6. Reliability Assessment Commitment and Look-Ahead Commitment Activities

The RAC and LAC processes provide input into the operation of the Real-Time Energy and Operating Reserve Market to ensure that sufficient Resources are available and on-line to meet the demand and Operating Reserve requirements within the Market Footprint, as projected by MISO for each hour, or sub-hour, or sub-hour, period of the Operating Day. These processes enable MISO to reliably operate the Transmission System throughout the Operating Day by committing additional Resources:

- Before the clearing of the Day-Ahead Energy and Operating Reserve Market, if required
- After the posting of the Day-Ahead Energy and Operating Reserve Market results but before the start of the Operating day, if required or
- Anytime during the Operating Day, if required.

The RAC process employs a SCUC algorithm to minimize the cost of committing the required capacity to meet forecasted demand, confirmed Interchange Schedule Exports and Operating Reserve requirements, including Start-Up Offer, No-Load Offer, cost to operate at the Hourly Economic Minimum Limit, Regulating Reserve Offers, Spinning Reserve Offers and Supplemental Reserve Offers for Generation Resources and DRRs-Type II and including Energy Offers, Shut-Down Offers, Hourly Curtailment Offers, Spinning Reserve Offers and Supplemental Reserve Offers for each DRR-Type I. The RAC analysis minimizes the cost of committing sufficient Resources to meet the forecasted capacity requirements, not the cost to serve the forecasted Energy. The RAC SCUC analysis focuses on hourly time intervals.

The LAC process employs a similar SCUC algorithm, with the exception that the SCUC algorithm used by LAC minimizes the total cost of production of the required capacity to meet forecast demand and other requirements. In other words, it minimizes the cost of committing sufficient Resources to meet the cost to serve the forecasted Energy, in addition to forecasted capacity requirements. When the forecast time gets closer to the current time, uncertainty decreases. For intervals further in the future, it is better to minimize commitment cost because of the higher uncertainty of need. Whereas, in near term, much of that uncertainty is resolved and it is better to minimize total production cost. The LAC SCUC analysis focuses on fifteen to thirty minute time intervals.

Resources are guaranteed to receive their Offers if committed. Offer rules that apply to the RAC/LAC are described in Section 4 of this BPM. The RAC/LAC timeline is presented in Exhibit 6-1, covering the four RAC/LAC processes:

- RAC Pre Day-Ahead
- RAC Post Day-Ahead
- RAC Intraday
- LAC

Exhibit 6-1: RAC/LAC Timeline

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Data Required for RAC Pre Day-Ahead Process		
OD-7 @ 0000	As available during RAC run	Transmission Owners/Operators submit requests for transmission facility outages
OD-7 @ 0000	As available during RAC run	Generation Owners/Operators submit planned generation facility outage Schedules
OD-7 @ 0000	As available during RAC run	LBAs submit Load Forecasts that are utilized as input to the MISO Load Forecast
RAC Pre Day-Ahead Process		
OD-7 @ 0000	OD-1 @ 1430 EPT	Perform Multi-day RAC as necessary to evaluate need for Long Lead Start Units
RAC Post Day-Ahead Process		
OD-1 @ 1330 EPT	OD-1 @ 1430 EPT	Resource Offer re-bidding
OD-1 @ 1430EPT	OD-1 @ 1800EPT	Perform RAC Next-Day Analysis
OD-1 @ 1800EPT	OD @ 0000	Notify Resources of scheduled commitment: ▪ Start time and Dispatch Minimum ▪ Stop time
RAC Intraday Process		
OD-1 @ 1800 EPT	OD @ 2400	Perform RAC Intraday Analysis as needed
LAC Process		
OH-4	DI-15	Perform LAC Analysis as needed

OD = Operating Day
OH = Operating Hour (00 to 23)
DI = Dispatch Interval
RAC = Reliability Assessment Commitment
LBA = Balancing Authority

Note: All times are in EST unless noted otherwise.

6.1 RAC/LAC Process Input Assumptions

The following assumptions are taken into account as part the RAC processes:

- Forecasted Load
- Operating Reserve Requirements
- Interchange Schedules greater than one day out
- Commitment of Resources where the sum of the Start-up Time and Start-up Notification Time exceeds 24 hours
- Scheduled outages
- Maintaining facility ratings

6.1.1 Forecasting Load

MISO produces and publishes an initial hourly forecast of Load for the Operating Day beginning seven days prior to that day and updated daily as the Operating Day approaches.

MISO requires LBAs to submit hourly Load Forecasts for a rolling seven days in the future. For each day, a 24-hour Load shape is developed. The first step in developing a Load Forecast is to obtain weather information for the time period. Weather information is provided at regular intervals by a contracted-for weather service. The forecast period is reviewed to determine any conditions that could affect MISO's Load, including but not limited to: day of week, holidays, special events, Daylight Savings Time ("DST") changes, and LBA Load Forecasts.

Load Forecast and Operating Reserve requirements are required by the Real-Time Energy and Operating Reserve Market RAC to ensure that sufficient Resources are committed. The RAC process ensures that sufficient generation capacity is scheduled on-line (or that available Quick-Start Resources will contribute to meeting Contingency Reserve requirements) to meet the Load in MISO's Market Footprint, including capacity needed for reserves. The RAC process is performed several times throughout the timeline. This Load Forecast is used in the Real-Time Energy and Operating Reserve Market RAC only; it is not used to clear the Day-Ahead Energy and Operating Reserve Market.

The LBAs provide to MISO, by the Day-Ahead Energy and Operating Reserve Market Offer deadline at 1030 EPT, a Load Forecast at an hourly granularity for the next seven days. MISO requires the MPs serving Load in a LBA to supply a forecast of these values to its LBA for the Load served by the MPs if the LBA needs the data to develop the LBA Forecast. MISO also

produces a seven-day hourly forecast for each LBA, considering the Load Forecasts provided by the LBAs, and utilizes its Load Forecast produced for use in the RAC process.

The coincident peak of the MISO STLF (as described in Section 3.5.3.2) is used as the forecast for the LAC process.

6.1.2 Operating Reserve Requirements

The Market-wide and Zonal Regulating Reserve and Contingency Reserve Requirements for the Post Day-Ahead, Intra-Day RAC, and LAC processes are generally the same as those requirements developed for use in the Day-Ahead Energy and Operating Reserve Market. MISO may increase these requirements if necessary to address system condition changes following the clearing of the Day-Ahead Energy and Operating Reserve Market and/or Emergency conditions in Real-Time.

6.1.3 Pre-Scheduling Interchange Schedules Greater than One Day Out

Pre-scheduled Interchange Schedules are transactions that are scheduled one or more days prior to their Operating Day for the Day-Ahead or Real-Time Energy and Operating Reserve Markets. Each MP making an Import Schedule or Export Schedule covering a period greater than the Operating Day must furnish all required information to MISO via a NERC E-Tag that transfers into webTrans.

MISO confirms the Interchange Schedule E-Tag with the affected adjacent external BA, as necessary, and may condition acceptance for scheduling on such confirmation. MISO provides the requesting MP with notice, as soon as is practicable, as to whether the pre-scheduled Interchange Schedule E-Tag request is accepted for scheduling and, if it is not accepted, the reason why. MISO responds to E-Tags in accordance with NERC established guidelines. MPs with pre-scheduled Interchange Schedules are subject to Ex Ante and Ex Post LMPs established for the Interface CPNode(s) that the schedule utilizes.

See Section 4.1.14.1.1 of this BPM for additional information on Interchange Schedules.

6.1.4 Submitting Resource Offers for Reliability Assessment Commitment

The following rules apply to all Resources:

- ***Resources designated as Capacity Resources for Module E Purposes*** – Not on a forced or maintenance outage must offer into the RAC any designated capacity, including Energy, and Contingency Reserve if qualified, not scheduled in the Day-

Ahead Energy and Operating Reserve Market or during any RAC process conducted prior to the Operating Day except to the extent that the Resource is unable to provide Energy or Contingency Reserve due to a forced or planned outage or other physical operating restrictions. These Resources can, but are not obligated to, offer any available capacity that has not been scheduled in the Day-Ahead Energy and Operating Reserve Market or any RAC processes performed prior to the Operating Day for use during the Operating Day.

- ***Other Resources*** – Can, but are not obligated to offer any available capacity that has not been scheduled in the Day-Ahead Energy and Operating Reserve Market.

Resources selected and committed by MISO in any RAC or LAC process(es) must adhere to MISO instructions, including start times. These Resources (except for Stored Energy Resources) must also submit an Energy Offer for their full range of Operable Capacity (or for Targeted Demand Reduction Level for DRRs-Type I), from Hourly Emergency Minimum Limit to Hourly Emergency Maximum Limit (or, to expected maximum limit, for DIRs), regardless of Module E capacity designation status, for use in the Real-Time Energy and Operating Reserve Market.

Generation Resources and DRRs-Type II committed by MISO are guaranteed recovery of Start-Up Offers, No-Load Offers, Energy Offers (at Non-Excessive Energy actual output), Regulating Reserve Offers, Spinning Reserve Offers and On-Line Supplemental Reserve Offers (if applicable) net the value of Real-Time Energy and Operating Reserve Market revenues for Energy and Operating Reserve earned during the commitment period. DRRs-Type I committed by MISO are guaranteed recovery of Energy Offers, Shut-Down Offers and Hourly Curtailment Offers net of the value of Real-Time Energy and Operating Reserve Market revenues for Energy earned during the commitment period (as calculated based upon DRR-Type I Actual Energy Injection). Further detailed Settlement information regarding Revenue Sufficiency Guarantees can be found in the BPM for *Market Settlements.*

6.1.5 Committing Long Start-Up Resources

MISO supports unit commitment service for Generation Resources or DRRs-Type II with Start-up Notification Time + Start-Up Times (or Shut-Down Notification Time + Shut-Down Times for DRRs-Type I) longer than those that can be accommodated in the post Day-Ahead RAC processes. These Resources can also Self-Schedule (except for DRRs-Type I) or engage in Financial Schedules and Interchange Schedules to utilize the Resource.

Uncommitted Generation Resources or DRRs-Type II with Start-Up Notification Times + Start-Up Times (or Shut-Down Notification Times + Shut-Down Times for DRRs-Type I) longer than those that can be committed as part of the post Day-Ahead RAC process can submit Offers for consideration by MISO as part of the Pre Day-Ahead RAC process. The following time frames reflect the process employed:

- ***Seven to Four Days prior to Operating Day:***
  - Generation Resources and DRRs-Type II with Start-Up Time plus Start-Up Notification Times greater than 24 hours must submit binding Hourly Economic Minimum and Maximum Limits and binding Start-Up Offers, No-Load Offers, and Energy Offers at Hourly Economic Minimum Limit along with the submittal of Start-Up Time and Start-Up Notification Time.
  - DRRs-Type I with Shut-Down Time plus Shut-Down Notification Times greater than 24 hours must submit binding Targeted Demand Reduction Levels and binding Energy Offers, Shut-Down Offers and Hourly Curtailment Offers along with the submittal of Shut-Down Time and Shut-Down Notification Time.
  - If adequacy violations are detected, they are logged and evaluated but no specific commitment action is taken until three days prior to the market day, unless three days prior would not allow sufficient time to resolve the potential violations.
- ***Three to Two Days prior to Operating Day:***
  - Generation Resources and DRRs-Type II that have not been committed by MISO may submit revised Start-Up Times and Start-Up Notification Times and binding Hourly Economic Minimum and Maximum Limits and binding Start-Up Offers, No-Load Offers, and Energy Offers at Hourly Economic Minimum Limit.
  - DRRs-Type I with Shut-Down Time plus Shut-Down Notification Times greater than 24 hours must submit binding Targeted Demand Reduction Levels and binding Energy Offers, Shut-Down Offers and Hourly Curtailment Offers along with the submittal of Shut-Down Time and Shut-Down Notification Time.
  - If violations of reliability criteria are detected, MISO coordinates with the local Operators to verify the violation. After the violation has been verified, MISO will direct certain Resource operations if the only alternative to resolve the Resource-adequacy or constraint violation is to commit a Generation Resource or DRR-Type II with a Start-Up Time plus Start-Up Notification

Time requirement or commit a DRR-Type I with a Shut-Down Time plus Shut-Down Notification Time requirement that is longer than can be accommodated in (OD-2) or (OD-1) RAC processes.

6.1.6 Scheduling Outages

MISO is responsible for approving the scheduling of maintenance on all transmission facilities making up the MISO Transmission System and coordinating with Generation Owners, as appropriate, the scheduling of maintenance on generation facilities. This information is required for determining Resource availability and the topology and capability of the transmission network. See the BPM for *Outage Operations* for a description of transmission and generation outage coordination process, which includes outage scheduling, outage analysis, and outage reporting.

6.1.7 Maintaining Facility Ratings

MPs, Transmission Owners, and MISO are required to fulfill requirements for facility ratings. All Transmission Owners must regularly update and verify facility ratings to the MISO Operations Planning Department (or successor department). These procedures are updated as needed and are further described in the Transmission Owner Agreement.

See MISO's facility rating Coordination Policy Manual for a description of the facility rating coordination process, including the responsibilities of MPs, Transmission Owners, and MISO.

6.1.8 Managing Hourly Regulation Schedules

The RAC process (specifically the intra-day RAC process) continuously evaluates which Resources should be scheduled to potentially provide Regulating Reserves for a given Operating Hour to ensure 1) a sufficient number of Resources are scheduled to meet the Market-Wide Regulating Reserve Requirement and the Reserve Zone Regulating Reserve Requirements and 2) the scheduling of Resources does not consume excessive amounts of capacity and ramp capability. In addition, the RAC process is used to manage the transition of Resources from a non-regulating state to a regulating state or vice versa to avoid situations where an excessive number of Resources scheduled to potentially provide Regulation Capability may not be available for Regulation Deployment Instructions at the beginning of the Operating Hour due to initial operation outside the regulation limits. To address these issues, MISO may limit the number of Resources that can transition from a regulating state to a non-regulating state at the beginning of an Operating Hour and/or utilize Manual Redispatch

provisions to move a Resource into the regulation operating range just prior to the beginning of the Operating Hour.

The SCUC algorithm incorporated into the Day Ahead and RAC processes determines the initial Regulation Schedule for a specific Operating Hour based on offers, constraints and the most up-to-date medium term load forecast (see Attachment C of this BPM for more details). However, given the dynamic nature of generation offers and control statuses, it is necessary for MISO to make incremental changes to the latest Regulation Schedule provided by prior regulation scheduling processes.

A regulation management tool provides MISO Real-Time Operations personnel with the information needed to make appropriate decisions regarding the adjustment of the Regulation Schedule provided by prior regulation scheduling processes. The regulation management tool provides an assessment of the current Regulation Capability of Resources in the Regulation Schedule and ranks Resources with regard to physical and economic attributes.

MISO system operators utilize the regulation management tool to determine if the number of resources scheduled to potentially provide Regulating Reserves during an Operating Hour is too high or too low based on up-to-date information including, but not limited to:

- Updated offer data
- Updated load forecast
- Updated net scheduled interchange
- Updated status of resources (including dispatch levels)
- Updated status of the transmission system.

Should it be necessary to adjust the Regulation Schedule produced by the prior regulation scheduling processes, MISO considers the following factors in making decisions to adjust the number of Resources scheduled to potentially provide Regulating Reserves:

- Regulating reserve offer price vs. energy offer price.
- Regulation capability based on applicable bi-directional ramp rate and regulation limits.
- Applicable economic maximum limit vs. regulation maximum limit.
- Applicable economic minimum limit vs. regulation minimum limit.
- Applicable bi-directional ramp rates vs. single-directional ramp rates.
- Number of resources transitioning from a non-regulating to a regulating state.

6.2 RAC Processes Under Shortage Conditions

If, during the Post Day-Ahead RAC or any of the Intra-Day RAC processes, MISO projects a shortage of available Capacity either on a system-wide basis or Sub-Area basis, based upon the sum of all non-Emergency Capacity (including Capacity from available Import Schedules, Generation Resources, DRRs-Type I, DRRs-Type II and External Asynchronous Resources) and Emergency Capacity (including both Resource Hourly Emergency Maximum Limits and Generation Resources, DRRs-Type I and DRRs-Type II designated for use only during Emergency conditions) to meet projected Energy (assuming Export Schedules are curtailed) and Operating Reserve requirements in any Hour of the Operating Day, MISO will implement the following procedures:

- ***Step One:*** MISO issues an alert, warning or event , in accordance with Emergency Operating Procedure – 002 (EOP-002) and posts on its website: (1) the hours in the Operating Day during which an EEA Level 1 is anticipated; (2) the hours during the Operating Day in which Export Schedules are expected to be curtailed; (3) the hours during the Operating Day in which Resource Hourly Emergency Maximum Limits[46] are expected to be utilized; and (4) the hours during the Operating Day in which Emergency only Resources[47] are expected to be committed.
- ***Step Two:*** If MISO projects that it cannot meet its Regulating Reserve requirement and all Contingency Reserve has been depleted, MISO issues an alert or warning in accordance with Emergency Operating Procedure – 002 (EOP-002) and posts on its website the anticipated hour in which an EEA Level 2 Emergency is expected to occur. If MISO declares an EEA-2 event, the following actions may be initiated in accordance with EOP-002: (1) instruct the Local Balancing Authorities to issue public appeals, (2) begin Emergency Energy purchase procedures described under Section 6.2.1 of this BPM; (3) issue EDR Dispatch Instructions to EDR Participants based on EDR Offers submitted; (4) direct LBAs to initiate voltage reduction procedures; and/or (5) direct LSEs to curtail appropriate amounts of Load Modifying Resources. At this point, MISO has exhausted all measures at its disposal to alleviate the shortage condition prior to entering into the real-time Operating Hour.

[46] Individual Resources are notified directly by MISO.

[47] Individual Resources are notified directly by MISO.

6.2.1 Emergency Energy Purchases

Following the declaration of an EEA Level 2, MISO may contact external Balancing Authorities through the applicable MISO to external Balancing Authority Agreements (BA-to-BA Agreements) and indicate that Emergency Energy may be needed. Payment for such purchases, if scheduled, will be in accordance with the payment terms specified in the applicable BA-to BA Agreement. Emergency Energy purchases shall be implemented in the form of a schedule in webTrans between MISO and the selected adjacent external Balancing Authority. Note that Transmission Service on external non-MISO transmission facilities provided may be needed to effectuate the schedule. MISO will implement and curtail these schedules with as much notice as practical to allow for a reasonable transition into and out of the shortage condition.

6.3 RAC Processes Under Surplus Conditions

If during the Post Day-Ahead RAC or any of the Intra-Day RAC processes, MISO projects a surplus of non-Emergency minimum Capacity (including minimum Capacity from firm Import Schedules, on-line Generation Resources, DRRs-Type I and DRRs-Type II) to meet projected Energy requirements less the Regulating Reserve requirement in any Hour of the Operating Day, MISO will implement the following procedures:

- ***Step One:*** MISO issues an appropriate Emergency alert, in accordance with Emergency Operating Procedure – 003 (EOP-003), and includes Resource Hourly Emergency Minimum Limits for both Generation Resources and DRRs-Type II as part of the RAC process.
- ***Step Two:*** If use of Hourly Emergency Minimum Limits is not sufficient to relieve the anticipated surplus condition, MISO may de-commit non-Must Run Resources on an economic basis that were committed as part of the Day-Ahead Energy and Operating Reserve Market clearing to relieve the anticipated surplus condition.

6.4 LAC Processes Under Shortage/Surplus Conditions

The actions described in Sections 6.3 and 6.4 above also apply during the LAC process. In addition, if shortage or surplus conditions have been identified, Resource emergency limits, as described in Sections 0 and 8.2.3.2, are also considered for use in the LAC process.

6.5 RAC/LAC Processes Results

The following output results are produced by all RAC/LAC Processes:

- For each affected Resource, a commitment schedule is produced for the Operating Day indicating which hours the Resource is scheduled to operate and which hours

uncommitted Quick-Start Resources have been scheduled to provide off-line Supplemental Reserve. This schedule does not become physically binding until it is communicated to the MP by MISO.

- For each affected Resource under the shortage conditions described under Section 6.2 above, a commitment schedule is produced for Resources with a Commitment Status of "Emergency" and an off-line Supplemental Reserve schedule is produced for uncommitted Resources with an Off-Line Supplemental Reserve Dispatch Status of Emergency. In addition, MISO will notify Market Participants electronically that the Hourly Emergency Maximum Limit will be used for a specific Resource for an Operating Hour. The notification that the Hourly Emergency Maximum Limit will be used will occur at least 10 minutes prior to the beginning of the Operating Hour but not more than 30 minutes prior to the beginning of the Operating Hour. Emergency commitment schedules, Emergency off-line Supplemental Reserve schedules and the use of Hourly Emergency Maximum Limits will become physically binding once communicated to affected MPs by MISO after MISO has verified and accepted the RAC/LAC results.
- For each affected Resource under the surplus conditions described under Section 6.3 above, a de-commitment schedule is produced and MISO will notify MPs electronically that the Hourly Emergency Minimum Limit will be used for a specific Resource for an Operating Hour. The notification that the Hourly Emergency Minimum Limit will be used will occur at least 10 minutes prior to the beginning of the Operating Hour but not more than 30 minutes prior to the beginning of the Operating Hour. Emergency de-commitment schedules and the use of Hourly Emergency Minimum Limits become physically binding once communicated to affected MPs by MISO after MISO has verified and accepted the RAC/LAC results.

6.6 MISO-PJM Coordinated Transaction Scheduling (CTS)

MISO-PJM Coordinated Transaction Scheduling (CTS) is an optional product available for scheduling real-time energy market transactions between MISO and PJM. CTS facilitates the efficient scheduling of interchange between the two regional transmission organizations (RTO) by utilizing forecasted LMPs, and participant-provided interface bids to clear only those transactions deemed economically consistent with projected interface price spreads.

Market Participants submit MISO-PJM CTS bids in PJM's ExSchedule system. Validated bids are then passed to both PJM and MISO's look-ahead commitment engines. In Real-Time, PJM sends MISO the forecasted LMPs calculated for PJM's MISO interface, while MISO sends PJM

the forecasted LMPs calculated for MISO's PJM interface to use as inputs to the CTS clearing process. Every 15 minutes in real-time (i.e., HH:00the top, HH:15, HH:30 and HH:45 of each hour of the Real-Time Energy and Operating Reserves Market), each RTO uses its Look Ahead Commitment engine to clear only those CTS bids that have an interface bid price that is less than or equal to the projected interface price spread. PJM and MISO then exchange the CTS clearing results. A common clearing process reconciles the CTS bids independently cleared by MISO and PJM. For each CTS bid, only those transaction MW cleared by both PJM and MISO will be scheduled to flow.

6.6.1 MISO-PJM Coordinated Transaction Scheduling Business Rules

A Coordinated Transaction Schedule (CTS) bid can have up to ten monotonically increasing price and MW quantity pairs with minimum price at $0.01 for each 15-minute scheduling interval. Coordinated Transaction Schedules must be submitted 75 minutes before the start of the scheduling interval.

Please refer to the BPM #007 Physical Scheduling document for rules governing the submission of MISO-PJM CTS transactions.

6.6.2 CTS Bid Clearing

The Intermediate Term Security Constrained Economic Dispatch (IT SCED) engine clears CTS bids in PJM. Look Ahead Commitment (LAC) engine clears CTS bids for MISO. Only the CTS bids commonly cleared between PJM and MISO will be scheduled to flow. The reconciliation of commonly cleared CTS bids is discussed in section 6.6.3.

MISO receives CTS bids plus the forecasted PJM interface price from PJM. Using these inputs plus MISO's forecasted LMP, CTS bids are cleared as noted below:

A CTS bid that is scheduled from MISO to PJM gets cleared if:

The CTS bid Segment Price <= $PJM_interface - $MISO_interface

A CTS bid that is scheduled from PJM to MISO gets cleared if:

The CTS bid Segment Price <= $MISO_interface - $PJM_interface

Where

$PJM_interface: LMP for the MISO interface as calculated by PJM
$MISO_interface: LMP for the PJM interface as calculated by MISO

In the case of a tie among multiple bids, cleared MWs will be prorated across tying bids based on the size of the marginal MW segment for each tying bid. The proration of cleared MW across tying bids is calculated based on the following formula:

*$MW_{transaction}$ = (MWneeded for power balance) * (MW from transaction's marginal segment/ total MW from the marginal segment)*

6.6.3 CTS Common Clearing

Common Clearing is a process that reconciles the results of CTS clearing from the MISO and PJM solutions. For each CTS bid, only those transaction MW cleared by both PJM and MISO will be scheduled to flow. Therefore:

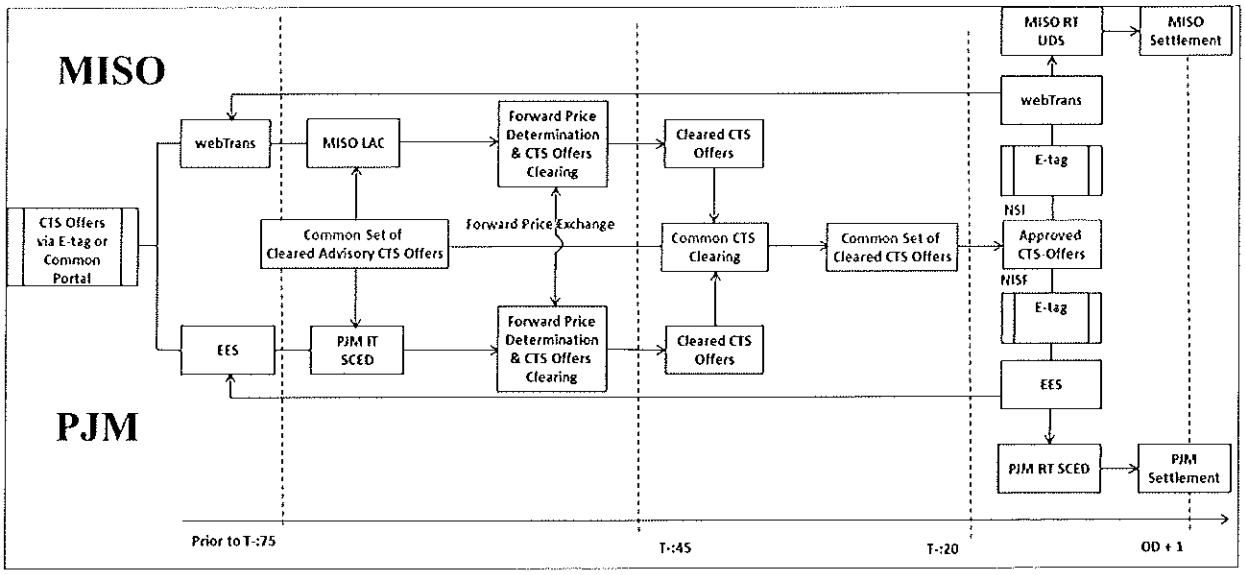
Common Cleared CTS Transaction MW = min (Cleared MISO MW, Cleared PJM MW)

The Common Clearing process executes for each 15 minute scheduling interval (HH:00, HH:15, HH:30, HH:45) at approximately 25 minutes before the start of CTS transaction. For example, the common clearing process for 12:00 runs at approximately 11:35.

The commonly cleared CTS results are posted in the ExSchedule portal and electronic tag (E-Tag) applications following the approval of the common clearing process.

6.6.4 CTS Timing and Data Exchange

The figure below shows the general timing of the various processes that will occur so that CTS transactions will flow at T-0:00. This figure shows the timeline for submittal of CTS bids, data exchanges between MISO and PJM, and common clearing process for each ISO.



Described below is the sequence of events associated with CTS processing:

1. E-Tag and E-Tag adjustments must be submitted at least 75 minutes prior to the listed start time.
2. The MISO advisory prices and schedules will come from the most recent MISO CTS clearing engine run that executes at T- 0:55.
3. At T- 0:40, the ITSCED case will execute for T-0 binding interval and include validated bid data and advisory pricing.
4. At T-25, common clearing case is executed at both ISO's.
5. Prior to T-20,scheduling system issues CTS Tag adjustments on MISO sinking Tags for T-0 intervals based on common cleared results.

6.6.5 CTS Clearing Suspension

For reliability or system maintenance reasons, either PJM or MISO may suspend the evaluation and clearing of CTS transactions temporarily. During the affected time, all CTS transactions will be cleared to 0 MW. Possible reasons for CTS suspension include but are not limited to:

- Initiation of Maximum Emergency Warning procedures.
- Scheduled system outage / maintenance.
- Inability to send or receive accurate forecast LMP data to/from partner RTO.

A message will be displayed in the ExSchedule system whenever CTS suspension is in effect.

6.6.6 CTS Settlement

MISO and PJM will settle the CTS transactions on each side of the MISO-PJM interface based on actual LMPs, not the projected prices. In other words, although the market clearing process for CTS transactions will use projected prices, the market settlement process for CTS transactions will use actual real-time prices. In MISO, CTS transactions will be settled as Real Time physical schedules, will be treated as generation dispatched up and down and, therefore, will be exempt from uplift charges such as Revenue Sufficiency Guaranty (RSG) and Revenue Neutrality Uplift (RNU) charges in the MISO market. Please refer to the Market Settlements calculation guide for additional details.

7. Day-Ahead Energy and Operating Reserve Market Activities

MPs who wish to participate in the Day-Ahead Energy and Operating Reserve Market must submit Resource Offers, Virtual Supply Offers, Demand Bids, and/or Interchange Schedules for the purchase and sale of Energy and Offers for the sale of Operating Reserve no later than 1030 EPT on the day prior to the Operating Day (OD-1) for use in clearing the Day-Ahead Energy and Operating Reserve Market. Exhibit 7-1 shows the timeline for the principal activities associated with the Day-Ahead Energy and Operating Reserve Market.

Exhibit 7-1: Day-Ahead Energy and Operating Reserve Market Activities Timeline

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Data Required for the Day-Ahead Energy and Operating Reserve Market		
As previously scheduled	OD-1 @ 1030EPT	Scheduled transmission facility outages
As previously scheduled	OD-1 @ 1030 EPT	Scheduled Generation Resource and Stored Energy Resource outages
OD-7 @ 0000 or previous submittal	OD-1 @ 1030 EPT	Resource Offer submittal into the Day-Ahead Energy and Operating Reserve Market for Energy, Regulating Reserve, Spinning Reserve and Supplemental Reserve
OD-7 @ 0000	OD-1 @ 1030 EPT	Fixed Demand Bids and Price-Sensitive Demand Bids into the Day-Ahead Energy and Operating Reserve Market only
OD-7 @ 0000	OD-1 @ 1030 EPT	Virtual Supply Offers and Virtual Demand Bids into the Day-Ahead Energy and Operating Reserve Market only
OD-7 @ 0000	OD-1 @ 1030 EPT	Day-Ahead Fixed Interchange Schedules – not considered binding until OD-1 @ 0900 – roll into Real-Time Energy and Operating Reserve Market, if cleared and not "zeroed" by MP
OD-7 @ 0000	OD-1 @ 1030 EPT	Day-Ahead Dispatchable Interchange Schedules – not considered binding until OD-1@0900 – roll into Real-Time Energy and Operating Reserve Market as Fixed Interchange Schedules, if cleared
OD-7 @ 0000	OD-1 @ 1030 EPT	Up-to-TUC Interchange Schedules (Day-Ahead Energy and Operating Reserve Market only) not considered binding until OD-1@0900 - roll into Real-Time Energy and Operating Reserve Market as Fixed Interchange Schedules, if cleared
OD-7 @ 0000	OD-1 @ 1030 EPT	GFA Schedules (Option B)
As scheduled by RAC	OD-1 @ 1030 EPT	Long lead time Resource schedules – from RAC
As previously entered	OD-1 @ 1030 EPT	Bid and Offer parameters and Network Model parameters
As previously entered	OD-1 @ 1030 EPT	Updated facility ratings

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Day-Ahead Energy and Operating Reserve Market Activities		
	OD-1 @ 1030 EPT	Close the Day-Ahead Energy and Operating Reserve Market and acquire data
OD-1 @ 1030 EPT	OD-1 @ 1330 EPT	Clear the Day-Ahead Energy and Operating Reserve Market
	OD-1 @ 1330 EPT	Post the Day-Ahead Energy and Operating Reserve Market Awards Results and Ex-Ante LMPs and MCPs
OD-1 @ 1330 EPT	OD-1 @ 1630 EPT	Post the Day-Ahead Energy and Operating Reserve Market Ex-Post LMPs and MCPs
OD-7 @ 0000	OD+6 @ 1200	Enter Financial Schedules for the Day-Ahead Energy and Operating Reserve Market (Note: Financial Schedules for Deviations must be submitted by OH-4)
OD = Operating Day RAC = Reliability Assessment Commitment SSR = System Support Resource TUC = Transmission Usage Charge		Note: All times are in EST unless indicated otherwise

MISO may extend or reopen the Day-Ahead Energy and Operating Reserve Market after market close time (1030 EPT) as listed in Exhibit 7-1, based on unanticipated events that:

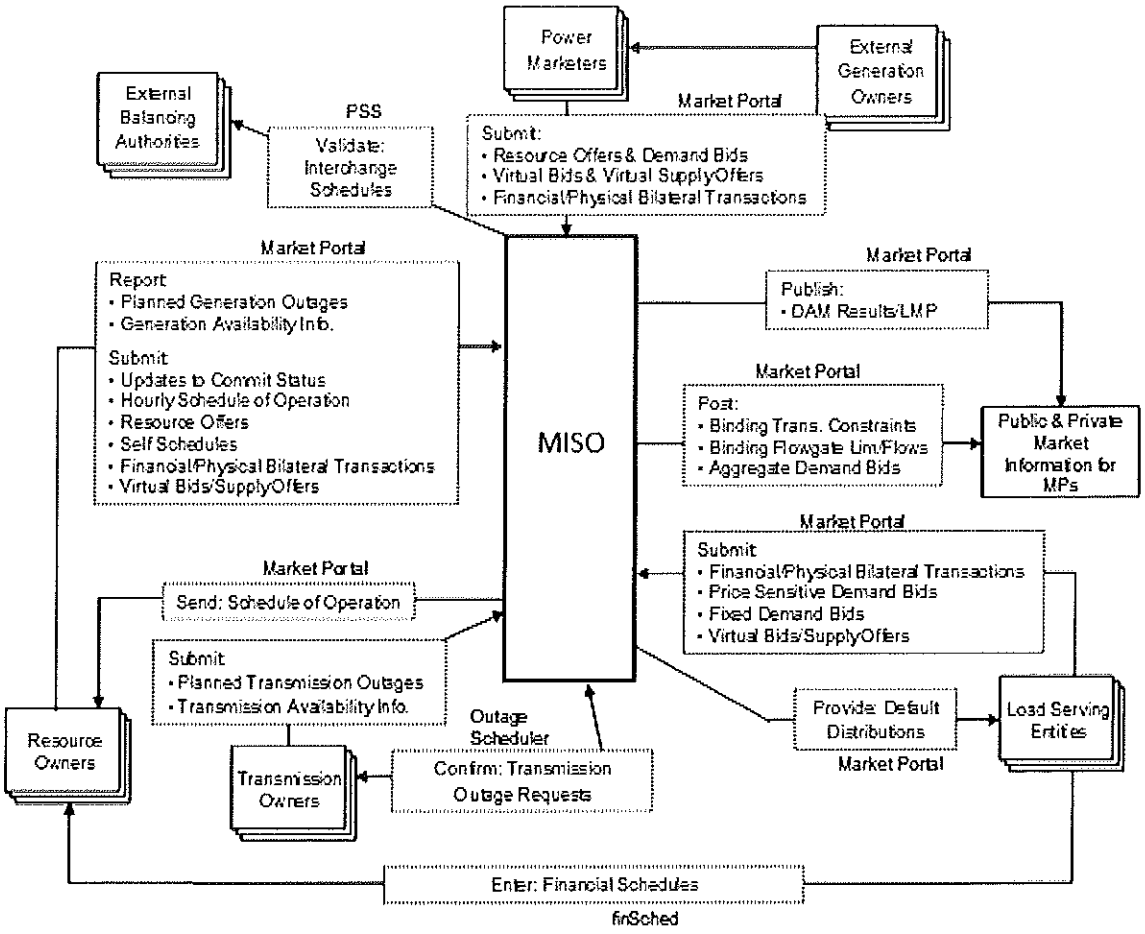
i) interfere with MISO's ability to receive or process Bid, Offer, or Interchange Schedule data;
ii) render Bid, Offer, or Interchange Schedule data plainly inaccurate in a manner that is likely to significantly impede MISO's ability to deliver a feasible market solution; or
iii) are otherwise likely to have a widespread negative impact on the results of the Day-Ahead Energy and Operating Reserve Market, in a manner that adversely threatens or affects the reliability of market operations or of the Transmission System.

MISO will post a notice of any extension or reopening of the market. The notice will state each extension or reopening's circumstances, rationale, duration, and whether such action enabled MISO to successfully address or minimize the issue that necessitated the extension or reopening.

Similarly, though MISO will strive to post the Day-Ahead Energy and Operating Reserve Market clearing results before 1330 EPT as listed in Exhibit 7-1, additional time may be needed for such posting from time to time due to unanticipated events.

The interactions and data flows between the entities that participate in the Day-Ahead Energy and Operating Reserve Market are shown in Exhibit 7-2.

Exhibit 7-2: Data Flow for Day-Ahead Energy and Operating Reserve Market



7.1 Market Participant Activities

MPs submit Offers and Interchange Schedules for use in the Day-Ahead Energy and Operating Reserve Market clearing process as follows.

7.1.1 Submitting Resource Offers

MPs may submit Resource Offers up to Day-Ahead Energy and Operating Reserve Market close time 1030 EPT on the day prior to the Operating Day for use in the Day-Ahead Energy

and Operating Reserve Market clearing process. See Section 4 of this BPM for a description of the valid Offer parameters. The following rules apply to all Resources:

- ***Resources designated as Capacity Resources for Module E Purposes*** – If not on a forced or maintenance outage, such Resources must offer into the Day-Ahead Energy and Operating Reserve Market any designated capacity, including Energy and Contingency Reserve if qualified except to the extent that the Resource is unable to provide Energy or Contingency Reserve due to a forced or planned outage or other physical operating restrictions.
- ***Other Resources*** – These Resources can, but are not obligated to, offer any available capacity into the Day-Ahead Energy and Operating Reserve Market.

DRR-Type I Offers should be accompanied by a Fixed Demand Bid for the associated host load zone equal to the expected Targeted Demand Reduction Level; otherwise, a Load deviation will be created in the Real-Time host load one settlement equal to the Targeted Demand Reduction Level if the DRR-Type I is committed.

Resources selected and committed as part of the Day-Ahead Energy and Operating Reserve Market clearing must adhere to MISO's instructions, including start times. These Resources must also submit an Energy Offer (except for Stored Energy Resources) for their full range of Operable Capacity, from Hourly Emergency Minimum Limit to Hourly Emergency Maximum Limit, regardless of Module E capacity designation status for use in the RAC Processes and in the Real-Time Energy and Operating Reserve Market. Generation Resources and DRRs-Type II committed by MISO are guaranteed recovery of Start-Up Offers, No-Load Offers, Energy Offers (at actual output), Regulating Reserve Offers, Spinning Reserve Offers and On-Line Supplemental Reserve Offers (if applicable) net the value of Day-Ahead Energy and Operating Reserve Market revenues earned based upon the Day-Ahead Schedule for Energy and Operating Reserve, and subject to restrictions on Self-Scheduling. DRRs-Type I committed by MISO are guaranteed recovery of Shut-Down Offers and Hourly Curtailment net the value of Day-Ahead Energy and Operating Reserve Market revenues earned based upon the Day-Ahead Schedule for Energy. Further detailed Settlement information can be found in the BPM for *Market Settlements*.

The availability of Generation Resources, DRRs-Type I, DRRs-Type II and Stored Energy Resources is also determined in the Day-Ahead Energy and Operating Reserve Market clearing by incorporating the status of the Resource in Outage Scheduler. Under normal operating conditions, if a Generation Resource, DRR-Type I or DRR-Type II is listed in Outage Scheduler

with an outage type of "Maintenance", "Construction", "Urgent", "Emergency", or "Forced", the Resource will be considered unavailable in the Day-Ahead Energy and Operating Reserve Market Clearing. Generation Resources listed in Outage Scheduler with an outage type of "Economy" or "Deration" will be considered available. Further detailed Outage Scheduler information can be found in the BPM for *Outage Operations.*

7.1.2 Submitting Bids and Virtual Supply Offers

MPs may submit Virtual Supply Offers, Demand Bids and Virtual Demand Bids up to Day-Ahead Energy and Operating Reserve Market close time (1030 EPT) on the day prior to the Operating Day for use in the Day-Ahead Energy and Operating Reserve Market clearing process. As stated in Section 7.1.17.1.1 above, Fixed Demand Bids must be submitted in conjunction with DRR-Type I and DRR-Type II Offers. See Section 4 of this BPM for a description of the valid Offer parameters.

7.1.3 Submitting Interchange Schedules

The following rules apply to submitting Interchange Schedules in the Day-Ahead Energy and Operating Reserve Market. See Section 4 of this BPM for detail relating to the types of Interchange Schedules that may be submitted.

- Interchange Schedules must start on the top, quarter-past, half-past, or quarter till the hour.
- MPs must submit all Interchange Schedules for the Day-Ahead Energy and Operating Reserve Market, via NERC E-Tag, prior to 1030 EPT of the day prior to the Operating Day (OD-1).
- Day Ahead Interchange Schedules must be fully approved and implemented prior to 1030 EPT in order to be considered as a DA Market submission.
- Should a Day Ahead Interchange Schedule be implemented after1030 EPT, the schedule will be rejected from the Day Ahead market, and an adjustment request will be sent to the corresponding E-Tag.
- If that Market Adjustment is denied by an external Balancing Authority or Transmission Provider; the Market Result remains unchanged. Any MWs that flow in Real Time will be settled at the Real-Time Ex Post LMP.
- On multi-day tags the pricing information must be the same.
- If an External Asynchronous Resource ("EAR") Offer is submitted, an associated Fixed Dynamic Interchange Schedule must also be submitted. The estimate of the maximum schedule amount for Imports and/or Exports into MISO should be less than or equal to the EAR's Hourly Emergency Maximum Limit. The estimate of the

maximum schedule amount for Exports out of MISO should be less than or equal to the EAR's Hourly Emergency Minimum Limit.

For further information on Interchange Schedules, please refer to the BPM for *Physical Scheduling (BPM-007).*

7.2 MISO Activities

MISO operates the Day-Ahead Energy and Operating Reserve Market via Security Constrained Unit Commitment ("SCUC"), Security Constrained Economic Dispatch ("SCED") and SCED-Pricing algorithms to develop commitment schedules and Day-Ahead Schedules of operation for each MP. The Day-Ahead Energy and Operating Reserve Market is a forward market in which hourly Ex Ante and Ex Post LMP values and hourly Ex Ante and Ex Post MCP values are calculated on a simultaneously co-optimized basis for each hour of the next Operating Day based on MP Offers and Bids for Energy and Offers for the sale of Operating Reserve. MPs purchase Energy and sell Energy and Operating Reserve in the Day-Ahead Energy and Operating Reserve Market at financially binding Day-Ahead Ex Post LMPs and Day-Ahead Ex Post MCPs.

The Day-Ahead unit commitment utilizes a simultaneously co-optimized Security-Constrained Unit Commitment algorithm ("SCUC") to commit sufficient Resources to meet the Fixed Demand Bids, cleared Price Sensitive Demand Bids, Fixed Interchange Schedule Exports, cleared Dispatchable Interchange Schedule Exports, cleared Virtual Demand Bids, forecasted Zonal and Market-Wide Regulating Reserve Requirements and forecasted Zonal and Market-Wide Contingency Reserve Requirements on an hourly basis. The objective of the SCUC is to minimize total costs over the entire commitment period while simultaneously enforcing physical constraints and reliability requirements.

The day-ahead economic dispatch utilizes a simultaneously co-optimized Security-Constrained Economic Dispatch algorithm ("SCED") and SCED-Pricing algorithm to dispatch Resources to meet the Fixed Demand Bids, cleared Price Sensitive Demand Bids, Fixed Interchange Schedule Exports, cleared Dispatchable Interchange Schedule Exports, cleared Virtual Demand Bids, forecasted Zonal and Market-Wide Regulating Reserve Requirements and forecasted Zonal and Market-Wide Contingency Reserve Requirements on an hourly basis. The objective of the security-constrained economic dispatch is to minimize total hourly costs while simultaneously enforcing physical constraints and reliability requirements. The SCED algorithm

produces DA Ex Ante LMPs and Ex Ante MCPs. The SCED-Pricing algorithm produces DA Ex Post LMPs and Ex Post MCPs.

MISO performs the Day-Ahead Energy and Operating Reserve Market Settlement based on the hourly Day-Ahead Schedules, hourly Day-Ahead Ex Post LMPs and hourly Day-Ahead Ex Post MCPs.

7.2.1 Energy and Operating Reserve Markets Requirements

Prior to the operation of the Energy and Operating Reserve Markets, MISO identifies Reserve Zones, calculates Zonal and Market-Wide Operating Reserve Requirements and develops Demand Curves for Operating Reserve, Regulating and Spinning Reserve, and Regulating Reserve which are required inputs into the Energy and Operating Reserve Markets clearing process. Calculation of Zonal and Market-Wide Operating Reserve Requirements is described under Section 3 of this BPM. Demand Curve development is described under Section 5 of this BPM.

7.2.2 Interchange Schedules

MISO applies the following rules and actions relating to MP-submitted Interchange Schedules for use in the Day-Ahead Energy and Operating Reserve Market. See Section 4 of this BPM for detail relating to the types of Interchange Schedules that may be submitted.

- MISO confirms the validated and compliant Interchange Schedule requests with appropriate neighboring external BAs.
- If the transaction clears the Day-Ahead Energy and Operating Reserve Market, the MP is settled at the Day-Ahead Ex Post LMP for the cleared MW amount.
- If cleared Day-Ahead Interchange Schedules are adjusted after the market clearing but before 20 minutes prior to the Operating Hour, the original schedule will be used in the Day-Ahead Energy and Operating Reserve Market and the adjusted MW schedule will be used in the Real-Time Energy and Operating Reserve Market.
- Partial hour pricing is not permitted.
- Interchange Schedule implementation is subject to ramping availability (see the BPM for *Physical Scheduling, BPM-007*).
- Interchange Schedules not adhering to the webTrans data requirements are denied. The MP is notified of the reason for denial via transaction denial and the MP may then submit another Interchange Schedule via a NERC E-Tag, if there is sufficient time prior to the submission deadlines.

- MISO submits a 'Market Adjust' to the NERC E-Tag when a Day-Ahead Energy and Operating Reserve Market Interchange Schedule is not cleared or is partially cleared. Entities with approval rights, as defined by NERC, must take approval actions.
- If a Market Adjust is denied by a non-MISO entity, the PSE will be responsible to provide the Energy in the Real-Time Energy and Operating Reserve Market or PSE adjusts the schedule to the market adjusted value.
- After the Day-Ahead Energy Market closes and prior to Day-Ahead Energy Market clearing, changes will not be permitted to Day-Ahead Schedules running the next day. MISO will deny such changes. Changes are allowed after Day-Ahead Energy Market clearing.

For further information on Interchange Schedules, please refer to the BPM for *Physical Scheduling (BPM-007)*.

7.2.3 Day-Ahead Energy and Operating Reserve Market Clearing

The Day-Ahead Energy and Operating Reserve Market clears for each hour of the upcoming Operating Day. A simultaneous co-optimization methodology, utilizing the SCUC, SCED and SCED-Pricing algorithms, is employed to simultaneously perform the following tasks:

- Commit offered Resources at least-Offer price using the SCUC algorithm to meet the Energy, Operating Reserve, transmission constraint and Sub-Regional Power Balance Constraint requirements throughout the projected upcoming Operating Day while respecting Resource operating constraints, including minimum run-times and minimum down-times, considering any carryovers from the previous day; and
- Clear Offers and Import Schedules to meet Demand Bids and Operating Reserve requirements for each hour of the upcoming Operating Day using the SCED and SCED-Pricing algorithm to yield Day-Ahead Schedules, Day-Ahead Ex Ante and Ex Post LMPs and Day-Ahead Ex Ante and Ex Post MCPs, respectively.

The objective in clearing the Day-Ahead Energy and Operating Reserve Market is to minimize the costs of Energy and Operating Reserve procurement over the 24-hour dispatch horizon, subject to network constraints and Resource operating constraints. The overall procurement costs include:

- Start-Up Offers and No-Load Offers for Generation Resources and DRRs-Type II committed by SCUC;

- Shut-Down Offers and Hourly Curtailment Offers for DRRs-Type I committed by SCUC;
- Energy Offers, Regulating Reserve Offers, Spinning Reserve Offers and Supplemental Reserve Offers of all Generation Resources, DRRs-Type II and External Asynchronous Resources selected by SCED for Day-Ahead Schedules;
- Regulating Reserve Offers of all Stored Energy Resources selected by SCED for Day-Ahead Schedules;
- Dispatchable Import Daily Offers selected by SCED for Day-Ahead Schedules;
- Spinning Reserve Offers or Supplemental Reserve Offers for DRRs-Type I selected by SCED for Day-Ahead Schedules that were not committed for Energy by SCUC;
- Price adjustments for the cost of committing Fast Start Resources, the Energy cost of Fast Start Resources dispatched at limits, Up Ramp Capability and Down Ramp Capability by SCED-Pricing; and
- Virtual Supply Offers.

The rules applying to the Day-Ahead Energy and Operating Reserve Market clearing of Energy, Regulating Reserve and Contingency Reserve on specific Resources are as follows:

- If a Resource has been scheduled to potentially provide Regulating Reserve, the cleared sum of Energy, Regulating Reserve, Contingency Reserve and Ramp Capability is constrained by the Hourly Regulation Maximum Limit.
- If a Resource has been scheduled to potentially provide Regulating Reserve, cleared Energy less cleared Regulating Reserve less cleared Down Ramp Capability is constrained by the Hourly Regulation Minimum Limit.
- If a Resource has not been scheduled to potentially provide Regulating Reserve, the cleared sum of Energy, Contingency Reserve and Up Ramp Capability is constrained by the Hourly Economic Maximum Limit.
- If a Resource has not been scheduled to potentially provide Regulating Reserve, Energy less cleared Down Ramp Capability is constrained by the Hourly Economic Minimum Limit.
- The cleared Energy is constrained by the applicable ramp rates.
- The cleared Regulating Reserve is constrained by the applicable ramp rates.
- The cleared Contingency Reserve is constrained by the applicable ramp rates.
- The amount of Regulating Reserve that may clear on a Resource is limited to a configurable percentage of the Market-Wide Regulating Reserve Requirement. This limit is required to ensure reliable dispersion of Regulating Reserve and may be modified by MISO based upon observed historical Regulating Reserve dispersion.

To the extent that this limit causes Regulating Reserve or Operating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.

- The amount of Contingency Reserve that may clear on a Resource is limited to a configurable percentage of the Market-Wide Contingency Reserve Requirement. This limit is required to ensure reliable dispersion of Contingency Reserve and may be modified by MISO based upon observed historical Contingency Reserve dispersion. To the extent that this limit causes Operating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.
- The amount of Ramp Capability that may clear on a Resource is limited to a configurable percentage of the Market-Wide Ramp Capability Requirement. This limit is required to ensure reliable dispersion of Contingency Reserve and may be modified by MISO based upon observed historical Contingency Reserve dispersion. To the extent that this limit causes Operating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.

MISO clears the Day-Ahead Energy and Operating Reserve Market, calculates the Day-Ahead Ex-Ante LMPs and MCPs and posts the results on MISO's Market Portal at 1330 EPT. MISO also calculates Ex-Post LMPs and MCPs and posts the results on MISO's Market Portal between 1330 and 1630 EPT. Posting of results may be delayed due to unanticipated events. The following Day-Ahead Energy and Operating Reserve Market results are posted:

- The 24 hourly injections for each Resource of each MP whose Offers are accepted in the Day-Ahead Energy and Operating Reserve Market, including all Self-Scheduled Resources, all cleared Resource Offers, all cleared Virtual Supply Offers, and all cleared Import Schedules.
- The 24 hourly withdrawals of each MP whose Bids are accepted in the Day-Ahead Energy and Operating Reserve Market, including all Fixed Demand Bids, cleared Price-Sensitive Demand Bids, cleared Virtual Demand Bids, and all cleared Export Schedules.
- The Day-Ahead Ex Ante and Ex Post LMPs and Day-Ahead Ex Ante and Ex Post MCPs are determined as described under Section 5 of this BPM.

7.2.3.1 Clearing Under Shortage Conditions

If, while clearing the Day-Ahead Energy and Operating Reserve Market, the sum of the Day-Ahead Fixed Demand Bids, Fixed Export Schedules and Operating Reserve requirements, either on a system-wide or zonal basis, cannot be satisfied with all available non-Emergency Offers (Generation Offers, DRR-Type I Offers, DRR-Type II Offers, Stored Energy Resource

Offers, External Asynchronous Resource Offers, Import Schedules, and Virtual Supply Offers), shortage conditions occur, MISO will attempt to meet fixed demands by utilizing offered Emergency Resources, and Emergency ranges of available resources. In order to appropriately value the Emergency resources such as and released Emergency range, Proxy Offers will be utilized in the ex post Emergency pricing as the maximum of the Emergency Offer Floor and the resource's offer for the applicable capacity block. The Emergency Offer Floor is calculated as the highest available economic energy offer or dispatchable import transaction existing prior to the release of the Emergency Resources and Emergency ranges.

MISO will implement the following steps to clear the Day-Ahead Energy and Operating Reserve Market:

- ***Step One*** – Market Participant Offers submitted for each Resource up to the Hourly Emergency Maximum Limit and Generation Resources, DRRs-Type I and DRRs-Type II that are designated as available only for use in Emergency conditions are made available to the SCUC algorithms.
    - Ex Ante. If use of this Emergency Capacity is sufficient to relieve an anticipated Operating Reserve shortage condition in a capacity Emergency, the Day-Ahead Energy and Operating Reserve Market will clear by incorporating the Emergency Resource, and Resource Emergency limit Offers as part of the co-optimized Day-Ahead Energy and Operating Reserve Market clearing results and the Ex Ante LMPs and Ex Ante MCPs produced by the SCED algorithm will not reflect any Scarcity Prices but will reflect the Emergency Offers associated with the Emergency ranges of those Resources.
    - Ex Post. Similarly if use of this Emergency Capacity is sufficient to relieve an anticipated Operating Reserve shortage condition in a capacity Emergency, the Day-Ahead Energy and Operating Reserve Market will clear by incorporating the Emergency Resource, and Resource Emergency limit Proxy Offers as part of the co-optimized Day-Ahead Energy and Operating Reserve Market clearing results. The Ex Post LMPs and Ex Post MCPs produced by the SCED-Pricing algorithm will not reflect any Scarcity Prices but will reflect the emergency pricing Proxy Offer for all Emergency Resources, external resources qualified as Planning Resources and Emergency range deployment.
    - If inclusion of the Emergency Capacity is sufficient to meet bid-in demand requirements but is not sufficient to relieve an anticipated Operating Reserve shortage in a capacity Emergency, the Day-Ahead Ex Ante and Ex Post MCPs

for Operating Reserve will reflect Scarcity Prices set by the Demand Curves based upon the level of the shortage.

- ***Step Two*** –If inclusion of this Emergency Capacity is not sufficient to meet bid-in demand requirements, the bid-in demand requirements, including fixed Export Schedules, are reduced pro-rata to match the available Capacity and all Day-Ahead Ex Ante and Ex Post LMPs and Ex Ante and Ex Post MCPs are set at the VOLL and Day-Ahead Schedules for demand are based upon the reduced pro-rata amount.

7.2.3.2 Clearing Under Surplus Conditions

If, while clearing the Day-Ahead Energy and Operating Reserve Market, either on a market-wide or zonal basis, the sum of: (1) Self-Scheduled Generation levels; (2) Self-Scheduled DRR-Type I Targeted Demand Reduction levels; (3) Self-Scheduled DRR-Type II levels; (4) Hourly Economic Minimum Limits (or Hourly Regulation Minimum Limits if cleared for Regulating Reserves) for Must Run Generation Resources; (5) Hourly Regulation Minimum Limits for any other Resources committed to provide Regulating Reserve; (6) Fixed Import Schedules; and (7) the applicable Regulating Reserve Requirement (either market-wide or zonal) exceeds the sum of: (1) Fixed Demand Bids; (2) cleared Price Sensitive Demand Bids; (3) cleared Export Schedules and (4) cleared Virtual Demand Bids, MISO will perform the following steps to clear the Day-Ahead Energy and Operating Reserve Market:

- ***Step One*** – For each Resource that is not providing Regulating Reserve, MP Offers submitted down to the Hourly Emergency Minimum Limit are made available to the SCUC algorithm. If use of this Emergency Capacity is sufficient to relieve the anticipated supply surplus condition, the Day-Ahead Energy and Operating Reserve Market will clear by incorporating the Resource Hourly Emergency Minimum Limit Offers as part of the co-optimized Day-Ahead Energy and Operating Reserve Market clearing results and the Ex Ante and Ex Post LMPs and Ex Ante and Ex Post MCPs will not reflect any Scarcity Prices but will reflect the Emergency Offers associated with the Hourly Emergency Minimum Limits of those Resources.
- ***Step Two*** – If inclusion of the Hourly Emergency Minimum Limits in Step One is not sufficient to relieve the supply surplus condition, MP Offers submitted down to the Hourly Emergency Minimum Limit are made available to the SCUC,SCED and SCED-Pricing algorithms for each Resource that had been providing Regulating Reserve. Use of these Hourly Emergency Minimum Limits will create a Regulating Reserve shortage and Ex Ante and Ex Post LMPs will contain negative Regulating Reserve Scarcity Prices and Regulating Reserve Ex Ante and Ex Post MCPs will

include positive Regulating Reserve Scarcity Prices based upon the applicable (market-wide or zonal) Regulating Reserve Demand Curves.

- ***Step Three*** – If the Energy balance is not achieved after Step Two, MISO reduces supply proportionately until Energy balance is achieved and the Day-Ahead Energy and Operating Reserve Market is cleared. Ex Ante and Ex Post LMPs and Regulating Reserve Ex Ante and Ex Post MCPs will continue to be set based upon the Regulating Reserve Demand Curves.

Note: Fast Start Resources shall not be partially committed in SCED-Pricing in Steps one, two or three

7.3 Monitoring and Mitigating Day-Ahead Energy and Operating Reserve Market

Any Offer, or change in availability submitted to MISO by MPs is subject to market monitoring and mitigation measures. The complete process is described in the BPM for *Market Monitoring and Mitigation*.

8. Real-Time Energy and Operating Reserve Market Activities

MPs that participate in the Real-Time Energy and Operating Reserve Market must submit new or revised Offers and/or new or revised Interchange Schedules for the purchase and sale of Energy and new or revised Offers for the sale of Operating Reserve no later than 30 minutes prior to the Operating Hour (OH-30) for use in clearing the Real-Time Energy and Operating Reserve Market. Exhibit 8-1Exhibit 8-1: shows the timeline for the principal activities associated with the Real-Time Energy and Operating Reserve Market.

Exhibit 8-1: Real-Time Energy and Operating Reserve Market Activities Timeline

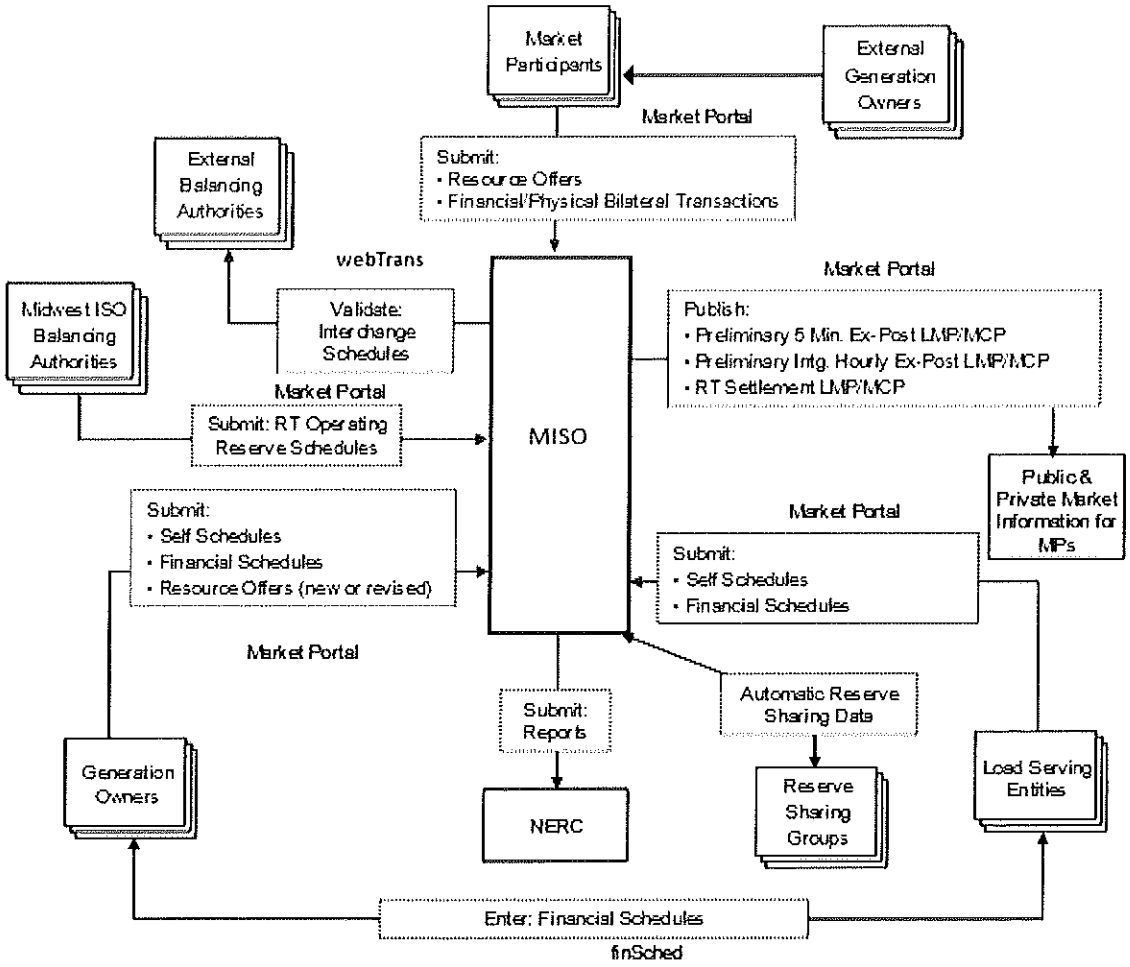
Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Data Required for Real-Time Energy and Operating Reserve Market		
OD-7 @ 0000	OD @ OH-30	Fixed Interchange Schedules into the Real-Time Energy and Operating Reserve Market
OD-7 @ 0000	OD @ OH-30	Dynamic Interchange Schedules (dispatchable and import only) into the Real-Time Energy and Operating Reserve Market
OD-7 @ 0000	OD+6 @ 1200	Financial Schedules for the Real-Time Energy and Operating Reserve Markets
OD-7 @ 0000	OD @ OH-30	Generation Resource Offers into the Real-Time Energy and Operating Reserve Market
OD-7 @ 0000	OD @ OH-30	DRR-Type I, DRR-Type II, Stored Energy Resource and External Asynchronous Resource Offers into the Real-Time Energy and Operating Reserve Market
OD @ OH-60	OD@RT	DIR Forecast Maximum Limit submitted into the Real-Time Energy and Operating Reserve Market via MUI
Ongoing	OD @ RT-10 min.	Constraint limits applied and removed based on MISO's power system security analyses
	OD @ RT-10 min.	Contingency Reserve deployment
Real-Time Energy and Operating Reserve Market Activities		
OD-1 @ 1800 EPT	OD-1 @ 2300	Review Load Forecasts and Reports
	OD @ 0000	Open/Close Operator's Log
	OD @ OH-30	Close the Real-Time Energy and Operating Reserve Market 30 minutes prior to the top of each Operating Hour
OD @ RT-10 Starts every 5 minutes	OD @ RT-5 Ends within 5 min. of start	Execute UDS
	OD @ RT-5	Send Resource Dispatch Targets to Resource operators

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
OD Continuous	OD Continuous	Send Setpoint Instructions to Resource operators on a 4 second periodicity that consists of Dispatch Target for Energy adjusted for Regulating Reserve deployment and Contingency Reserve deployment

OD = Operating Day
OH = Operating Hour (00 to 23)
RT = Real-Time (target time for UDS base points)
UDS = Unit Dispatch System Note: All times are in EST unless indicated otherwise

The interactions and data flows between the entities that participate in the Real-Time Energy and Operating Reserve Market are shown in Exhibit 8-1, excluding RAC.

Exhibit 8-1: Data Flow for Real-Time Energy and Operating Reserve Market (Excluding RAC)



8.1 Market Participant Activities

MPs submit Offers and Interchange Schedules for use in the Real-Time Energy and Operating Reserve Market clearing process as follows.

8.1.1 Notification Deadline

The Notification Deadline is the cut-off time, four hours prior to the beginning of each operating hour, by which schedule changes must be reported to the Transmission Provider to enable it to reflect such changes in the RAC process. For certain assets, schedule changes are automatically gathered from existing offers at the Notification Deadline; for others, specific Notification Deadline offer submittals are required. The following list describes the process that MISO uses to gather Notification Deadline information for each impacted schedule, asset, etc.:

- For Load Zones, a Real-Time Load Zone Demand Forecast may be submitted prior to the Notification Deadline, via the "Real-Time Demand Forecast submittal in the MUI. For Load Zones, positive values represent load. If a value is not submitted prior to the Notification Deadline, it will be deemed to be equal to the Day-Ahead Schedule.
- For Interchange Transactions, the MW quantity of each scheduled transaction that has an "Implemented" status in webTrans is automatically gathered.
- For Financial Schedules, the MW quantity of each Fin Sched that is an RSG Deviations Contract is automatically gathered.
- For Generation Resources (including DIRs and Intermittent Resources), and DRRs Type - II, the as-offered Economic Minimum Limit is automatically gathered.
- For Generation Resources (other than DIRs and Intermittent Resources), and DRRs Type - II, the as-offered Economic Maximum Limit is automatically gathered.
- For DIRs and Intermittent Resources, a Notification Deadline DIR Forecast may be submitted prior to the Notification Deadline, via the "Real-Time Demand Forecast" submittal in the MUI. For a DIR or Intermittent Resource, positive values represent generation. If a value is not submitted prior to the Notification Deadline, it will be deemed to be equal to the Day-Ahead Schedule. The as-offered Economic Minimum Limit for DIRs is automatically gathered.
- For Stored Energy Resources, the as-offered Regulation Minimum Limit and Regulation Maximum Limit are automatically gathered.
- For External Asynchronous Resources, the as-offered Economic Maximum Limit for imports into MISO and as-offered Economic Minimum Limit for exports out of MISO is automatically gathered.

For more information regarding the implications of Notification Deadline information, please see the BPM for *Market Settlements*.

8.1.2 Submitting Real-Time Resource Offers

In the Real-Time Energy and Operating Reserve Market, Resource Offers can be submitted that differ from the Day-Ahead Resource Offers. An MP with Resources that are scheduled in the Day-Ahead Energy and Operating Reserve Market or committed in the RAC process must promptly notify MISO's Real-Time Operators of any changes to the availability or operating plan of its Resource(s) for the Operating Day but no later than 30 minutes after the changes have occurred. MPs with Generation Resources can modify Energy Offers for the capacity that has not yet been dispatched, but is available during the Operating Day.

Resources within the Market Footprint can participate in the Real-Time Energy and Operating Reserve Market by submitting Resource Offers provided they can respond to 5-minute Dispatch Setpoint Instructions. These Resources are termed "dispatchable". A Resource that is considered dispatchable but does not consistently follow Setpoint Instructions may be reclassified as non-dispatchable. Such considerations are made on a case-by-case basis considering severity, number of occurrences, and reasons for deviations from Setpoint Instructions.

All other Resources (not able to respond to a 5-minute dispatch signal) except DRRs-Type I must Self-Schedule their Resource output.

8.1.2.1 Real-Time Resource Offer Rules

Resource Offers may be submitted in the Real-Time Energy and Operating Reserve Markets only at the registered location of that Resource. These Offers must be submitted at least 30 minutes prior to the Operating Hour[48].

- For Generation Resources and DRRs-Type II, the non-price related Offer parameters must reflect the actual known physical capabilities and characteristics of the Resource except that the Hourly Emergency Maximum Limit, Hourly Economic Maximum Limit, or Forecast Maximum Limit may, at the discretion of the MP, be reduced by an amount equal to any Capacity associated with the Resource that is i) not designated as a Capacity Resource, ii) not being used to provide Energy and/or Operating Reserve to the Day-Ahead Energy and Operating Reserve Market, iii) not being used to provide Capacity in any RAC process, iv) not being used to provide Energy and/or Operating Reserve to the Real-Time Energy and Operating Reserve Market and v) not being used to provide Energy and/or Operating Reserve to any other party or entity.
- An MP whose Resources are scheduled in the Day-Ahead Energy and Operating Reserve Market, committed in the RAC process, and/or have offered into the Real-Time Energy and Operating Reserve Market must promptly notify MISO's Real-Time Operators of any changes to the availability of its Resource(s) as soon as possible, but no later than 30 minutes after the changes have occurred.

[48] The DIR Forecast Maximum Limit is not subject to this requirement

- If a change has occurred that affects the Resource later in the day (e.g., loss of a coal mill that results in a derating from the Hourly Economic Maximum Limit of the unit) but that does not immediately affect the unit, the MP must update their Real-Time Schedule Offer to reflect the change in unit conditions. These changes can be submitted up to 30 minutes prior to the hour for a new or existing Real-Time Schedule Offer or 30 minutes prior to the hour for an existing Real-Time Schedule Offer.
- If the change in conditions affects Resource operations within the next 30 minutes, the MP must notify MISO's Real-Time Operators of the change by voice communications or by submitting a Real-Time Offer Override request via the Market Portal. MPs are urged to use Portal submitted override requests rather than voice requests. Override requests submitted via the portal are subject to same rules as real time offers (e.g., Emergency Max > Economic Max > Regulation Max etc.). Override requests must be submitted in complete sets and should be accompanied by a valid reason. Override requests can be accompanied with a reason "Other" along with a free form text description. Override requests are organized into eight sets as listed in the table below. Real-Time Offer Override requests submitted via the Market Portal are effective for the current hour and expire at the end of the next market hour to allow the Market Participants sufficient time to update their hourly offers. Portal submitted override requests are organized in sets. In general, a complete set must be submitted with an override request for a particular parameter. Sets are listed in Exhibit 8-2below.

Exhibit 8-2: Offer Override Sets

Set	Gen/DRR2/EAR Override Parameters	SER Parameters	DRR1 Parameters
Run Times	Notification Time		Notification Time
Operating Limits	Economic Min, Eco Max, Regulation Min, Reg Max, Emergency Min, Emer Max	Reg Min, Reg Max	Target Demand Reduction MW
Offline Response	OfflineRespMax		
Ramp Rates	RR Up, RR Down, Reg RR (bi-directional)	Ramp Rate Bidirectional	
Self Schedules	SelfMWEnergy, SelfMWSpin, SelfMWOnlineSupp, SelfMWReg, SelfMWOfflineSupp	SelfMWReg	SelfMWSpin, SelfMWOnlineSupp
Dispatch Status	Energy Dispatch Status, Reg Status, Spinning Reserve Status, Online Supp Status, Offline Supp Status, Ramp Capability Status	Reg Status	Online Supp Status, Spin Status
Commit Status	Energy Commit Status	Commit Status	Energy Commit Status
Off Control, EEE Flag	OffControlFlag, EEE Flag	OffControlFlag, EEE Flag	OffControlFlag, EEE Flag

- To commit a Generation Resource or DRR-Type II in the Real-Time Energy and Operating Reserve Market that does not have a current commitment or is outside of its Day-Ahead Energy and Operating Reserve Market schedule, the MP must submit

the status of "Must-Run" for the desired run period. Any Resource that operates without a commitment from the Day-Ahead or Real-Time Energy and Operating Reserve Markets will be considered to be "Must-Run" during the period of time for which no commitment is present.

- To decommit a Generation Resource or DRR-Type II in the Real-Time Energy and Operating Reserve Market that is not scheduled in the Day-Ahead Energy and Operating Reserve Market or the RAC, the MP must submit a status update of "Unavailable" or notify MISO's Real-Time Operators if the Real-Time Energy and Operating Reserve Market is closed for that hour or submit the override request for the commit status via Market Portal if the Real-Time Energy and Operating Reserve Market is closed for that hour.

If a Resource is scheduled in the Day-Ahead Energy and Operating Reserve Market or the RAC and wishes to deviate from that schedule (i.e., not run or run at a reduced output level) for economic reasons, the MP must contact MISO's Real-Time Operators to determine if this course of action is acceptable. MISO will determine one of the following:

- That the Resource is not needed for reliability purposes for the Operating Day; if so, then the Market Participant can decide not to run the Resource on an economic basis. The MP is still responsible for Settlement of the deviation between its Day-Ahead Schedule and Real-Time output.
- That the Resource is needed for reliability purposes and informs the MP that the Resource must remain committed to its schedule.

The guideline for notifying MISO of deviations for Generation Resources or DRRs-Type II is the sum of the unit's notification time plus the time to start. The minimum notification time is 90 minutes prior to the start time required for the operation of the Resource. This allows adequate time for determining if the unit is needed for reliability.

8.1.3 Submitting Real-Time Interchange Schedules

The following general rules apply to submitting any Interchange Schedules in the Real-Time Energy and Operating Reserve Market:

- All Interchange Schedules must begin on the top, quarter past, half, or quarter till the hour.
- MPs must submit all Interchange Schedules for the Real-Time Energy and Operating Reserve Market, via NERC E-Tag, at least 20 minutes prior to the start of the Interchange Schedule; however, Interchange Schedules may not be submitted

during the operating hour except for reliability purposes as determined by MISO. MISO confirms the validated and compliant Interchange Schedule requests with appropriate external BAs.

- Real-time PSE adjustments to Interchange Schedules must also be submitted no later than 20 minutes before the start of the schedule change or the start of the operating hour. Adjustments due to Transmission Loading Relief Procedures ("TLRs") or loss of generation will be permitted after this timeframe as specified by MISO.

8.2 MISO Activities

The Real-Time Energy and Operating Reserve Market provides a continuous process for least cost balancing of supply and demand while recognizing current operating conditions. MISO uses a Network Model to accurately dispatch Resources to match the short-term demand forecast and Operating Reserve requirements and manage congestion in Real-Time.

The Real-Time Energy and Operating Reserve Market clearing produces Resource Dispatch Targets for Energy, Regulating Reserve, Spinning Reserve and Supplemental Reserve and provides Ex Ante Real-Time LMPs for injections and withdrawals within MISO's Market Footprint and Ex Ante Real-Time MCPs for cleared Operating Reserve. MISO uses a Real-Time Security-Constrained Economic Dispatch ("SCED") algorithm to balance injections and withdrawals, meet Operating Reserve requirements, manage congestion, and produce LMPs and MCPs on a simultaneously co-optimized basis. The Real-Time Energy and Operating Reserve Market clearing operates continuously on a five-minute basis. The SCED runs every five minutes to develop Resource Dispatch Targets for the end of the next dispatch interval.

The objective of the security-constrained economic dispatch will be to minimize total costs for the dispatch interval while simultaneously enforcing physical constraints and reliability requirements. Total costs to be minimized include energy costs, reserve availability costs and reserve scarcity costs.

8.2.1 Checkout of Interchange Schedules

All MISO-adjacent external Balancing Authorities that are parties to Interchange Schedules with MISO are contacted and NSI is confirmed. Individual Interchange Schedules are not verified unless necessary to resolve any discrepancy.

Verification starts prior to the Operating Hour and is only performed if the NSI has not already been verified at a previous time.

See the BPM for *Physical Scheduling* for a detailed description of Checkouts (BPM-007).

8.2.2 Operating Reserve Requirements

The Market-wide and Zonal Regulating Reserve and Contingency Reserve Requirements for the Real-Time Energy and Operating Reserve Market will generally be the same as those requirements developed for use in the Day-Ahead Energy and Operating Reserve Market. MISO may increase these requirements if necessary to address system condition changes following the clearing of the Day-Ahead Energy and Operating Reserve Market and/or Emergency conditions in Real-Time.

8.2.3 Real-Time Energy and Operating Reserve Market Clearing

MISO clears the Real-Time Energy and Operating Reserve Market by determining the security-constrained dispatch that is the least costly means of balancing generation and Load (supply/demand) while meeting Operating Reserve requirements within the Market Footprint based on actual conditions, forecasted conditions, and on submitted Offers. The inputs to the SCED are identified and described below:

- ***Load Forecast*** – MISO forecasts Real-Time demand for use in the Real-Time Energy and Operating Reserve Market. The forecast is distributed to individual Load Buses using the most recent State Estimator results.
- ***Network Model*** – The Real-Time Energy and Operating Reserve Markets Network Model is populated with the most recent State Estimator results before starting the Real-Time Energy and Operating Reserve Market clearing process. This includes the current on-line status and output of Generation Resources, DRRs-Type II, Stored Energy Resources and External Asynchronous Resources. In addition, the current set of active constraints is obtained from the Constraint Logger (CLOGGER).
- ***Interchange Schedules*** – The expected values of Interchange Schedules for the following five-minute period, including any Transmission Loading Relief ("TLR"), are obtained from the webTrans.

- ***Resource Status*** – The Resource Status consists of a Regulation Flag and an Off-Control Flag. If the Off-Control Flag is set, the Resource is treated as having a fixed dispatch equal to the output from the most recent State Estimator result (or with fixed dispatch at zero output, if a SER). If the Off-Control Flag is not set and the Regulation Flag is set, the Resource is considered to be scheduled to potentially provide Regulating Reserve. Otherwise, the Resource will be considered to be a "Load Following" Resource. The ICCP-telemetered Resource Control-Mode is not an input to the SCED algorithm.
- ***Resource Information*** – The Real-Time Energy and Operating Reserve Market clears based upon the Generation Resource, DRR-Type-I, DRR-Type-II, Stored Energy Resource and External Asynchronous Resource Offers received 30 minutes prior to the operating hour for the next five-minute period. For Regulating Reserve, only Offers associated with Resources that have been scheduled to potentially provide Regulating Reserve are considered.
- ***SER - Specific Information*** – The ICCP-telemetered Energy Storage Level for each Stored Energy Resource is used, along with Stored Energy Resource Offers, to pre-determine the Energy Dispatch Target for the Stored Energy Resource in such a way as to maximize the Regulating Reserve capability available to the SCED co-optimization. For more information on the methodology for determining the Energy Dispatch Target pre-processing for Stored Energy Resources, see Attachment D of this BPM.

MISO economically dispatches, subject to ramp rate and other Resource constraints, Generation Resources, DRRs -Type II, Stored Energy Resources and External Asynchronous Resources that effectively meet forecast Load, Operating Reserve requirements and Interchange Schedules, subject to activated network constraints. The objective of the SCED algorithm is to minimize the as-offered Energy and Operating Reserve prices of Real-Time Energy and Operating Reserve procurement over the next dispatch interval, on a simultaneously co-optimized basis, subject to network constraints and Resource operating constraints, with the exception that Stored Energy Resource energy dispatch is not a component of this objective. Dispatch Target information is communicated directly to Generation Resources, Stored Energy Resources, External Asynchronous Resources, and DRRs Type-II via Setpoint Instructions.

The rules applying to the Real-Time Energy and Operating Reserve Market clearing of Energy, Regulating Reserve and Contingency Reserve on specific Resources are as follows:

- If a Resource has been scheduled to potentially provide Regulating Reserve the cleared sum of Energy, Regulating Reserve, Contingency Reserve, and Ramp Capability is constrained by the Hourly Regulation Maximum Limit.
- If a Resource has been scheduled to potentially provide Regulating Reserve, the cleared quantity of Energy less Regulating Reserve less Down Ramp Capability is constrained by the Hourly Regulation Minimum Limit.
- If a Resource has not been scheduled to potentially provide Regulating Reserve, the cleared sum of Energy, Contingency Reserve, and Up Ramp Capability is constrained by the Hourly Economic Maximum Limit.
- If a Resource has not been scheduled to potentially provide Regulating Reserve, Energy less Down Ramp Capability is constrained by the Hourly Economic Minimum Limit.
- The cleared Energy is constrained by the applicable ramp rates.
- The cleared Regulating Reserve is constrained by the applicable ramp rates.
- The cleared Contingency Reserve is constrained by the applicable ramp rates.
- The amount of Regulating Reserve that may clear on a Resource is limited to a configurable percentage of the Market-Wide Regulating Reserve Requirement. This limit is required to ensure reliable dispersion of Regulating Reserve and may be modified by MISO based upon observed historical Regulating Reserve dispersion. To the extent that this limit causes Regulating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.
- The amount of Contingency Reserve that may clear on a Resource is limited to a configurable percentage of the Market-Wide Contingency Reserve Requirement. This limit is required to ensure reliable dispersion of Contingency Reserve and may be modified by MISO based upon observed historical Contingency Reserve dispersion. To the extent that this limit causes Operating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.
- The amount of Ramp Capability that may clear on a Resource is limited to a configurable percentage of the Market-Wide Ramp Capability Requirement. This limit is required to ensure reliable dispersion of Contingency Reserve and may be modified by MISO based upon observed historical Contingency Reserve dispersion. To the extent that this limit causes Operating Reserve Scarcity, clearing above this amount on a single Resource will be allowed.

The SCED program produces the following outputs:

- ***Dispatch Targets*** – The Real-Time Energy and Operating Reserve Market clearing process develops the Dispatch Targets for Energy, Regulating Reserve, Spinning Reserve and On-Line Supplemental Reserve (if applicable) for each offered Generation Resource, DRR-Type II and External Asynchronous Resource, Dispatch Targets for Spinning Reserve or Supplemental Reserve for each offered DRR-Type I, and Dispatch Targets for Energy and Regulating Reserve (if applicable) for each offered Stored Energy Resource for the five-minute period. MISO communicates the desired Energy, Regulating Reserve, Spinning Reserve and/or On-Line Supplemental Reserve deployment to each Resource selected via Setpoint Instructions approximately every four seconds and communicates the Dispatch Targets for Energy, Regulating Reserve, Spinning Reserve, On-Line Supplemental Reserve (if applicable) and Supplemental Reserve (DRR-Type I) to each applicable Resource on a five-minute basis. Deviation from Setpoint Instructions may result in Excessive/Deficient Energy Deployment Charges, Contingency Reserve Deployment Failure Charges and/or Real-Time RSG Charges. MISO communicates Dispatch Targets (via XML notification and ICCP) and Setpoint Instructions (via ICCP) to the MP responsible for scheduling and dispatching the Resource. All MPs responsible for responding to Setpoint Instructions must have the ability to receive electronic Dispatch Targets and Setpoint Instructions from MISO. MISO also sends Dispatch Target Notifications and Start/Stop Notifications, via XML, to the Local Balancing Authority of each Resource. The Dispatch Targets for Energy are for the end of the five-minute period. All Generation Resources and DRRs-Type II that are on-line and External Asynchronous Resources and Stored Energy Resources that are available receive a Setpoint Instruction, regardless of whether they have submitted Self-Schedules and/or Offers.
- ***Ex-Ante LMPs*** – The Real-Time Energy and Operating Reserve Market clearing process also develops ex-ante LMPs for the five-minute period. These values are posted and are developed for informational purposes only.
- ***Ex-Ante MCPs*** – The Real-Time Energy and Operating Reserve Market clearing process also develops ex-ante MCPs for SER-based and generation based Regulating Reserve, demand-based and generation-based Spinning Reserve and demand-based and generation-based Supplemental Reserve on a Reserve Zone and Market-Wide basis for the five-minute period. These values are posted and are developed for informational purposes only.

The SCED-Pricing program produces the following outputs:

- ***Real-Time Ex Post LMPs*** – The Real-Time Energy and Operating Reserve Market clearing process also develops Real-Time Ex-Post LMPs for the five-minute period. These values are posted and developed utilizing the SCED-Pricing algorithm which includes the Extended LMP formation. The Real-Time Ex-Post formulation allows Fast Start Resources, Emergency Demand Response, Load Modifying Resources, Emergency Energy purchases as well as Emergency Resources and Emergency ranges to set prices. The Real-Time Ex-Post LMPs are used by MISO to settle the Real Time Energy and Operating Reserve Market.
- ***Real-Time Ex Post MCPs*** – The Real-Time Energy and Operating Reserve Market clearing process also develops Real-Time Ex-Post MCPs for SER-based and generation based Regulating Reserve, demand-based and generation-based Spinning Reserve and demand-based and generation-based Supplemental Reserve on a Reserve Zone and Market-Wide basis for the five-minute period. The Real-Time Ex-Post MCPs are used by MISO to settle the Real Time energy and Operating Market.

Real-time ex post and ex ante prices are expected to be identical majority of the time but could differ. There are specific circumstances that could result in Real-time ex ante and ex post price differences. Typically Real-Time Ex Post LMPs will be higher than Real-Time Ex Ante LMPs when online Fast Start Resources are available to set real-time ex post prices. Because the online Fast Start Resource's no load and start up portion of the Offer is included in the price setting, the Real-Time Ex-Post LMPs could be higher compared to the Real-Time Ex Ante LMPs. On the other hand, Real-Time Ex Post LMPs can be lower when there is transmission scarcity or Operating Reserve scarcity in the ex ante phase. In the latter case, Real-Time Ex Post LMPs can be lower due to the availability of Offline Fast Start Resources that are eligible to participate in price setting in Real-Time Ex Post LMP calculation and could result in the alleviation of the scarcity conditions,

The Real-Time Energy and Operating Reserve Market utilizes the same Network Model that is used in the Day-Ahead Energy and Operating Reserve Market, with all real-time network configurations and constraints as determined from the most recent State Estimator results.

8.2.3.1 Clearing Under Shortage Conditions

8.2.3.1.1 Real-Time Ex Ante

The Ex Ante SCED algorithm will utilize MP Offers for all Resource Capacity used in the RAC process immediately preceding the real-time operating Hour, including selected Hourly Emergency Maximum Limit segments, Emergency-only Resources and Emergency Energy purchases, in clearing the Real-Time Energy and Operating Reserve Market for each Dispatch Interval. If there is an actual Operating Reserve shortage during any Dispatch Interval, the Ex Ante MCPs for Operating Reserve will reflect Scarcity Prices set by the Demand Curves based upon the level of the shortage. As a last resort, if there is a shortage of available Capacity to meet demand requirements within the Operating Hour, MISO will issue an EEA Level 3 and begin Load Shedding procedures as described in the Tariff, and all Real-Time Ex Ante LMPs and Ex Ante MCPs will be set at the VOLL.

8.2.3.1.2 Real-Time Ex Post

The Ex-Post SCED-Pricing Algorithm will additionally utilize a Proxy Offer for all Emergency-Only Resources, External Resources qualified as Planning Resources, Emergency range of available on-line Resources, Emergency Energy Purchases, Load Modifying Resources, and Emergency Demand Response resources dispatched in the Real-Time Market. The Proxy Offer is described in section 5.2.3 (Market Clearing under Emergency Shortage Conditions) of this BPM.

8.2.3.2 Clearing Under Surplus Conditions

Within the real-time operating Hour, the SCED algorithm will utilize MP Offers for all Resource Capacity used in the RAC process immediately preceding the real-time operating Hour, including selected Hourly Emergency Minimum Limit segments, in clearing the Real-Time Energy and Operating Reserve Market for each Dispatch Interval. If use of Hourly Emergency Minimum Limits creates a Regulating Reserve shortage during any Dispatch Interval, the Ex Ante MCPs for Regulating Reserve will reflect Scarcity Prices and Ex Ante LMPs will reflect negative Scarcity Prices as set by the Regulating Reserve Demand Curve.

8.2.4 Regulating Reserve Deployment

Regulating Reserve Deployment in the up or down direction is limited to Resources that have cleared Regulating Reserve. The set of Resources available to regulate during a Dispatch Interval is limited to the set of Resources that cleared Regulating Reserve during the Dispatch Interval and that submit an ICCP-telemetered Control Mode equal to 2, and the amount of Regulating Reserve that can be deployed on these Resources during the Dispatch Interval is

limited to the amount of Regulating Reserve that cleared on these Resources during the Dispatch Interval. Regulating Reserve is deployed on specific Resources via Setpoint Instructions via the AGC system on a graduated pro-rata basis, based on the ramp available to each Resource providing Regulating Reserve; that is, the ramp rate of each Resource over five minutes less the change in Dispatch Target for that Resource during the Dispatch Interval. Resources are allocated into five groups, with Group 1 containing the Resources with the greatest ramp available and Group 5 containing the set of Resources with the least Ramp Available. Resources in Group 1 will be deployed on a pro-rata basis first, and Resources in Group 5 will be deployed on a pro-rata basis last. Resource undeployments occur in reverse order.

A Resource that has Control Mode equal to 1 or 2 but does not consistently follow Setpoint Instructions may be reclassified as Control Mode equal to 3, Off Control, per Section 3.13 of RTO-OP-010-r20 Generator Operator Communication with MISO including EEE Procedure. Such considerations are made, including input from the Market Participant, on a case-by-case basis considering severity, number of occurrences, and reasons for deviations from Setpoint Instructions.

Exhibit 8-3 shows the various ICCP-telemetered Resource Control Modes that may be selected by Market Participants and the corresponding AGC system treatment.

Exhibit 8-3: AGC System Resource Control Modes

Resource Control Mode	MISO AGC System Treatment
0	Offline (indicates Resource is NOT available to the market)
1	Online, NOT capable of Regulating (indicates Resource is available for Dispatch Target for Energy and/or Contingency Reserve deployment)
2	Online, capable of Regulating (indicates Resource is available for Regulating Reserve Deployment, Dispatch Target for Energy, and/or Contingency Reserve deployment)
3	Off Control (indicates Resource is online but off control) – Setpoint Instruction is an echo of the current MW reading)

For example, assume 20 Resources each cleared 30 MW of Regulating Reserve. Assume the change in the Energy Dispatch Target for 3 Resources is 0 MW, for 5 Resources is + 10 MW, and for the remaining 12 Resources is +15 MW. There will be five groups, each containing four Resources: Group 1 will contain the three Resources with a change in Energy Dispatch Target of 0 MW and one Resource with a change in Energy Dispatch Target of 10 MW; Group 2 will contain the remaining four Resources with a change in Energy Dispatch Target of 10 MW; and Groups 3, 4 and 5 will each contain four Resources with a change in Energy Dispatch Target of 15 MW. Assume the AGC system requires a system-wide regulation deployment of 120 MW in the upward direction. The AGC system would deploy + 30 MW on each of the four Resources in Group 1. No Regulating Reserve would be deployed from the remaining Groups, but should the system-wide regulation deployment signal increase, Regulating Reserve could be deployed on the other Resources within the remaining Groups as well.

8.2.5 Ensuring Bulk Electric System Reliability

The MISO Reliability Coordinator has ultimate responsibility for the reliability of MISO's Reliability Coordination footprint. As such, the RC must have the authority to take the actions deemed necessary to ensure a reliable system. MISO develops congestion management procedures in conjunction with its stakeholder groups that give the Reliability Coordinator guidance on appropriate mitigation strategies and actions available. These procedures may indicate a preferred order of mitigating actions while recognizing the Reliability Coordinator has the authority to take the actions in the order deemed necessary to protect the Bulk Electric System. The available mitigation options may include, but are not limited to:

- Implementation of Operating Guides
- System Reconfiguration
- Security Constrained Economic Dispatch
- Use of TLR
- Curtailment of Intermittent Resources
- Commitment/Decommitment of Resources
- Manual Dispatch of Resources
- Declaration of System or Local Emergencies and implementation of Emergency Procedures

8.2.6 Congestion Management and Transmission Constraint Demand Curves

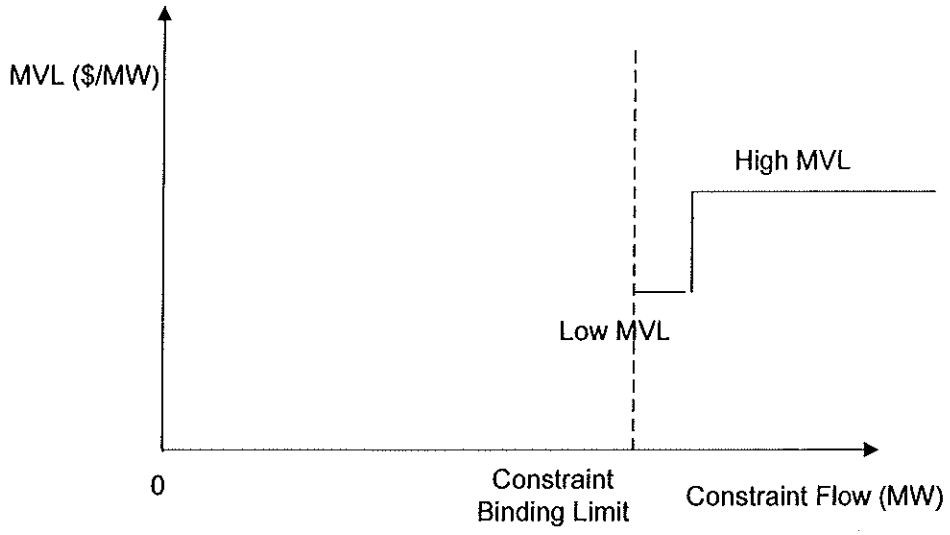
In order to solve the Security Constrained Economic Dispatch, each Transmission Constraint must have a marginal value limit (or MVL, also known as shadow price limit), expressed in $/MW, assigned to it. The MVL is the maximum marginal benefit that the SCED will consider when evaluating resource dispatches to meet the constraint. During any Dispatch Interval in which a transmission constraint cannot be managed within its limit, the marginal value (also known as the shadow price) of the constraint will be set to the MVL for the constraint. The following procedure is used to determine MVLs. For a more in-depth understanding of how MVLsare used in the co-optimization, please see Attachment A to this BPM, which provides an overview on optimization problems and constraint formulation.

MISO utilizes Transmission Constraint Demand Curves ("TCDC") in both the Day-Ahead and Real-Time Energy and Operating Reserve Markets to determine the MVL of each transmission constraint. The TCDC assigns a $/MW MVL according to the quantity flow across the constraint. The TCDC in use for each binding constraint will be published for each Dispatch Interval in Real-Time, regardless of what type of TCDC is used for that constraint.

8.2.6.1 TCDC Development

In the MISO Real-Time and Day-Ahead market, each MISO transmission constraint is assigned a TCDC which includes two pairs of Marginal Value Limits (in $/MW) and constraint flow (in MW or percentage of binding limit). The two block MVLs may be equal as in the case of IROLs. The TCDC is utilized to determine the MVL(s) that is used for commitment and dispatch of Resources.

Exhibit 8-4: Example of Transmission Constraint Demand Curve



There are three methods that MISO utilizes to assign a transmission constraint to a TCDC and determine the associated MVL.

- Group 1
- Group 2
- Temporary Override

Detailed TCDCs for Group 1 and 2 are available in Tariff Schedule 28A.

8.2.6.2 Assign Transmission Constraints with Group 1 TCDCs

MISO assigns a TCDC to each transmission Constraint based on its voltage level or impact (e.g., IROL). Most constraints will be assigned to default TCDC based on voltage level, TLR or IROL status. For simplicity, a two-step TCDC is currently used. The lower portion of the TCDC is used for flows just at or exceeding limits up to the higher block breakpoint. The higher TCDC will be used for larger exceedances of the transmission constraint limit.

8.2.6.3 Assign Transmission constraints with Group 2 TCDCs

There are a small number of constraints that do not respond well to Group 1 TCDCs. These constraints may be impacted by broad regional flows or may need different MVLs to achieve control. An example of this type of exception is a transmission constraint that is highly impacted by wind generation such that increasing wind output adversely impacts the constraint. Assuming

a very low production cost, a very low LMP is necessary to provide incentive for downward dispatch to the wind Resource(s).

When an exception is identified that is not managed well to the Group 1 TCDCs, MISO will add this constraint to Group 2.

Updates to the contents of Group 2 will be posted within two business days after a transmission constraint has been assigned to or removed from Group 2. This posting will identify the monitored element and the assigned TCDC for each constraint in Group 2.

8.2.6.4 Assign Transmission constraints with TCDC Temporary Overrides

To maintain reliable operation, MISO operators can temporarily override the MVL associated with Group 1 or 2 TCDC based on operating conditions for particular constraints in both the Day-Ahead and Real-Time markets. The MVL is returned to the Group 1 or 2 TCDC value as soon as system conditions and congestion management no longer require an overridden MVL. There are various circumstances that require the MISO operator to temporarily override the default TCDC. Any Operator Overrides to a Group 1 or Group 2 TCDC will be posted within two business days.

If MISO identifies that a TCDC does not allow for reliable constraint management, MISO Real-Time Operations personnel will assess the current costs and capabilities (shift factors) of available resources that impact the transmission constraint, and identify appropriate modifications to the TCDC to capture the benefits of further economic re-dispatch, in order to maintain both the reliability of constrained transmission elements and the economic efficiency of the market. This assessment will determine the shape and magnitudes of an override TCDC that allows MISO to achieve the required relief for the transmission constraint. The magnitude of the required TCDC change can be impacted by, but is not limited to impact by, the following:

- Economic and Physical characteristics of resources that impact the constraint.
- Local and system-wide product pricing.
- Changing system conditions (current and projected flows across the constrained element as well as nearby transmission element).

The following examples demonstrate the situations that operators need to temporarily override TCDC for particular constraints.

8.2.6.4.1 Temporary Overrides-Increasing the MVL

If a system operating limit (SOL) condition is expected to persist and the condition raises reliability concerns, the MVL values of the TCDC may be raised to reflect the heightened reliability concerns and mitigate the condition. Conditions that may lead to MVL increases include, but are not limited to: conflicting constraints, and high system-wide LMPs. Conflicting constraints refers to system conditions where congestion management of one transmission constraint adversely impacts the reliable management of one or more other transmission constraints. High system-wide marginal energy costs may require an increase to the MVLs because resources with negative impacts on a constraint tend to be dispatched upward during periods in which the MEC is high. The adjustment in the TCDC for a particular constraint required for congestion management is dependent on a number of factors, including the relief required, the ramp rates and limits of impacting resources, associated sensitivities of resources, and the MEC.

8.2.6.4.2 Temporary Overrides-Lowering the MVL

It may also be necessary to lower the MVL values of a TCDC for a particular constraint from the default values. The most common reason for doing so is to avoid conflicting constraints. In other situations, temporary operating guides or other action plans, which rely on post-contingency action to avoid SOL events, may provide the basis for lowering the MVLs of a transmission constraint.

8.2.7 Sub-Regional Power Balance Constraint Curves

In order to manage dispatched intra-regional flows, all constraints relating to applicable seams agreements, coordination agreements or operating procedures (Sub-Regional Power Balance Constraints) have a Marginal Value Limit (or MVL, also known as shadow price limit) assigned to them. The MVL is the maximum marginal benefit that the SCED will consider when evaluating resource dispatches to meet the Sub-Regional Power Balance Constraint. For any Dispatch Interval where a Sub-Regional Power Balance Constraint cannot be managed within its limit, the Marginal Value (also known as shadow price) will be set to the Marginal Value Limit.

8.2.7.1 Sub-Regional Power Balance Constraint Curve Development

In both the MISO Real-Time and Day-Ahead markets, each Sub-Regional Power Balance Constraint is assigned a curve that includes predefined levels of exceedance percentages and their corresponding prices. The curve is utilized to determine the MVL(s) used for commitment and dispatch of Resources. The curve can be found in Schedule 28B of the Tariff.

8.2.7.2 Assign Sub-Regional Power Balance Constraints with Appropriate Sub-Regional Power Balance Constraint Curve

MISO uses a tiered system to control Sub-Regional Power Balance Constraints. When the dispatch flow rises over the predefined percentage of exceedance, the price rises proportionally to allow the SCED to exert additional control.

8.2.7.3 Temporary Overrides of Sub-Regional Power Balance Constraint Curve

When the dispatch flow is expected to be greater than the limit for two or more consecutive Dispatch Intervals, MISO may temporarily override the Sub-Regional Power Balance Constraint Curve to more effectively manage flows. Constraint exceedance will be returned to the limit as soon as MISO determines system conditions and/or reliability no longer need the override. For any period where MISO overrides a limit, MISO will make a public posting on its website with:

1) The circumstances in which the temporary override was executed,
2) The Dispatch Intervals the temporary overrides were in place,
3) The values applied during the temporary override, and

8.2.8 Excessive/Deficient Energy Deployment Charges

The Excessive/Deficient Energy Deployment Charge is an hourly charge that is applied to any Resource that has Excessive Energy and/or Deficient Energy in four or more consecutive Dispatch Intervals in the same clock hour. The Excessive/Deficient Energy Deployment Charge consists of two components: (1) the Excessive/Deficient Charge Rate multiplied by the Resource's Actual Energy Injection; and (2) a recapture of net Regulating Reserve credits paid to the Resource. The first portion of the charge applies equally to all applicable Resources for causing an increased Regulating Reserve burden. The second portion of the charge applies only to Resources with Dispatch Targets for Regulating Reserve and is equivalent to non-payment of any net credits for cleared Regulating Reserve for failure to provide the Regulation Service. If a MP has elected to use the Common Bus option, the output of Resources identified at the Common Bus location will be considered in aggregate for the purposes of determining whether or not an Excessive/Deficient Energy Deployment Charge will apply, as described below. See the BPM for *Market Settlements* for additional details.

8.2.8.1 Excessive/Deficient Energy Deployment Charge Waiver

A MP is exempted from the Excessive/Deficient Energy Deployment Charge under certain conditions where the MP would otherwise be subject to the charge due to events beyond its control and without the fault or negligence of the MP. Such conditions include but are not limited to:

- Emergencies;
- A Resource in test mode;
- A Resource in start-up or shut-down mode;
- The Hour in which a Resource trips and goes offline;
- During a Contingency Reserve Deployment event, if the Resource has cleared Contingency Reserves; and/or
- Extremely high wind or other weather-related conditions materially impacting a Dispatchable Intermittent Resource's ability to provide Energy and resulting in a substantial reduction or cessation of wind generation activities.

A MP may request the Generation Balancing Authority Operator to waive the Excessive/Deficient Energy Deployment Charge for conditions other than those listed above, and the Generation Balancing Authority Operator shall grant such request subject to the Regional Generation Dispatcher's determination that the reason for the request is due to events beyond the MPs control that were not caused by the fault or negligence of the MP. A MP can also request to waive the Excessive/Deficient Energy Deployment Charge by submitting a real time override request via the Market Portal, stating valid reasons. Please see section 8.1.2 for details.

8.2.9 Contingency Reserve Deployment

Contingency Reserve procured in Real-Time will be deployed through a Contingency Reserve Deployment Instruction, via both ICCP and XML instruction, following a system event, normally following the sudden loss of a supply Resource. The amount of Contingency Reserve deployed will depend upon the MW size of the Resource loss or other extreme condition, and the anticipated response capability of the MISO Contingency Reserve Resources. Contingency Reserves will be deployed only on Resources with cleared Contingency Reserve. On-line Contingency Reserve (i.e., Spinning Reserve and Supplemental Reserve cleared on on-line Generation Resources, on-line DRRs – Type II, DRRs – Type I with Contingency Reserve Status set to "online", and/or on-line External Asynchronous Resources) will be prioritized ahead of off-line Contingency Reserve (i.e., Supplemental Reserve cleared on off-line Quick-Start Resources and DRRs - Type I with Contingency Reserve Status set to "offline"). If the amount of

undeployed Contingency Reserve carried on on-line Resources is greater than or equal to the Contingency Reserve Deployment Instruction, no off-line Contingency Reserve will be deployed. Contingency Reserve will be deployed on on-line Resources in proportion to the amount of Contingency Reserve cleared on each Resource. Should it be necessary to deploy Contingency Reserve on off-line Resources as well, off-line Quick-Start Resources and DRRs – Type I with Contingency Reserve Status set to "offline" will be deployed in merit order, subject to Reserve Zone import limits, based on economics. Offline merit order prices will be calculated as follows:

For an off-line Quick-Start Resource:

$$CRD\_CallonCost =$$

$$SU_i + \sum_{i=start\_hour}^{End\_hour} [(NL_i + \int_0^{Off-Line\_Deployed\_MW} IncEnergy_i) * Minutes\_run_i / 60]$$

$$MeritOrder = CRD\_CallonCost / (eventduration * Off-Line\_Deployed\_MW)$$

For a DRR Type-1:

$$CRD\_CallonCost = Shut\_Down\_Offer + \sum_{i=start\_hour}^{Endhour} HourlyCurtailmentOffer_i * Minutes\_run_i / 60$$

$$MeritOrder = CRD\_CallonCost / (eventduration * FixedReductionMW)$$

Where

- *CRD_CallonCost* is the Total Production cost for the Resource commitment for the commitment period
- SU_i is the Resource's Start-Up Offer. This Offer is a function of the unit condition, 'Hot', 'Intermediate', or 'Cold'
- NL_i is the Resource's No-Load Offer in hour i
- $IncEnergy_i$ is the Resource's Incremental Energy Offer in hour i
- *Shut_Down_Offer* is the DRR Type 1's Shut-Down Offer
- $HourlyCurtailmentOffer_i$ is the DRR Type 1's Hourly Curtailment Offer in hour i
- $Minutes\_run_i$ is the number of minutes of the commitment period in hour i
- *Off-Line_Deployed_MW*= Max (EconomicMin, Dispatched Supplemental)
- *Dispatched Supplemental* is MW of the Cleared Supplemental for the UDS interval on the off-line Resource
- *Start_hour* is Mkthour for current time

- *End_hour* is
  - Mkthour for current time + Max(min_run_time, event_duration) for Quick-Start Resources and
  - Mkthour for current time + Max(Minimum Interruption Time, event_duration) for DRRs - Type I
- *Fixed Reduction MW* – is the offered Targeted Demand Reduction Level of the DRR Type – I.

In order to provide maximum continuity in Setpoint Instructions during the loss recovery period, MISO may switch early to and send Setpoint Instructions based on the next Dispatch Interval, if available. Contingency Reserve deployment will be based on the Contingency Reserve cleared in the next Dispatch Interval, and setpoints will be adjusted to reflect the Contingency Reserve deployment, Regulating Reserve cleared and Energy cleared for the next Dispatch Interval. When a Contingency Reserve deployment is required early in a Dispatch Interval, MISO will re-execute the Real-Time Energy and Operating Reserve Market SCED algorithm for the next Dispatch Interval. The re-executed SCED algorithm will recognize the lost resource and the Contingency Reserve deployment.

When Contingency Reserve is deployed on Resources by the AGC system, that deployment is held for a period of 15 minutes.

8.2.10 Contingency Reserve Deployment Failure and Consequence

Compliance monitoring methods to ensure that Resources follow their Contingency Reserve Deployment Instructions are described in the following two sections. For Resources registered at a Common Bus, the sum of the output of all on-line Resources at the Common Bus plus the output of all Common Bus-registered Resources that were off-line prior to the Contingency Reserve Deployment Instruction will be added together to determine the actual output of the Resource or Resources deployed for Contingency Reserve at the Common Bus for the purposes of the four tests described under Section 8.2.10.1. However, if any of the Resources registered at the Common Bus have their Control Mode set equal to 3 at any time during the Contingency Reserve deployment event, those Resources may be excluded from the total Resource output calculation. Additionally, for a single Resource that is not associated with a Common Bus that is deployed for Contingency Reserve, if the Resource Control Mode is changed to 3 following receipt of the Contingency Reserve Deployment Instruction, the Resource will continue to receive a Setpoint Instruction that includes the full amount of

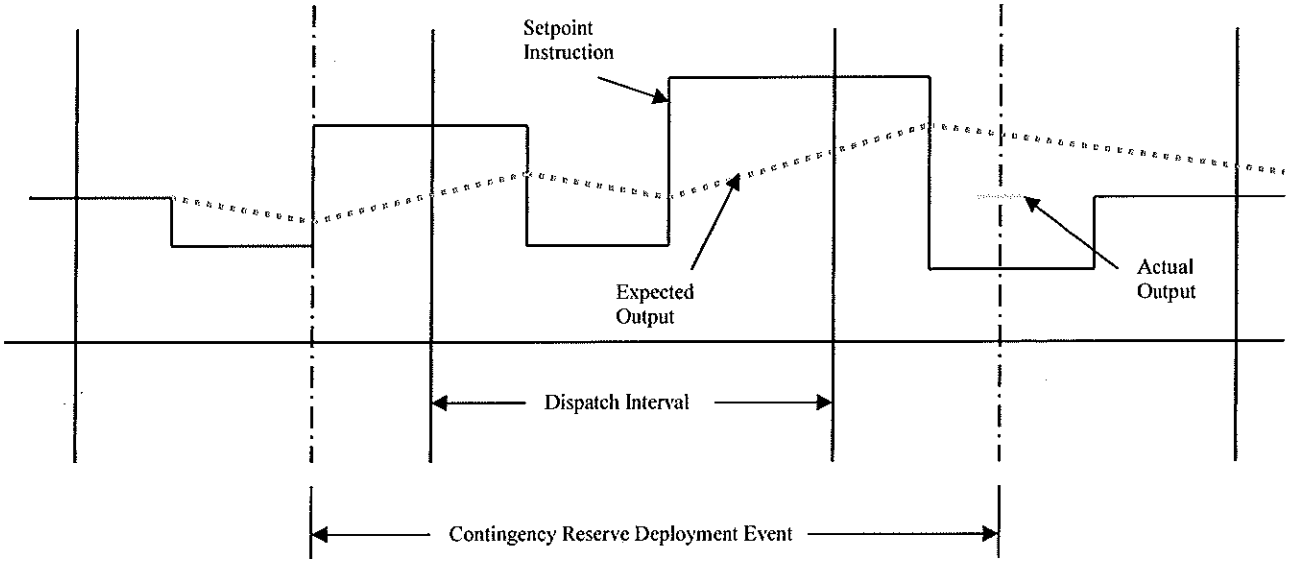
Contingency Reserve deployment as opposed to an echo of the current MW reading. See Section 8.2.4 for a description of Control Modes.

8.2.10.1 Generation Resources, EARs and DRRs-Type II

If a Generation Resource, an EAR or a DRR-Type II passes one or more of the following four tests, then that Resource has deployed Contingency Reserve in an amount greater than or equal to the amount specified in the Contingency Reserve Deployment Instruction within the Contingency Reserve Deployment Period and no Contingency Reserve Deployment Failure Charges will be assessed. For the purposes of this testing, the Setpoint Instruction for a Resource deploying Offline Supplemental Reserves is the lesser of the Cleared Offline Supplemental MW and the Maximum Off-Line Response Limit offer parameter.

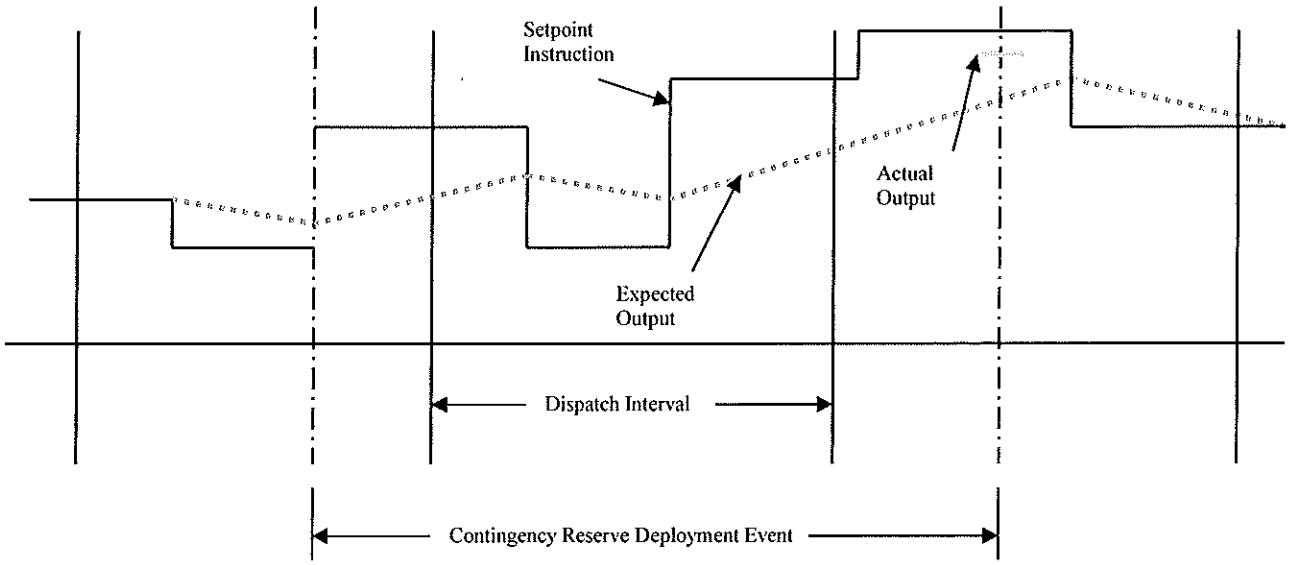
- Test 1: At the end of the Contingency Reserve Deployment Period, if the Resource output is greater than or equal to the Resource Setpoint Instruction, the Resource has passed Test 1. Exhibit 8-5 shows an illustration of how a Resource would pass Test 1.

Exhibit 8-5: CR Deployment Test 1 Illustration



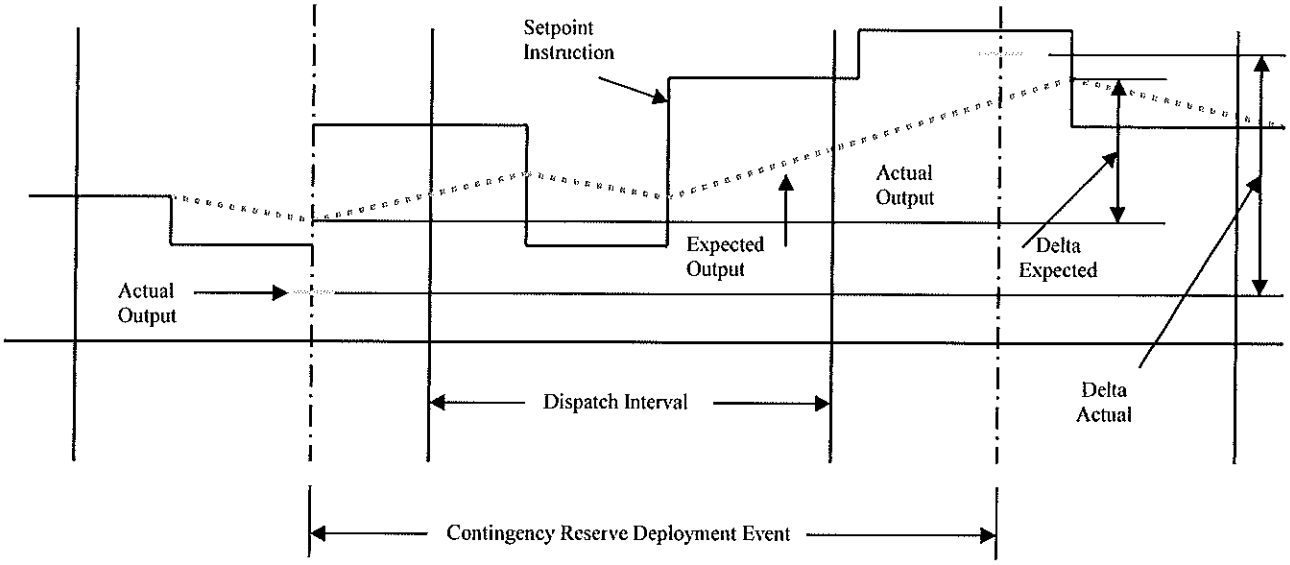
- Test 2: At the end of the Contingency Reserve Deployment Period, if the Resource output is greater than or equal to the expected Resource output, the Resource has passed Test 2. The expected Resource output is calculated assuming the Resource follows its Setpoint Instructions via a linear ramp based on the applicable ramp rate. Exhibit 8-6shows an illustration of how a Resource would pass Test 2.

Exhibit 8-6: CR Deployment Test 2 Illustration



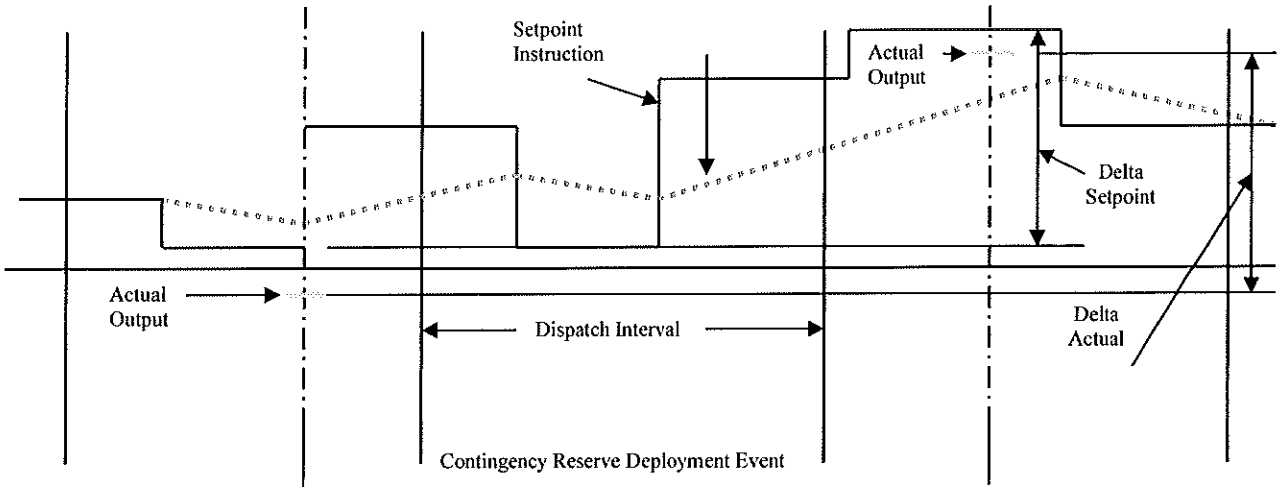
- Test 3: If the change in Resource output is greater than the change in expected Resource output across the Contingency Reserve Deployment Period, the Resource has passed Test 3. The expected Resource output is the Resource output assuming the Resource follows the Setpoint Instructions via a linear ramp based on the applicable ramp rates. Exhibit 8-7 shows an illustration of how a Resource would

Exhibit 8-7: CR Deployment Test 3 Illustration



- Test 4: If the change in Resource output is greater than the change in Setpoint Instruction across the Contingency Reserve Deployment Period, the Resource has passed Test 4. Exhibit 8-8 shows an illustration of how a Resource would pass Test 4.

Exhibit 8-8: CR Deployment Test 4 Illustration



If a Resource fails all of these four tests, then the Resource is subject to a Contingency Reserve Deployment Failure Charge for the Shortfall Amount. If the Resource is a Generation Resource, a DRR – Type II or an External Asynchronous Resource, the Shortfall Amount is calculated as the difference between the change in the expected output of the Resource less the change in the actual output of the Resource over the Contingency Reserve Deployment Period. For example, if a Resource fails to successfully deploy Contingency Reserve, the actual Resource output increased by 25 MW and the expected Resource output was expected to increases by 30 MW, then the Shortfall Amount is equal to 5 MW.

MPs with Resources that have failed to deploy the full amount of Contingency Reserve specified in the Contingency Reserve Deployment Instruction are subject to a Contingency Reserve Deployment Failure Charge that is equal to the shortfall amount multiplied by the Resource's Ex Post LMP for each Hour in which a failure occurs.

In addition to the Contingency Reserve Deployment Failure Charge, payment will not be made for any Contingency Reserve cleared but not deployed for the hour and the Dispatch Target for

Contingency Reserve on that Resource will be limited to the actual amount of Contingency Reserve provided for each remaining Hour of the Operating Day. See the BPM for *Market Settlements* for additional details.

For any Offline Supplemental Contingency Reserve Deployment failure, the Asset Owner is required to limit their Maximum Off-Line Response Limit offer parameter in both Day-Ahead and Real-Time Markets to the actual output achieved at the end of the Contingency Reserve Deployment Period until a higher level is achieved in a subsequent deployment or test.

8.2.10.2 Demand Response Resources – Type I

For Contingency Reserve deployment compliance related to a DRR-Type I, the difference between the Calculated DRR-Type I Output at the end of the Contingency Reserve Deployment Period and the Calculated DRR-Type I Output at the beginning of the event must be greater than or equal to the lesser of the DRR-Type I Dispatch Target for Contingency Reserve at the time of the request or the Targeted Demand Reduction Level. To the extent that this condition is not met, the Shortfall Amount is calculated as the difference between: (1) the lesser of the DRR-Type I Dispatch Target for Contingency Reserve at the time of the request or the Targeted Demand Reduction Level; and (2) the change in Calculated DRR-Type I Output over the Contingency Reserve Deployment Period. For example, if a DRR-Type I has cleared 20 MW of Supplemental Reserve and has a Targeted Demand Reduction Level of 30 MW and is deployed, if the Calculated DRR-Type I Output at the end of the Contingency Reserve Deployment Period is 15 MW, the Shortfall Amount would be equal to 5 MW (assuming a Calculated DRR-Type I Output of 0 MW at beginning of deployment period).

MPs with DRRs – Type I that have failed to deploy the lesser of the amount of cleared Contingency Reserve or the full amount of Contingency Reserve specified in the Contingency Reserve Deployment Instruction are subject to a Contingency Reserve Deployment Failure Charge that is equal to the Shortfall Amount multiplied by the Resource's Ex Post LMP for each Hour in which a failure occurs.

In addition to the Contingency Reserve Deployment Failure Charge, payment will not be made for any Contingency Reserve cleared but not deployed for the hour and the Dispatch Target for Contingency Reserve on that Resource will be limited to the actual amount of Contingency Reserve provided for each remaining Hour of the Operating Day. See the BPM for *Market Settlements* for additional details.

For any Offline Supplemental Contingency Reserve Deployment failure, the Market Participant is required to limit their Maximum Off-Line Response Limit offer parameter in both Day-Ahead and Real-Time markets to the actual output achieved at the end of the Contingency Reserve Deployment Period until a higher level is achieved in a subsequent deployment or test.

8.2.10.3 Resource Offline Supplemental Testing

Any Resource that becomes eligible to qualify to provide Offline Supplemental Reserves to the MISO (i.e., new Resources, or Resources that add capabilities to supply Offline Supplemental Reserves) must contact MISO, through their Regional Generation Dispatcher, and request an Offline Supplemental test be performed. These resources shall be paid Ex Post LMP for the MW produced.

Any resource that has failed to provide their offered level of Offline Supplemental Reserves when deployed may request a test of the resource when the issues causing the failure have been identified and corrected. These resources shall be paid Ex Post LMP for the MW produced. If the resource is subsequently committed by MISO for capacity in the Day-Ahead or Real-Time processes, the resource shall be paid under normal market settlement practices for the capacity commitment period.

Upon receipt of the testing request, the MISO will test the resource within the next 5 business days, based on the need to commit resources for capacity needs.

MISO may test resources that are clearing Offline Supplemental Reserves if they have not been deployed or tested within the previous 6 months. These resources shall be paid as though committed by MISO in a RAC process.

The Offline Supplemental test consists of a notification from the MISO Generation Balancing Authority Operator to the Asset Owner that a test of the Resource's Offline Supplemental Reserve is being conducted. The notification will be either through normal Contingency Reserve Deployment electronic notification and verification by phone or by direct notification and verification by phone if necessary. The Resource should respond as though the test is an actual deployment of Supplemental Reserves. The level of output at the end of 10 minutes from time of test notification will be captured by MISO and verified with the Asset Owner at the end of the test. The output level achieved during the test must be used as the highest level for the Resource's Maximum Off-Line Response Limit offer parameter in both Day-Ahead and Real-Time markets.

8.2.11 Inadvertent Interchange

The Inadvertent Interchange Energy is the difference between NSI and Net Actual Interchange ("NAI") for MISO and is calculated separately for On-Peak and Off-Peak hours. Inadvertent Interchange is tracked on a monthly basis.

MISO manages and pays back its net Inadvertent Interchange balance following NERC policy. Inadvertent Interchange payback is performed based on an objective and publicly available process that is triggered on balances exceeding statistical norms (allows normal "breathing" of balances) and is performed during periods and in amounts such that payback does not burden others. MISO does not use financial gain as a factor when determining whether to payback or recover Inadvertent Interchange.

MISO will pay back inadvertent "in-kind" as outlined by applicable Reliability Standards and MISO policies and procedures.

8.2.12 Calculating Ex-Post LMPs and MCPs

MISO calculates initial Real-Time Ex-Post LMPs and MCPs on a simultaneously co-optimized basis using the same input data that is used to clear the Real-Time Energy and Operating Reserve Market in the SCED-Pricing algorithm. Initial Real-Time Ex-Post LMPs and MCPs may be recalculated if input data errors are detected and/or adjustments are needed to comply with the Tariff (i.e., remove the impact of penalty pricing).

See Section 5 and Section 9 of this BPM for further descriptions of the Ex-Post LMP and MCP Calculations.

8.3 Local Balancing Authority Activities

LBAs perform the following activities to support the Real-time Energy and Operating Reserve Market:

- Provide Load Forecast
- Implement MISO Setpoint Instructions, if applicable.

8.3.1 Providing Load Forecast

MISO determines the Load forecast for the Real-Time Energy and Operating Reserve Market. MISO requires each LBA within the Market Footprint to send an hourly, rolling seven-day Load Forecast to MISO. This forecast must be at an hourly granularity and reflects the amount of Load in the LBAA that is served by the generation that is modeled by MISO.

LBAs submit the actual LBAA Load via ICCP and may submit a short-term forecast of non-conforming Load, exclusive of any non-conforming Load associated with DRRs-Type II, via ICCP if desired. If non-conforming Load Forecast data is not submitted, MISO assumes all Load is conforming in its short-term Load Forecast for the Real-Time Energy and Operating Reserve Market.

When it is necessary to indicate the expected performance of a non-conforming Load or to make a correction to MISO's Real-Time Load Forecast, the LBA may indicate a Load Forecast adjustment through the ICCP.

Section 3 of this BPM describes the Load Forecast process in greater detail.

8.3.2 Implementing MISO Setpoint Instructions

Dispatch is the process of signaling controllable Resources to follow their Setpoint Instructions. The LBA (and the selected Resource) receive Dispatch Targets every five minutes via XML and four-second Setpoint Instructions via ICCP from MISO.

Dynamic Interchange Schedules require Real-Time telemetry between MISO and the adjacent external BA. Both apply adjustments to their four-second NSI target received from MISO, which is the Real-Time DS amount from the telemetry observed by the two BAs.

8.4 Monitoring and Mitigating Real-Time Energy and Operating Reserve Market

Any Offers, adjustments, or changes in availability submitted to MISO by MPs to the Real-Time Energy and Operating Reserve Market are subject to Market Monitoring and Mitigation. Market power mitigation measures are described in the BPM for *Market Monitoring and Mitigation*.

9. Energy and Operating Reserve Markets Closure Activities

This section describes the activities that take place during and after the closure of the Real-Time Energy and Operating Reserve Market Operating Day but prior to the "Day 7" settlements. These activities are separated into three parts:

- Real Time Ex-Post LMP and MCP calculations that occur on a five-minute interval basis
- Five-minute interval and Hourly data verification in preparation for settlement and billing
- Post Operations Processor hourly billing determinant calculation for use in settlement and billing.

Exhibit 9-1 presents the sequence of processes following Operating Hour, Operating Day and culminating in Settlement.

Exhibit 9-1: Real-Time Market Closure Activity Timeline.

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Preliminary Hourly Real-Time Ex-Post LMP Calculator – Repeat Following Each OH		
	OD @ OH+1:00	Acquire the interval Ex-Post LMPs and MCPs that were calculated for the OH.
OD @ OH+1:00	OD @ OH+1:mm	Calculate the Preliminary Hourly Ex-Post LMP and Ex-Post MCP.
	OD @ OH+1:mm	Store the Preliminary Hourly Ex-Post LMP and Ex-Post MCP for information only.
Real-Time Ex-Post LMP Verification Window – Repeat Following Each OD		
	OD+1@ 1200	Post the preliminary Hourly Ex-Post LMPs and Hourly MCPs for the OD
OD+1 @ hh:mm	OD+5B @ 1700	Acquire Ex-Post LMP and MCP data for the OD and make any necessary corrections
	OD+5B @ 1700	Posting Deadline for the Final Hourly Ex-Post LMPs and MCPs[49] for the OD
Bilateral Transactions – Repeat for Each OD		
OD-7 @ 0000	OD+6 @ 1200	Financial Schedules can be entered for the Day-Ahead and Real-Time Energy and Operating Reserve Markets
OD+1 @ 0000	OD+1 @ 1200	After-the Fact Checkout of Interchange Schedules for the OD is performed by MISO
OD @ OH+1:00	OD+2B @ 1200	After-the Fact Entry of Reserve Sharing and other Emergency Schedules for the OD is performed by MISO

[49] Note that the time and quantity-weighted hourly MCPs for use in Settlement will not be publicly posted as they are Resource specific. **But MCPs will be *privately* posted for the respective MPs.**

Beginning Day @ Time	Ending Day @ Time	Description of Processes and Events
Energy and Operating Reserve Markets Settlements – Repeat Following Each OD		
	OD+6 @ 1200	Acquire all validated settlement data
OD+6 @ 1200	OD+7@ 07:00	Prepare Energy and Operating Reserve Markets Settlements
	OD+7+1B @ 0800	Publish the Energy and Operating Reserve Markets Settlements (privately to MPs)
OD = Operating Day B = Business Day	OH = Operating Hour (00 to 23)	BA = Balancing Authority

9.1 Real Time Ex-Post LMP/MCP Calculation

MISO calculates the Real-Time Locational Marginal Prices ("LMPs") for Energy at Load Zone, Hub, Interface, and Resource CPNodes and Market Clearing Prices ("MCPs") for Regulating Reserve, Spinning Reserve and Supplemental Reserve at Generating Resources CPNodes, Demand Response Resource CPNodes and External Asynchronous Resource CPNodes. The LMPs include separate components for the marginal costs of energy, congestion, and losses as described under Section 5 of this BPM. Real Time Ex-Post LMPs and MCPs are calculated every five minutes using the SCED-Pricing algorithm. The five-minute Ex-Post LMPs are integrated on a time-weighted basis, and the five-minute Ex-Post MCPs are integrated on a time and quantity-weighted basis to form the hourly Real-Time Energy and Operating Reserve Market LMPs and MCPs used for Settlement. This section describes the process by which these Real-Time Ex-Post LMPs and MCPs are calculated.

9.1.1 Real Time Ex-Post LMP/MCP Calculation Sequence

The calculation of Ex-Post LMPs and MCPs is performed every five minutes, depending on and following UDS case approval. The sequence of operations that is repeated every five minutes is shown in Exhibit 9-2.

Exhibit 9-2: Ex-Post LMP Calculation - Timeline

Beginning Time in minutes	Ending Time in minutes	Description of Processes and Events
UDS – Repeat Every 5 Minutes		
	RT-10	Acquire initial conditions data and RT Load Forecast for RT SCED
RT-10	RT-5	Execute UDS for RT, producing desired Resource Dispatch Targets, Ex-Ante LMPs and Ex-Ante MCPs
	RT-5	Send Dispatch Targets to Resources
Setpoint Instructions – Send and Execute Continuously		
	RT-5	Resources receive Dispatch Targets from MISO
RT-5	RT	Send Setpoint Instructions to Resources, which include Dispatch Target for Energy adjusted to include Regulating Reserve and Contingency Reserve deployment
Ex-Post Calculator		
RT-5 (UDS case approval time)	RT	Calculate interval Ex-Post LMPs and MCPs for RT in RT SCED-Pricing
	RT	Store Ex-Post LMPs and MCPs for hourly calculations
RT = Real-Time (target time for Dispatch Target Instructions) UDS = Unit Dispatch System		

The following sequence of processes produces the Ex-Post LMPs and MCPs:

- ***Real-Time Security Constrained Economic Dispatch ("SCED")*** – Executes during the five-minute period, beginning at (RT-10 minutes), where the time "RT" serves as a reference point for discussion purposes. At time (RT-5 minutes), the results of the RT-SCED for power system conditions projected at (RT minutes) are sent to Resources.
- ***Setpoint Instructions*** – Setpoint Instructions, which reflect the Dispatch Target for Energy adjusted for Regulating Reserve and Contingency Reserve deployment, are sent directly to Resources on a 4 second periodicity for generation adjustment and real-time system control.
- ***Ex-Post Calculator*** **("SCED-Pricing")** – A set of Ex-Post LMPs and MCPs is produced using the same input data as the Real-Time Market in the SCED-Pricing

algorithm. Ex Post LMPs and MCPs may differ from the Ex Ante LMPs and MCPs related to Fast Start Resources as outlined in Section 5 of this BPM.

9.1.2 Real Time Ex-Post LMP/MCP Calculation Process

The Real-Time Ex-Post LMP/MCP calculation algorithm executes automatically upon the approval of each UDS case. The initial five-minute Ex-Post LMPs and MCPs are calculated using the same input data as and utilize the SCED-Pricing algorithm applied by the Real-Time Energy and Operating Reserve Market. The calculated interval Ex-Post LMPs and MCPs are integrated into hourly LMPs and MCPs values and considered preliminary and not used for Settlement purposes until the daily verification of Ex-Post LMPs and MCPs is complete.

9.1.3 Real Time Ex-Post LMP/MCP Verification

The Real-Time Ex-Post LMP/MCP verification process is an off-line analysis that occurs during and after the Operating Day. The purpose of the verification process is to identify and correct any intervals with input data errors, program failures, or any prices that do not comply with the Tariff (i.e., prices that contain penalty pricing components not specified in the Tariff) The verification process ensures the Ex-Post LMPs and Ex-Post MCPs used for the Real-Time Energy and Operating Reserve Market Settlement comply with the tariff and reflect accurate input data. Following the verification process, the Ex-Post LMPs and MCPs are sent to the Settlement system.

9.1.3.1 Verification Process

The verification process is an audit of Ex-Post LMPs and MCPs for the Operating Day. MISO actively monitors both inputs and outputs of the Ex-Post Calculator process. Predetermined limits have been established for these inputs and outputs, and whenever these limits are violated, the specific interval is flagged for an in-depth analysis. In addition, the verification staff may randomly flag Ex-Post intervals for audit to ensure that a sufficient cross-section of cases has been analyzed. For these flagged intervals, the verification staff then performs a detailed review. The inputs/outputs to the Ex-Post Calculator process, operator actions affecting each 5-minute case audited, and all records available describing MISO's system state at the time are reviewed and validated. The verification process is intended to ensure appropriate and accurate inputs were fed into the Ex-Post Calculator process leading to appropriate and accurate Ex-Post LMPs and MCPs, as well as to ensure Ex-Post LMPs and MCPs comply with the Tariff. If the in-depth analysis of flagged cases reveals a data input failure or program failure, MISO corrects the error and recalculates the Ex-Post LMPs and MCPs prior to releasing the calculation as final.

9.1.3.1.1 MISO Verification Actions

MISO staff drives the verification process with the Ex-Post Calculator Market Operator Interface ("MOI"). Five-minute interval inputs and outputs describing CPNodes, Binding Transmission Constraints, the Sub-Regional Power Balance constraint and Market wide/Zonal market clearing prices are available for review. The MOI helps identify and correct intervals and is used to examine the data within those intervals. If a problem is uncovered during the verification process, staff may change specific inputs for the interval from the Ex-Post Calculator MOI. The Ex-Post Calculator MOI allows for the exclusion or re-execution of intervals with questionable data. Intervals may be re-executed due to a data input failure or program failure, when it is determined that more accurate data is available. The same interval may be re-executed multiple times if additional data changes are required.

Results from the re-run are reviewed from the Ex-Post Calculator MOI summary screens with the re-run case replacing the original output data. The process of reviewing results, changing inputs and re-executing is repeated for all impacted intervals from the verification day. Once MISO is satisfied with the Operating Day's five minute results, the impacted hourly LMPs and MCPs are recalculated. Staff verifies that after the recalculation, LMPs and their related components should be available for each CPNode for every hour for the current Network and Commercial Model. In addition, staff verifies that Market Clearing Prices ("MCPs") for every Operating Reserve Zone are available for all valid intervals.. Once approved, the Real-Time Energy and Operating Reserve Market results are used for the settlement of the MISO Real Time Energy and Operating Reserve Market.

9.1.4 Real Time LMP/MCP Replacements

In the event of a data input failure or program failure that makes Ex-Post LMPs and MCPs unavailable or inaccurate without any way to perform a correction, leading to exclusion, 'replacement' values are calculated in the following way:

- Where the stale data or program failure exists for eleven or fewer intervals within the same Hour, the affected intervals are replaced with data from the last successful interval or the next successful interval, as appropriate, as described in Section 9.1.5.1.
- Where the stale data or program failure exists for all intervals within the same Hour, the following occurs:
    1. Where the Hour is unconstrained and Scarcity Prices have not been applied, the Ex-Post LMP is replaced with the Ex-Ante LMP and the Ex-Post MCP is replaced with the Ex-Ante MCP;

2. Where the system is constrained, the Ex-Post LMP values and Ex-Post MCP values are recalculated using data from the best available sources. The Ex-Post LMP and MCP values are recalculated for each five-minute Dispatch Interval and then integrated and weighted in accordance with the calculations under Sections 9.1.5 and 0 of this BPM.

9.1.5 Real Time Hourly Ex-Post LMPs

9.1.5.1 Hourly Bus LMPs

Hourly average LMPs are computed to be the time-weighted average of 5-minute interval Real-Time Ex-Post LMPs. Each interval is assigned a 5-minute weight. For instances where an interval is not available, the weight for the missing interval will be assigned to the last successful interval or the next successful Dispatch interval, as appropriate, within the same Hour. Where multiple intervals within the same hour, but not the entire hour, are missing, the weight for all missing intervals will be assigned to the last successful interval or next successful Dispatch Interval, as appropriate, within the same Hour. For instance, if interval 1225 is missing, intervals 1220 and 1230 will split the weight for the missing interval and each will be assigned 7.5 minutes for the hourly calculation. If intervals 1225 and 1230 are missing, then intervals 1220 and 1235 will be assigned 10 minutes for the hourly calculation. If interval 1205 is missing, interval 1210 will be weighted for ten minutes. If interval 1300 is missing, interval 1255 will be weighted for ten minutes during the hourly time weighted calculation.

Hourly marginal price for Energy at Node ei:

$$\overline{\lambda}_{ei,h} = \frac{\sum_{t \in Hour(h)} \lambda_{ei,t} * AMinutes_t}{\sum_{t \in Hour(h)} AMinutes_t}$$

Where:

- $AMinutes_t$ is the number of minutes that the Ex-Post Calculator case is active. Typically, each interval will be active for five minutes. There will be a total of sixty active minutes for each hour.
- λ_t is the marginal price for Energy at Node ei for interval *t*.

Hourly marginal transmission loss price at Node *ei*:

$$\overline{\gamma}_{ei,h} = \frac{\sum_{t \in Hour(h)} \gamma_{ei,h} * AMinutes_t}{\sum_{t \in Hour(h)} AMinutes_t}$$

Where:

- $AMinutes_t$ is the number of minutes that the Ex-Post Calculator case is active. Typically, each interval will be active for five minutes. There will be a total of sixty active minutes for each hour..
- $\gamma_{ei,t}$ is the Transmission Loss Price at Node *ei* for interval *t*.

Hourly marginal congestion price at Node *ei*:

$$\overline{\rho}_{ei,h} = \frac{\sum_{t \in Hour(h)} \rho_{ei,h} * AMinutes_t}{\sum_{t \in Hour(h)} AMinutes_t}$$

Where:

- $AMinutes_t$ is the number of minutes that the Ex-Post Calculator case is active. Typically, each interval will be active for five minutes. There will be a total of sixty active minutes for each hour.
- $\rho_{ei,t}$ is the Transmission and Sub-Regional Power Balance Congestion Price at Node *ei* for interval *t*.

Composite hourly LMP at Node *ei*:

$$\overline{LMP}_{ei,h} = \overline{\lambda}_{ei.h} + \overline{\gamma}_{ei,h} + \overline{\rho}_{ei,h}$$

9.1.5.2 Hourly Aggregate Node LMPs

The following are hourly average calculations for aggregate Commercial Pricing Nodes. A distinction is made between the calculation for aggregates that represent a combined cycle (and cross compound) and all other aggregate CPNodes (which include Hub and Load Zone aggregates).

Hourly system marginal price for energy at aggregate pnode api:

The hourly Energy prices at aggregate CPNodes are weighted averages of Energy prices at participating electrical Nodes. This is expressed as follows:

$$\overline{\lambda}_{api,h} = \frac{\sum_{ei \in pNod(api)} \overline{w}_{ei,h} * \overline{\lambda}_{ei,h}}{\sum_{ei \in pNod(api)} \overline{w}_{ei,h}}$$

Where:

For combined cycle (and cross compound) aggregates the hourly average weighting factor for electrical Node *ei* participating in aggregate combined cycle (and cross compound) pnode *api* is:

$$\overline{w}_{ei,h} = \frac{\sum_{t \in Hour(h)} P_{ei,t} * AMinutes_t}{\sum_{ei \in pNod(api)} \left(\sum_{t \in Hour(h)} P_{ei,t} * AMinutes_t \right)}$$

Where:

- $AMinutes_t$ is the number of minutes that the Ex-Post Calculator case is active. Typically, each interval will be active for five minutes. There will be a total of sixty active minutes for each hour.
- $P_{ei,t}$ is the Total Real-Time MW injection at Node *ei* and the interval *t*.

For all other aggregates (including Hub and Load Zone aggregates):

- $\overline{w}_{ei,h}$ is the weighting factor from the database for electrical Node ei participating in aggregate pnode *api*.
- For Load Zone Aggregates and ARR Zone-Related Hubs the same weighting factors are used for all 24 hours of the Operating Day, and are based on the average of the 24 hourly State Estimators, seven days prior to the Operating Day.

Hourly marginal transmission loss price at aggregate pnode *api*:
The hourly Marginal Losses prices at aggregate CPNodes are weighted averages of Marginal Losses prices at participating electrical Nodes. This is expressed as follows:

$$\bar{\gamma}_{api,h} = \frac{\sum_{ei \in pNode(api)} \bar{w}_{ei,h} * \bar{\gamma}_{ei,h}}{\sum_{ei \in pNode(api)} \bar{w}_{ei,h}}$$

Where:

- $\bar{\gamma}_{ei,h}$ is the hourly marginal transmission loss price at Node *ei.*
- $\bar{w}_{ei,h}$ is the weighting factor from the database for electrical Node ei participating in aggregate pnode *api.*
- For Load Zone Aggregates and ARR Zone-Related the same weighting factors are used for all 24 hours of the Operating Day and are based on the average of the 24 hourly State Estimators, seven days prior to the Operating Day.

Hourly marginal congestion price at aggregate pnode *api*:
The hourly marginal congestion prices at aggregate CP Nodes are weighted averages of transmission and Sub-Regional Power Balance congestion prices at participating electrical Nodes. This is expressed as follows:

$$\bar{\rho}_{api,h} = \frac{\sum_{ei \in pNode(api)} \bar{w}_{ei,h} * \bar{\rho}_{ei,h}}{\sum_{ei \in pNode(api)} \bar{w}_{ei,h}}$$

Where:

- $\bar{\rho}_{ei,h}$ is the hourly marginal transmission and Sub-Regional Power Balance congestion price at Node *ei.*
- $\bar{w}_{ei,h}$ is the weighting factor from the database for electrical Node ei participating in aggregate pnode *api.*
- For Load Zone Aggregates the same weighting factors are used for all 24 hours of the Operating Day and are based on the average of the 24 hourly State Estimators, seven days prior to the Operating Day.

Composite LMPs at aggregate Node api:

$$\overline{LMP}_{api,h} = \bar{\lambda}_{api,h} + \bar{\gamma}_{api,h} + \bar{\rho}_{api,h}$$

9.1.6 Real Time Hourly Time-Weighted MCPs

Hourly time-weighted MCPs for Regulating Reserve, Spinning Reserve and Supplemental Reserve are calculated and posted for informational purposes only and are not used in Settlement.[50] Hourly time-weighted MCPs are calculated as follows for each Reserve Zone:

$$MCP_{RZ,h} = \left\{ \frac{\sum_{t \in Hour(h)} MCP_t * AMinutes_t}{\sum_{t \in Hour(h)} AMinutes_t} \right.,$$

Where:

- $Aminutes_t$ is the number of minutes that the Ex-Post Calculator case is active. Typically, each interval will be active for five minutes. There will be a total of sixty active minutes for each hour.
- MCP_t is the MCP for Regulating Reserve, Spinning Reserve or Supplemental Reserve, as applicable, for interval *t*.

9.1.7 Real Time LMP/MCP Results Posting

Preliminary Hourly Ex-Post LMPs and their components are normally posted for all CPNodes and Hourly Ex-Post MCPs are normally posted for all Reserve Zones[51] by 1200 EST the day after the Operating Day (OD+1). Final approval of Ex-Post LMPs and MCPs will be done as soon as the verification process is complete, but the OD should be approved by 1700 EST on the fifth Business Day (OD+5) following the Operating Day. Any posting of final Hourly Ex-Post LMPs exceeding five Business Days from the applicable Operating Day requires approval by MISO's Board of Directors.

[50] Hourly Ex-Post MCPs for use in Settlement are computed to be the time and quantity-weighted average of 5-minute Real-Time Ex-post MCPs for each Resource. The quantity-weighted Hourly Ex-Post MCP calculations are described under Section 9.2.

[51] The hourly time-weighted MCPs are for information purposes only and are posted for each Generation Resource and Demand Response Resource in each of the MISO Reserve Zones.

9.2 Hourly Post Operations Processor Calculations

The Post Operations Processor ("POP") performs calculations using validated 5-minute data to create hourly billing determinants for use in Settlements. Please see MS-OP-031 Post Operating Processor Calculation Guide in the Market Settlements BPM for calculation details.

9.3 After-the-Fact Schedules

After-the-fact ("ATF") schedules that had not previously been entered into webTrans because a tag had not been required are added to the list of schedules. These are:

- Reserve Sharing Schedules
- Schedules created as part of an Operating Guide

9.4 After-the Fact Check Out

Beginning at 0000 EST during Daylight Savings Time ("DST") and at 0100 EST when DST ends of the day following the Operating Day, all adjacent external BAs and RTOs that have Interchange Schedules with MISO are contacted by MISO scheduling staff and the ATF checkout process begins. Import Schedule and Export Schedule values are checked for the previous day.

9.4.1 Regional Reporting Procedures

MISO will check out for the previous month with all adjacent external BAs and RTOs by the 15th Business Day of each current month. On the 15th Business Day, MISO will report the on and off-peak totals for each BA and RTO to the necessary regions using the appropriate tools. If re-reporting is needed, MISO will contact the necessary region to re-report.

10. Current Tuning Parameter Settings

This section describes current parameter settings for Day-Ahead Market Engines, Reliability Assessment Commitment Engines, and Real-Time Settings. Appendices B, C and D to this document contain more information on the use of these parameters.

10.1 Day-Ahead Market Tuning Parameter Settings

Following are the current parameter settings for the Day-Ahead Market Engines.

10.1.1 Day-Ahead SCUC Tuning Parameter Settings

Listed below are the current tuning parameter settings for the Day-Ahead SCUC algorithm:

- ContResRampMult = 1.0
- ContResDeployTime = 10 Minutes
- MaxContResFactor = 0.2
- MaxRegResFactor = 0.2
- RegRampMult = 1.0
- RegResponseTime = 5 Minutes

10.1.2 Day-Ahead SCED and SCED-Pricing Tuning Parameter Settings

Listed below are the current tuning parameter settings for the Day-Ahead SCED and SCED-Pricing algorithm:

- ContResRampMult = 1.0
- ContResDeployTime = 10 Minutes
- MaxContResFactor = 0.2
- MaxRegResFactor = 0.2
- RegRampMult = 1.0
- RegResponseTime = 5 Minutes

10.2 Reliability Assessment Commitment Tuning Parameter Settings

Following are the current parameter settings for the RAC engines.

10.2.1 RAC SCUC Tuning Parameter Settings

Listed below are the current tuning parameter settings for the RAC SCUC algorithm:

- ContResRampMult = 1.0
- ContResDeployTime = 10 Minutes
- MaxContResFactor = 0.2
- MaxRegResFactor = 0.2
- RegRampMult = 1.0
- RegResponseTime = 5 Minutes

10.3 Real-Time Market Tuning Parameter Settings

Following are the current parameter settings for the Real-Time Market Engines.

10.3.1 Real-Time SCED and SCED-Pricing Tuning Parameter Settings

Listed below are the current tuning parameter settings for the Real-Time SCED and SCED-Pricing algorithm:

- ContResRampFact = 1.0
- ContResDeployTime = 10 Minutes
- MaxContResFactor = 0.2
- MaxRegResFactor = 0.2
- RegRampFact = 1.0
- RegResponseTime = 5 Minutes

BEFORE THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

In the Matter of the Adjustment of Union Electric Company d/b/a Ameren Missouri's Fuel Adjustment Clause for the 32nd Accumulation Period.	)))	**File No. ER-2020-0143** Tariff No. JE-2020-0088

ORDER DIRECTING NOTICE, SETTING INTERVENTION DEADLINE AND DIRECTING STAFF RECOMMENDATION

Issue Date: November 25, 2019 Effective Date: November 25, 2019

On November 22, 2019, Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri") submitted direct testimony and a tariff designed to implement an adjustment to its Fuel and Purchased Power Adjustment Clause ("FAC"). The submitted tariff bears an effective date of January 27, 2019.

Pursuant to Commission Rule 20 CSR 4240-20.090(4), the Commission's Staff shall submit a recommendation regarding the proposed adjustment no later than 30 days after its filing. No later than 60 days after receiving the proposed adjustment, the Commission must: (1) enter an interim rate adjustment; (2) approve or reject the tariff as submitted; or (3) allow the tariff to go into effect by operation of law. Consequently, the Commission shall issue notice, set an intervention deadline, and direct its Staff to file a recommendation.

Commission Rule 20 CSR 4240-20.090(17)(A) provides that parties to the rate case in which the Commission approved Ameren Missouri's fuel adjustment clause are automatically parties to this tariff case, without the necessity of having to apply for intervention. Therefore, the Commission acknowledges that the parties to File No. ER-

2016-0179 (the file in which Ameren Missouri's FAC was most recently re-approved) are parties to this case, and will direct its Data Center to add those parties to the service list.

THE COMMISSION ORDERS THAT:

1. The Commission's Data Center shall serve a copy of this order upon the parties to File No. ER-2016-0179.

2. The Commission's Data Center shall add all parties to File No. ER-2016-0179 to the service list for this case.

3. Any person or entity wishing to intervene shall file an application to intervene no later than December 5, 2019.

4. The Staff of the Missouri Public Service Commission shall file a recommendation regarding its examination and analysis of Union Electric Company d/b/a Ameren Missouri's application no later than December 20, 2019.

5. The Commission's Data Center shall serve a copy of this order upon the county commission of each county in the service territory of Union Electric Company d/b/a Ameren Missouri.

6. The Commission's Public Policy and Outreach Department shall make notice of this order available to the members of the Missouri General Assembly representing the residents of the service area of Union Electric Company d/b/a Ameren

Missouri and to the news media serving the residents of the service territory of Union Electric Company d/b/a Ameren Missouri.

7. This order shall become effective when issued.

BY THE COMMISSION

Morris L. Woodruff
Secretary

Charles Hatcher, Regulatory Law Judge,
by delegation of authority pursuant to
Section 386.240, RSMo 2016.

Dated at Jefferson City, Missouri,
on this 25th day of November, 2019.