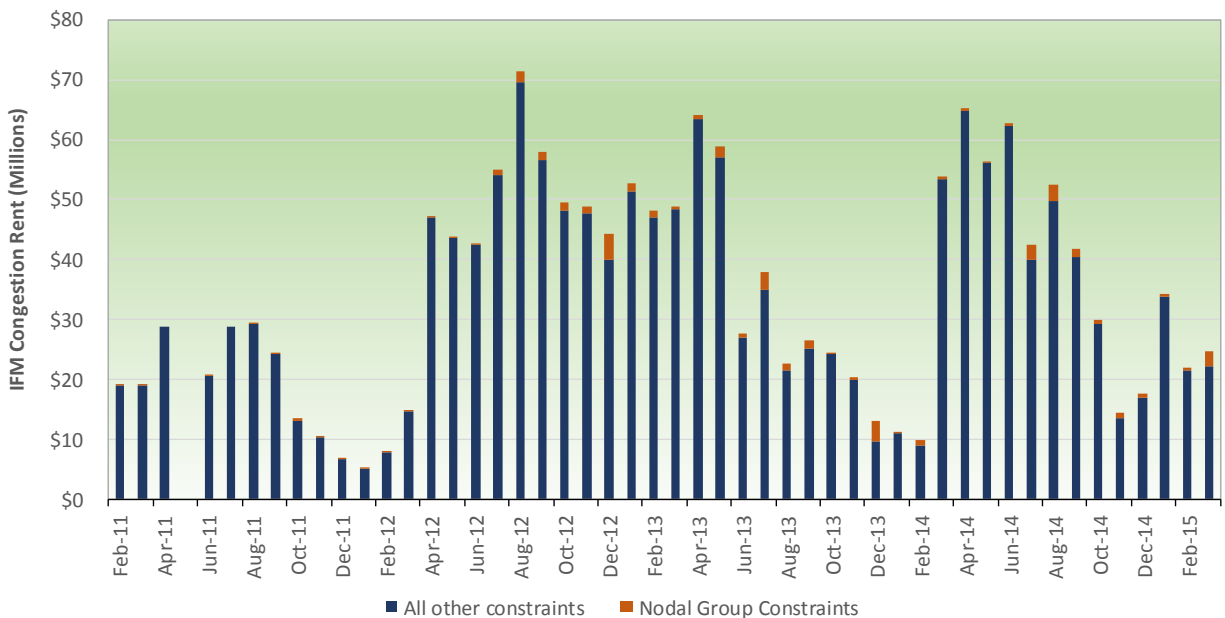
The congestion rents on the nodal constraints are very small compared to congestion rents collected on other constraints, representing about 2 percent of all congestion rents. The ISO analyzed the

total congestion rents collected from the IFM for the period of February 1, 2011 through the first quarter of 2015.

Figure 2 shows the congestion rents by illustrating the relative share of rents from nodal group constraints; this is an upper-bound estimate of rents that may have been collected from this type of constraint. As can be observed, the congestion rents from nodal constraint is a relatively small share of the overall rents.

CRR Settlements Rule

Congestion revenue rights are financial instruments made available through the ISO's CRR allocation and auction processes and traded through secondary market transactions. Congestion revenue rights enable CRR holders to manage variability in the congestion cost component of the locational marginal prices for transactions in the ISO's markets. Congestion revenue rights are acquired primarily, although not solely, for the purpose of offsetting congestion costs between generation and supply nodes in the ISO's day-ahead market. Convergence bidding is a mechanism whereby market participants can submit purely financial bids, called virtual bids, to sell or buy energy in the ISO's day ahead market, with the explicit requirement to buy back (or sell back) that energy in the real time market.

The ISO's convergence bidding feature was implemented on February 1, 2011, almost two years after the implementation of the locational marginal pricing market design. During the policy development phase of the convergence bidding initiative, the ISO identified the potential for market participants that are both CRR holders and virtual bidders, to submit virtual bids to alter the value of their congestion revenue rights. This would be accomplished by submitting virtual bids in the day-ahead market to congest certain locations which would influence the congestion component of the location marginal price, and subsequently influence the value of CRRs that are sources or sinks for those locations. While liquidating virtual bids in the real-time market may appear to be unprofitable due to differences between day-ahead and real-time system marginal energy prices and losses, it may be profitable to submit virtual bids in the day-ahead market because the settlement of CRR revenues are based on the congestion costs collected in the day-ahead market. To dissuade such behavior, the ISO developed the CRR settlements rule, which automatically adjusts the revenue from CRR for any participant that engages in convergence bidding behavior that affects the value of the congestion revenue rights it holds.[7]

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[7] The ISO set forth the details of the congestion revenue right resettlement rule in section 11.2.4.6 of the ISO tariff. This indicates that the ISO will adjust the revenue from the congestion revenue rights of a CRR holder that is also a convergence bidding entity whenever either of the following creates a significant impact on the value of the congestion revenue rights held by that entity: the CRR holder/convergence bidding entity submits virtual bids; or the CRR holder/convergence bidding entity reduces in the real-time market an import or export awarded in a day-ahead schedule.

The CRR settlements rule was implemented as part of the convergence bidding initiative on February 1, 2011. This settlements rule is a post-process. As such, this process requires the feeding and availability of various data points, such as congestion prices, shift factors, and congestion revenue right positions in order to calculate the claw back amounts. As indicated in the filing about this CRR settlements rule, after ISO's evaluation and investigation of the CRR settlements rule, the ISO has determined that, while it intended the CRR resettlement rule to include the congestion impact of nodal constraints, the implementation of the CRR resettlement rule did not capture those amounts. This issue has been present since this rule became effective on February 1, 2011. Subsequently the ISO clarified the expectation of applying this CRR settlements rule through the September 2, 2014 filing and developed the software solution to include nodal constraints. The application of the CRR settlements rule including nodal constraints became operational on September 10, 2014.

The main objective of this bulletin is to provide an impact assessment of not including nodal constraints in the CRR settlements rule from February 1, 2011 through September 1, 2014. The ISO performed a study to estimate the CRR settlement rule adjustment cost for congestion on nodal constraints by replicating the intended logic of the CRR settlements rule for nodal constraints.

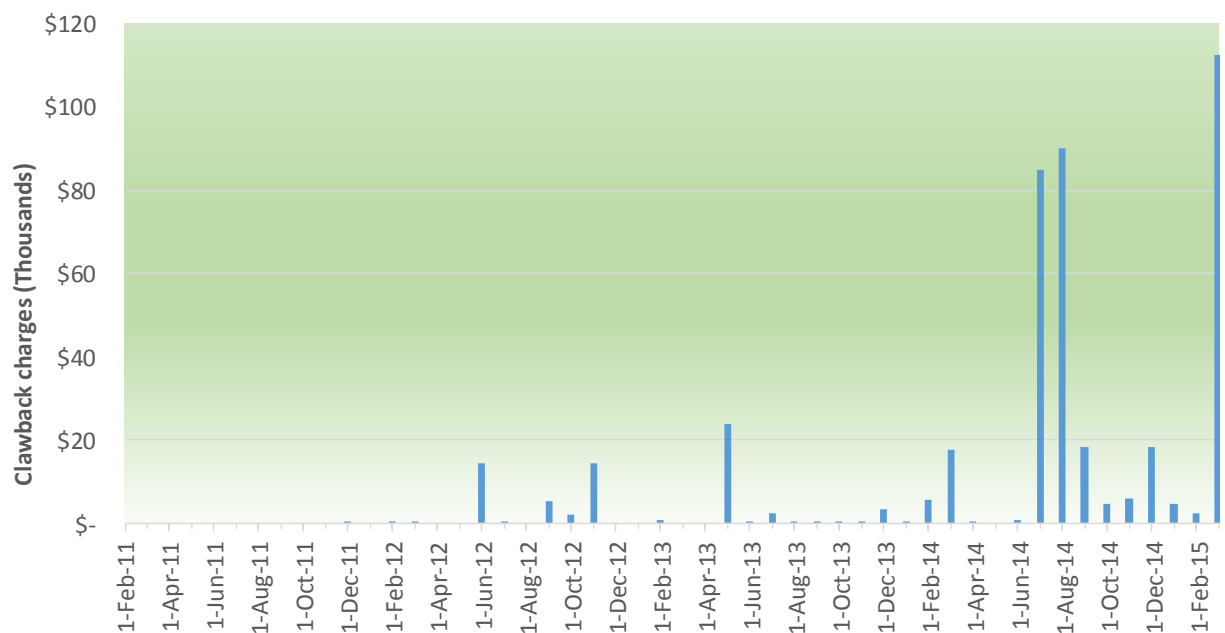**Figure 3 CRR Settlements rule revenue- January 2013-August 2014**

Figure 3 above shows the estimated CRR settlements rule (CRR claw back) amounts expected to be charged to CRR holders for a time period of February 2011 through March 2015 from all those scheduling coordinators who had their virtual bids causing congestion on nodal group constraints. For this timeframe the estimated total amount charged to scheduling coordinators for this period is $384,819. In comparison, the total CRR settlement rule amount for all other constraints was more than $4.59 million;

thus, the CRR settlement rule for nodal constraints amounts to just about 8 percent of all the CRR settlement rule amount.

Specifically for the impact assessment for the period of May 1, 2014 through September 1, 2014, which is the period under analysis of this report for re-settlements, the estimated missed charges to scheduling coordinators is about $194,000. This is, relatively speaking, a very small impact on the market as a whole in reference to both the total claw back volume and the total congestion volume. The estimated missed charges for the period since February 2011 through April 2014 is about $92,000.

In addition to the overall magnitude of the market impact, another consideration is to determine how concentrated this impact was among market participants. Based on the estimates, these charges would be applied among six different participants, with the two top participants absorbing about 85 percent of the overall amount.

Other issues about CRR settlements rule

Through analysis and monitoring of the CRR settlement rule outcomes, it was determined that the CRR settlements rule stopped working as designed in May 2014; the cause of this was separate and apart from the nodal constraint issue. To different degrees, these issues have been the result of software changes to accommodate new design features of the market and fix data errors. The major problem can be traced to the implementation of the Spring 2014 software release in May 2014.

Essentially, the issues relate to how the CRR settlement rule application is established. There are many strict parameters on how data should appear. With the major market changes implemented in the Spring 2014 release, the data sets that the tool relied upon were no longer available in a form that could be consumed. Accordingly, the CRR settlement rule did not produce results consistent with the tariff as of May 1, 2014. As of May 1, 2015 the CRR settlement rule has been functioning as designed, including the nodal constraints.

Because the market impact due to nodal constraints was not significant prior to the Spring 2014 release, the ISO will be submitting a filing at the Commission requesting approval to apply nodal constraint between May 1, 2014 and September 2, 2014 consistent with its commitment in the September 2, 2014 transmittal letter in support of the nodal constraint tariff clarification filing. Also, due to the problems that trace back to the May 1, 2014 spring release, the ISO will be re-settling the CRR settlement rule in its entirety as of the May 1, 2014 trading day.[8]

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[8] The ISO will only be seeking FERC approval for resettlement of the nodal constraint. The resettlement of the CRR settlement rule generally falls within the ISO's normal resettlement process. These resettlements will not require price corrections.

Furthermore, the ISO continues to analyze and evaluate the impact of other potential issues that may have affected the CRR settlement rule outcomes prior to May 2014. Based on these, the ISO will determine the next steps for the period prior to May 2014.

Next Steps

The ISO has scheduled a conference call on August 7, 2015 to discuss the content of this bulletin and the next steps. Participants can submit written comments to gbalderete@caiso.com by close of business August 14, 2015.

Addendum

Since publication of the CRR Settlement rule Market Issues Bulletin, the ISO has continued its review of the performance of the CRR settlement rule. The ISO has identified two additional issues. The first issue, discussed below, is the calculation of the average hourly shadow price that is used in the CRR settlement rule. Second, the ISO has identified another subset of constraints that are subject to the CRR settlement rule but were not fully captured, namely transmission contingency constraints to protect against N-1 contingencies. Both issues have been addressed prospectively in the market with a fix and will be also addressed retrospectively with the resettlement along with nodal constraints.

Below the ISO provides information on the hourly shadow price calculation. The Addendum concludes with a discussion on the resettlement process that the ISO is implementing.

Issue 1. Real-Time Averaging of shadow prices.

The flow-based approach of the CRR settlement rule is designed to provide a methodology to limit CRR payments to scheduling coordinators who are also convergence bidding entities and their virtual bids in the day-ahead market increase their CRR payments. The details of the CRR settlements rule is provided in appendix F of the Market Operations BPM. A gap was identified between the CRR settlement rule design and the intended implementation. The CRR settlement rule implementation can be described in two steps. In the first step, identify the combined effect of virtual awards portfolio that have a net impact of increasing the shadow prices in the day-ahead market or reduce the congestion on constraints in the day-ahead market which would otherwise bind in absence of the virtual award. The latter scenario relates to those cases in which entities eliminates or reduces congestion in day-ahead in order to reduce payment to ISO from counter flow CRRs. This step is captured numeric formulation below:

$$F_{DA,k,t,i} = \sum_{j \in \{J\}_{i,t}} S_{DA,k,j,t} VB_{j,t,i}$$

Where:

$S_{DA,k,j,t}$ is the IFM shift factor of constraint k with respect to Virtual Awards at node j during hour t,

$\{J\}_{i,t}$ is the set of all nodes at which entity, i, has Virtual Awards for the hour t, and

$VB_{j,t,i}$ is the volume (MW) of Virtual Awards of the entity at node j.

In some cases, it is possible that virtual awards in the day-ahead market would completely eliminate congestion from the day-ahead market; however, the constraint may bind in the real-time market. If the constraint is binding in the fifteen minute market, but not in the IFM, then real-time shift factors are used to calculate flow impact.

In the second step, the ISO determines the value of the CRR payment based on the congestion in real-time and compares it with the payment to the CRR based on the congestion in the day-ahead market as it relates to the constraint that was identified in step one. The CRR settlement rule payment adjustment is the difference between these two amounts. This step is captured in the numerical formulation below:

$$d_{k,c,t,i} = Q_{c,t,i} * \left(\Delta_{DA,k,c,t} - \Delta_{RT,k,c,t} \right)$$

Where :

$$\Delta_{DA,k,c,t} = \left(\left(-S_{DA,k,Sink_c,t} \right) \left(\lambda_{DA,k,t} \right) - \left(-S_{DA,k,Source_c,t} \right) \left(\lambda_{DA,k,t} \right) \right)$$

$$\Delta_{RT,k,c,t} = \left(\frac{\sum_{h_{\sin k}}^{H_{\sin k}} \left[\left(-S_{RT,k,Sink_c,t,h_{\sin k}} \right) \left(\lambda_{RT,k,t,h_{\sin k}} \right) \right]}{H_{\sin k}} - \frac{\sum_{h_{source}}^{H_{source}} \left(-S_{RT,k,Source_c,t,h_{source}} \right) \left(\lambda_{RT,k,t,h_{source}} \right)}{H_{source}} \right)$$

$Q_{c,t,i}$ is the MW quantity of CRR, *c*, owned by the entity for Trading Hour, *t*.

$S_{RT,k,Sink_c,t}$ is the real-time shift factor of constraint k with respect to the sink node of c.

$\lambda_{RT,k,t}$ is the shadow price of the constraint *k* in the real-time for Trade Hour, *t*.

h stands for the fifteen-minute interval during each Trading Hour, thus H=4 intervals for each Trading Hour.

$\Delta_{DA,k,c,t}$ is the constraint *k*'s contribution to the CRR's per MW "day-ahead" value for hour, *t*, and

$\Delta_{RT,k,c,t}$ is the constraint *K*'s contribution to the CRR's per MW "real-time" value for hour, *t*.

It was identified that the calculation of $\Delta_{RT,k,c,t}$ was not implemented as intended in the original design. Whenever a constraint was not binding in any of the four fifteen minute intervals those intervals were completely dropped from the calculation; however, it was indented to use zero shadow prices for those intervals. By not including the zero shadow price, it effectively increased the CRR payment based on real-time congestion and hence impacted the adjustment to CRR payment. This issue is explained here using a simplified example. Consider a constraint *k* is binding in day-ahead market with shadow price of $200/MWh for an hour. The same constraint is binding for only two intervals for the same hour in the FMM market. The shadow price for each interval is captured in table below. The real-time effective shadow price was calculated using only non-zero intervals, however it was expected that the calculated shadow price would use all four intervals. Thus the effective real-time shadow price was calculated as $100/MWh instead of $50/MWh. A higher average real-time shadow price results in lower amount of CRR claw based and vice versa. This was corrected in the market in September 2015.

Table 1: FMM interval shadow prices for a sample constraint *k*

FMM Interval	Shadow Price for constraint k
Interval 1	$0 (constraint didn't bind)
Interval 2	$100
Interval 3	$100
Interval 4	$0 (constraint didn't bind)
Effective shadow price using only two intervals	$ (100+100)/2= $100
Effective shadow price using all four intervals	$(0+100+100+0)/4= $50

Resettlement

The ISO is resettling the CRR settlement rule as of May 1, 2014, which is the date of the implementation of the spring 2014 release. The resettlement will include all of the corrections discussed in this Market Issues Bulletin so that resettlement during this period will be consistent with the intended design principles and Business Practice Manual for Market Operations including the implementation of nodal constraints contingency constraints and the correct calculation of the hourly shadow prices. Resettlement will be reflected under Charge code 6703 Convergence Bidding CRR Adjustment Settlement on the T+35M recalculation settlement statement scheduled for publication beginning April 5, 2017.

The ISO selected May 1, 2014 due to the general disruption in functionality associated with the spring 2014 release causing significant performance issues. The May 1, 2014 date captures the time period some virtual bidders used the absence of nodal constraints to benefit CRR revenues. This issue is the main topic of the market issues bulletin.

In moving forward with the resettlement, the ISO has reconsidered its statement on page six above (copied immediately below) on whether it needs further FERC authorization to resettle the Nodal Constraints prior to September 2, 2014.

> In the September 2, 2014 filing, the ISO also indicated that it would evaluate the impact of the absence of nodal constraints on participants' settlements outcome, through its existing Market Issues process described in Appendix G of the ISO's Business Practice Manual for Market Operations. The ISO also indicated that it would seek further authorization from FERC if the ISO proposes to apply the nodal constraint for any period prior to September 2, 2014.

As noted, the ISO made the same commitment in its September 2, 2014 tariff clarification filing. In light of this commitment, the ISO filed a motion on July 31, 2015 to seek FERC authorization to resettle. In its October 1, 2015 order,[9] FERC counseled that a motion was not the appropriate mechanism to request authorization. Instead, the ISO should file a request for a declaratory order. The ISO has reconsidered whether further FERC authorization is warranted and concluded that it is not necessary to seek a declaratory order.

The ISO's position has always been that the intent and tariff language included Nodal Constraints and filed the tariff clarification only to eliminate any going forward question on this issue. When it filed the September 2014 tariff clarification, the ISO had sought and received a declaratory order to allow it to resettle a component of its complicated bid cost recovery rules in a way that was inconsistent with the method described in the Business Practice Manual and involved, in essence, a reinterpretation of the ISO tariff. The bid cost recovery situation is distinguishable from the CRR settlement rule.

Resettlement of the CRR settlement rule does not require reinterpretation of the tariff or prior inconsistent business practice manual language. Rather, with respect to the CRR settlement rule, the ISO identified errors in the original implementation that the ISO has corrected and is now resettling back to May 1, 2014, the date when the spring 2014 release caused additional disruption in performance. Accordingly, the ISO sees no need for and is not pursuing a request for declaratory order to interpret and apply its tariff.

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[9]   *Cal. Indep. Sys. Operator Corp.*, 153 FERC ¶ 61,003 (2015).