- *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

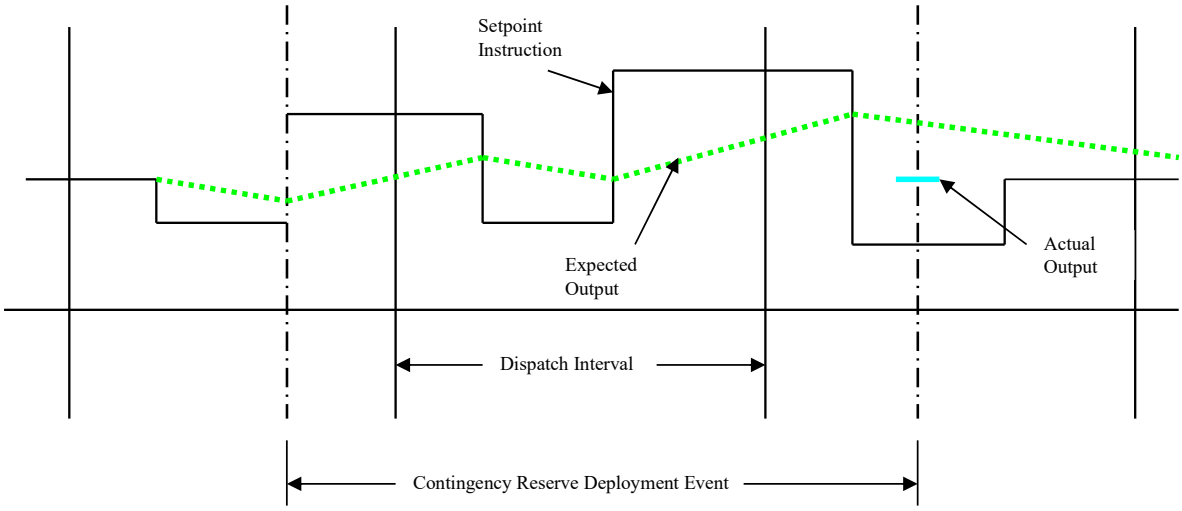
Compliance monitoring methods to ensure that Resources follow their Contingency Reserve Deployment Instructions are described in the following two sections. For Resources registered at a Common Bus, the sum of the output of all on-line Resources at the Common Bus plus the output of all Common Bus-registered 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.

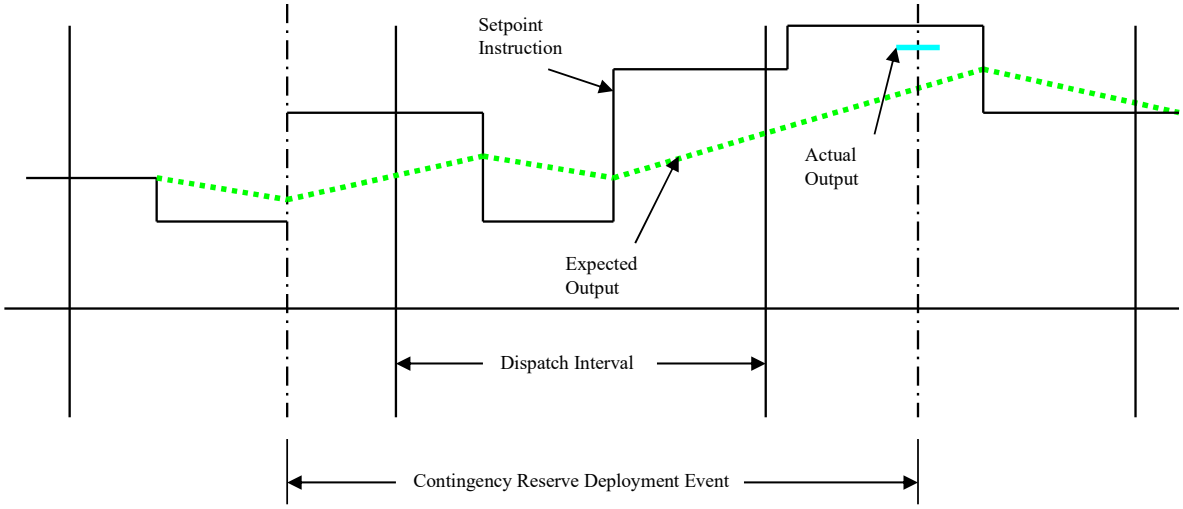
- Test 1: At the end of the Contingency Reserve Deployment Period, if the Resource output is greater than or equal to the Resource Setpoint Instruction, the Resource has passed Test 1. Exhibit 8-6 shows an illustration of how a Resource would pass Test 1.

Exhibit 8-6: CR Deployment Test 1 Illustration


Setpoint
Instruction
Expected
Output
Actual
Output
Dispatch Interval
Contingency Reserve Deployment Event

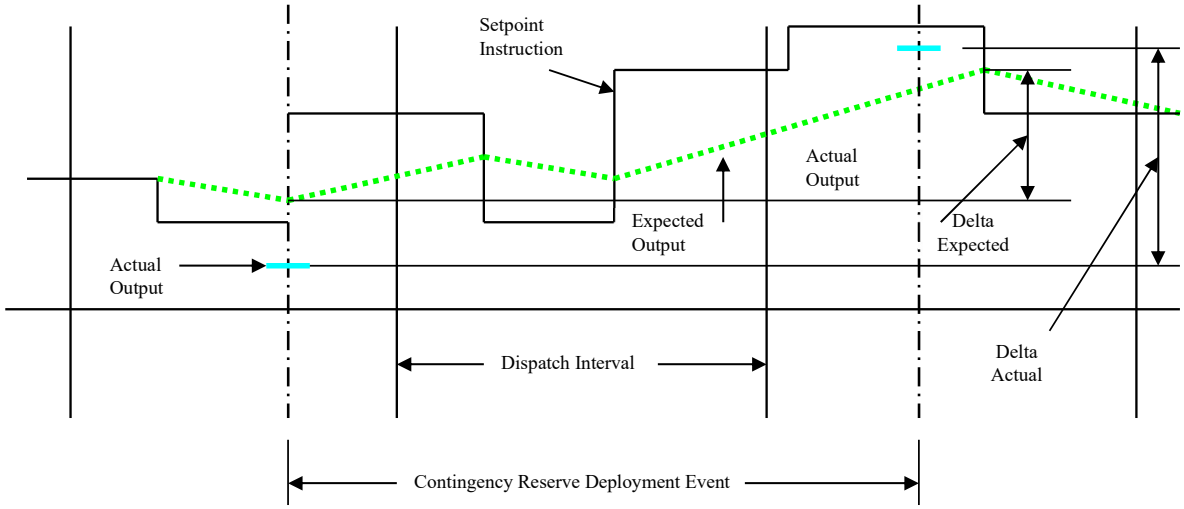
- Test 2: At the end of the Contingency Reserve Deployment Period, if the Resource output is greater than or equal to the expected Resource output, the Resource has passed Test 2. The expected Resource output is calculated assuming the Resource follows its Setpoint Instructions via a linear ramp based on the applicable ramp rate. Exhibit 8-7shows an illustration of how a Resource would pass Test 2.

Exhibit 8-7: CR Deployment Test 2 Illustration



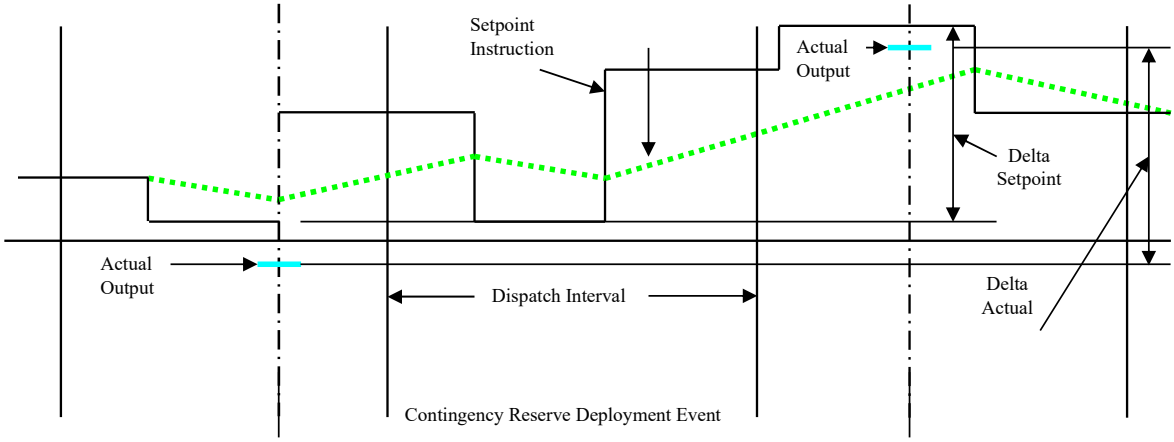
- Test 3: If the change in Resource output is greater than the change in expected Resource output across the Contingency Reserve Deployment Period, the Resource has passed Test 3. The expected Resource output is the Resource output assuming the Resource follows the Setpoint Instructions via a linear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

Exhibit 8-8: 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 8-9 shows an illustration of how a Resource would pass Test 4.

Exhibit 8-9: 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 increase 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.

8.2.13 Online Short-Term Reserve Performance Monitoring

Online Short-Term Reserve response is embedded in a resource's UDS energy instruction and UDS may or may not dispatch resources on which Short-Term Reserve was cleared as system conditions change during the Short-Term Reserve response period. Consequently, there will be

no separate confirmation of online Short-Term Reserve performance. The overall real-time resource performance relative to its dispatch instructions will be measured and subject to the existing uninstructed deviation penalties if the resource does not respond as instructed. Short-Term Reserve clearing will consider resource capabilities in the current interval to ensure that the cleared Short-Term Reserve is consistent with the anticipated resource capabilities.

8.2.14 Offline Short-Term Reserve Performance Monitoring

Offline Short-Term Reserve response for a Short-Term Reserve need will receive commitment instructions. The commitment instruction and UDS treatment during startup will be the same as any other resource beginning to produce energy in response to a commitment instruction. Depending on the start-up and notification time of the resource, it may reach its minimum before the end of the Short-Term Reserve response period and become dispatchable within UDS. If the resource does not reach its minimum within the Short-Term Reserve response period, the output achieved during its start-up sequence will be counted toward its Short-Term Reserve response.

When the resource reaches its minimum and becomes dispatchable, it is possible that UDS may not dispatch the resource to its maximum potential within the Short-Term Reserve response period. In this case, the resource may not get the opportunity to demonstrate its Short-Term Reserve response capability. The resource Short-Term Reserve response will be considered met if the resource reaches its minimum and becomes dispatchable.

Each resource will be evaluated on an individual basis. The common bus logic used for Contingency Reserve will not be applied for Short-Term Reserve evaluation. Due to the length of the STR response period, MISO would have time to coordinate the response from another resource if a resource committed for Short-Term Reserve is not able to respond. The Short-Term Reserve approach differs from the Contingency Reserve approach, where the shorter Contingency Reserve response time does not provide as much time for coordination with MISO and the participant may decide to use a resource at the same common bus to provide the Contingency Reserve response. A resource which is not able to provide the cleared offline Short-Term Reserve after receiving a commitment instruction should coordinate with MISO to enable MISO to select a different resource to provide the needed Short-Term Reserve

response. If the resource fails to meet at least one of these criteria, it will be subject to Short-Term Reserve deployment failure charges. In case of missing essential measurement data, there will be no performance test conducted. The Resource will be automatically granted PASS on this performance test.

In the event of a Short-Term Reserve deployment failure, the Market Participant would be responsible for buying back its day-ahead position in the hour of failure and the remaining hours of the Operating Day. The amount of Short-Term Reserve available for payment on that Resource shall be restricted to zero (0) in the Hour of deployment failure and for the remaining Hours in the Operating Day. Short-Term Reserve clearing will not be capped, but could be disqualified by the operator.

8.2.15 Offline Short-Term Reserve Deployment Failure Charge

When a shortfall in an offline Short-Term Reserve deployment is determined for a specific resource, the resource will be subject to the new Offline Short-Term Reserve Deployment Failure Charge which is equal to the shortfall amount times the energy LMP at the resource's Commercial Pricing Node. The collected amounts of Short-Term Reserve Deployment Failure Charges are dispersed to Asset Owners through Revenue Neutrality Uplift.

8.2.16 Online Short-Term Reserve Revenue Clawback within the Uninstructed Deviation Penalty

If a resource fails to follow dispatch in a given hour, the Resource will receive an Excessive Deficient Energy Deployment Charge. The Excessive Deficient Energy Deployment Charge will be updated to include the claw back of any day-ahead and real-time Short-Term Reserve credits for that hour.

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 8.3 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 Backup Dispatch Notification 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[66] 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

[66] 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
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
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, Supplemental Reserve, Ramp Capability, and Short-Term 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 5.1 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 and Emergency Operations 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:

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

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.
- 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).

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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:

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

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:

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

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:

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

Where:

- $\bar{\gamma}_{ei,h}$ is the hourly marginal transmission loss price at Node *ei.*
- $\overline{w}_{ei,h}$ is the weighting factor from the database for electrical Node ei participating in aggregate pnode *api*.
- For Load Zone Aggregates and ARR Zone-Related 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:

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

Where:

- $\bar{\rho}_{ei,h}$ is the hourly marginal transmission and Sub-Regional Power Balance congestion price at Node *ei.*
- $\overline{w}_{ei,h}$ 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:

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

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.[67] 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[68] 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.

[67] 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.

[68] 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
- STRResponseTime = 30 Minutes
- MaxSTRResFactor = 1.0

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
- STRResponseTime = 30 Minutes
- MaxSTRResFactor = 1.0

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
- STRResponseTime = 30 Minutes
- MaxSTRResFactor = 1.0

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
- STRResponseTime = 30 Minutes
- MaxSTRResFactor = 1.0