Local Market Power Mitigation Enhancements 2015

Draft Final Proposal

January 12, 2016

LMPM Enhancements 2015 Draft Final Proposal

1 Changes and responses to stakeholder comments

Most stakeholder were supportive of the planned and proposed changes to the local market power mitigation (LMPM) system presented in the straw proposal. The issues raised by stakeholders did not warrant making any changes to the proposal.

1.1 Stakeholder concerns

1.1.1 Market performance issues

Several market participants, including PG&E, SCE, SDGE, and WPTF, expressed concerns about how the new approaches to LMPM and DCPA would impact market run times, and possibly lead to increased failures and DC solutions.

The planned and proposed changes should not have an impact on the number of DC solutions. DC solutions are due to issues related to network modeling. Changes to the LMPM process should not impact the frequency of DC solutions.

Market performance is affected by all changes to the market design. Whenever there is a change to market design, the ISO's technology group works with our vendor to implement market changes in an efficient way, and tests those changes to ensure adequate performance. This change will not be significantly different, in that respect, to other changes to the market design. DMM and the ISO's Technology group worked together to generate the design presented in the straw proposal, ruling out options that were likely to threaten system performance. The proposed LMPM changes will be tested significantly and implemented when the ISO and its vendor are confident in the performance of the market systems with the new design, and DMM will continue to monitor the functioning and impact of local market power mitigation in all the ISO markets.

1.1.2 Improvements expected by proposed changes

Stakeholders also asked for more information on how much we expect the new procedures to improve LMPM outcomes. The planned changes for the real-time pre-dispatch (RTPD) LMPM process are similar in nature to the IFM LMPM process. We can expect accuracy for the new RTPD process to be similar to the IFM results. As reported in the 2014 annual report, IFM congestion was accurately predicted 88% of the time, compared to 69% for RTPD congestion using the old system. Over predicted congestion accounted for only 5% of IFM congested constraint intervals, compared to 20% of RTPD intervals. Because of differences in commitment procedures and possibilities between IFM and RTPD, it may be reasonable to expect that the new RTPD would still be slightly less accurate than IFM, but even half of that improvement would be significant.

One key improvement that will come from the new process is that we will be able to rule out changes to exogenous inputs like load, or renewable output, as a source of over prediction of congestion. The planned changes to RTPD will virtually eliminate any overpredicted congestion that is due to factors other than bid mitigation and the resulting changes in dispatch. Because the LMPM run and the binding market run are happening in the same interval, there will be no changes to exogenous inputs between the runs. Changes in congestion between LMPM run and the binding market run will be due to differences in the market solution between the run with unmitigated bids, and the run with mitigated bids.

Expected improvements to the real-time dispatch (RTD) mitigation can be quantified. Below is a table that shows comparisons between different systems to predict RTD congestion. Units for all comparisons are congested constraint intervals. Each interval in which a constraint is congested in either the mitigation run, the bidning market run, or both, counts as one observation. The comparison for flowgates and nomograms is pulled form data starting on December 18th and running to January 7th. No earlier data is available. EIM transfer values are compared starting on November 4th, when the current formulation of the EIM transfers was first implemented. The first column compares congestion present in the current binding RTPD runs to congestion present in the current binding RTD runs. This is an approximation of the expected accuracy in RTD of the planned changes for RTPD due to be implemented in the spring. The second column compares congestion in current binding RTD runs to congestion in current advisory RTD runs. That set of numbers approximates the proposal for RTD mitigation. The data suggest that even after the Spring changes are in effect, as many as 25.7% of congested flowgate and nomogram constraint intervals in RTD could be underpredicted. Using the advisory interval for RTD mitigation can be expected to lower that number to less than 9%. Similarly, the share of congested constraint intervals that are accurately predicted could be as low as 42% in the planned system, with expected improvement to over 75% with the advisory RTD mitigation in place.The results for EIM transfers also show a drastic improvement.

Table 1: Estimated improvements in RTD mitigation accuracy with proposed changes

	No mitigation in RTD		Advisory mitigation in RTD	
	Share predicted accurately	Share with underpredicted congestion	Share predicted accurately	Share with underpredicted congestion
Flowgates and Nomograms	42.6%	25.7%	75.8%	8.8%
EIM transfer constraints	21.8%	45.1%	65.8%	14.0%

Earlier studies on the old formulation of the EIM constraints showed similar levels of expected improvements.

1.1.3 Carrying mitigation between markets

NRG expressed concerns about continuing to carry forward what they deemed 'unnecessary mitigation.' To clarify, the fact that congestion is present in an LMPM run, but not in the corresponding market run, does not mean that the LMPM run was wrong. If any bids are mitigated, those resources will have different levels of output in the binding market run than they had in the LMPM run. These changes in output can relieve congestion on the constraint that caused the mitigation. In that case, the constraint would not be congested in the binding market run. This is a necessary and desirable outcome of market power mitigation. It is also possible that some congestion in the LMPM run does not materialize in the binding market run because of changes to exogenous inputs. Because we cannot separate these two categories, both of these outcomes are grouped into over predicted congestion in the graphs. As explained above, one of the goals of the planned RTPD enhancement is to drastically reduce or eliminate over predicted congestion due to changes in exogenous inputs.

1.1.4 Significance of impact

WPTF expresses some concerns that the impact of this will be extremely small, and that because of that this initiative may not be worthwhile. However, WPTF appears to have misinterpreted the graphs that were included in the presentation. More detail on these graphs is available in the proposal, where the units are more clearly explained. Contrary to WPTF's assertion that this may only impact 800 MW in a high load month, the impact would be on 800 constraint intervals, or 200 constraint hours. Constraints vary greatly in size, from around 10 MWs up to several thousand. Suppose the average constraint size was around 100 MWs. In this case, the 800 constraint intervals in a month could represent around 20,000 MWh for that month.

2 Introduction

The paper presents planned and proposed enhancements to the current system of measuring and mitigating market power in the real time market that have been developed by the Department of Market Monitoring (DMM) and the ISO. Specifically, the paper discusses changes planned for the market power mitigation process to address *under-mitigation* and potential *over-mitigation* in the 15-minute RTPD market, and proposes additional changes to address issues in the 5-minute RTD markets. These modifications can significantly improve the accuracy of mitigation by ensuring that mitigation is applied when constraints may be binding in real-time, while avoiding mitigation when constraints are not binding in the real-time market. The enhancements will be applied to real-time mitigation procedures within the ISO balancing area as well as to balancing areas in the Energy Imbalance Market (EIM).

The proposed modifications to the 5-minute RTD market require stakeholder feedback and tariff changes. This paper presents the issues that give rise to a need for modifications, and explains the proposed enhancements. Changes planned for the 15-minute RTPD market do not require a tariff change, but are instead a process improvement. Both sets of enhancements have been considered within the ISO before, but were deemed to be technologically infeasible at the time. The ISO has determined that they are now feasible.

The current Real-time Dynamic Competitive Path Assessment (DCPA) and Local Market Power Mitigation (LMPM) work in a predictive manner. The congestion and competitiveness in each binding market run are predicted based on data from an earlier advisory run. When the results of the advisory run differ from the results of the binding run, this may result in what DMM has referred to as *under-mitigation* or *over-mitigation.* [1]

Under-mitigation occurs due to constraints that do not bind in the predictive LMPM run subsequently binding in the RTPD run or RTD run for the financially binding interval. In other cases, mitigation occurs when congestion that can create local market power does not materialize in the financially binding market run. This has been referred to as potential *over-mitigation*, since market bids may be mitigated using cost-based default energy bids. Although over-mitigation would not result in market inefficiencies as long as bids are not mitigated below actual marginal costs, these proposed enhancements will also address the possibility that this could occur.

[1] For more information, see section 6.3 of the 2014 Annual Report at http://www.caiso.com/Documents/2014AnnualReport_MarketIssues_Performance.pdf

3 Plan for stakeholder engagement

This process is planned for an expedited schedule in order to facilitate implementation in the fall of 2016. The proposed schedule is below.

December 4, 2015	Post Agenda and Presentation
December 8, 2015	Stakeholder Call
December 22, 2015	Comments Due
January 12, 2016	Draft final proposal posted
January 19, 2016	Stakeholder call on Draft final proposal
February 2, 2016	Comments Due on Draft final proposal
March 24-25, 2016	Board of Governors meeting

4 Possible causes of inaccurate congestion predictions

The market power mitigation framework described in the Local Market Power Mitigation Enhancements stakeholder initiative in 2010 and 2011 involves two steps.[2] The first step involves using the LMPM run to predict congestion on constraints in the model and assess whether these potentially congested constraints are competitive. The second step involves mitigating the bids of generating units that can relieve this congestion if certain conditions are met.

The area of concern addressed by these planned and proposed enhancements is the accuracy of the LMPM run in predicting congestion on constraints in the binding RTPD and RTD market runs. Mitigation of bids occurs when the LMPM run predicts that non-competitive congestion will occur on a constraint in the next interval. If congestion does not occur in the LMPM run, but congestion then occurs in the subsequent market run, the level of competition on the relevant constraint will not be tested and no mitigation can occur. Reducing the inconsistencies between the LMPM process and the binding market runs should reduce concerns about unmitigated market power. It should also reduce concerns about over-estimated congestion that could lead to mitigation when local market power may not have been exercised.

Results of the market run used to determine mitigation and results of the subsequent financially binding market run can be different for any interval for several reasons. Many of the important reasons can be placed into three groups:

- Differences in inputs

[2] Details of that process can be found at http://www.caiso.com/Documents/DraftFinalProposal-LocalMarketPowerMitigationEnhancements.pdf

- Differences in modeling (including different constraint definitions)
- Solution issues or solution errors

Differences in inputs: Binding RTPD and RTD market runs both take place after the LMPM run that is used to predict congestion in RTPD and RTD. In the time between any two market runs, information will become available, forecasts will be updated, and some things will change. A number of the inputs to the model change in this timeframe, like the exact level of load that is forecast, the limits on transmission lines, the actions or deviations of curtailable load and other resources, base schedules for EIM resources, and forecasts for wind and solar generation. As these inputs to the model change, they can move the solution that minimizes cost and impact whether or not congestion occurs on particular constraints.

Differences in modeling: In addition to changes in inputs to the model, different models are optimized in the different market runs. An example is the difference in time granularity between the RTPD runs and the RTD runs. Congestion on a line in a single five minute interval may be higher or lower than in the fifteen minute interval that subsumes that five minute interval and two others. Differences are not limited to RTPD vs RTD. Each RTPD interval has a slightly different run and different set of advisory intervals that are included. Different solutions can result from the inclusion of different advisory intervals.

Solution issues: Inconsistency between the solutions in two different model runs can also come from random errors. Random errors can include differences in the calculated solution due to limits of the optimizing algorithm. The optimization may have considerable room around the optimal solution where the value of the objective function is similar across a range of solutions. While looking for the best solution, the optimization could move around this area without significant differences in the value of the objective function. Another way to think of this is that many possible solutions can qualify as ‘good enough’ according to the solution criteria of the market optimization. If the differences between the set of potential ‘good enough’ solutions are big enough in certain measures, they could result in different congestion outcomes.

The impact of under-predicting congestion depends on the level of competition on the constraint in question. If there is a competitive supply of counter flow to the constraint, then under-predicting congestion is a smaller concern. If there is not a competitive supply of counter flow, strategic behavior could lead to artificially high prices. Under predicting congestion on any constraint in an area with a limited number of suppliers of counter flow could provide opportunities for the exercise of local market power.

5 Inaccurately predicted congestion

Under-predicted congestion is a potential concern in both the ISO area and in the EIM. Unforeseen congestion occurs in both the RTPD and RTD binding market runs. Additionally, congestion predicted in the advisory runs sometimes does not materialize in the binding market runs. As reported in DMM’s annual report for 2014, accuracy of congestion predictions is higher in RTPD than in RTD. It is not perfect in either market. Of the approximately 23,000 constraint intervals that were congested in either the advisory or binding runs of RTPD for 2014, 69% were predicted accurately. Another 20% were predicted to be congested in the advisory run but then were not congested in the binding run.

When constraints are predicted to be congested in the advisory run, and then are not congested in the binding run, two causes could be to blame. One is that exogenous system conditions may have changed and counter flow to the constraint is no longer needed. Another possibility is that mitigation in the LMPM run caused an increase in production on the downstream side of the constraint, and so there is enough counter flow to cause the constraint to be non-binding. The second type of over-identified congestion is a necessary and desirable result of market power mitigation, but the first type is not.

The following charts illustrate the accuracy of the LMPM system in predicting congestion in the real time markets. The data in these charts includes results for all flowgates, nomograms, and branch groups. The EIM scheduling limit style transfer constraints are not included.

Figure 1. Accuracy of congestion predictions for constraints in RTPD

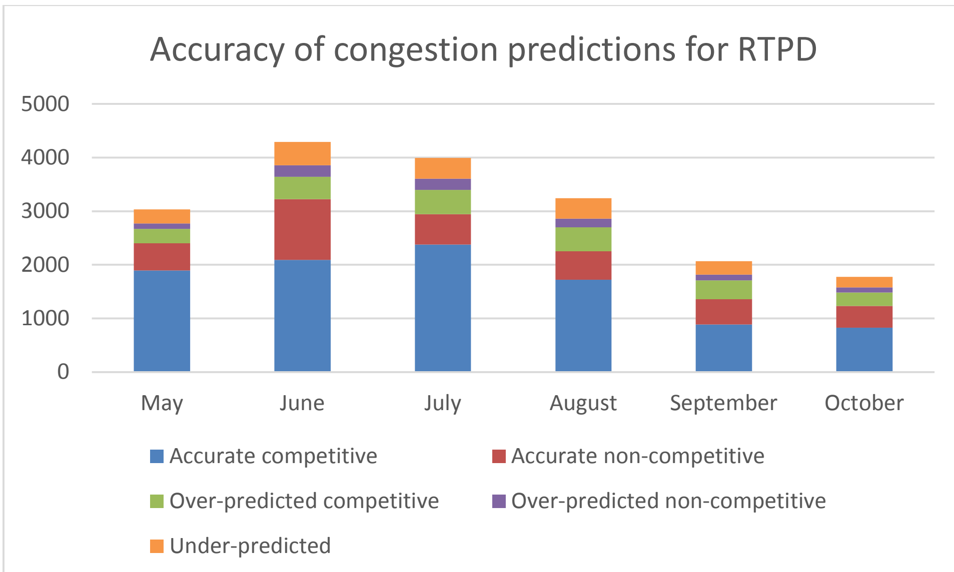
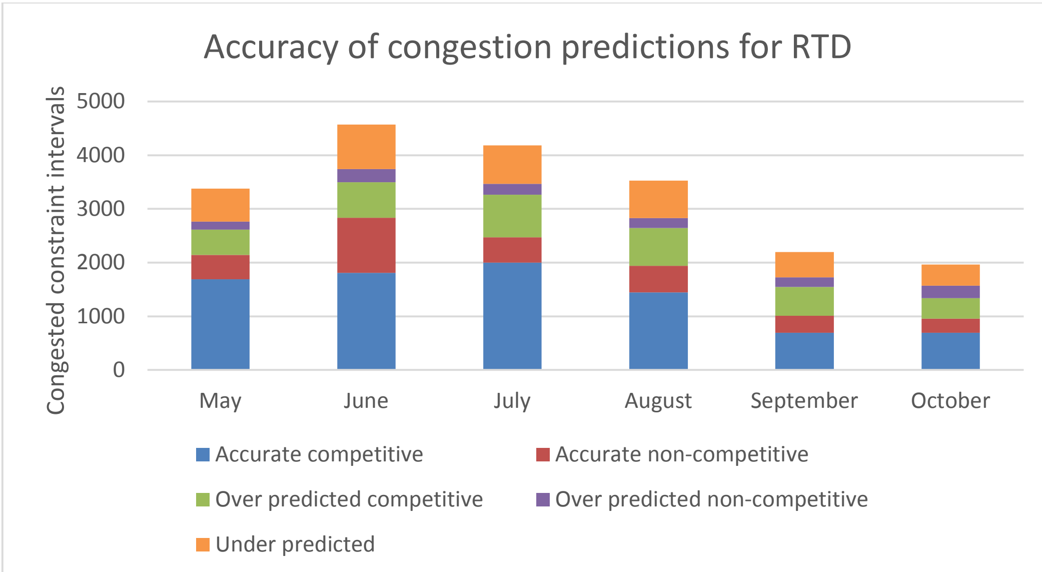


Figure 1 shows the relationship between predicted and actual congestion in the RTPD markets for several months of 2015. About 10 to 12 percent of congested constraint intervals in financially binding RTPD runs are missed by the LMPM process every month. Another 10 to 20 percent are predicted to be congested in the LMPM run but are not congested in the financially binding run. The modifications to RTPD LMPM that we describe below will lower both of those numbers, and should raise overall accuracy of the LMPM process for RTPD drastically. These enhancements to the RTPD LMPM process will significantly reduce both under-mitigation and over-mitigation.

Figure 2. Accuracy of congestion predictions for constraints in RTD



As would be expected, the accuracy of the LMPM run in predicting RTD congestion is worse than the accuracy of the LMPM run in predicting RTPD congestion. RTD runs happen further in time away from the LMPM run. This leaves more time for changes to system inputs such as load and VER forecasts. Also, the RTD optimization is solving a slightly different problem than the one solved by the RTPD system. Those differences in system inputs and in systems result in there being less consistency between LMPM and RTD than between LMPM and RTPD.

Around 20 percent of congested constraint intervals in financially binding RTD runs are missed by the LMPM process in a given period. Another 20 to 30 percent are expected to be congested by the LMPM process but are not congested in the financially binding RTD run. The proposed enhancements to the RTD LMPM process described below will drastically reduce under-mitigation in RTD.

The above graphs show that the enhancements we discuss below can improve the current systems. These enhancements had been discussed internally by the ISO and DMM previously, but technological limitations prevented their implementation before now.

6 Planned enhancements to RTPD mitigation: Incorporate LMPM into the binding interval RTPD run

Currently, the LMPM run for a given interval is the first advisory interval (interval 3) of the binding RTPD run for the previous interval. For example, the LMPM run for hour 1 interval 2 is part of the binding RTPD run for hour 1 interval 1. The inputs to the LMPM run are set 15 minutes prior to setting the inputs to the binding RTPD run for the same interval. This can result in significant differences to the inputs used in the LMPM run and the binding interval RTPD run.

The best option for reducing RTPD under-mitigation caused by differences in inputs is to perform the LMPM run as an integral part of the binding interval RTPD run. This will result in the LMPM run having the same exogenous inputs as the binding interval RTPD run and should eliminate most under-mitigation due to differences in inputs. In addition to virtually eliminating missed mitigation in RTPD runs, this will also lead to more accurate competitive baseline prices used in the mitigation process.

Adopting an RTPD mitigation process that operates in the binding interval as opposed to the advisory interval will also reduce or eliminate some sources of potential over-mitigation. While we currently do not have any evidence that over-mitigation is a significant concern, this is an appealing aspect of these planned enhancements.

In addition to resolving issues in RTPD, the planned changes to the RTPD mitigation process will also help to improve the accuracy of mitigation in RTD. Mitigation in RTPD is passed to RTD, so moving RTPD mitigation to the financially binding RTPD interval will also move some of the RTD mitigation 15 minutes closer to the financially binding RTD runs. Inaccuracies in mitigation due to changes in parameters that occur in those 15 minutes should be reduced.

These enhancements to RTPD mitigation are scheduled for implementation in the spring of 2016. The final details of the enhancements will be described in upcoming changes to the relevant Business Practice Manual.

7 Proposal for enhancements in the 5 minute RTD markets: establish predictive RTD mitigation procedure

One source of missed mitigation in the RTD market is the differences in constraint limits and definitions between the RTD runs and the RTPD runs. High bids could be dispatched in the RTD runs when modeling differences lead to different results in the RTD runs than in the RTPD runs where mitigation takes place. When constraints are defined differently or have different limits in RTPD than in RTD, the RTPD model cannot accurately predict congestion on those constraints in RTD. One way to resolve this issue would be to implement additional mitigation into RTD. Building mitigation into the RTD runs will significantly reduce RTD under-mitigation caused by differences in constraint limits and definitions between RTPD and RTD, as well as under-mitigation caused by significant differences in the system inputs between the financially binding RTPD run and the first advisory RTD run.

The proposed enhancement to RTD mitigation is to create a process within the RTD runs that performs market power mitigation. Proposed mitigation in the RTD run would work the same way that mitigation currently works in the RTPD run. The current RTPD procedure (not the enhancements described elsewhere in this paper) uses a predictive advisory run to estimate congestion. Just like the current RTPD system, the proposed RTD mitigation would feed results from the advisory RTD interval to the LMPM module. The LMPM module would then feed mitigated bids to the binding interval RTD run. The LMPM module would use the same procedures for LMP decomposition, RSI calculation and bid mitigation as those that are currently used in the RTPD system[3]. This kind of predictive system is well suited to the RTD market, where advisory and binding runs are only 5 minutes apart, allowing relatively little time for conditions to change.

The proposed RTD enhancements would differ from the current RTPD system in two ways. First, the proposed RTD mitigation system will not start with unmitigated bids. Instead, the input bids to each RTD interval will be the final, potentially mitigated, bids used in the financially binding RTPD run for the corresponding RTPD interval. The proposed RTD enhancements would be an additional system that could mitigate bids that were not mitigated in the RTPD mitigation process, or that could mitigate bids further than they were mitigated in the RTPD mitigation process.

Second, whereas the current RTPD mitigation system (as well as the planned RTPD enhancements) maintains a mitigated bid through the hour, the proposed RTD enhancements would only maintain a mitigated bid through the rest of the RTD intervals corresponding to the same RTPD run as the original mitigated RTD interval. In other words, the input bids to the RTD mitigation process for the first of the three RTD runs corresponding to a particular RTPD interval will be the final mitigated bids used for that RTPD interval. The proposed RTD mitigation process could then result in additional bid mitigation for the first of the three RTD runs. The input bids to the RTD mitigation process for the second of the three RTD runs corresponding to the RTPD interval will be the final mitigated bids used in the first RTD run. The proposed RTD mitigation process could result in additional bid mitigation for the second of the three RTD runs. Similarly, the input bids to the RTD mitigation process for the third of the three RTD runs corresponding to the particular RTPD interval will be the final mitigated bids used in the second RTD run.

The next (fourth) RTD interval, however, will be the first of three RTD intervals corresponding to a new RTPD interval. The input bids to the RTD mitigation process for this 'fourth' RTD interval will not be the final mitigated bids used in the third RTD run. Instead, the input bids to the RTD mitigation process for this fourth RTD run will be the final mitigated bids that were used in the new RTPD interval that corresponds to this fourth RTD run. A diagram is included in the appendix to this proposal that illustrates the mitigation carry through process.

This means that the mitigation of bids mitigated in RTD would carry through to up to two additional RTD intervals after the RTD mitigation. Some bid mitigation carry through is necessary for consistency between advisory interval and binding interval dispatches. Limiting that carry through to the corresponding RTPD interval instead of the corresponding hour minimizes the risk of mitigating resources that are not exercising local market power.[4]

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[3] For more detail on these systems see: http://www.caiso.com/Documents/RevisedDraftFinalProposal-DynamicCompetitivePathAssessment.pdf

and : http://www.caiso.com/Documents/RevisedDraftFinalProposal-DynamicCompetitivePathAssessment.pdfs

[4] The tradeoff between the number of RTD intervals that bids mitigated in RTD need to be carried-over to, and the consistency between binding and advisory interval dispatches, will need to be assessed during implementation.

DMM and the ISO look forward to feedback and perspective from stakeholders on any issues that this RTD mitigation proposal may create. We also look forward to resolving those issues with stakeholder cooperation.

8 Relationship of proposed RTD mitigation to BCR

Adding mitigation into the RTD process means that RTD bids will not always be the same as RTPD bids. This change is important to account for in bid cost recovery BCR calculations. Currently, the ISO systems settle RTPD and RTD as two separate markets, and account for costs and revenue in two separate steps that are then netted together. This means that systems changes necessary for providing the proper BCR using different bids for RTD than for RTPD are minimal. Costs and revenues in the RTD market will continue to be calculated as incremental to the RTPD market. If a resource is mitigated in RTD and dispatched up, the costs that are accounted for in the BCR process would include the RTPD dispatch at the RTPD bids, and the RTD dispatch at the RTD bids. The following example will illustrate the BCR proposal.

Imagine a resource with a marginal cost of $40 for its entire range, from a pmin of 10 to a pmax of 100. The resource has no day-ahead schedule. In the real time markets the resource submits bids for $50 from pmin up to 50 MW and for $60 for energy above 50 MW up to its maximum output. In a given RTPD interval, the resource is not effective against any non-competitive constraints and its bids are not mitigated in RTPD. Price for that interval at the resource's node is $55, so the resource is dispatched to 50 MW. In an RTD interval that corresponds to the same time period, a constraint is binding that causes the resource to have market power. The LMPM process mitigates the resource's bids to $40, and the price of $41 causes the resources to be dispatched to 100 MW, assuming the resource is capable of reaching that output.

For the settlement interval that corresponds to this RTD interval, the energy from 10 MW to 50 MW will be considered at the RTPD bid price of $50. The energy from 50 MW to 100 MW will be considered at the RTD bid price of $40. The resource's costs for this interval would be given by:

$$cost_{RTPD} = (MLC + (50 - 10) * RTPD\ bid)/12$$

$$cost_{RTD} = (100 - 50) * RTD\ bid/12$$

8.1 BCR reasons for mitigation carry through

The proposed mitigation for RTD will preserve mitigation that occurs in the RTPD market and pass those mitigated bids into the RTD runs. This passing of mitigation is necessary to avoid undesirable BCR results. For example, suppose a resource operating in the RTPD market has a bid of $50 and a DEB of $25, from pmin of 10 MW to pmax of 100 MW. In the RTPD market, the resource is effective against a non-competitive constraint. In the RTD market, the constraint is not binding. When the constraint is binding in RTPD and the resource's bids are mitigated the resource is dispatched to 100 MW. If the mitigated bids are not carried through to RTD, and the constraint does not bind in RTD, then the resource could be dispatched lower in RTD. If prices are higher in RTD than in RTPD, the resource will be forced to buy back RTD energy at a price higher than what it received to produce the energy in RTPD. That higher price would still be below the unmitigated RTD bid which is used to compare costs and revenue. The end result is that the resource could receive conflicting dispatches and lose money due to this phenomenon. The basic example is illustrated in the following table, where the RTD without bids mitigated in RTPD being passed through to RTD is under the column RTD 1. The RTD with bids mitigated in RTPD passed through to RTD is under the column RTD 2.

Table 2: Illustration of need for mitigation carry through

	RTPD	RTD 1	RTD 2
Bid	25	50	25
dispatch	100	10	100
price	30	40	n/a
Revenue	3000	-3600	0
Bid costs	2500	-5400	0
Net		-600	500

In the case where the mitigation is not passed to RTD from RTPD, the resource is made to pay $600 to the market. Because its bid cost is less than its revenue (i.e., the bid is higher than the price at which the energy is bought back), the resource is not eligible for BCR. In the case where the mitigation is passed to RTD from RTPD, the resource produces at 100 MW and is paid $3000. According to the resource's DEB, this represents an accounting profit of $500.

9 Proposed timeline for improvements to LMPM

Both the RTPD and RTD improvements detailed above constitute important and useful changes to the ISO systems. The changes to RTPD are a process improvement. They do not necessitate changes to the tariff and will be implemented by the ISO in the spring of 2016. Adding mitigation into the RTD does involve changing the tariff. The ISO and DMM plan to propose the RTD mitigation enhancements to the ISO board in March of 2016 for implementation with the fall release of 2016. Timely consideration and feedback from stakeholders will be important in meeting that timeline.

10 Appendix : chart and explanation of proposed mitigation process timeline

Figure 3: diagram of RTD mitigation

		8:00			8:15			8:30		
		8:00	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40
		Final bids from RTPD run 1								
		↓								
RTD run 12		advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6	advisory 7	advisory 8	advisory 9
		↓								
		LMPM Module								
		↓								
RTD run 1		binding	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6	advisory 7	advisory 8
			↓							
			LMPM Module mitigates bid							
			↓							
RTD run 2			binding (M)	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6	advisory 7
				↓						
				LMPM Module (no change)	Final bids from RTPD run 2					
				↓	↓					
RTD run 3				binding (M)	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6
					↓					
					LMPM Module					
					↓					
RTD run 4					binding	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5
						↓				
						LMPM Module				
						↓				
RTD run 5						binding	advisory 1	advisory 2	advisory 3	advisory 4
							↓			
							LMPM Module	Final bids from RTPD run 3		
							↓	↓		
RTD run 6							binding	advisory 1	advisory 2	advisory 3
								↓		
								LMPM Module		

The bids for RTD 1 of the 8:00 hour start from the final bids that are used in RTPD 1 for the same hour. Those bids are used in advisory interval 1 of the RTD 12 run of the previous hour. The results of that advisory run are passed to the LMPM module where any necessary mitigation is applied. After mitigation, the bids are passed to the RTD run that will issue binding results for RTD 1 for the 8:00 hour.

In the example in the figure, no mitigation is deemed necessary during that initial interval of the hour. When the binding results for RTD 1 are issued, advisory results for RTD 2 are passed to the LMPM module. The figure shows that the LMPM module finds reason to mitigate some bids, and those bids are passed to the RTD run that will issue binding results for RTD 2. The mitigated bids are represented by (M) in binding intervals in the figure. Those mitigated bids persist in the next RTD run for RTD 3, but are replaced in that run for RTD 4 and beyond. RTD 4 corresponds to a different RTPD interval, RTPD 2. In the RTD run that issues binding results for RTD 3, the mitigated bids are used for RTD 3, but RTD 4 uses the final bids from RTPD 2. RTD 4 is the first advisory interval in that run, so results of RTD 4, using the RTPD 2 bids, will be passed to the LMPM module for analysis and possible mitigation. In the example used for the figure, no mitigation is deemed necessary for RTD 4.