California ISO

Business Requirements Specification

Real Time Dispatch Local Market Power Mitigation (RTD LMPM)

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Revision History

Date	Version	Description
3/21/2016	1.0	Created Document
12/21/2016	1.1	RTDLMPM-BRQ5122: Removed language “Further detail shall be refined in design.” ISO will implement based on the formula. RTDLMPM-BRQ5110: Removed language “Further detail shall be refined in design.” ISO will implement based on the formula.

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1. Introduction

1.1 Purpose

The purpose of this document is to capture and record a description of what the Users and Business Stakeholders of the **Real Time Dispatch Local Market Power Mitigation Enhancements (RTD LMPM)** project wish to obtain by providing high-level business requirements. This document establishes the basis for the agreement between the initiators and implementers of the project. The information in this document serves as input to determining the scope of projects and to all Business Process Modeling and System Requirements Specifications efforts.

Business requirements are what must be delivered to provide value for the Users and Business Stakeholders. Systems, software, and processes are the ways (how) to delivery, satisfy or meet the business requirements (what). The Initial BRS will provide sufficient information to determine the scope of the project and will provide the functional business requirements so that the Architecture Decision can be made. Following the Architecture Decision, the remaining non-functional business requirements, such as data, performance, web services, and security can be added to complete the Final BRS.

2. Details of Business Need/Problem

2.1 Description

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

The 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) are to address under-mitigation and potential over-mitigation in the 15-minute RTPD market and to address issues in the 5-minute RTD markets. 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. Potential over-mitigation refers to that mitigation occurs when congestion that can create local market power does not materialize in the financially binding market run, since market bids may be mitigated using cost-based default energy bids.

2.1.1 Enhancements to RTPD mitigation: Incorporate LMPM into the binding interval RTPD run

- Performing the LMPM run as an integral part of the binding interval RTPD run could reduce RTPD under-mitigation caused by differences in inputs.
- 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.
- No changes to exogenous inputs or optimization between LMPM and RTPD.

- Results will still possibly include differences.
- Mechanics of measuring competition and rules of mitigation do not change, nor does mitigation carry-over.
- No changes to HASP.

Figure 1. below shows the proposed mitigation process timeline of RTPD run.

The bids for RTPD binding interval uses mitigated bids from LMPM module embedded in this binding interval. LMPM and DCPA process will not be run on the advisory interval, and instead LMPM module evaluates information and creates mitigated bid set against the RTPD financial binding interval, as the mitigated bids for the binding interval.

	Flow times	8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45	10:00
Run times										
RTPD run 2 at 7:37		buffer	binding (uses mitigated bids from LMPM module)	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6	advisory 7
			↓↑							
			LMPM Module evaluates information creates mitigated bid set							
RTPD run 3 at 7:52			buffer	binding (uses mitigated bids from LMPM module)	advisory 1	advisory 2	advisory 3	advisory 4	advisory 5	advisory 6
				↓↑						
				LMPM Module evaluates information creates mitigated bid set						

Figure 1: Diagram of RTPD mitigation

2.1.2 Enhancements to RTD markets: Establish predictive RTD mitigation procedure

- Creating a process within the RTD runs that performs market power mitigation. The RTD mitigation shall feed results from the advisory RTD interval to the LMPM module, and the LMPM module shall then evaluate information and create mitigated bid for the binding interval RTD run.
- The LMPM module in RTD run shall work the same way as in the current RTPD run, where adjustments are needed to be applied to RTD mitigation, for
    a) Residual Supply Index (RSI) calculation using Dynamic Competitive Path Assessment (DCPA) to evaluation non-competitive constraints,
    b) LMP decomposition to estimate if bid mitigation is necessary, and
    c) bid mitigation.

- More appropriate to use predictive method for RTD because time lag is shorter and potential changes are fewer and smaller.
- RTD shall still start with RTPD mitigated/final bids.

Two differences between proposed RTD mitigation and current RTPD system:

- The input bids to each first of the three RTD intervals (advisory run) shall be the final, potentially mitigated, bids used in the financially binding RTPD run for the corresponding RTPD interval, not the currently used unmitigated bids. The proposed RTD enhancements shall 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.
- The mitigated bid is maintained through the rest of the RTD intervals corresponding to the same RTPD run, not the entire trading hour. To be more specific:
    1) Input bids to the first of the three RTD runs (advisory run) corresponding to a particular RTPD interval shall be the final mitigated bids used for that RTPD interval. Proposed RTD mitigation process could then result in additional bid mitigation for the first of the three RTD runs (binding run).
    2) Input bids to the second of the three RTD runs (advisory run) corresponding to the RTPD interval shall be the final mitigated bids used in the first RTD run (binding run). Proposed RTD mitigation process could result in additional bid mitigation for the second of the three RTD runs (binding run).
    3) Input bids to the third of the three RTD runs (advisory run) corresponding to the particular RTPD interval shall be the final mitigated bids used in the second RTD run (binding run). The proposed RTD mitigation process could result in additional bid mitigation for the third of the three RTD runs (binding run).
    4) Similar to 1), the next (fourth) RTD interval will be the first of three RTD intervals corresponding to a new RTPD interval. Input bids to this 'fourth' RTD interval (advisory run) shall not be the final mitigated bids used in the third RTD run (binding run), but the final mitigated bids used in the new RTPD interval that corresponds to this fourth RTD run. These processes will continue for the rest of the hour, and continue to next hour and so on.

Figure 2. below shows the proposed mitigation process timeline for RTD run.

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 2, 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.

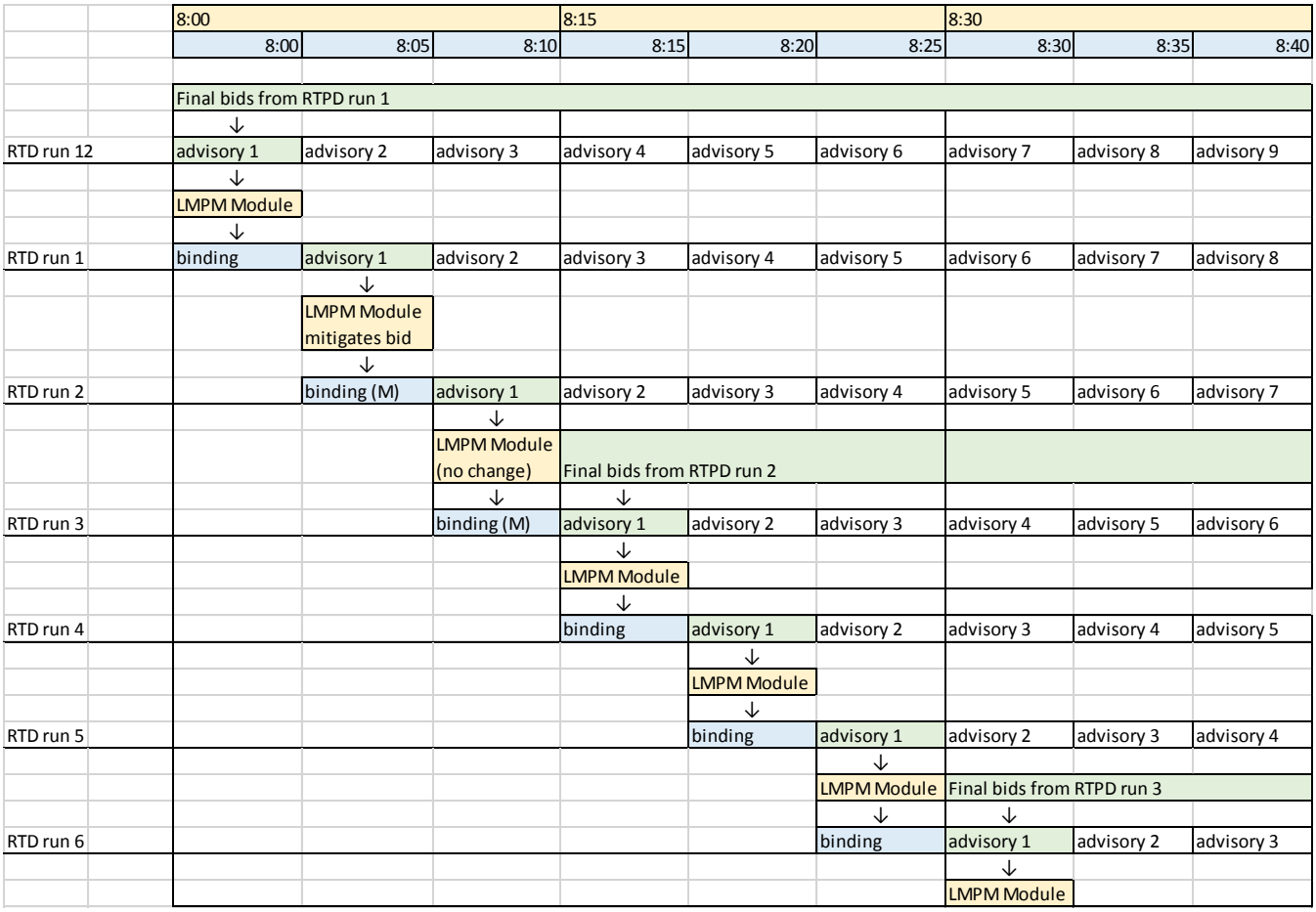

Figure 2: Diagram of RTD mitigation

2.1.3 Relationship of proposed RTD mitigation to BCR

BCR calculations shall account for adding mitigation into the RTD process as RTD bids will not always be the same as RTPD bids.

- 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. Systems changes necessary for providing the proper BCR using different bids for RTD than for RTPD are minimal. Costs and revenue in the RTD dispatch at the RTPD bids, and the RTD dispatch at the RTD bids.

- The proposed mitigation for RTD shall 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.

3. Business Process Impacts

3.1 High Level Description of Business Process

- **Manage Markets & Grid**
  - ***Level II – Manage Real Time Operations – Maintain Balancing Area***
- **ATF – System Operations**
- **ATF – System Operations – Real Time**

3.2 Justification

The LMPM Enhancements 2015 project will make changes for the market power mitigation process to address under-mitigation and potential over-mitigation in the 15-minute RTPD market, and 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 modifications to the 5-minute RTD market require stakeholder feedback and tariff changes.

Changes 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.

4. Business Requirements

The sections below describe the Business Processes and the associated Business Requirements involved in the project. These may represent high level functional, non-functional, reporting, and/or infrastructure requirements. These business requirements directly relate to the high level scope items determined for the project.

Overview of RTD LMPM Requirements

RTD Local Market Power Mitigation (LMPM) (see Figure 2 above)

- Use first RTD advisory interval to conduct LMPM for the next binding RTD interval. LMPM includes:
  - Dynamic Competitive Path Assessment

- LMP decomposition
- Bid mitigation

Differences between RTD LMPM and RTPD LMPM:

1) RTD advisory interval shall use the lastest mitigtated bids from the corresponding financial binding RTPD run or RTD run, not the unmitigated bids.
2) RTD Mitigated bids is maintained through the rest of the RTD intervals corresponding to the same RTPD, not the entire hour.
3) Operation range calculations use Ramp for 5-minute.
4) RTD LMPM shall use the same Shift Factors as for the corresponding RTPD interval, except for the force event run that RTD LMPM shall calculate new Shift Factors on the non-competitive paths, using new reference bus.
5) Entitlement Rate of Change (ROC) constraints for EIM are included as non-competitive constraint for RTD LMPM.
6) Real Time Contingency Dispatch (RTCD), Real Time Disturbance Dispatch (RTDD) and Real Time Manual Dispatch (RTMD) shall use the lasted mitigated bids, and ODCP/MED (Manual Exceptional Dispatch) will not be affected. RTCD here only refers to California ISO RTCD, not BAA RTCD. For BAA RTCD, LMPM shall still be performed.
7) The system must be able to turn on and turn off the RTD mitigation with LMPM module.
8) MQS shall store RTPD and RTD mitigated bids.
9) MQS shall use RTPD bids for RTPD Energy calculation, use RTD bids for RTD Energy calculation.
10) CMRI shall display RTD mitigated bids.
11) OASIS shall display MPM Market Clearing and MPM Pnode Clearing for RTD.
12) No negative impact on RTD market timeline.

The other business rules are the same for RTPD and RTD LMPM.

4.1 Business Process: < Manage Real Time Market >

4.1.1 Business Requirements

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5101	**LMPM RTPD Modification** • The system shall perform the LMPM run as an integral part of the binding interval RTPD run. • Mitigation in RTPD shall be passed to RTD. • No changes to exogenous inputs or optimization between LMPM and RTPD. • Mechanics of measuring competition and rules of mitigation do not change, nor does mitigation carry-over. • No changes to HASP hour mitigation.	Core	RTM
RTDLMPM-BRQ5102	LMPM RTPD binding interval mitigation. RTPD algorithm shall be modified to execute the LMPM and DCPA process against the financial binding interval, not to run it on the advisory interval. The financial binding interval is defined by a parameter, 0 for the 1st interval, and 1 for the 2nd interval.	Core	RTM
RTDLMPM-BRQ5103	**RTD LMPM** The mitigation in RTD run shall work the same way as the current RTPD run. The RTD mitigation shall feed results from the advisory RTD interval to the LMPM module, the LMPM module shall then evaluate information and create mitigated bids for the RTD binding interval run. The LMPM module shall use the same procedure as in the current RTPD system, where adjustments are needed to be applied to RTD mitigation, for a. Residual Supply Index (RSI) calculation using Dynamic Competitive Path Assessment (DCPA) to evaluation non-competitive constraints b. LMP decomposition to estimate if bid mitigation is necessary c. bid mitigation Note: Interval t in the requirements below means 5-minute interval, if not identified as other meanings.	Core	RTM, MPM, RTD

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5104	The system must be able to turn on and turn off the RTD mitigation with LMPM module. There shall be a flag in database to turn **On/Off** the RTD mitigation process.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5105	The system shall deliver and display the same data for the RTD mitigation process, as for the RTPD mitigation process.	Core	RTM, MPM, RTD

RTDLMPM-BRQ5106	**RTD Mitigation Process** 1) The first of the three RTD runs (advisory run) corresponding to the same RTPD interval shall use the final mitigated bids in the financially binding corresponding RTPD run, to feed to the LMPM module and then to the binding interval. 2) The second and third of the three RTD runs (advisory run) shall use the final mitigated bids from the previous RTD run (binding run), to feed to the LMPM module and then to the binding interval. 3) The mitigated bid is maintain through the rest of the RTD intervals corresponding to the same RTPD run as the original mitigated RTD interval. Example. RTD run4- 6 for a trading hour (see Figure 2 above) RTD run4: • Input bids to the RTD mitigation process for the first of the three RTD runs (advisory1 in RTD run3) corresponding to the same RTPD interval (RTPD run2), shall be the final mitigated bids used for the corresponding RTPD run2 (same as in later RTD run6). • Results from the previous advisory1 in RTD run3 are fed to the LMPM Module to generate mitigated bids for RTD run4 (binding interval). • Input bids to the RTD mitigation process for the second of the three RTD runs (advisory1 in RTD run4) corresponding to RTPD run2, shall be the final mitigated bids in RTD run4 (binding run), from LMPM Module. RTD run5: • Results from the previous advisory1 in RTD run4 are fed to the LMPM Module to generate mitigated bids for RTD run5 (binding interval). • Input bids to the RTD mitigation process for the third of the three RTD runs (advisory1 in RTD run5) corresponding to RTPD run2, shall be the final mitigated bids in RTD run5 (binding run), from LMPM Module. RTD run6: • Results from the previous advisory1 in RTD run5 are fed to the LMPM Module to generate mitigated bids for RTD run6 (binding interval). • Input bids to the RTD mitigation process for the first of next three RTD runs (advisory1 in RTD run6) corresponding to RTPD run3,	Core	RTM, MPM, RTD

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
	shall be the final mitigated bids used in the new corresponding RTPD run3. RTD run7, similar to RTD run4: • The next/fourth RTD binding interval will be the first of three RTD intervals corresponding to a new/next RTPD run3. • Results from the previous advisory1 in RTD run6 are fed to the LMPM Module to generate mitigated bids for RTD run7 (binding interval). The above process shall continue for the rest of the trading hour, and continue to next trading hour and so on.		
RTDLMPM-BRQ5107	RTD MPM shall designate Non-competitive (NC) path using dynamic CPA.	Core	RTM, MPM, SMDM
RTDLMPM-BRQ5108	Non-competitive constraints shall not include intertie constraints, and nodal constraints. These constraints are always deemed as competitive. No dynamic CPA is needed for there constraints.	Existing Functionality	RTM, MPM, SMDM
RTDLMPM-BRQ5109	Non-competitive constraints shall include nomogram constraints, flow gate group constraints, EIM constraints, and entitlement rate of change (ROC) constraints. Dynamic CPA shall be applicable for these constraints. If DCPA for ROC constraints fails, the system shall use the default competitiveness for the constraints. For the multi-segment nomogram, the DCPA shall be performed for each segment. If DCPA designate non-competitive for the nomogram of any segment, the whole nomogram shall be deemed as non-competitive for the interval. The group constraints related the operation order of pump, or generation will not be considered for non-competitive constraints.	Core	RTM, MPM, SMDM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5110	For each 5-minute RTD interval, RTD LMPM shall use the same Shift Factors as for the corresponding RTPD interval, except for the force event run that RTD LMPM shall calculate new Shift Factors on the non-competitive paths, using new reference bus. The calculation may need the old shift factors that use distributed load bus as reference bus. Following formula is used to describe the concept. ~~Further detail shall be refined in the design.~~ $$SF_l^{i-n} = SF_l^{i-o} - SF_l^{n-o}$$ SF_l^{i-n}: $ShiftFactor\ of\ i\ on\ l\ using\ new\ reference\ bus$ SF_l^{i-o}: $Shift\ Factor\ of\ i\ on\ l\ using\ old\ reference\ bus$ SF_l^{n-o}: $Shift\ Factor\ of\ n\ on\ l\ using\ old\ reference\ bus$	Core	RTM, MPM, RTD
RTDLMPM-BRQ5111	RTD MPM shall identify all resources that controlled by each net seller or net buyer portfolio j. If the resource has tolling contract, the resource shall be allocated to the SC that controls the resource.	Core	MF, MPM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5112	RTD MPM shall calculate Withheld Capacity ($WC_{k,j}$) for the units (i) that are net suppliers (j), and calculate Shift Factor ($SF_{k,i}$ < threshold) for the congested constraint k from 15-minute RTPD run in each three of the 5-minute intervals. If the MSG plan is in transition, then WC shall be 0. The operation range shall be calculated base on ramp rate and operation capacity. $WC_{k,j} = \Sigma_i \ (-SF_{k,i}) * [\min (LDOP_i + RR_i * 5 , ENGYMAX_i) – \max (LDOP_i - RR_i * 5 , ENGYMIN_i)]$ • $LDOP_i$ is the local dispatch operating point for physical or virtual supply resource i. (virtual supply is not mitigated in LMPM) • RR_i is resource i's effective ramp rate in MW/minute • $ENGYMAX_i = \min[(MAXCAP_i – OR_i – RU_i), (MAXECON_i – OR_i)]$ • $MAXCAP_i = \min[(PMAX_i – DERATE_i)$, Maximum exceptional dispatch] • $MAXECON_i = \min[(PMAX_i – DERATE_i)$, Max economic bid MW, Maximum exceptional dispatch] • $PMAX_i$ is regulation Pmax if on regulation otherwise operational Pmax • OR_i is the awarded spinning capacity plus awarded non-spinning capacity. • RU_i is regulation up capacity. • $ENGYMIN_i = \max[(MINCAP_i + RD_i)$, Self scheduled energy] • $MINCAP_i = \max [(Pmin_i + Pmin\ RERATE_i)$, minimum exceptional dispatch] • $PMIN_i$ is regulation pmin if on regulation otherwise operational pmin • RD_i is qualified self scheduled regulation down. The withheld capacity calculation shall consider the supply side of pump storage resources, pseudo generators associated with PDR/RDRP/Dispatched Pump resources, NGR LESR and NGR DDR. For MSGs, only the MSG configuration that is committed is taken into account.	Core	MPM, RTD

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5113	For each congested constraint k and each 5-minute interval t, RTD MPM shall Rank ($WC_{k,j}$) calculated in RTDLMPM-BRQ5112 from highest to lowest, the top three net supplier portfolio js are identified as the set for the potentially pivot suppliers (PPS) for the constraint k.	Core	MPM, RTD
RTDLMPM-BRQ5114	For each congested constraint k and each 5-minute interval t, RTD MPM shall designate the fringe competitive suppliers (FCS) that are: 1) net suppliers which are not part of three PPS, and 2) net buyers.	Core	MPM, RTD
RTDLMPM-BRQ5115	For each congested constraint *k* and each 5-minute interval t, RTD MPM shall calculate the effective supply of physical counterflow (SPCF) for potentially pivot suppliers (PPS): $SPCF^{PPS}_{k,j,i} = (-SF_{k,i}) * [\max(LDOP_i - RR_i * 5 , ENGYMIN_i)]$ for resources i in potentially pivot supplier portfolio j with $SF_{k,j}$ < threshold. Where $ENGYMIN_i$ is defined above in BRQ5112 • $SPCF^{PPS}_{k,j} = \sum_i (SPCF^{PPS}_{k,j,i})$ • $SPCF^{PPS}_{k} = \sum_j (SPCF^{PPS}_{k,j})$ • $SCF^{PPS}_{k} = SPCF^{PPS}_{k}$	Core	MPM, RTD
RTDLMPM-BRQ5116	For each congested constraint k and each5-minute interval t, RTD MPM shall calculate the effective supply of physical counterflow ($SPCF^{FCS}_{k}$) for fringe competitive suppliers. $SPCF^{FCS}_{k,j,i} = -SF_{k,i} * [\min (LDOP_i + RR_i * 5, ENGYMAX_i)]$ for resources i in fringe competitive supplier portfolio j with $SF_{k,j}$ < threshold. Where $ENGYMAX_i$ is defined above in BRQ5112 • $SPCF^{FCS}_{k,j} = \sum_i (SPCF^{FCS}_{k,j,i})$ • $SPCF^{FCS}_{k} = \sum_j (SPCF^{FCS}_{k,j})$ • $SCF^{FCS}_{k} = SPCF^{FCS}_{k}$ The counter flow calculation shall consider the supply side of pump storage resources, pseudo generators associated with PDR/RDRP/Dispatched Pump resources, NGR LESR and NGR DDR.	Core	MPM, RTD

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5117	For each congested constraint k and each 5-minute interval t, RTD MPM shall calculate demand for counterflow DCF_k as the sum of all dispatched energy that will flow on k in the counterflow direction: $DCF_k = \Sigma_i -SF_{k,i} * DOP_i$ for physical resources i with $SF_{k,i} <$ threshold where DOP_i is the dispatch operating point for physical supply resource i. All the resources are included for net seller and net buyer portfolios. Note: The flow direction is defined by the MPM AC run flow direction on binding constraint. The sign convention used in this document reflects the resource injection contribution on the binding constraint, SF>0 means the contribution is in the same direction as flow binding in AC run. SF<0 means counterflow for the binding direction.	Core	MPM, RTD
RTDLMPM-BRQ5118	For each congested constraint k and each 5-minute interval t, RTD MPM shall calculate $RSI_k = (SCF^{PPS}_k + SCF^{FCS}_k) / DCF_k$	Core	MPM, RTD
RTDLMPM-BRQ5119	For each congested constraint k and each 5-minute interval t, if RSI_k <1, MPM shall designate k as NC path for the interval t for LMP decomposition and bids mitigation. Apply the same process to each congested constraint k to determine if it is competitive or non-competitive.	Core	MPM, RTD
RTDLMPM-BRQ5120	Relative to a reference bus free of local market power, a positive non-competitive component LMP_i^{NC} , is an indicator of local market power. The system shall define the configurable reference buses and conditions for LMP decomposition: either Distributed Load Slack Bus or A High Voltage Bus Free of Local Market Power. EIM transfer constraint does not default to non-competitive, but has to be tested. If DCPA fails, the system use default competitiveness for the EIM transfer constraint.	Core	RTM, MPM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5121	If there are no binding non-competitive constraints, then $\mathrm{LMP_i^{NC}}=0$, no local market power and the bids of resources at that location will not be mitigated. If there are binding non-competitive constraints, the physical resources with $\mathrm{LMP_i^{NC}}>\mathrm{Mitigation\ Threshold\ Price}$ potentially have local market power and the bids or resources at that location will be subject to mitigation.	Core	RTM, MPM
RTDLMPM-BRQ5122	RTD MPM process shall calculate LMP congestion cost component $LMP_{i-n}^{NC;t}$ for binding NC paths for each cnode and each 5-minute interval by sum of (Shift Factors * NC constraint shadow prices) from AC run, for corresponding reference bus. Following formula is used to describe the concept. ~~Further detail shall be refined in design.~~ $$LMP_{i-n}^{NC;t} = \sum_{l \epsilon NC} \left(SF_l^{i-n} * TSC_l^t \right)$$ $LMP_{i-n}^{NC;t}$: $LMP\ congestion\ cost\ \ for\ node\ i$ SF_l^{i-n}: $Shift\ Factor\ of\ i\ on\ l\ using\ corresponding\ reference\ bus$ TSC_l^t: $Shadow\ price\ of\ constraint\ l\ at\ interval\ t$	Core	RTM, MPM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5123	For $LMP_{i-n}^{NC;t} > mitigation\ threshold\ price,$ MPM shall calculate $Competitive\ LMP\ for\ node\ i$: $LMP_i^C = LMP_i^t - LMP_{i-n}^{NC;t}$ LMP_i^t: LMP from AC run for node i, interval t $LMP_{i-n}^{NC;t}$ congestion cost for NC for each node and each interval. Under the LMP decomposition approach, the market power mitigation run produces dispatches and prices that are potentially impacted by market power. Each resulting LMP is then "decomposed" into four components. The different reference bus will not change the LMP at location i. The different reference bus will change the LMP components, EC, LC, CC and NC. EC = the energy component, LC = the loss component, CC = the competitive constraint congestion component, and; NC = the non-competitive constraint congestion component. LMP decomposition: the LMP congestion cost is broken into two components: a competitive component LMP^{CC} and a non-competitive component LMP^{NC}; $$LMP_i^t = LMP_i^{EC;t} + LMP_i^{LC;t} + LMP_i^{CC;t} + LMP_i^{NC}$$ Relative to a reference bus free of local market power, a positive non-competitive component LMP_i^{NC}, is an indicator of local market power. $Competitive\ LMP\ for\ node\ i\ interval\ t$: $$LMP_i^{C,t} = LMP_i^t - LMP_i^{NC;t}$$ $$LMP_i^{CC;t} = LMP_i^{C,t} - LMP_i^{EC;t} - LMP_i^{LC;t}$$	Core	RTM, MPM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5124	RTD MPM shall calculate each component of the LMP for the reference bus at both market resource and Pnode/Apnode: $LMP_{i-n}^{EC;t}$: node i LMP energy component for the reference bus for t $LMP_{i-n}^{LC;t}$: node i LMP loss component for the reference bus for t $LMP_{i-n}^{cC;t}$: node i LMP competitive congestion component for the reference bus for t $LMP_{i-n}^{NC;t}$: node i LMP non-competitive congestion component for the reference bus for t Node i competitive LMP for the reference bus for t is: $$LMP_{i-n}^{C;t} = LMP_{i-n}^{EC;t} + LMP_{i-n}^{LC;t} + LMP_{i-n}^{CC;t}$$ Competitive LMP does not include GHG component.	Core	RTM, MPM
RTDLMPM-BRQ5125	RTD MPM shall perform the bid mitigation for each 5-minute interval: If the non-competitive constraint congestion component of a physical supply bid is greater than Mitigation Threshold Price (default value 0) ($LMP_i^{NC} > Mitigation\ Threshold\ Price$), its bid shall be mitigated to the higher of DEB and its competitive LMP, if the higher one is lower than the unmitigated bid (submitted bid): $$Bid_i^{Mitigated;t} = Min\left[Bid_i^{Submitted;t}, Max(DEB_i^t, LMP_i^{c,t})\right];$$ The bid mitigation calculation is for each 5-minute interval of RTD. The bid mitigation shall apply to all the physical resources subject to LMPM, regardless whether the resource is on-line or not for the trading intervals. $Bid_i^{Submitted;t}$: is per segment of bid-in monotonic cost curve	Core	RTM, MPM
RTDLMPM-BRQ5126	RTM MPM shall perform bid mitigation for each three 5-minute intervals that correspond to the same 15-minute RTPD interval. Each interval can have different non-competitive path designation based on CPA. Each 5-minute RTD interval could have different reference bus. Each interval can have different mitigated bids.	Core	RTM, MPM

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5127	Convergence (virtual) bids shall not be mitigated. PDR bids shall not be mitigated. Dispatchable Demand Resource (DDR) bids shall not be mitigated.	Core	RTM, MPM
RTDLMPM-BRQ5128	Limited Energy Storage Resource (LESR) shall be subject to mitigation same as pump storage unit: positive bids shall be mitigated if the LESR is designated to LMPM, and has a DEB; negative bids shall not be mitigated.	Core	RTM, MPM
RTDLMPM-BRQ5129	If no dynamic CPA is conducted for 5-minute RTD, RTD shall use the most recent mitigated bids.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5130	RTD shall calculate and store the LMP components for the reference bus at both resource and Pnode/Apnode: $Ref\ Bus, LMP_{i-n}^{EC;t}, LMP_{i-n}^{LC;t}, LMP_{i-n}^{CC;t}, LMP_{i-n}^{NC;t}$	Core	RTM, MPM,
RTDLMPM-BRQ5131	RTM (RTD) shall provide through web services the LMP components from the LMPM pass (whenever the LMPM is executed) for the reference bus at Pnode/Apnode that are associated for physical bids only (not virtual) for each trading 5-minute intervals: $Ref\ Bus, LMP_{i-n}^{EC;t}, LMP_{i-n}^{LC;t}, LMP_{i-n}^{CC;t}, LMP_{i-n}^{NC;t}$	Core	RTM, MPM, OASIS
RTDLMPM-BRQ5132	Whenever the LMPM is executed, the RTM (RTD) shall send the following to OASIS (through web services) for every 5-minute interval: • List of binding constraints from the LMPM pass and • shadow prices for each trading 5-minute intervals. Each interval can have different binding constraints.	Core	RTM, MPM, OASIS
RTDLMPM-BRQ5133	For each path that is tested for competitiveness using the Dynamic CPA, the system shall send the results to OASIS via web services. For RTD, the results would include the designation for each 5-minute intervals. Each interval can have different non-competitive path designation. Competitiveness for RTD and RTPD could be different	Core	MPM, OASIS

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5134	The RTD MPM using dynamic CPA shall update the designation of the (previously NC) paths after CPA.	Core	MPM, RTM
RTDLMPM-BRQ5135	For the trading 15-minute RTPD, the resources that not be mitigated by the prior RTD second interval process will use the original RTPD bids in RTD.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5136	Capacity pump storage resources, pseudo generators associated with PDR/ RDRP/Dispatched Pump resources, NGR LESR and NGR DDR, will NOT be included in the calculation for withholding capacity in RTD but WILL BE included in the calculation for effective supply of counter-flow and demand for counter-flow. Capacities from the resources when consuming are always excluded in all calculations.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5137	Units that are ramping up, i.e. cleared value less than Pmin, will have a withholding capacity and available supply equal to the current intervals cleared value. Supply will be multiplied by the SF to calculate effective supply of counter-flow.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5138	In RTD, only the MSG configuration which is committed will be considered for MPM.	Core	RTM, MPM, RTD
RTDLMPM-BRQ5139	RTD shall send mitigated bids to CMRI every 5 minutes CMRI (an existing functionality for RTPD and DA).	Core	RTM, MPM, RTD, CMRI
RTDLMPM-BRQ5140	A new display called *Mitigated Bid* for RTD shall be created. The new display will have a drop down list for Resources. For every selected resource, the display will show the market bid, default bid, and all mitigated bids on a tabular display as well as on a graph.	Core	RTM, MPM, RTD, CMRI
RTDLMPM-BRQ5141	The RTM shall store the overview and details of Dynamic CPA data for RTD, using the same way and representation as for RTPD. It also must be stored in EDR. See the detailed list of data to be stored in EDR from RTD LMPM in RTDLMPM-BRQ5803.	Core	RTM, MPM, RTD, EDR

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5142	The shift factors (of binding constraints) for the DCPA and bid mitigation, including the RTPD and RTD second interval must be stored in EDR table.	Core	RTM, MPM, RTD, EDR
RTDLMPM-BRQ5143	RTCD (real time contingency dispatch), RTDD (real time disturbance dispatch) and RTMD (real time manual dispatch) shall use the most recent updated RTD. RTCD here only refers to California ISO RTCD, not BAA RTCD. For BAA RTCD, LMPM shall still be performed. Note: RTCD/RTDD/RTMD itself does not have any DCPA or LMPM. Note: ODCP/MED (Manual Exceptional Dispatch) will not be affected.	Core	RTM, RTD
RTDLMPM-BRQ5144	For RTD with forced event run, the DCPA shall need to use the new shift factor.	Core	RTD
RTDLMPM-BRQ5145	If current RTD fails, the system shall use the lasted mitigated bids.	Core	RTD
RTDLMPM-BRQ5146	RTD mitigation shall be included in the Frequently Mitigated Unit (FMU) Adder in Default Energy Bid Calculations.	Core	ECIC
RTDLMPM-BRQ5147	The implementation of RTD LMPM shall not negatively impact the execution time of any of the RTD dispatch. RTD performance with RTD LMPM shall remain the same as current RTD performance.	Core	RTD
RTDLMPM-BRQ5148	The system shall need to provide the 5-minute RTD mitigation results to FERC, with data dependency on EDR (which would have the 5-minute RTD mitigation results).	Core	RTD, FODD, EDR

4.2 Business Process: < Manage Market Quality System >

4.2.1 Business Requirements

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5201	MQS shall use RTM effective Bid Curve (mitigated bid curve) that can be potentially mitigated on a 5-minute basis for RTD and 15-minute basis for RTPD. MQS shall account that RTD bids may differ between each 5-minute interval. Currently MQS stores and uses one set of RTD bids for each 15-minute interval.	Core	RTM, MPM, RTD, MQS
RTDLMPM-BRQ5202	MQS shall calculate the LMP MW values, expected energy, expected energy allocation and commodity allocation using RTM effective bid curves. Make sure LMP and bid price are from corresponding binding interval from applicable market.	Core	RTD, MQS
RTDLMPM-BRQ5203	For RTPD and/or RTD, if there is a disruption in the run or publication in the market software, MQS shall fill bid data from the last available RTPD/RTD interval's final bids (mitigated bids where applicable, clean bids if no mitigation), within the same hour for the corresponding market type. If the first RTPD or RTD interval should have a disruption in the run or publication, then MQS shall fill bid data from the hourly RT clean bid set for that trade hour.	Core	RTPD, RTD, MQS, Integration
RTDLMPM-BRQ5204	Bid processing (hold bids after resource shutdown, modify bids for VERS, etc.) must be performed for both RTPD and RTD bids.	Core	RTPD, RTD, MQS
RTDLMPM-BRQ5205	The FCS (forecast) bid curve for VERs must be updated by market type to reflect either RTPD or RTD final bids, as appropriate.	Core	RTPD, RTD, MQS
RTDLMPM-BRQ5206	A default competitive path list shall use the binding RTPD interval.	Core	RTPD, RTD, MQS
RTDLMPM-BRQ5207	MQS shall consume final bid reflecting all applicable Market Power Mitigation in RTPD and/or RTD. MQS shall consume these data via web services.	Core	RTPD, RTD, MQS, Integration

4.3 Business Process: < Manage CMRI >

4.3.1 Business Requirements

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5301	CMRI shall display 5 minute (RTD) interval resource-level mitigated bids upon receipt from the RTD market run results.	Core	RTD, CMRI

4.4 Business Process: < Manage OASIS >

4.4.1 Business Requirements

ID#	Business Feature	Requirement Type	Potential Application(s) Impacted
RTDLMPM-BRQ5401	The system shall display 5 minute RTD system-level mitigation results, upon receipt from the RTD market run results, similar to current RTPD reports. Under tab “PRICES” • MPM RT Locational Marginal Prices • MPM Nomogram/Branch Shadow Prices • MPM Nomogram/Branch Competitive Paths • MPM Intertie Constraint Shadow Prices • MPM Intertie Constraint Competitive Paths • MPM Reference Bus Under tab “ENERGY” • Market Power Mitigation Status	Core	RTD, OASIS