Post Operating Processor Calculations Guide

(formerly known as Attachment C)

For Operating Days after JAN-05-2009

TABLE OF CONTENTS

A. Purpose

The Post Operations Processor Calculation Guide defines how certain hourly determinants are calculated. The Post Operations Processor (POP) performs calculations using validated Dispatch Interval data to create hourly determinants for use in Market Settlements. For further detail on the calculation of hourly charge types, please see the Market Settlements Calculation Guide.

B. Scope

These calculations apply to Operating Days after January 5, 2009.

C. Acronyms and Definitions

In addition to the List of BPMs and Definitions BPM, there are several abbreviations and definitions that are unique to the POP.

C.1 Acronyms

Acronym	Term	Definition
AC_ECON_MIN	As-Committed Economic Minimum	See Market Settlements Calculation Guide.
AC_ECON_MAX	As-Committed Economic Maximum	See Market Settlements Calculation Guide.
ACH_MW_PH	Achievable energy MW value for the previous market hour	The Hourly Achievable energy MW value for the previous market hour within the Must-Run Commitment period
ACT_BLL_DIFF	Real-Time Metered Actual Volume, Alternate Total Energy Difference	= RT_BLL_MTR* – ATE
ACT_MIL**	Actual Mileage	The actual movement, in MWs, relative to Setpoint Instructions for a Regulating qualified Resource within a Dispatch Interval.
ACH_MIN_MW	Achievable minimum MW value	The Hourly Achievable Minimum MW value for Day-Ahead Must-Run unit

Acronym	Term	Definition
ACH_MW	Achievable Megawatt (also known as Initial Energy Output)	See Attachment D of the Energy and Operating Reserves Markets BPM
ADD_REG_MIL_VOL*	Additional Regulating Mileage Volume	Any amount of INST_REG_MIL for a Regulating qualified Resource in a Dispatch Interval beyond the amount of REG_MW**.
ADJ_RT_ECON_MIN	Adjusted Real-Time Economic Minimum	See “Real-Time Economic Minimum/Maximum Dispatch” section of this document.
ADJ_RT_ECON_MAX	Adjusted Real-Time Economic Maximum	See “Real-Time Economic Minimum/Maximum Dispatch” section of this document.
AS	Ancillary Service	Collectively refers to Regulating, Regulating Reserve substituted for Spinning Reserve, Spinning, and Supplemental Reserve.
AS_MCP**	Ancillary Service Market Clearing Price	Collectively refers to RT_REG_MIL_MCP**, REG_MCP**, SPIN_MCP**, and SUPP_MCP**.
AS_MW**	Ancillary Service Cleared Megawatt Volume	Collectively refers to REG_MW**, REG_SPIN_MW**, SPIN_MW**, and SUPP_MW**.
ATE	Alternate Total Energy	Hourly time-weighted integration of the Dispatch Interval TEL_VOL**.
AUC	Area Under the Offer Curve	See “Area Under the Offer Curve” section of this document.
AVG_BP**	Average Basepoint	= ((BP** at time t) + (BP** at t – 5 minutes)) / 2
AVG_SP	Average Setpoint Instruction	For a given Dispatch Interval, is equal to the sum of AVG_BP** and REG_DEPL**.

Acronym	Term	Definition
AVOF	Availability Offer	The Market Participant's offer data for a given AS.
BO	Base Output	See "Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)" of this document.
BP**	Basepoint	Dispatch Target for Energy at time t.
BP_DIFF	Basepoint Difference	= (BP** at time t) – (BP** at time t – 5 minutes)
CMODE**	Control Mode	The Control Mode at the beginning of a given Dispatch Interval.
CP	Commitment Period	A Commitment Period is defined as a set of contiguous Commitment Blocks.
CPN_NAME**	Commercial Pricing Node Name (also defined as CPNode)	See List of BPMs and Definitions BPM.
CRD	Contingency Reserve Deployment	N/A
CRDC	Contingency Reserve Deployment Compliance	N/A
CRDC_PASS_TEST	Contingency Reserve Deployment Compliance Pass Test	IF the Resource has passed at least 1 of the 4 compliance checks either at the resource level or at the common bus, the value is set to one, otherwise the value is set to zero
CRD_DPL_ACT	Contingency Reserve Deployment Actual	= MAX (Meter_before – Meter_after, 0)
CRD_INST_MW	Contingency Reserve Deployment Instruction MW	The MW value requested for the resource for the CRD Event from the Transmission Provider.

Acronym	Term	Definition
CRD_SHORTFLL_MW	Contingency Reserve Deployment Shortfall MW	Represents the Shortfall MW amount for the Contingency Reserve Event for a CRD Resource
CRD_DPL_VOL**	Contingency Reserve Deployment MW	The MW amount deployed for Contingency Reserve
DA_CONROL_STATUS*	Day-Ahead Unit Control Status	Hourly value. “0” represents Off-Line, “1” represents online non-regulating, “2” represents online for Regulation; and, “3” represents online but off control.
DA_AS_SS_VOL	Day-Ahead Ancillary Service Self-Scheduled Volume	The Day-Ahead Hourly offered Self-Schedule MW value for a given Ancillary Service.
DA_AS_VOL*	Day-Ahead Ancillary Services Volume	Collectively refers to DA_REG_VOL*, DA_REG_SPIN_VOL*, DA_SPIN_VOL*, and DA_SUPP_VOL*.
DA_AS_MCP	Day-Ahead Ancillary Services Market Clearing Price	Collectively refers to DA_REG_MCP*, DA_SPIN_MCP*, and DA_SUPP_MCP*.
DA_ASOF_MWP*	Day-Ahead As Offered Make Whole Payment	See Market Settlements Calculation Guide.
DA_ECON_MAX	Hourly Economic Maximum Limit	Refers to the As-Offered limits reflected in offer data
DA_ECON_MIN	Hourly Economic Minimum Limit	Refers to the As-Offered limits reflected in offer data
DA_LMP_EN*	Day-Ahead Location Marginal Price	See Market Settlements Calculation Guide.
DA_MAP*	Day-Ahead Margin Assurance Preservation Payment	See Market Settlements Calculation Guide.

Acronym	Term	Definition
DA_MIL_POT_MWP*	Day Ahead Potential Mileage Make-Whole Payment	Day Ahead Mileage Potential Make-Whole Payment
DA_MIN_LIMIT	Day-Ahead Minimum Limit MW	The Hourly Day-Ahead minimum Limit MW value calculated based on the unit's Day-Ahead Regulating or Economic minimum limit
DA_PROD_SUB_FL*	Day-Ahead Hourly Product Substitution	See "Product Substitution" section of this document
DA_DRC_MCP*	Day-Ahead Down Ramp Capability Market Clearing Price	See Market Settlements Calculation Guide.
DA_DRC_VOL*	Day-Ahead Down Ramp Capability Volume	See Market Settlements Calculation Guide.
DA_RC_VOL*	Day-Ahead Ramp Capability Volume	Collectively refers to DA_DRC_VOL* and DA_URC_VOL*.
DA_REG_MCP*	Day-Ahead Regulation Market Clearing Price	See Market Settlements Calculation Guide.
DA_REG_VOL*	Day-Ahead Regulation Volume	See Market Settlements Calculation Guide.
DA_REG_SPIN_VOL*	Day-Ahead Regulation for Spinning Reserve Volume	See Market Settlements Calculation Guide.
DA_RR	Day-Ahead Ramp Rate	Ramp Rate for a given Hour used in the Day-Ahead Energy and Operating Reserve Market for a given Resource.
DA_RSG_ELIGIBILITY*	Day-Ahead Revenue Sufficiency Guarantee Eligibility	See Market Settlements Calculation Guide.
DA_RSG_EN_VAL	Hourly Day-Ahead Revenue Sufficiency Market Energy Amount	See Market Settlements Calculation Guide.

Acronym	Term	Definition
DA_RSG_EN_VAL_TOTAL	Daily Day-Ahead Revenue Sufficiency Market Energy Amount	See Market Settlements Calculation Guide.
DA_RSG_MWP*	Day-Ahead Revenue Sufficiency Guarantee Make Whole Payment Amount	See Market Settlements Calculation Guide.
DA_SCHD*	Day-Ahead Schedule Volume	For the language and calculations included in this document, a negative DA_SCHD* will represent load and a positive DA_SCHD* will represent injection.
DA_SPIN_MCP*	Day-Ahead Spinning Reserve Market Clearing Price	See Market Settlements Calculation Guide.
DA_SPIN_VOL*	Day-Ahead Spinning Reserve Volume	See Market Settlements Calculation Guide.
DA_SUPP_MCP*	Day-Ahead Supplemental Reserve Market Clearing Price	See Market Settlements Calculation Guide.
DA_SUPP_VOL*	Day-Ahead Supplemental Reserve Volume	See Market Settlements Calculation Guide.
DA_UNUSED_MARGIN*	Day Ahead Unused Regulating Reserve Margin	Day Ahead Net Positive Unused Regulating Reserve Margin
DA_DB_ELMP_MWP*	Day-Ahead Hourly Price Sensitive Demand Bid ELMP MWP Amount	Hourly Price Sensitive Demand Bid ELMP Make Whole Payment Amount at Loading Zone CP Nodes or EAR CP Node in Day-Ahead Market
DA_URC_MCP*	Day-Ahead Up Ramp Capability Market Clearing Price	See Market Settlements Calculation Guide.

Acronym	Term	Definition
DA_URC_VOL*	Day-Ahead Up Ramp Capability Volume	See Market Settlements Calculation Guide.
DB_ELMP_MWP	Demand Bid ELMP Make Whole Payment	Hourly Price Sensitive Demand Bid ELMP Make Whole Payment
DESIRED_MIL**	Desired Mileage	The movement, in MW, that a Regulating qualified Resource is capable to provide during a Dispatch Interval in response to Setpoint Instructions based on the Resource's applicable RT_BI_RR, starting from its TEL_VOL** at the beginning of each Dispatch Interval.
DESIRED_SP	Desired Setpoint	The 4-second Setpoint for a Resource based on the Resource’s applicable RT_BI_RR, starting for its TEL_VOL** at the beginning of each Dispatch Interval.
DFE*	Deficient Energy	See Market Settlements Calculation Guide. DFE_i refers to the Dispatch Internal DFE.
DFE_T	Deficient Energy Threshold	See List of BPMs and Definitions BPM. DFE_T_i refers to the Dispatch Interval DFE_T.
DISP	Dispatchable	A flag that defines if a given Resource, based on the initial parameters to the UDS, is able to be dispatched by the UDS.
DIR_FORECAST_MAX	Dispatchable Intermittent Resource Dispatch Interval Forecast Maximum Limit	See BPM 002 Energy and Operating Reserves Markets

Acronym	Term	Definition
EC	Economic Dispatch Status	Applicable to REG_DISP_STATUS
EDEDC*	Excessive/Deficient Energy Deployment Charge	See List of BPMs and Definitions BPM.
EEEF* / **	Excessive Energy Exemption Flag	Hourly and Dispatch Interval flag representing exemption from EDEDC*.
ELMP	Extended Locational Marginal Price	Compared to LMP, this is a new LMP calculated by considering certain fast-start and EDR Resources (effective on 03/01/2015)
ENERGY_SS_MW	Energy Self-Schedule MW	The Hourly offered Self-Schedule MW value for Energy.
EXE*	Excessive Energy	See Market Settlements Calculation Guide. EXE_i refers to the Dispatch Internal EXE.
EXE_T	Excessive Energy Threshold	See List of BPMs and Definitions BPM. EXE_T_i refers to the Dispatch Interval EXE_T.
EXP*	Excessive Energy Price	See Market Settlements Calculation Guide. EXP_i refers to the Dispatch Internal EXP.
FFDF*	Hourly Failure to Follow Dispatch Flag	See Market Settlements Calculation Guide.
FMPTF (* / **)	Failure Mileage Performance Test Flag	The flag is set to 1 or ‘Y” if the Regulating Resource fails the mileage performance accuracy measurement test.

Acronym	Term	Definition
FOLLOW_PER**	Follow Percent	The measurement of following the desired mileage when the FMPTF is set to 1 or “Y”
ICCP	Inter-Control Center Protocol	A protocol to manage the inbound and outbound SCADA data.
INST_ENG_MIL**	Instructed Energy Mileage	The movement, in MW, that a Regulating qualified Resource is asked to provide during a Dispatch Interval in response to Energy Dispatch Targets and Contingency Reserve Deployment Instructions using a Resource’s applicable ramp rate.
INST_REG_MIL	Instructed Regulating Mileage	The movement during a Dispatch Interval, in MW, that a Regulating qualified Resource is asked to provide in response to Regulation Reserve Deployment instructions.
INST_TOT_MIL**	Instructed Total Mileage	The movement, in MW, that a Regulating qualified Resource is asked to provide during a Dispatch Interval in response to Setpoint Instructions using the Resource’s applicable ramp rate.

Acronym	Term	Definition
IOH	InitialOnHours	InitialOnHours (IOH) is the number of hours (rounded to the nearest whole number) elapsed since the Resource was On-Line as determined by the Day-Ahead Commitment Process. The IOH value is driven by the market plan for a specified resource; therefore, any existing commitment period and/or Control Mode (CMODE) transition may affect the IOH calculation. A positive value means that the Resource was On-Line for a period of time leading up to the start of the OD. A negative value means that the Resource Off-Line for a period leading up to the start of the OD.
MIL_CHARGE_AMT*	Mileage Charge Amount	See Market Settlements Calculation Guide.
MKT_INT_BEG_EST**	Market Interval Begin in Eastern Standard Time	In some examples, this has been shortened to 'MKT_INT' to save space.
MIL_OF	Mileage Offer	The price, in dollars per MW, at which a Regulating Reserve qualified Resource has agreed to provide Regulating Mileage.
MQF**	Mileage Qualify Flag	Dispatch Interval flag that is set equal to '1' when a Resource is committed to provide Regulating Reserve.
MR_ELMP_MWP*	Day-Ahead Must-Run ELMP Make Whole Payment	The hourly RSG MWP for a Day-Ahead Must-Run Resource
MR_IE_COST	Must-Run Incremental Energy Cost	The hourly Day-Ahead Must-Run Resource Incremental Energy Production Cost

Acronym	Term	Definition
MR_MWP_ELIG_FL	Day-Ahead Must-Run ELMP MWP Eligibility Flag	An hourly flag used to determine if a Day-Ahead Must-Run Resource is eligible for ELMP MWP
MRD_FL*	Manual Re-Dispatch Flag	An hourly flag that defines if a resource has been Manually Re-Dispatched within a given hour.
NDL_ECON_MAX*	Hourly Notification Deadline Economic Maximum Volume	The economic maximum limit for a generation asset at the Notification Deadline.
NDL_ECON_MIN*	Hourly Notification Deadline Economic Minimum Volume	The economic minimum limit for a generation asset at the Notification Deadline.
NRGA*	Net Regulation Adjustment	See “Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*)” section of this document. $NRGA_i$ refers to Dispatch Interval NRGA*.
NXE	Non-Excessive Energy	See Market Settlements Calculation Guide. NXE_i refers to the Dispatch Interval NXE amount For the purposes of this document, a negative NXE_i represents load and a positive NXE_i represents injection.
NWF	Normalized Weighting Factor	A factor used to weight a given value by another value.
OD	Operating Day	See List of BPMs and Definitions BPM.
Offer@AVG_BP	Offer Price at AVG_BP**	Dollar amount corresponding to the price point where the AVG_BP** crosses a Resource Offer Curve.
PO	Pay Output	The PO is equal to the NXE_i for each Dispatch Interval in the Hour. PO_i refers to the Dispatch Interval PO.

Acronym	Term	Definition
POP	Post Operations Processor	N/A
RAMP_ADD	Utilized Ramp MW Adder	See the “Excessive/Non-Excessive/Deficient Energy” Section of this document.
RAMP_ADJ	Shared Ramp MW Adjustment	See the “Excessive/Non-Excessive/Deficient Energy” Section of this document.
RAMPED_SP	Ramped Setpoint	This is the 4-second ICCP data for a Resource.
RAO_MW	Regulation Actual Output	See “Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*)” section of this document.
REG_DEPL**	Ramped Regulation Deployment	See “Ramped Regulation Deployment (REG_DEPL**)” section of this document.
REG_DISP_STATUS	Regulating Reserve Dispatch Status	Hourly flag that represents the Regulating Reserve Dispatch Status for a given Resource (i.e. Economic, Self-Schedule, etc.).
REG_MCP**	Regulating Reserve Market Clearing Price	N/A
REG_MW**	Real-Time Dispatch Interval Dispatch Target Regulating Reserve	N/A

Acronym	Term	Definition
REG_MIL_DPL_RATIO	Regulating Mileage Deploy Ratio	The Market-Wide monthly average ratio of Dispatch Interval TARGET_REG_MIL and REG_MW** between the 15^{th} day of the previous month and the 15^{th} day of the current month. Once the ratio has been calculated, it is applied for the upcoming month.
REG_MIL_UNDP_VOL*	Regulating Mileage Undeployed Volume	The MW volume of Target_Reg_Mileage below the REG_MW**
REG_MIL_UNDP_AMT*	Regulating Mileage Undeployed Amount	The charge amount to a Regulating qualified Resource based on the Undeployed Regulating Mileage volume times the Real Time Regulating Mileage MCP
REG_QUALIFIED	Regulating Reserve Qualified	Yes/No flag established during the Commercial Model Registration Process defining a given Resource is qualified to provide Regulating Reserve.
REG_SPIN_SS_MW	Regulating Reserve for Spinning Reserve Substitution Self-Schedule MW	Calculated Self-Schedule of Regulating Reserve for Spinning Reserve substitution
RES_LP_VOL**	Resource Load Profiled Volume	Represents the Resource Dispatch Interval TEL_VOL**, adjusted for RT_ACT_MTR.
RSG_XMPT*	Hourly Real-Time RSG Distribution Exemption Flag	Results in the exemption of Real-Time RSG Distribution megawatt volume for the given Commercial Pricing Node
RT	Real-Time	See List of BPMs and Definitions BPM.

Acronym	Term	Definition
RT_ACT_MTR	Real-Time Metered Actual Volume	See Market Settlements Calculation Guide.
RT_AS_MCP*	Real-Time Ancillary Service Market Clearing Price	Collectively refers to the RT_REG_MIL_MCP*, RT_REG_MCP*, RT_SPIN_MCP*, and RT_SUPP_MCP*.
RT_AS_SS_VOL	Real-Time Ancillary Service Self-Scheduled Volume	The Real-Time Hourly offered Self-Schedule MW value for a given Ancillary Service.
RT_ASM_NRGA*	Net Regulation Adjustment Amount	See Market Settlements Calculation Guide.
RT_ASM_NXE*	Real-Time Non-Excessive Energy Amount	See Market Settlements Calculation Guide.
RT_ASM_REG*	Real-Time Regulation Amount	See Market Settlements Calculation Guide.
RT_ASOF_MWP*	Real-Time As-Offered Make Whole Payment	See Market Settlements Calculation Guide.
RT_BI_RR	Real-Time Bi-Directional Ramp Rate	Real-Time up and down directional ramp rate (MW/Minute) for a Dispatch Interval.
RT_BLL_MTR*	Real-Time Metered Billable Volume	See Market Settlements Calculation Guide. Also see the “Resource Load Profiled Volume (RES_LP_VOL**) section of this document.
RT_DB_ELMP_MWP*	Real-Time ELMP Make Whole Payment for EAR Wheel-Out Schedule	Hourly Price Sensitive Demand Bid ELMP Make Whole Payment Amount at EAR CP Node in Real-Time Market

Acronym	Term	Definition
RT_DISP_MAX	Dispatch Interval Real-Time Maximum Dispatchable Volume	The maximum achievable MW level at which a Resource may be dispatched by the UDS in RT.
RT_DRC_MCP* / **	Hourly and Dispatch Interval Real-Time Down Ramp Capability Market Clearing Price	Real-Time Hourly and Dispatch Interval Down Ramp Capability Market Clearing Price in $/MW.
RT_DRC_MW**	Real-Time Dispatch Interval Cleared Down Ramp Capability	N/A
RT_DSP_TARG_EN*	Hourly Real Time Dispatch Target for Energy	Hourly Integrated Average Basepoint for a Resource
RT_DISP_MIN	Dispatch Interval Real-Time Minimum Dispatachble Volume	The minimum achievable MW level at which a Resource may be dispatched by the UDS in RT.
RT_ECON_MAX	Hourly Economic Maximum Limit	The Economic Maximum Limit of a Resource used by the UDS.
RT_ECON_MIN	Hourly Economic Minimum Limit	The Economic Minimum Limit of a Resource used by the UDS.
RT_ELIG_MWH*	Real-Time Eligible Megawatt-Hour (MWh)	See Market Settlements Calculation Guide.
RT_LMP_EN*	Real-Time Locational Marginal Price	See Market Settlements Calculation Guide.
RT_MAX_DSP*	Hourly Real-Time Maximum Dispatchable Volume	See Market Settlements Calculation Guide.
RT_MIL_POT_MWP*	Real-Time Potential Mileage Make-Whole Payment	Real-Time Mileage Potential Make-Whole Payment
RT_MIL_TOT_MWP	Real-Time Mileage Total Make-Whole Payment	The total amount of Make Whole Payment due to a Resource.

Acronym	Term	Definition
RT_MIN_DSP*	Hourly Real-Time Minimum Dispatchable Volume	See Market Settlements Calculation Guide.
RT_MKT_EN_VAL	Hourly Real-Time Market Energy Amount	See Market Settlements Calculation Guide.
RT_ORSGP_FL*	Real-Time Offer Revenue Sufficiency Guarantee Flag	See Market Settlements Calculation Guide.
RT_PROD_SUBST_FL**	Real Time Dispatch Interval Product Substitution	See “Product Substitution” section of this document
RT_RC_MCP*	Real-Time Ramp Capability Market Clearing Price	Collectively refers to the RT_DRC_MCP* and RT_URC_MCP*.
RT_REG_MCP*	Hourly Real-Time Regulation Market Clearing Price	See Market Settlements Calculation Guide.
RT_REG_MIL_MCP*/**	Hourly and Dispatch Interval Regulating Mileage Marginal Clearing Price	Real-Time Hourly and Dispatch Interval Regulation Mileage Market Clearing Price in $/MW
RT_REG_SPIN_MW**	Regulating Reserve for Spinning Reserve Substitution	The amount, in MW, of Regulating Reserve that is substituted for Spinning Reserve for a Dispatch Interval.
RT_RR	Real-Time Ramp Rate	Minimum Resource ramp rate used as an input into a given Dispatch Interval UDS case.
RT_RSG_ADD_EN_MARGIN *	Real-Time Revenue Sufficiency Guarantee Additional Energy Margin	See Market Settlements Calculation Guide.

Acronym	Term	Definition
RT_RSG_DIST1*	Real-Time Revenue Sufficiency Guarantee First Pass Distribution Amount	See Market Settlements Calculation Guide.
RT_RSG_ELIGIBILITY*	Real-Time Revenue Sufficiency Guarantee Eligibility	See Market Settlements Calculation Guide.
RT_RSG_EN_VAL_CP	Commitment Period Real-Time Market Energy Amount	See Market Settlements Calculation Guide.
RT_PC_AMT_MIT_CP	Commitment Period Real-Time Mitigated RSG Production Cost Amount	See Market Settlements Calculation Guide.
RT_RSG_MWP*	Real-Time Revenue Sufficiency Guarantee Make Whole Payment Amount	See Market Settlements Calculation Guide.
RT_SPIN_MCP*	Hourly Real-Time Spinning Reserve Market Clearing Price	See Market Settlements Calculation Guide.
RT_SUPP_MCP*	Hourly Real-Time Supplemental Reserve Market Clearing Price	See Market Settlements Calculation Guide.
RT_UDS_CS	Real-Time Unit Dispatch Control Status (also known as Control Status)	See Attachment D of the Energy and Operating Reserve Markets BPM
RT_UNUSED_MARGIN*	Real-Time Net Unused Regulating Reserve Margin	Real-Time Net Positive Unused Regulating Reserve Margin

Acronym	Term	Definition
RT_URC_MCP* / **	Hourly and Dispatch Interval Real-Time Up Ramp Capability Market Clearing Price	See Market Settlements Calculation Guide.
RT_URC_MCP* / **	Hourly and Dispatch Interval Real-Time Up Ramp Capability Market Clearing Price	Real-Time Hourly and Dispatch Interval Up Ramp Capability Market Clearing Price in $/MW.
RT_URC_MW**	Real-Time Dispatch Interval Cleared Up Ramp Capability	N/A
RTN_AS_VOL*	Real-Time Net Ancillary Service Volume	Collectively refers to RTN_REG_VOL*, RTN_REG_SPIN_VOL*, RTN_SPIN_VOL*, and RTN_SUPP_VOL*. $RTN\_AS\_VOL_i$ refers to the Dispatch Interval RTN_AS_VOL.
RTN_DRC_VOL*	Real-Time Net Down Ramp Capability Volume	See Market Settlements Calculation Guide.
RTN_RC_VOL*	Real-Time Net Ramp Capability Volume	Collectively refers to RTN_DRC_VOL* and RTN_URC_VOL*. $RTN\_RC\_VOL_i$ refers to the Dispatch Interval RTN_RC_VOL
RTN_REG_SPIN_VOL*	Real-Time Net Regulating Reserve for Spinning Reserve Substitution Volume	The difference between the RT_REG_SPIN_VOL and the DA_REG_SPIN_VOL.
RTN_REG_VOL*	Net Real-Time Regulation Reserve Volume	See Market Settlements Calculation Guide.

Acronym	Term	Definition
RTN_SPIN_VOL*	Net Real-Time Cleared Spinning Reserve Volume	See Market Settlements Calculation Guide.
RTN_SUPP_VOL*	Net Real-Time Cleared Supplemental Reserve Volume	See Market Settlements Calculation Guide.
RTN_URC_VOL*	Real-Time Net Up Ramp Capability Volume	See Market Settlements Calculation Guide.
RTMR	Real-Time Must-Run	N/A
RTORSGP*	Real-Time Offer Revenue Sufficiency Guarantee Payment	See Market Settlements Calculation Guide.
RTORSGP_ASM_REV_HR	Real-Time Hourly Operating Reserve Revenue	See Market Settlements Calculation Guide.
RTORSGP_EN_REV_HR	Real-Time Hourly Energy Revenue	See Market Settlements Calculation Guide.
RTORSGP_RC_REV_HR	Real-Time Hourly Ramp Capability Revenue	See Market Settlements Calculation Guide.
SPIN_MCP**	Dispatch Interval Real-Time Spinning Reserve Marginal Clearing Price	N/A
SPIN_MW**	Dispatch Interval cleared Spinning Reserve volume	N/A
SEMW	State Estimator Megawatt	N/A
SS	Self-Schedule	See List of BPMs and Definitions BPM. Applicable to REG_DISP_STATUS.
STEPPED_SP	Stepped Setpoint	4-second ICCP data of adding the Operating Reserve deployment MW to the Dispatch Target for Energy.

Acronym	Term	Definition
SUPP_MCP**	Dispatch Interval Real-Time Supplemental Reserve Marginal Clearing Price	N/A
SUPP_MW **	Dispatch Interval cleared Supplemental Reserve volume	N/A
TARGET_REG_MIL	Target Regulating Mileage	=MIN (INST_REG_MIL, DESIRED_MIL**)
TEL_VOL **	Dispatch Interval Telemetry Volume	See “Data Substitution Hierarchy” section of this document.
TOL_%	Tolerance Percentage	Excessive / Deficient Energy Tolerance Percentage (Currently 8% as of 03/01/2010)
TOL_MAX	Tolerance Max	Excessive / Deficient Energy Tolerance Maximum MW (Currently 30 MW as of 03/01/2010)
TOL_MIN	Tolerance Min	Excessive / Deficient Energy Tolerance Minimum MW (6 MW)
VIRT_ELMP_MWP*	Virtual Transaction ELMP Make Whole Payment	Hourly Day-Ahead Make Whole Payment for Both Virtual Bid and Offer Transactions

** These determinants, intermediate calculations, or charge types appear on the DA and/or RT settlement statements.*

*** These determinants appear on the 5-minute Dispatch Interval settlement statements*

*Note: The ‘AS’ variables, referring to Ancillary Services (AS), defined above also contain the * or ** annotation as they collectively refer to a group of AS values.*

C.2 Definitions

Capitalized terms herein shall have the meaning provided in the MISO Tariff, the NERC Reliability Standards ("NERC Standards"), the NERC Glossary of Terms Used in Reliability Standards ("NERC Glossary"), or as defined by this document.

- **Adjusted DA Schedules**: DA_SCHD* and/or DA_AS_VOL* adjusted for any RT de-rates.
- **As-Committed Offer**: The Market Participant's offer data at the close of the DA Energy and Operating Reserve Market or at the clock time the Resource is issued a RT commitment.
- **As-Dispatched Offer**: The Market Participant's offer data at the close of the DA Energy and Operating Reserve Market or close of the RT Hour. The close of the RT Hour occurs 30 minutes prior to each Hour.
- **Commitment Block**: A Commitment Block is a single set of MISO specified DA or RT SCUC instructions. In short, a Commitment Block refers to a Call On / Call Off SCUC instruction pair. Adjacent or overlapping Commitment Blocks form a single continuous CP.
- **Control Mode**: The Control Mode is a flag set by the Asset Owner that indicates the status of each Resource.
- **Cooling Time**: Cooling Time represents how long it takes a Resource to cool from a state of hot to intermediate or from a state of hot to cold. Both of these values are submitted by Market Participants as part of their offer parameters. The Cooling Time is used to determine the state of the Resource for the next start-up (and the related Start-up Cost).
- **CP Start Time**: Call On time of the CP as defined by the SCUC instructions.
- **CP Stop Time**: Call Off time of the CP as defined by the SCUC instructions
- **Curtailment Cost**: Dollar amount representing the cost incurred by the Market Participant for operating a Demand Response Resource-Type I at the Targeted Demand Reduction Level as submitted via an Hourly Curtailment Offer. Synonymous with No-Load Cost, unless otherwise specified.
- **Demand Response Tool**: A software application that performs Demand Response Resource enrollment, settlement, measurement and verification.

- **Dispatchable Intermittent Resources**: A Generation Resource whose Economic Maximum Dispatch is dependent on forecast-driven fuel availability.
- **Fixed Dispatch**: See Attachment D of the Energy and Operating Reserve Markets BPM.
- **Hourly Production Cost**: Collectively refers to No-Load Cost, Incremental Energy Cost and Operating Reserve Cost.
- **Initial Commit Status**: Indicates the original commitment status for the initial Commitment Block within a CP.
- **Meter_After**: DRR Metered MW 10 minutes after the beginning of a given Contingency Reserve Deployment event
- **Meter_Before**: DRR Metered value at the beginning of a given Contingency Reserve Deployment event.
- **Minimum Run Time**: See the Energy and Operating Reserve Markets BPM.
- **Notification Deadline**: Compensation requested by the Market Participant for operating an On-Line Resource at zero (0) MW.
- **Notification Deadline**: The cut-off time, four hours prior to the operating hour, by which schedule changes must be reported to the Transmission Provider to enable it to reflect such changes in the RAC process.
- **Notification Period Start**: The CP Start Time minus the Start-up time minus Notification Time.
- **Notification Window**: The period of time bounded by the Notification Period Start and the CP Start Time.
- **Off-Line**: The Resource has a breaker status of open and/or has a zero RES_LP_VOL**.
- **Off Duration**: See “Start-Up and Shut-Down Cost” section of this document.
- **On-Line**: The Resource has a breaker status of closed and/or has a non-zero RES_LP_VOL**.
- **Price Volatility**: Price variations that can exist between ex-ante and ex-post prices and Dispatch Interval ex-post to hourly ex-post prices.
- **Regulation**: Deployed Regulating Reserve.
- **Regulating Mileage Offer**: The price, in dollars per MW, at which a Regulating qualified Resource has agreed to provide Regulating Mileage.

- **Regulating Reserve Capacity Offer**: The price, in dollars per MW per Hour, at which a Regulating qualified Resource has agreed to sell Regulating Reserve
- **Regulating Reserve Total Offer**: The sum of Regulating Reserve Capacity Offer and the Regulating Mileage Offer adjusted by the Regulating Mileage Deploy Ratio (REG_MIL_DPL_RATIO).
- **RSG Market Value**: Energy and Operating Reserve Revenue.
- **RT_ENERGY_DISP_STATUS**: Represents Market Participant submitted Real-Time Energy Dispatch Status
- **RTMR "on-line" Contingency Reserve Deployment Commitment**: An On-line DRR Type I Resource Real-Time Must Run Unit Commitment for a Contingency Reserve Deployment Event.
- **SER_ENERGY_ADJ**: The MW adjustment applied to the Unit Dispatch System clearing for SERs.
- **Shut-Down Cost**: Dollar amount representing all fixed costs incurred by the Market Participant associated with fulfilling a MISO commitment associated with a Demand Response Resource-Type I as submitted via a Shut-Down Offer.
- **Start Time Window**: The Start Time Window is the period between the CP Stop Time of the first non-contiguous Commitment Block preceding the CP and the CP Stop Time of the CP.
- **Start-Up Cost**: Dollar amount representing all fixed costs incurred by the Market Participant associated with fulfilling a MISO commitment associated with a Generation Resource or Demand Response Resource-Type II as submitted via a Start-up Offer.
- **Total Production Cost**: Collectively refers to Hourly Production Costs and Start-up and/or Shut-Down Cost.

D. Calculations

D.1 Resource Load Profiled Volume (RES_LP_VOL**)

Resource Load Profiled Volume (RES_LP_VOL**) represents the Resource Dispatch Interval Telemetry Volume (TEL_VOL**), adjusted for hourly Real-Time Metered Actual Volume (RT_ACT_MTR). If no RT_ACT_MTR is supplied for a given Resource, the Dispatch Interval RES_LP_VOL** will be equal to the TEL_VOL**. Please see the “Data Substitution Hierarchy” section in this document for more detail about the data substitution hierarchy. If no Telemetry Volume (TEL_VOL**) or other substituted data (except for the RT_ACT_MTR value) exists, the Dispatch Interval RES_LP_VOL** will be equal to RT_ACT_MTR.

D.1.1 Calculation Overview

RES_LP_VOL** is calculated according to the following steps:

1. Calculate the hourly Alternate Total Energy (ATE) for each Resource.

   $$\text{ATE} = \left(\sum_{i=1}^{12} \text{TEL\_VOL} \right) / 12$$

   Where: i represents each Dispatch Interval in the Hour.

2. Calculate the difference between Real-Time Metered Billable Volume (RT_BLL_MTR*) and ATE (ACT_BLL_DIFF).

   IF RT_ACT_MTR EXISTS **THEN**
     RT_BLL_MTR = RT_ACT_MTR
   ELSE
     RT_BLL_MTR = ATE
   END IF
   ACT_BLL_DIFF = RT_BLL_MTR – ATE
   Note: If RT_ACT_MTR does not exist, ACT_BLL_DIFF = 0

3. Calculate the positive Normalized Weighting Factor (NWF_i) for each Dispatch Interval. The NWF_i is calculated as the absolute value of each TEL_VOL**, divided by the average of the absolute value of the TEL_VOL** for every Dispatch Interval in the Hour.

$$NWF_i = \textbf{ABS} \text{ (TEL\_VOL) / \{ = (} \sum_{i=1}^{12} \text{ TEL\_VOL) / 12 \}}$$

4. Calculate the RES_LP_VOL** as the sum of (1) the TEL_VOL** and (2) the product of (a) the ACT_BLL_DIFF and (b) the NWF_i.

RES_LP_VOL = TEL_VOL + (ACT_BLL_DIFF × NWF_i)

D.1.2 Calculation Example

Consider the following example which shows a Resource with both generation and load in a given Hour and the resultant RES_LP_VOL** due to a difference between RT_ACT_MTR and ATE:

RES_LP_VOL Calculation Example**

Hourly Inputs

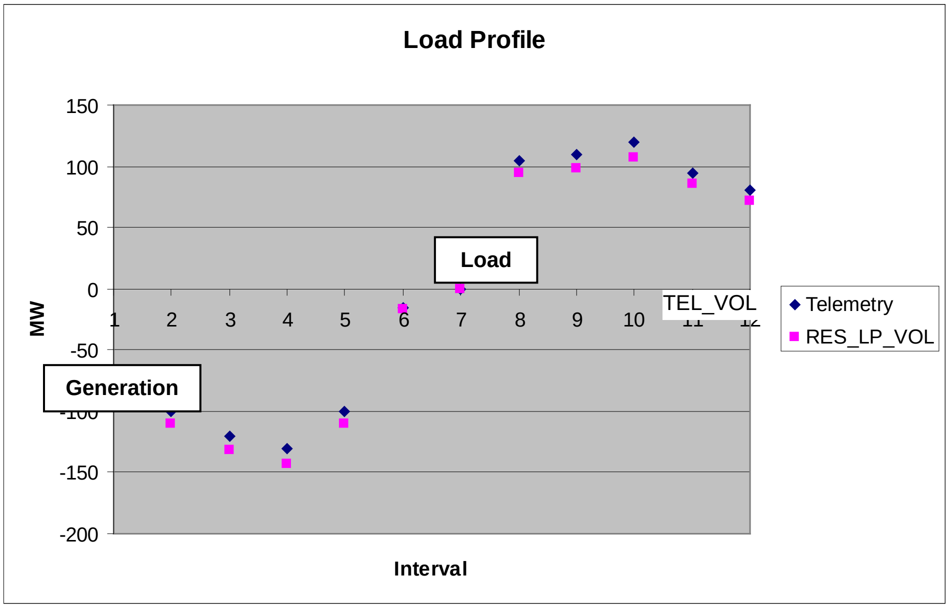
ATE	-2.92
RT_BLL_MTR*	-12.00
ACT_BLL_DIFF	-9.08

Note: Since RT_ACT_MTR EXISTS, RT_BLL_MTR = RT_ACT_MTR*

Interval Inputs

Interval	TEL_VOL**	ABS(TEL_VOL**)	NWF_i	RES_LP_VOL**
1	-80	80.00	0.91	-88.27
2	-100	100.00	1.14	-110.33
3	-120	120.00	1.36	-132.40
4	-130	130.00	1.48	-143.43
5	-100	100.00	1.14	-110.33
6	-15	15.00	0.17	-16.55
7	0	0.00	0.00	0.00
8	105	105.00	1.19	94.15
9	110	110.00	1.25	98.64
10	120	120.00	1.36	107.60
11	95	95.00	1.08	85.18
12	80	80.00	0.91	71.73

Graphical Representation



D.2 Real-Time Net Ancillary Service Volumes (RTN_AS_VOL*) and Real-Time Ancillary Service Market Clearing Prices (RT_AS_MCP*)

Real-Time Net Ancillary Services Volumes (RTN_AS_VOL*) are the integration of the difference between the Real-Time Dispatch Interval Ancillary Service Volume (AS_VOL**) and the Day-Ahead Ancillary Service Volumes (DA_AS_VOL*) and are calculated separately for each Resource per Ancillary Service (AS). The RT_AS_MCP* is the quantity-weighted average of Dispatch Interval Ancillary Services Market Clearing Prices (AS_MCP**) and are calculated separately for each Resource per AS. The Real-Time Net Regulation Volume (RTN_REG_VOL) will only consider the amount of cleared Regulating Reserve that is not substituted for Spinning Reserve. The Real-Time Net Regulation for Spinning Reserve Volume (RTN_REG_SPIN_VOL) will be paid the Real-Time Spinning Reserve Marginal Clearing Price (RT_SPIN_MCP).

D.2.1 Calculation Overview

The calculation of RTN_AS_VOL* is defined below:

$$RTN\_AS\_VOL = \left(\sum_{i=1}^{12} AS\_VOL - DA\_AS\_VOL \right) / 12$$

The calculation of the RT_AS_MCP* is defined below:

$$RT\_AS\_MCP = \sum_{i=1}^{12} \left[\left(RTN\_AS\_VOL_i \Big/ \sum_{i=1}^{12} (AS\_VOL - DA\_AS\_VOL) \right) \times AS\_MCP \right]$$

Note: The RT_AS_MCP for a given product is zero if the RTN_AS_VOL* is zero.*

D.2.2 Calculation Example

Consider the following example which shows the DA and RT Regulating Reserve clearing results for a Resource and the resultant Real-Time Net Regulation Volume (RTN_REG_VOL*) and Real-Time Regulation Market Clearing Price (RT_REG_MCP*):

RTN_AS_VOL* and RT_AS_MCP* Calculation Example

Dispatch Interval	DA_REG_VOL* (1)	REG_MW** (2)	REG_MCP** (3)	RTN_REG_VOL$_i$ (4)=(2)-(1)	NWF$_i$ (5)=Interval(4) / Total(4)	RT_REG_MCP* (6) = (5)*(3)
1	20	0	10	-20	0.250	2.500
2	20	0	10	-20	0.250	2.500
3	20	10	12	-10	0.125	1.500
4	20	15	14	-5	0.063	0.875
5	20	25	15	5	-0.063	-0.938
6	20	25	15	5	-0.063	-0.938
7	20	20	15	0	0.000	0.000
8	20	20	15	0	0.000	0.000
9	20	20	12	0	0.000	0.000
10	20	15	10	-5	0.063	0.625
11	20	10	10	-10	0.125	1.250
12	20	0	10	-20	0.250	2.500
Total				**-80**	**1.000**	**9.875**
Average	**20**	**13.333**	**12.333**	**-6.667**		

The values shown in green are the hourly determinants for the RT Regulation Amount (RT_ASM_REG*). The Resource has a RTN_REG_VOL* of -6.667 and RT_MCP_VOL* of 9.875. Therefore the Resource would be charged a RT_ASM_REG* mount of $65.83, the product of the RTN_REG_VOL* and RT_REG_MCP*, multiplied by -1. This is an example of a Resource buying out of a DA position, therefore receiving a RT_ASM_REG* charge.

D.3 Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*)

Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*) is calculated in each Dispatch Interval for Resources with Ramped Regulation Deployment (REG_DEPL**). For Dispatch Intervals in which the REG_DEPL** is equal to zero, Dispatch Interval NRGA ($NRGA_i$) is not calculated, and is therefore assumed to be zero. For more information on the REG_DEPL**, please see the “Ramped Regulation Deployment Calculation” section of this document.

Regulation is deployed in an upward or downward direction. For each Dispatch Interval, an average Regulation deployment above the Resource’s Average Basepoint (AVG_BP**) results in a positive REG_DEPL**, while an average Regulation deployment below the Resource’s AVG_BP** results in a negative REG_DEPL**.

In Dispatch Intervals with positive REG_DEPL** and a RT Offer Curve greater than the Real-Time Locational Marginal Price (RT_LMP_EN*), the $NRGA_i$ is a payment to the Resource to ensure that the Resource receives full compensation for the Energy it produced. In Dispatch Intervals with positive REG_DEPL** and a RT Offer Curve less than the RT_LMP_EN*, the $NRGA_i$ is a charge to the Resource to ensure that MISO does not overpay the Resource for Energy reserved and paid for in the Regulating Reserve Market.

In Dispatch Intervals with negative REG_DEPL** and a RT Offer Curve greater than the RT_LMP_EN*, the $NRGA_i$ is a charge to the Resource to ensure that MISO does not overpay the Resource for Energy reserved and paid for in the Regulating Reserve Market. In Dispatch Intervals with a negative REG_DEPL** and a RT Offer Curve less than the RT_LMP_EN*, the $NRGA_i$ is a payment to the Resource since it is being forced to buy out of its Day-Ahead position or is missing out on an opportunity to profit from producing Energy it otherwise would have produced but for the reduced downward Regulation deployment.

D.3.1 Calculation Overview

$NRGA_i$ with positive REG_DEPL** is the difference between (1) the result of (RAO_MW – AVG_BP**) × RT_LMP_EN*, and (2) the RT Area Under the Offer Curve (AUC) from AVG_BP** to Regulation Actual Output (RAO_MW). $NRGA_i$ with negative REG_DEPL** is the difference between (1) the RT AUC from RAO_MW to AVG_BP **, and (2) the result of (AVG_BP** - RAO_MW) × RT_LMP_EN*. The AUC is further described in the "Area Under the Offer Curve" section of this document.

$NRGA_i$ **=**
IF REG_DEPL > 0 **THEN**

$$NRGA_i = (1/12) \times ((RAO\_MW - AVG\_BP) \times RT\_LMP\_EN - \int_{AVG\_BP}^{RAO\_MW} RT\_Offer\_Curve)$$

ELSIF REG_DEPL < 0 **THEN**

$$NRGA_i = (1/12) \times (\int_{RAO\_MW}^{AVG\_BP} RT\_Offer\_Curve - (AVG\_BP - RAO\_MW) \times RT\_LMP\_EN)$$

ELSE
$NRGA_i = 0$
END IF
Where:
RAO_MW =
IF REG_DEPL > 0 **THEN**
RAO_MW = MAX (AVG_BP, MIN (-RES_LP_VOL, AVG_SP))
ELSIF REG_DEPL < 0 **THEN**
RAO_MW = MIN (AVG_BP, MAX (-RES_LP_VOL, AVG_SP))
ELSE
RAO_MW = AVG_BP
END IF

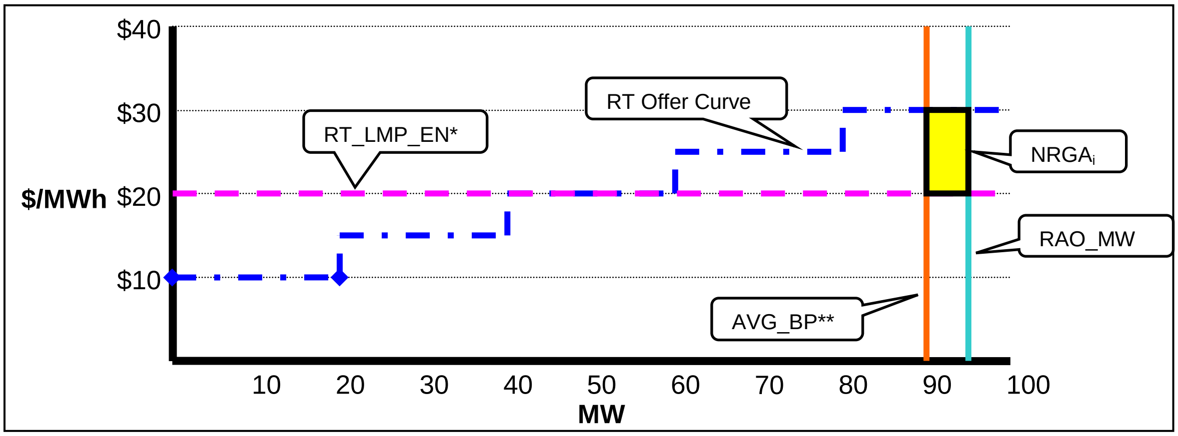
The Resource's RT_ASM_NRGA* is calculated by summing the $NRGA_i$ amounts for the hour.

$$RT\_ASM\_NRGA = (\sum_{i=1}^{12} NRGA_i)$$

D.3.2 Calculation Example

The following are examples of $NRGA_i$ credits and charges for situations with positive REG_DEPL**.

$NRGA_i$ with Positive REG_DEPL**

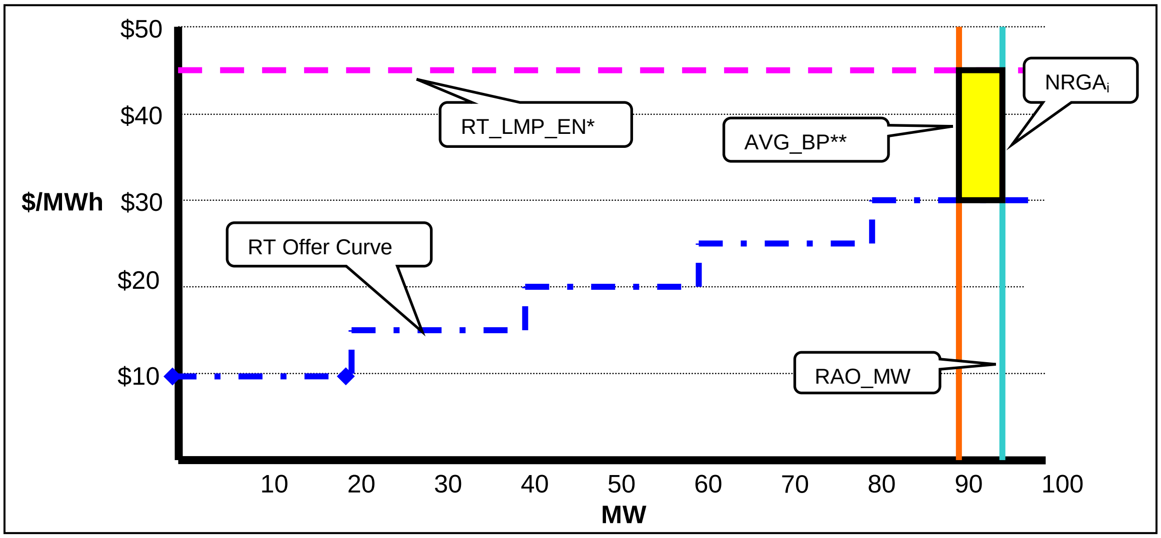


In this example, the $NRGA_i$ is a payment to the Resource:

$$NRGA_i = (1/12) \times \left((RAO\_MW - AVG\_BP) \times RT\_LMP\_EN - \int_{AVG\_BP}^{RAO\_MW} RT\_Offer\_Curve \right)$$

$NRGA_i$ = (1/12) × ((95-90) × \$20 - \$150) = -\$4.17

NRGA$_i$ with Positive REG_DEPL**



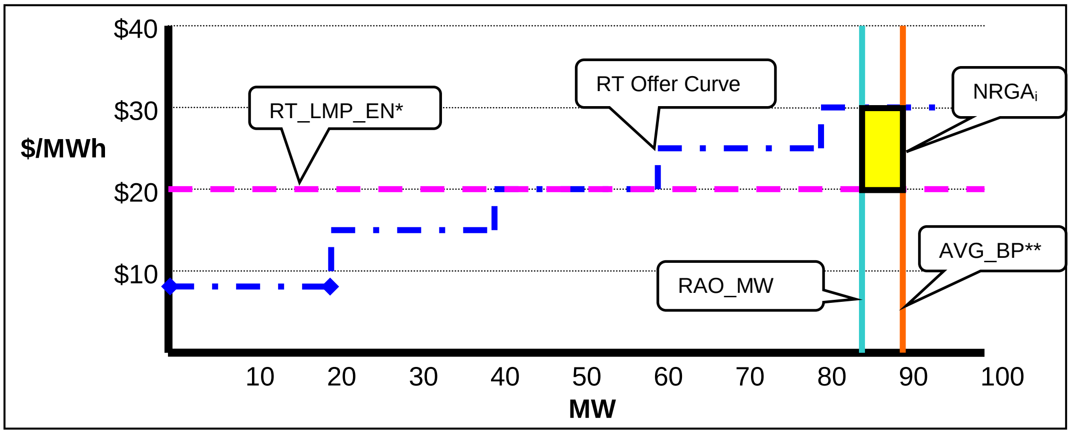
In this example, the NRGA$_i$ is charge to the Resource.

$$NRGA_i = (1/12) \times ((RAO\_MW - AVG\_BP) \times RT\_LMP\_EN - \int_{AVG\_BP}^{RAO\_MW} RT\_Offer\_Curve)$$

$$NRGA_i = (1/12) \times ((95-90) \times \$45 - \$150)= \$6.25$$

The following are examples of NRGA$_i$ credits and charges for situations with negative REG_DEPL**.

NRGA$_i$ with Negative REG_DEPL**

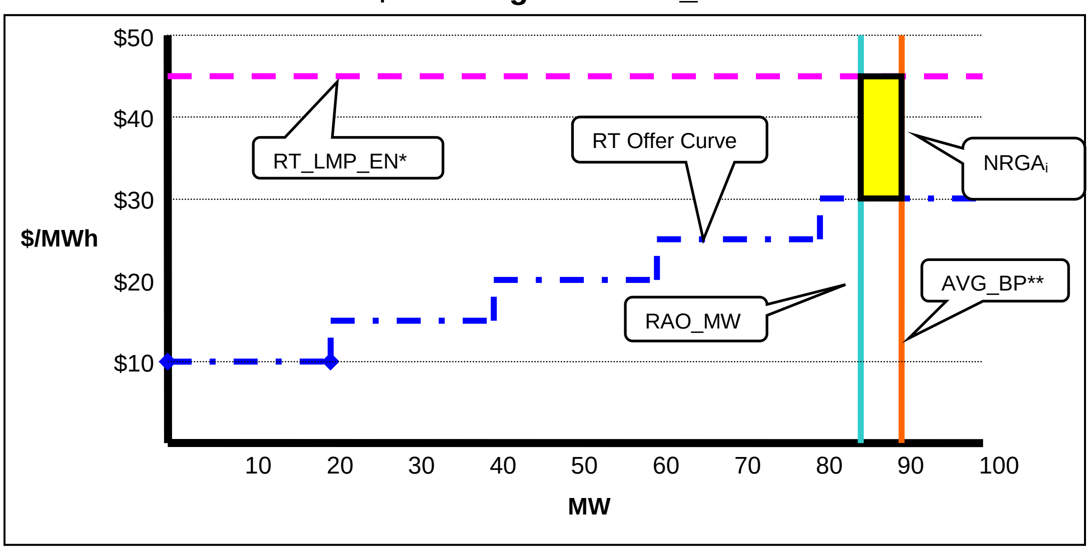


In this example, the NRGA$_i$ is charge to the Resource.

$$NRGA_i = (1/12) \times \left(\int_{RAO\_MW}^{AVG\_BP} RT\_Offer\_Curve - (AVG\_BP - RAO\_MW) \times RT\_LMP\_EN \right)$$

$$NRGA_i = (1/12) \times (\$150 - (90 - 85) \times \$20) = \$4.17$$

NRGA$_i$ with Negative REG_DEPL**



In this case, the $NRGA_i$ is a payment to the Resource.

$$NRGA_i = (1/12) \times \left(\int_{RAO\_MW}^{AVG\_BP} RT\_Offer\_Curve - (AVG\_BP - RAO\_MW) \times RT\_LMP\_EN \right)$$

$NRGA_i$ = (1/12) × (\$150 - (90 – 85) × \$45) = -\$6.25

Consider an Hour in which the $NRGA_i$ is exactly equal to the value of the last example (-\$6.25) for seven Dispatch Intervals and zero for the remaining five Dispatch Intervals. The hourly RT_ASM_NRGA* is calculated as follows:

$$RT\_ASM\_NRGA = \left(\sum_{i=1}^{12} NRGA_i \right)$$

RT_ASM_NRGA = (-\$6.25 + -\$6.25 + -\$6.25 + -\$6.25 + -\$6.25 + -\$6.25 + -\$6.25 + 0 + 0 + 0 + 0 + 0)

RT_ASM_NRGA = -\$43.75

In this example, the Resource would receive a RT_ASM_NRGA* credit of -\$43.75.

D.4 Excessive/Non-Excessive/Deficient Energy

Dispatch Interval Excessive Energy (EXE_i) and Dispatch Interval Deficient Energy (DFE_i) are calculated whenever a Resource's RES_LP_VOL** is outside of its Dispatch Interval Excessive Energy Threshold (EXE_T_i) or Dispatch Interval Deficient Energy Threshold (DFE_T_i). A Resource's EXE_T_i and DFE_T_i are calculated around the Dispatch Interval Average Setpoint Instruction (AVG_SP_i) of the Resource. Within the Tolerance Minimum (TOL_MIN) and Tolerance Maximum (TOL_MAX), the EXE_T_i and DFE_T_i allow for the Tolerance Percent (TOL_%) of the AVG_SP_i plus the MW amount of the ramp utilized in the Dispatch Interval, referred to as the Utilized Ramp MW Adder (RAMP_ADD). The resultant value, accounting for the TOL_MIN and TOL_MAX, is then adjusted for the ramp that is utilized and shared between the Basepoint Difference (BP_DIFF) and Ramped Regulation Deployment (REG_DEPL**). This value is referred to as the Ramp Adjustment (RAMP_ADJ).

D.4.1 Calculation Overview

The EXE_T_i and DFE_T_i are calculated as follows:

IF EEEF** is FALSE **THEN**

EXE_T_i = AVG_SP_i + **MIN** (**MAX** ((AVG_SP_i × TOL_%) + RAMP_ADD , TOL_MIN) , TOL_MAX) – **MIN** (RAMP_ADJ , 0)

DFE_T_i = AVG_SP_i – **MIN** (**MAX** ((AVG_SP_i × TOL_%) + RAMP_ADD , TOL_MIN) , TOL_MAX) – **MAX** (RAMP_ADJ , 0)

ELSE

EXE_T_i = - RES_LP_VOL

DFE_T_i = - RES_LP_VOL

END IF

Note: In the event that the Dispatch Interval EXE_T_i or DFE_T_i are negative, the EXE_T_i and/or DFE_T_i will be set equal to zero.

Where:

AVG_SP_i = AVG_BP + REG_DEPL

RAMP_ADD = **ABS** (BP_DIFF + REG_DEPL)

RAMP_ADJ =

IF (BP_DIFF > 0 AND REG_DEPL > 0) **THEN**
MIN (BP_DIFF , REG_DEPL)
ELSEIF (BP_DIFF < 0 AND REG_DEPL < 0) **THEN**
MAX (BP_DIFF , REG_DEPL)
ELSE
RAMP_ADJ = 0
END IF

Dispatch Interval EXE_i is equal to the negative of RES_LP_VOL** that is above the Resource's EXE_T_i and Dispatch Interval DFE_i is equal to the negative of RES_LP_VOL** that is below the Resource's DFE_T_i.

EXE_i = **MAX** (**-**RES_LP_VOL – EXE_T_i ,0)
DFE_i = **MAX** (DFE_T_i – (**-**RES_LP_VOL) ,0)

Dispatch Interval NXE_i is equal to the lesser of the negative of RES_LP_VOL** or the Resource's EXE_T_i.

NXE_i = MIN (**-**RES_LP_VOL, EXE_T_i)

Dispatch Interval EXE_i and DFE_i are calculated for each Dispatch Interval within the Hour and integrated to arrive at the hourly EXE* and DFE* amounts for use in Market Settlements when Failure to Follow Dispatch Flag (FFDF*) is set to true (1 or "Y") for that Hour.

IF FFDF = 1 **THEN**

$$EXE = \left(\sum_{i=1}^{12} EXE_i \right) / 12$$

$$DFE = \left(\sum_{i=1}^{12} DFE_i \right) / 12$$

ELSE

EXE = 0

DFE = 0

END IF

Hourly NXE is calculated as Real-Time Metered Billable Volume (RT_BLL_MTR*) plus EXE*.

NXE = RT_BLL_MTR + EXE

Note: EXE is positive, while RT_BLL_MTR* is negative for injection and positive for withdrawal.*

Resources with the Excessive Energy Exemption Flag (EEEF*/**) set to true (1 or "Y") will not be subject to the calculation of EXE_i or DFE_i. Furthermore, Dispatch Intervals in which the RES_LP_VOL** is positive or zero (representing load or off-line), will not be subject to the calculation of EXE_i or DFE_i.

EXE* and DFE* are used in the calculation of Real-Time Revenue Sufficiency Guarantee charges. EXE* is settled at the lesser of the RT_LMP_EN* or the Offer Price at AVG_BP** (Offer@AVG_BP). The calculation of EXE* compensation is described in the "Excessive Energy Price (EXP*)" section of this document.

DRR Type-I Resources cannot provide Regulation and have a single Targeted Demand Reduction MW, or AVG_BP**, for a given Hour. Therefore, the RAMP_ADD and RAMP_ADJ for DRR Type-I are equal to zero.

D.4.2 Calculation Example

The following are examples of the Dispatch Interval calculations, resultant hourly determinants, and a graphical representation related to Excessive/Non-Excessive/Deficient Energy Calculations. Each example provides this information for a given Hour.

DRR Type-I or Generation Resource with RAMP_ADD = 0 and RAMP_ADJ = 0

Tolerance Inputs

TOL_MIN	6
TOL_MAX	30
TOL_%	8%

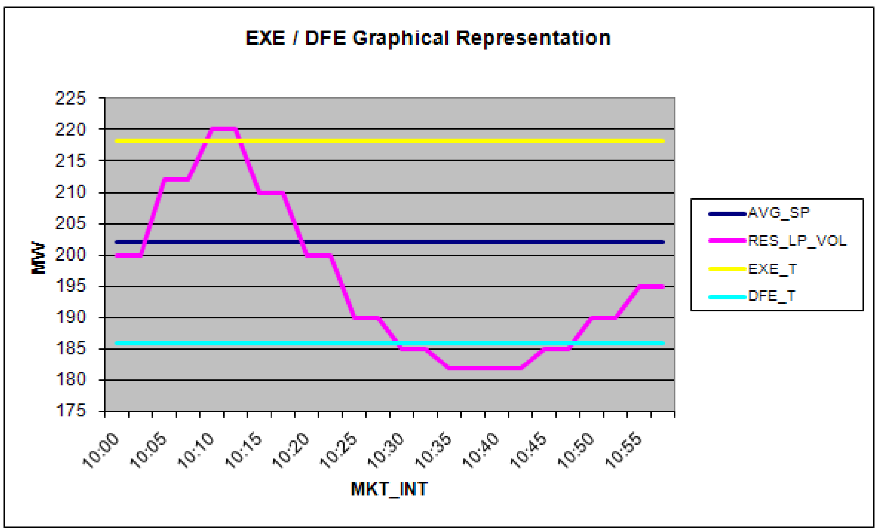
Hourly Values

RT_ACT_MTR*	202	RT_ASM_NXE*	202.153
EXE*	0.153	FFDF*	1
DFE*	0.78		

Dispatch Interval Inputs and Calculations

MKT_INT	BP**	AVG_BP**	REG_DEPL**	AVG_SP	RES_LP_VOL**	BP_DIFF	RAMP_ADD	RAMP_ADJ	EXE_T	DFE_T	EXE_5	DFE_5	NXE	FFDF_5
9:55	202													
10:00	202	202	0	202	-200	0	0	0	218.2	185.8	0	0	200	0
10:05	202	202	0	202	-212	0	0	0	218.2	185.8	0	0	212	0
10:10	202	202	0	202	-220	0	0	0	218.2	185.8	1.84	0	218.2	1
10:15	202	202	0	202	-210	0	0	0	218.2	185.8	0	0	210	0
10:20	202	202	0	202	-200	0	0	0	218.2	185.8	0	0	200	0
10:25	202	202	0	202	-190	0	0	0	218.2	185.8	0	0	190	0
10:30	202	202	0	202	-185	0	0	0	218.2	185.8	0	0.84	185	1
10:35	202	202	0	202	-182	0	0	0	218.2	185.8	0	3.84	182	1
10:40	202	202	0	202	-182	0	0	0	218.2	185.8	0	3.84	182	1
10:45	202	202	0	202	-185	0	0	0	218.2	185.8	0	0.84	185	1
10:50	202	202	0	202	-190	0	0	0	218.2	185.8	0	0	190	0
10:55	202	202	0	202	-195	0	0	0	218.2	185.8	0	0	195	0

(blue)	Calculated Cell
(yellow)	Key Calculated Cells
(white)	Input Variable



Generation Resource with non-zero RAMP_ADD and RAMP_ADJ = 0

Tolerance Inputs

TOL_MIN	6
TOL_MAX	30
TOL_%	8%

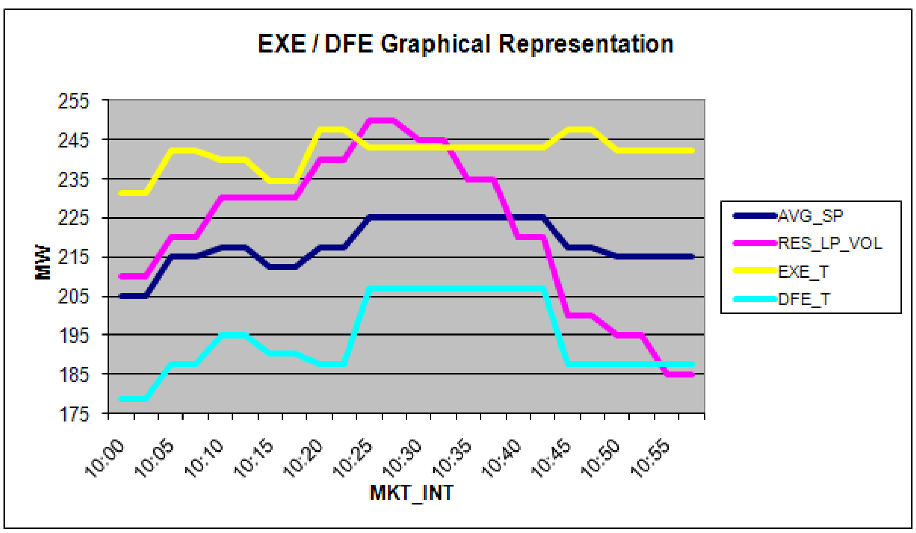
Hourly Values

RT_ACT_MTR*	-221.667	RT_ASM_NXE*	-221.667
EXE*	0	FFDF*	0
DFE*	0		

Dispatch Interval Inputs and Calculations

MKT_INT	BP**	AVG_BP**	REG_DEPL**	AVG_SP	RES_LP_VOL**	BP_DIFF	RAMP_ADD	RAMP_ADJ	EXE_T	DFE_T	EXE_5	DFE_5	NXE	FFDF_5
9:55	200													
10:00	210	205	0	205	-210	10	10	0	231.4	178.6	0	0	210.0	0
10:05	220	215	0	215	-220	10	10	0	242.2	187.8	0	0	220.0	0
10:10	215	217.5	0	217.5	-230	5	5	0	239.9	195.1	0	0	230.0	0
10:15	210	212.5	0	212.5	-230	5	5	0	234.5	190.5	0	0	230.0	0
10:20	225	217.5	0	217.5	-240	15	15	0	247.5	187.5	0	0	240.0	0
10:25	225	225	0	225	-250	0	0	0	243	207	7	0	243.0	1
10:30	225	225	0	225	-245	0	0	0	243	207	2	0	243.0	1
10:35	225	225	0	225	-235	0	0	0	243	207	0	0	235.0	0
10:40	225	225	0	225	-220	0	0	0	243	207	0	0	220.0	0
10:45	210	217.5	0	217.5	-200	15	15	0	247.5	187.5	0	0	200.0	0
10:50	220	215	0	215	-195	10	10	0	242.2	187.8	0	0	195.0	0
10:55	210	215	0	215	-185	10	10	0	242.2	187.8	0	2.8	185.0	1

(blue)	Calculated Cell
(yellow)	Key Calculated Cells
(white)	Input Variable



Generation Resource with non-zero RAMP_ADD and non-zero RAMP_ADJ

Tolerance Inputs

TOL_MIN	6
TOL_MAX	30
TOL_%	8%

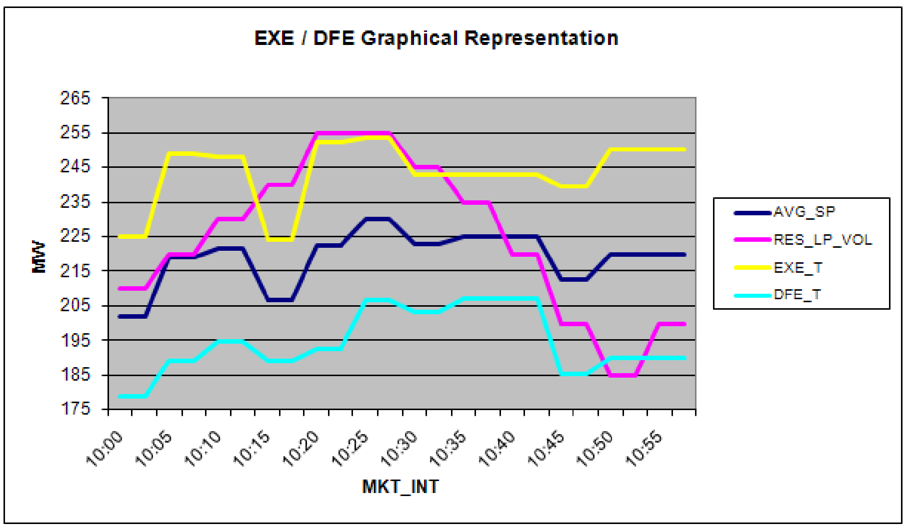
Hourly Values

RT_ACT_MTR*	218.333	RT_ASM_NXE*	220.186
EXE*	1.853	FFDF*	1
DFE*	0.417		

Dispatch Interval Inputs and Calculations

MKT_INT	BP**	AVG_BP**	REG_DEPL**	AVG_SP	RES_LP_VOL**	BP_DIFF	RAMP_ADD	RAMP_ADJ	EXE_T	DFE_T	EXE_5	DFE_5	NXE	FFDF_5
9:55	200													
10:00	210	205	-3	202	-210	10	7	0	225.2	178.8	0	0	210.0	0
10:05	220	215	4	219	-220	10	14	4	249	189	0	0	220.0	0
10:10	215	217.5	4	221.5	-230	5	9	4	248.2	194.8	0	0	230.0	0
10:15	210	212.5	-6	206.5	-240	5	1	0	224	189	15.98	0	224.0	1
10:20	225	217.5	5	222.5	-255	15	20	5	252.5	192.5	2.5	0	252.5	1
10:25	225	225	5	230	-255	0	5	0	253.4	206.6	1.6	0	253.4	1
10:30	225	225	-2	223	-245	0	2	0	242.8	203.2	2.16	0	242.8	1
10:35	225	225	0	225	-235	0	0	0	243	207	0	0	235.0	0
10:40	225	225	0	225	-220	0	0	0	243	207	0	0	220.0	0
10:45	210	217.5	-5	212.5	-200	15	10	0	239.5	185.5	0	0	200.0	0
10:50	220	215	5	220	-185	10	15	5	250	190	0	5	185.0	1
10:55	210	215	5	220	-200	10	15	5	250	190	0	0	200.0	0

	Calculated Cell
	Key Calculated Cells
	Input Variable



D.4.3 Excessive Energy Price (EXP*)

Resource Excessive Energy (EXE*) is settled at the Excessive Energy Price (EXP*) as the Excessive Energy Amount (RT_ASM_EXE*).

D.4.3.1 Calculation Overview

Hourly Excessive Energy (EXE*) is calculated as the average of the Dispatch Interval EXE (EXE_i) values when the Hourly Failure to Follow Dispatch Flag (FFDF*) is set to true (1 or "Y"), as follows:

IF FFDF = 1 **THEN**

$$EXE = \left(\sum_{i=1}^{12} EXE_i \right) / 12$$

ELSE

EXE = 0

END IF

The Excessive Energy Price (EXP*) is calculated as the average of the Dispatch Interval EXP (EXP_i), as follows:

$$EXP = \left(\sum_{i=1}^{12} EXP_i \right)$$

The Dispatch Interval EXP (EXP_i) is calculated as the product of (1) lesser of the Resource Offer Price at AVG_BP** (Offer@AVG_BP) and the RT_LMP_EN* and (2) the EXE_i divided by the sum of EXE_i for the Hour.

EXP_i = **MIN** (Offer@AVG_BP, RT_LMP_EN) × (EXE_i / EXE)

The Excessive Energy Amount (RT_ASM_EXE) is then calculated as the negative of multiplying the EXE* and EXP*.

RT_ASM_EXE = -1 × (EXE × EXP)

D.4.3.1.1 Offer@AVG_BP

The Offer@AVG_BP is calculated depending upon whether the Resource offer prices were submitted as piece-wise linear or block type. If the Offer Curve is piece-wise linear, the Offer@AVG_BP is determined by identifying the two Resource offer points that the AVG_BP** falls between, and then using a linear model (slope of line) to interpolate the corresponding Offer@AVG_BP between the two nearest generation offer points.

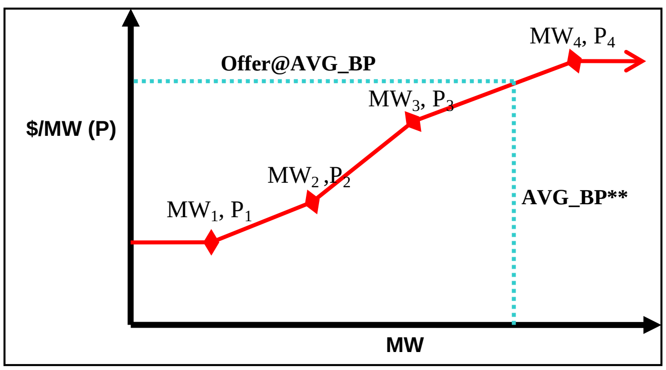
For example, on the Offer Curve below containing Price (P) and MW segments, the calculation of the Offer@AVG_BP is as follows:

Offer@AVG_BP = Slope × (AVG_BP – MW_3) + P_3

Where:

Slope = (P_4 – P_3) / (MW_4 – MW_3)

EXP_i Determination with a Piece-wise Linear Offer Curve

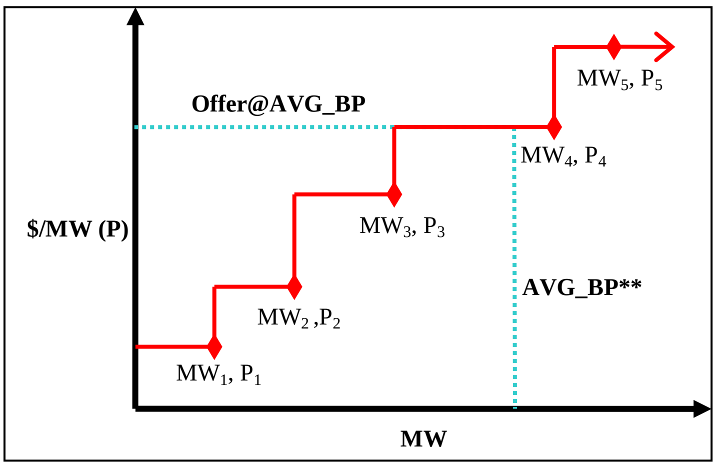


If the offer curve is a block type, offer price P_n is considered valid up to MW_n. Therefore, the AVG_BP** falling on block n will have an offer price of P_n.

For example, on the Offer Curve below containing Price (P) and MW segments, the calculation of the Offer@AVG_BP is as follows:

Offer@AVG_BP = P_4

EXP_i Determination with a Block Offer Curve



Calculation Example

Consider the following example:

EXP* and RT_ASM_EXE* Calculation Example

Hourly Value

EXP*	19.31
EXE*	3.38
RT_ASM_EXE*	-65.33

$EXP^* = \sum EXP_i$

$RT\_ASM\_EXE^* = -1 \times (EXE^* \times EXP^*)$

Offer Data

MKT_HOUR	SEGMENT	PRICE	MW	UBS	Slope
10:00	1	14.4	91	1	0
10:00	2	20	100	1	0.62222222
10:00	3	25.5	105	1	1.1

Interval Inputs and Calculations

MKT_INT	AVG_BP**	EXE_i	RT_LMP_EN*	Offer@AVG_BP	EXP_i
10:00	100	0	19.5	20	0.00
10:05	98	1.5	19.5	18.76	0.69
10:10	99.6	1.4	19.5	19.75	0.67
10:15	97.60	1.9	19.5	18.51	0.87
10:20	98.4	4.6	19.5	19	2.15
10:25	99.10	5.9	19.5	19.44	2.83
10:30	99.10	5.9	19.5	19.44	2.83
10:35	99.50	3.3	19.5	19.69	1.58
10:40	99.7	4.3	19.5	19.81	2.07
10:45	98.5	4.5	19.5	19.07	2.11
10:50	99.2	3.6	19.5	19.5	1.73
10:55	99.3	3.7	19.5	19.56	1.78

$EXP_i = MIN\ (\ Offer@AVG\_BP,\ RT\_LMP\_EN^*\ ) \times (EXE_i\ /\ EXE^*)$

	Calculated Cell
	Input Variable

In this example, the EXE* is 3.38, EXP* is 19.31, and resultant RT_ASM_EXE* is a credit of -$65.33.

D.5 Real-Time Economic Minimum/Maximum Dispatch

The Hourly Real-Time Maximum Dispatchable Volume (RT_MAX_DSP*) and Hourly Real-Time Minimum Dispatchable Volume (RT_MIN_DSP*) are inputs to the Real-Time Revenue Sufficiency Guarantee First Pass Distribution Amount (RT_RSG_DIST1*) calculation.

D.5.1 Calculation Overview

RT_MAX_DSP* and RT_MIN_DSP* are the integration of the Dispatch Interval Real-Time Maximum Dispatchable Volume (RT_DISP_MAX) and Dispatch Interval Real-Time Minimum Dispatchable Volume (RT_DISP_MIN), respectively. In general, if a given Resource is Dispatchable (DISP) and can be dispatched to within its economic limits, based on the Real-Time Ramp Rate (RT_RR), then the RT_DISP_MIN and RT_DISP_MAX are equal to the RT_ECON_MIN and RT_ECON_MAX, respectively. For Intermittent Resources RT_DISP_MIN and RT_DISP_MAX is equal to the negative of the Resource Load Profile Volume (RES_LP_VOL**), with a minimum of zero. For Dispatchable Intermittent Resources, RT_DISP_MAX is equal to the DIR_FORECAST_MAX. In the event that a given Resource is not DISP and cannot be dispatched to within its economic limits, based on the RT_RR, then the RT_DISP_MIN and RT_DISP_MAX are equal to the negative of the RES_LP_VOL**, with a minimum of zero. In the event that a given Resource submits a Real-Time Self-Schedule MW (ENERGY_SS_MW) greater than zero and its Real-Time energy dispatch status (RT_ENERGY_DISP_STATUS) is Self-Schedule (SS), the Adjusted Real-Time Economic Minimum (ADJ_RT_ECON_MIN) is equal to the greater of the ENERGY_SS_MW and the RT_ECON_MIN, and the Adjusted Real-Time Economic Maximum (ADJ_RT_ECON_MAX) is equal to the greater of the ENERGY_SS_MW and the RT_ECON_MAX.

The following shows how the RT_DISP_MIN and RT_DISP_MAX are calculated for each Dispatch Interval:

IF ENERGY_SS_MW > 0 **AND** RT_ENERGY_DISP_STATUS = “SS" **THEN**
  ADJ_RT_ECON_MIN = **MAX** (RT_ECON_MIN, ENERGY_SS_MW)
  ADJ_RT_ECON_MAX = **MAX** (RT_ECON_MAX, ENERGY_SS_MW)
ELSE
  ADJ_RT_ECON_MIN = RT_ECON_MIN
  ADJ_RT_ECON_MAX = RT_ECON_MAX
END IF
IF –RES_LP_VOL <= 0 MW **AND** DISP = FALSE **THEN**
    RT_DISP_MIN = 0
    RT_DISP_MAX = 0
ELSE IF RESOURCE TYPE = INTERMITTENT **THEN**
    RT_DISP_MIN = **MAX** ((-RES_LP_VOL) , 0)
    RT_DISP_MAX = **MAX** ((-RES_LP_VOL) , 0)
ELSE IF DISP = FALSE **AND** (BP < ADJ_RT_ECON_MIN **OR** BP > ADJ_RT_ECON_MAX) **OR** BP = 0) **THEN**
    RT_DISP_MIN = **MAX** ((-RES_LP_VOL) , 0)
    RT_DISP_MAX = **MAX** ((-RES_LP_VOL) , 0)
ELSE IF RESOURCE TYPE = DIR **THEN**
    RT_DISP_MAX = DIR_FORECAST_MAX
    RT_DISP_MIN = **MAX** (ADJ_RT_ECON_MIN , 0)
ELSE
    RT_DISP_MIN = **MAX** (ADJ_RT_ECON_MIN , 0)
    RT_DISP_MAX = **MAX** (ADJ_RT_ECON_MAX , 0)
END IF

Once the RT_DISP_MAX and RT_DISP_MIN values are calculated for each Dispatch Interval, these values are integrated and transferred to Market Settlements as the RT_MAX_DSP* and RT_MIN_DSP*, respectively.

$$RT\_MAX\_DSP = \left(\sum_{i=1}^{12} RT\_DISP\_MAX \right) / 12$$

$$RT\_MIN\_DSP = \left(\sum_{i=1}^{12} RT\_DISP\_MIN \right) / 12$$

D.5.2 Calculation Example

The following is an example of the RT_DISP_MAX, RT_DISP_MIN, RT_MAX_DSP*, and RT_MIN_DSP* calculation.

RT_DISP_MAX, RT_DISP MIN, RT_MAX_DSP*, and RT_MIN_DSP* Calculation Example

Hourly Result

RT_MAX_DSP*	285
RT_MIN_DSP*	227.5

Interval Input and Calculations

Interval	RES_LP_VOL	BP	RT_ECON_MIN	RT_ECON_MAX	ENERGY_SS_MW	ENERGY_DISP_STATUS	DISP.	ADJ_RT_ECON_MIN	ADJ_RT_ECON_MAX	RT_DISP_MIN	RT_DISP_MAX
1	-210	210	230	350	240	EC	0	230	350	210	210
2	-220	220	230	350	240	EC	1	230	350	230	350
3	-230	215	230	350	240	EC	0	230	350	230	230
4	-240	210	230	350	240	EC	1	230	350	230	350
5	-250	225	230	350	240	EC	0	230	350	250	250
6	-240	225	230	350	240	EC	1	230	350	230	350
7	-235	225	230	350	240	EC	0	230	350	235	235
8	-220	225	230	350	240	SS	1	240	350	240	350
9	-200	225	230	350	240	SS	0	240	350	200	200
10	-190	210	230	350	240	SS	1	240	350	240	350
11	-195	220	230	350	240	SS	0	240	350	195	195
12	-200	210	230	350	240	SS	1	240	350	240	350

Input Variable	
Calculated Value	

D.6 Hourly Real Time Dispatch Target for Energy

Hourly Real-Time Dispatch Target for Energy (RT_DSP_TARG_EN*) is input to the Real-Time Revenue Sufficiency Guarantee First Pass Distribution Amount (RT_RSG_DIST$_1$*) calculation.

Real Time Dispatch Target for Energy is the hourly integration of average basepoint for a given Resource.

$$\text{RT\_DSP\_TARG\_EN} = \left(\sum_{i=1}^{12} AVG\_BP\right)/12$$

D.7 Hourly Notification Deadline and As-Committed Economic Minimum/Maximum Volume Proration

The Hourly Notification Deadline and As-Committed Economic Minimum Volume (NDL_ECON_MIN* and AC_ECON_MIN*) and Hourly Notification Deadline and As-Committed Economic Maximum Volume (NDL_ECON_MAX* and AC_ECON_MAX*) for a given Resource are set to zero if either the Resource is not committed or its Notification Deadline commitment status is Outage, Not Available, or Not Participate; otherwise they are prorated based on the number of committed minutes in the market hour.

For example, a resource has a Commitment Period of 7:45 – 9:00. The offered NDL_ECON_MIN* and RT_ECON_MIN* volume is 50 MW. The offered NDL_ECON_MAX* and RT_ECON_MAX volume is 150 MW. This would result in the following hourly volumes:

<u>HE 8</u>
NDL_ECON_MIN and AC_ECON_MIN = 50 MW × (15 min/60 min) = 12.5 MW
NDL_ECON_MAX and AC_ECON_MAX = 150 MW × (15 min/60 min) = 37.5 MW

<u>HE 9</u>
NDL_ECON_MIN and AC_ECON_MIN = 50 MW × (60 min/60 min) = 50 MW
NDL_ECON_MAX and AC_ECON_MAX = 150 MW × (60 min/60 min) = 150 MW

D.8 Day-Ahead and Real-Time Revenue Sufficiency Guarantee Make Whole Payment (DA_RSG_MWP* and RT_RSG_MWP*)

Resources economically committed by MISO that receive SCUC instructions in the DA and RT Energy and Operating Reserve Markets are guaranteed recovery of their Total Production Costs, providing they meet specified eligibility criteria. A settlement calculation compares the Hourly Real-Time Market Energy Amount (RT_MKT_EN_VAL) and/or the Daily Day-Ahead Revenue Sufficiency Market Energy Amount (DA_RSG_EN_VAL_TOTAL) to the Total Production Cost during the relevant SCUC instructed hours of operation. In the DA Energy and Operating Reserve Market, the comparison occurs across all eligible hours within a single Operating Day (OD). In the

RT Energy and Operating Reserve Market, the comparison occurs across the hours of each Commitment Period (CP) within a single OD.

D.8.1 Calculation Overview

For the DA Energy and Operating Reserve Market, if the DA_RSG_EN_VAL_TOTAL is less than the sum of the eligible Total Production Cost, the difference is credited to the Market Participant as a Day-Ahead As-Offered Make Whole Payment (DA_ASOF_MWP*). For the RT Energy and Operating Reserve Market, if the RT_RSG_EN_VAL_CP is less than the sum of the eligible Total Production Cost, the difference is credited to the Market Participant as Real-Time As-Offered Make Whole Payment (RT_ASOF_MWP*). In order to be eligible for full payment of RT_ASOF_MWP*, Resources must satisfy the Real-Time RSG Full Payment Criteria; otherwise, failure of the specified criteria may result in a reduced RT_ASOF_MWP*. For more information regarding the Hourly settlement calculations of DA_ASOF_MWP* and RT_ASOF_MWP* please see Market Settlements Calculation Guide.

D.8.2 Calculation Example

This example is applicable to either DA_ASOF_MWP* or RT_ASOF_MWP*. This example will be referenced throughout the document as eligibility rules and calculations are discussed. The objective of this section is to provide the reader with an introduction to basic calculation components. Later sections will break these components down into more granular elements.

RSG MWP Calculation for a Resource with CP of 12 Hours

	Market Value						Production Cost and Operating Reserve Cost					
HE	**Energy MWh**	**LMP**	**Spin MW**	**Spin MCP**	**Energy MV**	**Spin MV**	**Start-Up**	**No-load**	**Increm Energy**	**Spin Offer**	**Prod Cost**	**Net**
1	30	19	10	6	570	60	250	50	666	4	1006	-359.33
2	30	18	10	6	540	60	250	50	666	4	1006	-359.33
3	30	17	10	6	510	60	250	50	666	4	1006	-359.33
4	30	17	10	6	510	60	250	50	666	4	1006	-359.33
5	30	18	10	7	540	70	250	50	666	4	1006	-359.33
6	30	18	10	7	540	70	250	50	666	4	1006	-359.33
7	30	19	10	6	570	60	250	50	666	4	1006	-359.33
8	30	20	10	6	600	60	250	50	666	4	1006	-359.33
9	30	21	10	7	630	70	250	50	666	4	1006	-359.33
10	30	21	10	8	630	80	250	50	666	4	1006	-359.33
11	30	22	10	8	660	80	250	50	666	4	1006	-359.33
12	30	22	10	7	660	70	250	50	666	4	1006	-359.33
Totals					**6960**	**800**					**12072**	-4312

In this example, Energy and Spinning Reserve is provided by the Resource and the RSG MWP Amount of -$4,312 will be allocated over all hours of the CP (HE1-12). The Market Participant will see -$359.33 (-$4,312/12) as the RSG MWP Amount.

The calculation for a DRR-Type I differs only in the name associated to each cost above. For a DRR-Type I, Shut-Down Cost is equivalent to Start-up Cost and Curtailment Cost is equivalent to No-Load Cost. Furthermore, a DRR-Type I can only clear Energy, Spinning Reserve and/or Supplemental Reserve, so for the purposes of DRR-Type I MWP, Regulating Reserve Costs are assumed to be zero.

D.8.3 Start-up and Shut-Down Cost

Start-Up Cost represents all costs associated with making a Resource available at the start of the CP. The Start-Up Cost should include all fixed costs associated with being available at the beginning of the CP.

Start-Up Cost is calculated using three sets of Market Participant submitted data: 1) Cooling Time, 2) Start-Up Time, and 3) Start-Up Offer. This data is organized into three states: cold, intermediate and hot. Only a single Shut-Down Time and Shut-Down Cost value may be submitted for a DRR-Type I.

Start-Up and Shut-Down Cost Submitted Data

State	Cooling Time	Start-Up/Shut-Down Time	Start-Up Cost	Shut-Down Cost
Cold	HottoColdTime	ColdStartupTime	ColdStartupCost	Not Applicable
Intermediate	HottoIntermediateTime	IntermediateStartupTime	IntermediateStartupCost	Not Applicable
Hot	Not Applicable	HotStartupTime	HotStartupCost	Not Applicable
DRR-Type I	Not Applicable	Shutdowntime	Not Applicable	Shutdowncost

The time value submitted by the Market Participant for Cooling Time represents how long it takes the Resource to cool from a state of hot to intermediate (HottoIntermediateTime) and from a state of hot to cold (HottoColdTime).

The time value submitted by the Market Participant for Start-Up Time represents how long it takes to make the Resource available from each of the three states (including ramp time).

The time value submitted by the Market Participant for Shut-Down Time represents the time required for a DRR-Type I to reduce consumption equal to its Targeted Demand Reduction Level.

The calculation for determining the appropriate Start-Up Cost is:

If (Off Duration) >= (HotToColdTime) + (ColdStartupTime) then (ColdStartupCost)
Elseif (Off Duration) >= (HotToIntermediateTime) + (IntermediateStartupTime) then (IntermediateStartupCost)
Else (HotStartupCost)

For a DA CP, the Off Duration is the number of hours in the Operating Day (OD) up to the CP Start Time minus the lesser of InitialOnHours (IOH) or zero. The Off Duration is then evaluated against the sum of the Cooling Time and Start-up Time to determine the eligible Start-Up Cost. For a RT CP, the Off Duration is the time difference between (1) the Resource’s most recent Control Mode transition to OFF prior to the earliest Control

Mode transition to ON within the Start Time Window and (2) the CP Start Time of the CP.

Start-Up Cost Determination Examples

HottoColdTime HottoIntTime	ColdStartupTime IntStartupTime HotStartupTime	Control Mode transition to OFF	CP Start Time	Result
24 hours 12 hours	12 hours 8 hours 5 hours	01/03/00 01:00	01/03/00 17:00	Hot
24 hours 12 hours	12 hours 8 hours 5 hours	01/02/00 10:00	01/03/00 17:00	Intermediate
24 hours 12 hours	12 hours 8 hours 5 hours	01/02/00 02:00	01/03/00 17:00	Cold
24 hours 12 hours	5 hours 4 hours 4 hours	01/03/00 02:00	01/03/00 17:00	Hot
24 hours 12 hours	5 hours 4 hours 4 hours	01/03/00 01:00	01/03/00 17:00	Intermediate

D.8.3.1 Eligibility Rules

This section will address the eligibility rules for Start-Up Cost. Eligibility rules unique to the DA or RT Energy and Operating Reserve Markets will be discussed in their own subsection.

Resource must be committed by MISO: A Resource CP with an Initial Commit Status of Must-Run is not eligible for Start-Up Cost recovery.

As part of their offer, a Resource can submit the following commitment statues:

1. ***Outage***: designates the Resource is not available for consideration in Energy and Operating Reserve Markets commitment because the Resource is on a Generator Planned Outage or Generator Forced Outage.
2. ***Emergency***: designates the Resource is available for commitment in Emergency situations only.
3. ***Economic***: designates the Resource is available for commitment by MISO. The default status for a Generation Resource or DRR-Type II is the Economic status.
4. ***Must-Run (self-commit)***: designates the Resource as committed per MP request and is available for dispatch by MISO.
5. ***Not Participating:*** designates that the Resource will not participate in the Day-Ahead and/or Real-Time Energy and Operating Reserve Market but is otherwise available.

As part of their offer, a DRR Type-I can submit the following commitment statues:

1. ***Not Participating***: designates the DRR-Type I is not available for Energy commitment in the Energy and Operating Reserve Markets for that Hour but could be available for Contingency Reserve clearing depending on the Spinning Reserve or Supplemental Reserve Dispatch Status.
2. ***Emergency***: designates the DRR-Type I is available for commitment for Energy in Emergency situations only.
3. ***Economic***: designates the DRR-Type I is available for commitment for Energy by MISO. The default status for a DRR-Type I is the Economic status.

D.8.3.1.1 Day-Ahead Eligibility

A Resource economically committed by MISO in DA will be represented on the Settlement Statement by a Day-Ahead Revenue Sufficiency Guarantee Eligibility flag (DA_RSG_ELIGIBILITY*) of true (1 or “Y”).

The rules for Start-up Cost recovery eligibility in the DA are outlined below for Resources. DRR-Type I Resources are always eligible for Shut-Down Cost recovery in the DA Energy and Operating Reserve Market if the DRR-Type I is committed.

DA Start-Up Cost Eligibility Summary for a Resource

Commitment Period	Condition(s)	Eligibility
Day-Ahead Schedule starts after HE1 and ends before HE24	Not adjacent to a Must-Run Commitment Period.	Eligible
Day-Ahead Schedule starts after HE1 and ends before HE24	Adjacent to a Must-Run Commitment Period.	Ineligible
Day-Ahead Schedule starts on HE1	InitialOnHours is greater than zero.	Ineligible
	InitialOnHours is less than zero.	Eligible
Day-Ahead Schedule ends on HE24	First hour of next Operating Day is forecasted to be Must-Run.	Ineligible
	First hour of next Operating Day is forecasted not to be Must-Run.	Eligible

D.8.3.1.2 Real-Time Eligibility

A RT economic CP is represented on the Settlement Statement by the Real-Time Revenue Sufficiency Guarantee Eligibility flag (RT_RSG_ELIGIBILITY*) of true (1 or “Y”).

The rules for Start-up Cost recovery eligibility in RT are outlined below for Resources. Adjacent Commitment Blocks inherit the Start-Up Cost eligibility and Start-Up Cost of the oldest Commitment Block in the contiguous CP.

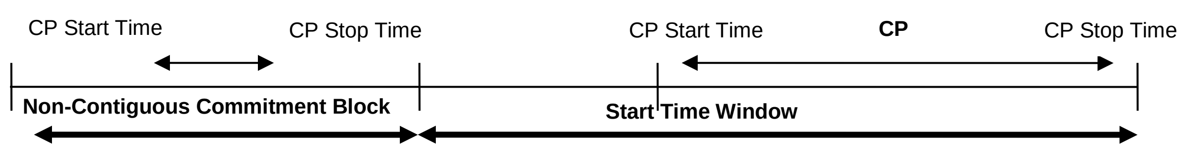
Real-Time Start-Up Cost Eligibility Summary for Resources

Commitment Period	Condition(s)	Eligibility
RT CP adjacent/overlapping DA CP	No other conditions are required.	Ineligible
RT CP adjacent/overlapping RTMR CP	RTMR CP pre-existing the initial CP.	Ineligible
	Must-Run added after RT CP.	Eligible
Real-Time CP in current OD	RT CP Start Time prior to the current OD.	Ineligible
	RT CP Start Time in current OD.	Eligible

Note: Not Applicable to DRR-Type I

Resource shall start within the specified Start Time Window: Resources that do not have a Control Mode transition to ON within their Start Time Window will not be reimbursed their Start-Up Cost. Resources that fail to properly set the Control Mode shall be deemed ineligible for Start-Up Cost recovery. MISO will not grant exemptions for improperly set Control Mode instances. Control Mode transitions do not apply to DRR-Type I.

Exhibit D.2.2.2-2: Start Time Window



Resource must be available and Injecting Energy during the CP: Resources must inject energy during the CP as determined by having at least one Dispatch Interval within the CP with a RES_LP_VOL** representing energy injection. Special provisions apply to MISO initiated cancellations and are defined in the "Cancellations" subsection below.

Timing of Must-Run designation impacts eligibility: The timing of designating a Resource as Must-Run is a factor in determining Start-Up Cost eligibility. For example, a Resource is committed for two hours (HE4 – HE5) with a Must-Run status in the hour after the CP (HE6). If HE6 was offered as Must-Run before the CP was created, the Resource is not eligible to recover Start-Up Cost. If HE6 was designated as Must-Run after the CP was created, the Resource is eligible for Start-Up Cost.

D.8.3.2 Offer Determination

In general, two sets of offer data are used: 1) As-Dispatched Offer and 2) As-Committed Offer. The Start-Up Cost calculation uses As-Committed Offer data.

D.8.3.3 Allocation Rules

Start-Up Cost is allocated in the first hour of the CP. The costs are allocated independent of the Resource On-Line or Off-Line times.

In the following example, if the Start-Up Cost is $810.01 and the CP is from 7:00AM to 11:30AM, the Start-Up Cost will be $810.01 for HE8.

Start-Up Cost Allocation Example

HE	Start-Up Cost
8	$810.01
9	$0.00
10	$0.00
11	$0.00
12	$0.00
Total	$810.01

D.8.3.4 Cancellations

In the event that the Resource is cancelled, a special set of rules to determine the awarded Start-Up Cost.

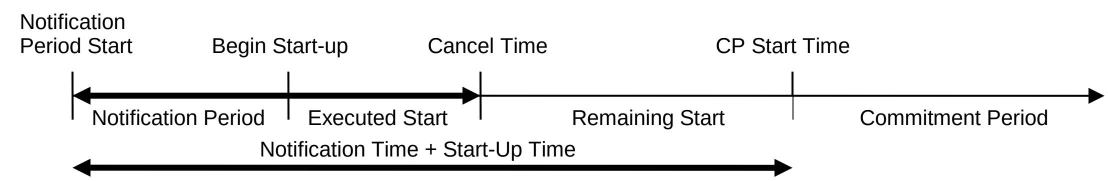
Common Cancellation Scenarios

Event Time	MISO Initiated Cancel
Before Commitment Period Start	Eligible for prorated Start-up Cost Award.
After Commitment Period Start	Eligible for full Start-up Cost Award.

If MISO cancels the Resource prior to the CP Start Time, then the Start-Up Cost is prorated by applying the following formula:

Prorated Start-Up Cost

$$\text{Awarded Start-Up Cost} = \text{Full Start-Up Cost} \times \left\{ 1 + \left[\frac{(\text{Cancel Time} - \text{CP Start Time})}{(\text{Start-up Time} + \text{Notification Time})} \right] \right\}$$



When a Resource is cancelled by MISO after the start of the CP, the Resource is eligible for Total Production Costs providing it meets all other eligibility criteria.

In the event a Resource is cancelled by MISO then issued a CP that overlaps with the original CP, the original CP is treated as if it never existed and the new CP is evaluated for Start-Up Cost eligibility just like any other CP.

D.8.4 Hourly Production Costs

Hourly Production Costs include No-Load Cost, Incremental Energy Costs, and Operating Reserve Cost. Incremental Energy Costs are based on the Resource Offer Curve and are calculated as the Area Under the Offer Curve (AUC). For Day-Ahead, the AUC is determined for each Hour as the integral of the Offer Curve from zero to the Day-Ahead Schedule (DA_SCHD*). For Real-Time, the AUC is determined for each Dispatch Interval as the integral of the Offer Curve from zero to the Dispatch Interval Non-Excessive Energy (NXE_i). Operating Reserve Cost is equal to the amount of Regulating Reserve, Regulating Reserve substituted for Spinning Reserve, Regulating

Mileage, Spinning Reserve and/or Supplemental Reserve multiplied by that Resource's Regulating Reserve Total Offer, Regulating Reserve Capacity Offer, Regulating Mileage Offer, Spinning Reserve and/or Supplemental Reserve Offer, respectively. The Dispatch Interval No-Load Cost, Incremental Energy Cost, Operating Reserve Cost within the CP are integrated to determine the Hourly Production Costs.

D.8.4.1 Eligibility Rules

Resource must be economically committed: A Resource CP with an Initial Commit Status of Must-Run is not eligible for Hourly Production Costs.

Must-Run hours do not receive Hourly Production Costs: Resources will not be eligible to recover Hourly Production Costs during Must-Run hours. Must-Run offers submitted after the initial commitment do not qualify for Hourly Production Costs.

RT Eligibility is based on DA Eligibility: Hours in a RT CP that overlap with a DA CP are not eligible for Hourly Production Costs.

Hourly Production Costs are calculated based on NXE_i: Hourly Production Costs are integrated within the CP when the Resource has a NXE_i representing injection.

D.8.4.1.1 Real-Time RSG Full Payment Criteria

In order to be eligible for full payment of RT_RSG_MWP*, Resources must satisfy the following eligibility criteria:

- The Resource does not have the Failure to Follow Dispatch Flag (FFDF*) equal to true (1 or 'Y')
- The Resource's RT Economic Minimum Dispatch must be less than or equal to the maximum of the following: (1) the As-Committed Hourly Economic Minimum Limit; (2) the As-Committed Self-Schedule MW (ENERGY_SS_MW) for instances where the Energy Dispatch Status is self-schedule; (3) the As-Committed Hourly Regulation Minimum for instances where the Resource is scheduled to potentially provide Regulating Reserve.
- For DRR-Type I Resources, the real-time Dispatch Target for Energy must be less than or equal to the As-Committed Targeted Demand Reduction Level.

- For Resources where all limits used within a specified Dispatch Interval have a dispatch range greater than 1 MW, the following criteria must be satisfied:
    - *Note: Not performed for DRR-Type I Resources.*
  - The Resource is Dispatchable (DISP)
    - Eligibility failure occurs if the Resource fails this criterion in 4 or more consecutive Dispatch Intervals in an Hour.
  - The Real-Time Ramp Capability Dispatch Status must be Economic (EC).
  - The RT Ramp Rate (RT_RR) must be greater than 0.5 MW/minute.
  - The RT_RR must be greater than 0.5% of the RT_ECON_MAX and non-decreasing except in the instance that:
      - *Note: Not performed for Dispatchable Intermittent Resources.*
    - The ACH_MW is greater than or equal to 90% of the RT_ECON_MAX, in which case the RT_RR must be greater than 0.5 MW/minute.
    - The ACH_MW is less than or equal to RT_ECON_MIN plus 10% of RT_ECON_MAX, in which case the RT_RR must be greater than 0.5 MW/minute.
- Eligibility failure occurs if the Resource fails any Ramp Rate criterion described above in 4 or more consecutive Dispatch Intervals in an Hour.

The above requirements are verified for each Dispatch Interval within the RT Economic CP sequentially. In the event that a Resource fails the above eligibility criteria in 4 or more consecutive Dispatch Intervals in an Hour, it will be subject to a RT_RSG_MWP* reduction in the Hour the failure occurs and all subsequent Hours of the RT Economic CP.

D.8.4.1.2 RT_RSG_MWP Reduction

In the event a Resource fails the above Real-Time RSG Full Payment Criteria, the potential RT_RSG_MWP* will be reduced during the affected Hours of the RT Economic CP. The reduction includes two phases: 1) a reduced Real-Time RSG Eligible MWh (RT_RSG_ELIG_MWH*) value and 2) the consideration of additional energy margin (RT_RSG_ADD_EN_MARGIN*) resulting from the RT_RSG_MWP* Reduction.

- The RT_RSG_ELIG_MWH* will be equal to the lesser of the following: 1) NXE; 2) the As-Committed Hourly Economic Minimum (RT_ECON_MIN); 3) the As-Committed Self-Schedule MW (ENERGY_SS_MW) for instances where the Energy Dispatch Status is self-schedule; or (4) the As-Committed Hourly Regulation Minimum for instances where the Resource is scheduled to potentially provide Regulating Reserve.
- For DRR-Type I Resources, the RT_RSG_ELIG_MWH* will be equal to the lesser of the following: 1) Actual Energy Injection; or 2) the As-Committed Targeted Demand Reduction Level.
- The RT_RSG_ADD_EN_MARGIN* is calculated as the greater of the following: (1) the difference between (a) energy revenue associated with Actual Energy Injections between the RT_RSG_ELIG_MWH* and NXE; and (b) the Production Costs for the Energy associated with Actual Energy Injections between the RT_RSG_ELIG_MWH* and NXE; and (2) zero.

IF NXE > RT_RSG_ELIG_MWH THEN

MAX { [(NXE – RT_RSG_ELIG_MWH) * RT_LMP] –

$$[\int_{RT\_RSG\_ELIG\_MWH}^{NXE} RT\_Offer\_Curve] , 0\}$$

ELSE 0

END IF

D.8.4.2 Offer Determination

D.8.4.2.1 Real-Time

In general, two sets of offer data are used: 1) As-Dispatched Offer and 2) As-Committed Offer.

Both As-Committed Offer and As-Dispatched Offer data are considered in determining RT Hourly Production Costs. The As-Dispatched Offer data may reflect changes that the Market Participant made to their offers between the time the Resource was committed and when the resource was dispatched. For each CP, the minimum of a

Resource's As-Committed Offer or As-Dispatched Offer Hourly Production Costs are used in the RT_RSG_MWP* calculation.

D.8.4.2.2 Day-Ahead

During a given Operating Day (OD), the DA_RSG_MWP* calculation will evaluate the DA Offer data from the prior OD and the DA Offer data for the current OD when all of the following conditions are true:

- The Resource has a non-zero DA_SCHD during the last Hour of the prior OD;
- The Resource has a non-zero DA_SCHD during the first Hour of the DA Economic CP in the current OD; and
- The Resource has a positive IOH value that is less than the Resource's Minimum Run Time for the current OD.

In the event a Resource meets the above conditions, the minimum of the Resource's DA Offer data for the prior OD and DA Offer data for the current OD will be used in Hourly Production Costs evaluation during the affected Hours of the current OD. The affected Hours are those Hours in the DA Economic CP that are impacted by the Minimum Run Time. For DRR-Type I, the Minimum Interruption Duration will be used in lieu of Minimum Run Time.

D.8.4.3 Prorated CP Rules

Hourly Production Costs are prorated if the CP does not start or end at the top of the Hour, if the Resource does not have RES_LP_VOL** representing injection at the CP Start Time, or does not have RES_LP_VOL** representing injection up to the CP Stop Time. Hourly Production Costs are based on when the Resource has RES_LP_VOL** representing injection. Market Participants can avoid prorated Hourly Production Costs by being On-Line prior to the CP Start Time and by going Off-Line after the CP Stop Time. Any Resource that comes On-Line, scheduled or unscheduled, will receive a Basepoint (BP), and if applicable, Ancillary Service Cleared Megawatts Volumes (AS_MW**).

In the "Calculation Example" the Resource is On-Line at the CP Start Time and Off-Line at the CP Stop Time. If the Resource was On-Line at 12:13AM, resulting in the first non-zero RES_LP_VOL** in interval end 12:15 AM, the first Hour's Hourly Production Costs would be prorated. The resultant Hourly No-Load, Incremental Energy, and Operating Reserve Cost would be $37.50, $499.50 and $30.00, respectively for the first Hour. Further examples of Hourly Production Costs calculations can be found in the "Hourly Production Costs as calculated by Dispatch Interval" section of this document.

D.8.4.4 Cancellations

In the event that the Resource is cancelled, a special set of rules apply to determine the Hourly Production Costs, as follows:

Cancellation Scenarios

Event Time	MISO Initiated Cancel
Before CP Start Time	Not Eligible for Hourly Production Costs
After CP Start Time	Eligible for Hourly Production Costs

D.8.5 ELMP Make Whole Payments

The ELMP Make Whole Payment is a make whole payment for Day-Ahead Must-Run Resources (MR_ELMP_MWP*), Day-Ahead Virtual Transactions (VIRT_ELMP_MWP*), Day-Ahead Price Sensitive Demand Bids (DA_DB_ELMP_MWP*) including Day-Ahead External Asynchronous Resources Export Schedules, Day-Ahead Dispatchable Interchange Schedule (DISP_ELMP_MWP*), Day-Ahead "UP-to-TUC" Interchange Schedules (TUC_ELMP_MWP*), and Real-Time External Asynchronous Resources Export Schedules Price Sensitive Demand Bids (RT_DB_ELMP_MWP*).

The calculations of MR_ELMP_MWP*, VIRT_ELMP_MWP*, DA_DB_ELMP_MWP*, and RT_DB_ELMP_MWP* are explained in this Section, and the calculations of DISP_ELMP_MWP* and TUC_ELMP_MWP* are explained in the Market Settlements Calculation Guide (MS-OP_029). The inclusion of these new make whole payments in the Day-Ahead RSG Make Whole Payment Amount (DA_RSG_MWP) Charge Type and Real-Time RSG Make Whole Payment Amount (RT_RSG_MWP) Charge Type are presented in the Market Settlements Calculation Guide.

D.8.5.1 Day-Ahead Must-Run ELMP Make Whole Payment (MR_ELMP_MWP*)

Resources that have a commit status of Must-Run (MR) in the Day-Ahead Market are eligible for ELMP MWP for a given Market Hour if its Day-Ahead cleared schedule is above its achievable minimum MW level for energy, or if any of its Day-Ahead Cleared Operating Reserves is above the corresponding DA Self-Schedule.

MR_ELMP_MWP* is equal to the net positive difference between the MR Resource's production cost and the operating revenue.

1. Calculation Overview

For each Market Hour, the calculation is as follows:

a. Hourly Achievable Energy for Previous Market Hour (ACH_MW_PH)

Calculate the Hourly Achievable Energy value for the previous Market Hour (ACH_MW_PH) within the Must-Run Commitment:

IF MARKET_HOUR <> FIRST_COMMITED_HR **THEN**
 = DA_SCHD – (60 × DA_RR)
ELSE
 = 0
END IF

Where DA_SCHD is the DA_SCHD* for previous Market Hour, and
FIRST_COMMITED_HR is the first Market Hour for a given MR Commitment Period.

b. Hourly Day-Ahead Minimum Limit MW (DA_MIN_LIMIT)

The Hourly Day-Ahead Minimum Limit Volume (DA_MIN_LIMIT) is equal to either the Day-Ahead Economic Minimum, or the Day-Ahead Regulation Minimum. This value is determined by the Day-Ahead Control Status, as described in the below logic:

IF DA_CONTROL_STATUS = 2 **THEN**
 = DA_REG_MIN
ELSE
 = DA_ECON_MIN
END IF

WhereDA_CONTROL_STATUS* is the Hourly Day-Ahead Unit Control Status: "0" represents Off-Line, "1" represents online not regulating, "2" represents online for Regulation; and, "3" represents online but off control.

c. Hourly Achievable Minimum MW (ACH_MIN_MW)

Calculate the Hourly Achievable Minimum MW (ACH_MIN_MW), which is the minimum achievable MW level at which a Must-Run Resource may be cleared for Energy in Day-Ahead Market:

IF DA_ENERGY_DISP_STATUS = "SS" **THEN**
= MAX (DA_MIN_LIMIT, ENERGY_SS_MW, ACH_MW_PH)
ELSE
= MAX (DA_MIN_LIMIT, ACH_MW_PH)
END IF

Where DA_ENERGY_DISP_STATUS represents the Market Participant-submitted Dispatch Status as either Unavailable (UN), Economic (EC), Emergency (ME), Self-Schedule (SS), or Must Run (MR).

d. Hourly Day-Ahead Must-Run ELMP MWP Eligibility Flag (MR_MWP_ELIG_FL*)

The Hourly Day-Ahead Must-Run ELMP MWP Eligibility Flag (MR_MWP_ELIG_FL*) represents the Day-Ahead ELMP MWP eligibility for a given Market Hour for a Must-Run Resource. A value of "Y" represents that the Resource is eligible for DA ELMP MWP and a value of "N" represents that the Resource is ineligible for DA ELMP MWP.

IF COMMIT_STATUS = "MR" **AND**
[DA_SCHD > ACH_MIN_MW O**R** DA_AS_VOL > DA_AS_SS_VOL]
THEN
= "Y"
ELSE
= "N"
END IF

e. Hourly Day-Ahead Must-Run Incremental Energy Cost (MR_IE_COST)

Calculate the Hourly Day-Ahead Must-Run Incremental Energy Cost (MR_IE_COST):

IF DA_SCHD > ACH_MIN_MW **THEN**

$$= \int_{ACH\_MIN\_MW}^{DA\_SCHD} DA\_Offer\_Curve$$

ELSE

= 0

END IF

Where DA_Offer_Curve is the Day-Ahead As-Committed Incremental Energy Offer.

f. Hourly Day-Ahead Regulating Reserve Cost (MR_REG_COST)

Calculate the Hourly Day-Ahead Regulating Reserve Cost (MR_REG_COST) for a Must-Run Resource:

= MAX [0, (DA_REG_VOL – DA_REG_SS_VOL)] × DA_REG_AVOF

Where DA_REG_SS_VOL represents the amount of Day-Ahead Self-Schedule Regulating Reserve.

g. Hourly Day-Ahead Spinning Reserve Service Cost (MR_SPIN_COST)

Calculate the Hourly Day-Ahead Spinning Reserve Service Cost (MR_SPIN_COST) for a Must-Run Resource:

= { MAX [0, (DA_SPIN_VOL – DA_SPIN_SS_VOL)] × DA_SPIN_AVOF } +
{ MAX [0,(DA_REG_SPIN_VOL – DA_REG_SPIN_SS_MW) × DA_REG_CAP_AVOF]}

Where DA_REG_SPIN_SS_MW represents the amount of Day-Ahead Self-Schedule Regulating Reserve substituted for Spinning Reserve.

h. Hourly Day-Ahead Supplemental Reserve Service Cost (MR_SUPP_COST)

Calculate the Hourly Day-Ahead Supplemental Reserve Service Cost (MR_SUPP_COST) for a Must-Run Resource:

IF DA_CONTROL_STATUS = 0 **THEN**

= MAX [0, (DA_SUPP_VOL – DA_SUPP_OFF_SS_VOL)] × DA_SUPP_OFF_AVOF

ELSE

= MAX [0, (DA_SUPP_VOL – DA_SUPP_ON_SS_VOL)] × DA_SUPP_ON_AVOF

END IF

i. Hourly Day-Ahead Must-Run Incremental Energy Revenue (MR_IE_REV)

Calculate the Hourly Day-Ahead Must-Run Incremental Energy Revenue (MR_IE_REV):

= MAX [0, DA_SCHD – ACH_MIN_MW] × DA_LMP_EN

j. Hourly Day-Ahead Regulating Reserve Amount (MR_REG_REV)

Calculate the Hourly Day-Ahead Regulating Reserve Amount (MR_REG_REV) for a Must-Run Resource:

= MAX [0, (DA_REG_VOL – DA_REG_SS_VOL)] × DA_REG_MCP

Where DA_REG_SS_VOL is the amount of Day-Ahead Self-Scheduled Regulating Reserve.

k. Hourly Day-Ahead Spinning Reserve Amount (MR_SPIN_REV)

Calculate the Hourly Day-Ahead Spinning Reserve Amount (MR_SPIN_REV) for a Must-Run Resource:

= {MAX [0, (DA_SPIN_VOL – DA_SPIN_SS_VOL)] + [(DA_REG_SPIN_VOL – DA_REG_SPIN_SS_MW)] × DA_SPIN_MCP}

Where DA_SPIN_SS_VOL is the amount of Day-Ahead Self-Scheduled Spinning Reserve

l. Hourly Day-Ahead Supplemental Reserve Amount (MR_SUPP_REV)

Calculate the Hourly Day-Ahead Supplemental Reserve Amount (MR_SUPP_REV) for a Must-Run Resource:

IF DA_CONTROL_STATUS = 0 **THEN**

= MAX [0, (DA_SUPP_VOL – DA_SUPP_OFF_SS_VOL)] × DA_SUPP_MCP

ELSE

= MAX [0, (DA_SUPP_VOL – DA_SUPP_ON_SS_VOL)] × DA_SUPP_MCP

END IF

Where DA_SUPP_OFF_SS_VOL is Day-Ahead Offline Self-Schedule Supplemental Reserve volume, and DA_SUPP_ON_SS_VOL is Day-Ahead Online Self-Schedule Supplemental Reserve volume.

m. Hourly Day-Ahead Ramp Capability Amount (MR_RC_REV)

Calculate the total Hourly Day-Ahead Ramp Capability Amount (MR_RC_REV) for a Must-Run Resource:

= SUM [(DA_DRC_VOL * DA_DRC_MCP), (DA_URC_VOL * DA_URC_MCP)]

2. Calculations for MR_ELMP_MWP*

The Hourly Day-Ahead Must-Run Resource ELMP MWP is calculated as follows:

IF MR_MWP_ELIG_FL = “Y“ **THEN**

= MAX {0, [(MR_IE_COST + MR_REG_COST + MR_SPIN_COST + MR_SUPP_COST) - (MR_IE_REV + MR_REG_REV + MR_SPIN_REV + MR_SUPP_REV + MR_RC_REV)]}

ELSE

= 0

END IF

D.8.5.2 Virtual Transaction ELMP Make Whole Payment (VIRT_ELMP_MWP*)

The Virtual Transaction ELMP MWP for an Asset Owner (AO) at a given Commercial Pricing (CP) node is the sum of Virtual Offer MWP and Virtual Bid MWP. The Virtual Offer MWP is equal to the net positive difference between the Virtual Schedule Offer Production Costs and Virtual Schedule Offer Revenue. .The Virtual Bid MWP is equal to the net positive difference between the Virtual Schedule Bid Charge and the Virtual Schedule Bid Willingness-To-Pay.

1. Calculation Overview

For each Market Hour, the calculation is as follows:

a. Hourly Virtual Schedule Offer Production Cost (VIRT_OFFER_COST)

The Hourly Virtual Schedule Offer Production Cost (VIRT_OFFER_COST) is the cost for an AO offering virtual supply at a CP node for a given Market Hour. A detailed explanation of this calculation is in the Section titled “DA ELMP MWP Production Cost or Willingness-to-Pay Calculation Examples” in this document. Calculate the VIRT_OFFER_COST:

$$= \int_{0}^{-DA\_VSCHDSeller} VIRT\_Offer\_Curve$$

Where DA_VSCHD_{Seller} is the Hourly cleared Virtual Schedule supply MWh (negative value) for an AO at a given CP node, and VIRT_Offer_Curve is the the offer curve supplied by the AO for its virtual supply at the CP node.

b. Hourly Virtual Schedule Offer Revenue (VIRT_OFFER_REV)

The Hourly Virtual Schedule Offer Revenue (VIRT_OFFER_REV) for an AO at a given CP node is calculated as the revenue the AO receives for its cleared virtual supply at a given CP node.

$$= [(-1) \times DA\_VSCHD_{Seller}] \times DA\_LMP\_EN$$

c. Hourly Virtual Offer ELMP MWP (VIRT_OFFER_ELMP_MWP)

Calculate the Hourly Virtual Offer ELMP MWP for an AO at a given CP node:

= MAX [0, (VIRT_OFFER_COST - VIRT_OFFER_REV)]

d. Hourly Virtual Schedule Bid Willingness-To-Pay Amount (VIRT_BID_WTP)

The Hourly Virtual Schedule Bid Willingness-To-Pay Amount (VIRT_DIB_WTP) is the amount an AO is willing to pay for a virtual demand bid at a given CP node and Market Hour. A detailed explanation of this calculation is in the Section titled “DA ELMP MWP Production Cost or Willingness-to-Pay Calculation Examples” in this document. Calculate the VIRT_BID_WTP:

$$= \int_{0}^{DA\_VSCHDBuyer} VIRT\_BID\_Curve$$

Where DA_VSCHD_{Buyer} is the Hourly cleared Virtual Schedule demand MWh (positive value) for an AO at a given CP node, and VIRT_BID_Curve is the the bid curve supplied by the AO for its virtual demand bid at the CP node.

e. Hourly Virtual Schedule Bid Charge Amount (VIRT_BID_CHARGE)

The Hourly Virtual Schedule Bid Charge Amount (VIRT_BID_CHARGE) for an AO at a given CP node is the dollar amount charged to the AO for a cleared virtual demand bid MW at a given CP node for a given Market Hour.

$= DA\_VSCHD_{Buyer} \times DA\_LMP\_EN$

f. Virtual Bid MWP (VIRT_BID_ELMP_MWP*)

Calculate the Hourly Virtual Bid ELMP MWP for an AO at a given CP node:

= MAX [0, (VIRT_BID_CHARGE - VIRT_BID_WTP)]

2. Calculations for VIRT_ELMP_MWP*

Calculate the Hourly Virtual Transaction ELMP MWP Amount for an AO at a given CP node:

= VIRT_OFFER_ELMP_MWP + VIRT_BID_ELMP_MWP

D.8.5.3 Price Sensitive Demand Bid ELMP Make Whole Payment (DB_ELMP_MWP)

The Day-Ahead Price Sensitive Demand Bid ELMP MWP (DA_DB_ELMP_MWP*) is a payment to an AO for its price sensitive demand bid when the Day-Ahead Charge Amount is greater than its Willingness-To-Pay.

The Real-Time Price Sensitive Demand Bid ELMP MWP (RT_DB_ELMP_MWP*) is a payment to an AO for its price sensitive demand bid when the Real-Time Charge Amount is greater than its Willingness-To-Pay.

1. Calculation Overview

For each Market Hour, the calculation is as follows:

a. Hourly Price Sensitive Demand Bid Willingness-To-Pay Amount (DB_WTP)

The Hourly Price Sensitive Demand Bid Willingness-To-Pay Amount (DB_WTP) is the amount an AO is willing to pay for cleared Day-Ahead price sensitive demand bid MW including External Asynchronous Resources Export Schedule MW at a CP node for a given Market Hour. A more detailed explanation of this calculation is in the Section titled “ELMP MWP Production Cost or Willingness-to-Pay Calculation Examples” in this document.

In the Day-Ahead Market, the DA_DB_WTP is calculated as follows:

$$= \int_{0}^{DA\_SCHD\_DB} DB\_Curve$$

Where DA_SCHD_DB is cleared Hourly Day-Ahead price sensitive demand bid MWh (positive value) including External Asynchronous Resources Export Schedule MWh, and DB_Curve is the Day-Ahead price sensitive demand bid curve supplied by the Market Participant.

In the Real-Time Market, for an External Asynchronous Resources Export Schedule, the RT_DB_WTP is calculated as follows:

$$= MAX\left(\int_{DA\_SCHD\_DB}^{RT\_SCHD\_DB} DB\_Curve, 0\right)$$

Where RT_SCHD_DB is the hourly Real-Time Export Schedule MWh, and DB_Curve is the Real-Time Price Sensitive Demand bid curve supplied by the Market Participant.

b. Hourly Price Sensitive Demand Bid Charge Amount (DB_CHARGE)

The Hourly Price Sensitive Demand Bid Charge Amount (DB_CHARGE) is calculated for the Day-Ahead and Real-Time Markets, respectively, using the following logic.

In the Day-Ahead Market, the DA_DB_CHARGE is calculated as follows:
= DA_SCHD_DB × DA_LMP_EN
In the Real-Time Market, the RT_DB_CHARGE is calculated as follows:
= MAX (RT_SCHD_DB - DA_SCHD_DB, 0) x RT_LMP_EN

2. Calculations for DB_ELMP_MWP*

Calculate the Day-Ahead Hourly Price Sensitive Demand Bid ELMP MWP (DA_DB_ELMP_MWP*):
= MAX [0, (DA_DB_CHARGE – DA_DB_WTP)]

Calculate the Real-Time Hourly Price Sensitive Demand Bid ELMP MWP (RT_DB_ELMP_MWP*):
= MAX [0, (RT_DB_CHARGE – RT_DB_WTP)]

D.8.5.4 ELMP MWP Production Cost or Willingness-to-Pay Calculation Examples

The calculation of the ELMP_MWP for Virtual Supply, Virtual Demand, and Price-Sensitive Demand use a similar calculation that takes the integral from zero up to some MW quantity under a bid or offer curve:

$$\int_{0}^{MW} Bid\_Curve$$

The structure of a bid curve or a supply curve for virtual transactions differs from that of a traditional Resource supply curve, requiring a different approach to the calculation of the Area-Under the Offer Curve (AUC). This Section will define the formulations for calculating the AUC for these types of transactions, and also provides some numerical examples.

1. Calculation Overview

All supply offers must be monotonically non-decreasing (the price for a given incremental MW quantity cannot decrease) and all demand bids at Loading Zone Commercial Pricing Node must be monotonically non-increasing (the price for a given incremental MW quantity cannot increase).

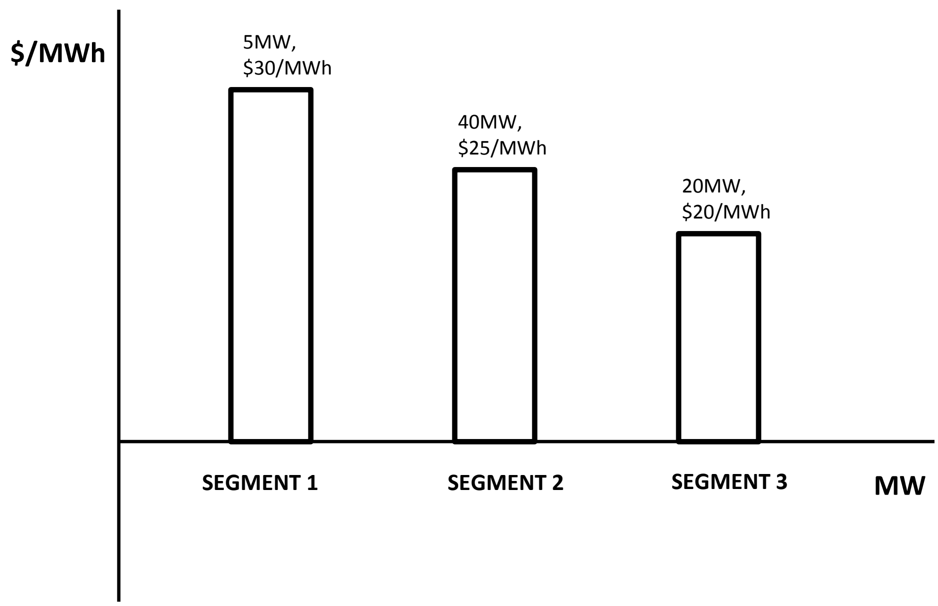
For a supply offer or demand bid at Loading Zone Commercial Pricing Node containing ‘n’ segments (SEGMENT) with an associated MW (BIDMW) and price (BIDPRICE) for each segment, the Hourly production cost or Willingness-to-Pay (COST) for a given Day-Ahead cleared Schedule MW (DA_SCHD) is calculated as follows:

```
COST = 0
CURMW = 0
USEDMW = 0
FOR SEGMENT = 1 TO n
    CURMW = CURMW + BIDMW
    IF CURMW <= DA_SCHD TEHN
            COST = COST + BIDMW × BIDPRICE
            USEDMW = USEDMW + BIDMW
    ELSE
            COST = COST + (DA_SCHD – USEDMW) × BIDPRICE
            END LOOP
    END IF
LOOP
```

2. Calculation Example for Virtual Demand or Price Sensitive Demand Bid at Loading Zone Commercial Price Node

Consider the following Virtual Demand Bid for a market Hour:

Virtual Demand Bid Curve



First, consider the Day-Ahead cleared Virtual Bid volume (DA_SCHD) of 3 MW for a Market Hour, which indicates only first Segment is considered because the DA_SCHD (3 MW) is less than the first segment BIDMW (5 MW). The logic used to calculate the Hourly Virtual Demand Bid Willingness-to-Pay Amount is outlined below.

```
DA_SCHD = 3 MW
COST = 0;
CURMW = 0;
USEDMW = 0;
FOR SEGMENT = I TO 3
    (For SEGMENT 1)
    CURMW = 0 + 5 = 5
    IF 5 <= 3 THEN
        FALSE
    ELSE
        COST = 0 + (3 – 0) MWh × $30/MWh = $90
        END LOOP (SEGMENT 2 and 3 are excluded)
    END IF
LOOP
```

Therefore, the total Hourly Willing-to-Pay Amount is $90 for the cleared Virtual Demand Bid of 3 MW.

Consider the Virtual Demand Bid DA_SCHD of 60 MW for a Market Hour, which indicates all 3 segments are considered; however, Segment 3 is partially considered because DA_SCHD (60 MW) is less than the sum of the first three bid MWs (5 + 40 + 20), but larger than the sum of the first two bid MWs (5 + 40). The logic used to calculate the Virtual Demand Willingness-to-Pay Amount is outlined below.

```
DA_SCHD = 60 MW
COST = 0;
CURMW = 0;
USEDMW = 0;
FOR SEGMENT = I TO 3
        (For SEGMENT 1)
        CURMW = 0 + 5 = 5
        IF 5 <= 60 THEN
                COST = 0 + 5MWh × $30/MWh = $150
                USEDMW = 0 + 5 = 5
        END IF
        (For SEGMENT 2)
        CURMW = 5 + 40 = 45
        IF 45 <= 60 THEN
                COST = $150 + 40 MWh × $25/MWh = $1150
                USEDMW = 5 + 40 = 45
        END IF
        (For SEGMENT 3)
        CURMW = 45 + 20 = 65
        IF 65 <= 60 THEN
                FALSE
        ELSE
                COST = $1150 + (60 – 45) MWh × $20/MWh = $1450
                END LOOP
        END IF
LOOP
```

Therefore, the total Hourly Willingness-to-Pay Amount is $1450 for the cleared Virtual Demand Bid of 60 MW.

Finally, using a Virtual Demand Bid DA_SCHD of 65 MW for a Market Hour, all 3 Segments are considered because DA_SCHD (65 MW) is exact the sum of the three bid MWs (5 + 40 + 20). The logic used to calculate the Willingness-to-Pay Amount is outlined below.

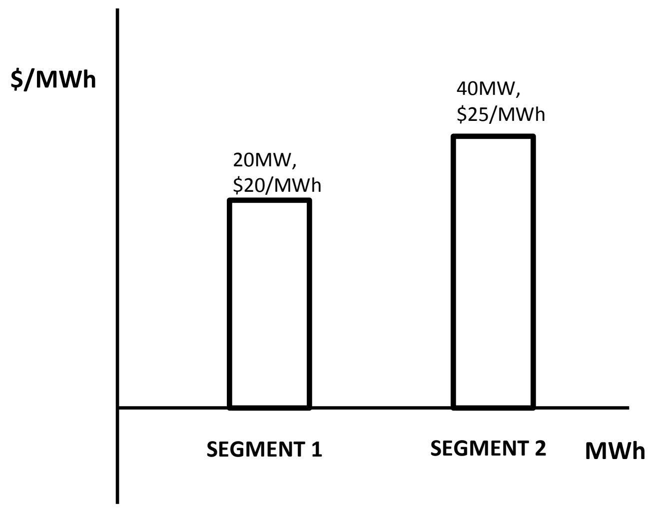
```
DA_SCHD = 65 MW
COST = 0;
CURMW = 0;
USEDMW = 0;
FOR SEGMENT = I TO 3
        (For SEGMENT 1)
                CURMW = 0 + 5 = 5
        IF 5 <= 65 THEN
                COST = 0 + 5MWh × $30/MWh = $150
                USEDMW = 0 + 5 = 5
        END IF
        (For SEGMENT 2)
        CURMW = 5 + 40 = 45
        IF 45 <= 65 THEN
                COST = $150 + 40 MWh × $25/MWh = $1150
                USEDMW = 5 + 40 = 45
        END IF
        (For SEGMENT 3)
        CURMW = 45 + 20 = 65
        IF 65 <= 65 THEN
                COST = $1150 + 20 MWh × $20/MWh = $1550
                USEDMW = 45 + 20 = 65
        END IF
LOOP
```

Therefore, the total Hourly Willingness-to-Pay Amount is $1550 for a cleared Virtual Demand Bid of 65 MW.

3. Calculation Examples for Virtual Supply

Consider the following Virtual Supply Offer for a market Hour:

Virtual Supply Offer



First, consider the Day-Ahead cleared Virtual offer supply volume (DA_SCHD) of 3 MW for a Market Hour, which indicates only Segment 1 is considered because the DA_SCHD (3 MW) is less than the first segment BIDMW (20 MW). The logic used to calculate the Hourly Virtual Supply Offer Cost Amount is outlined below.

```
DA_SCHD = 3 MW
COST = 0;
CURMW = 0;
USEDMW = 0;
FOR SEGMENT = I TO 2
    (For SEGMENT 1)
    CURMW = 0 + 20 = 20
    IF 20 <= 3 THEN
        FALSE
    ELSE
        COST = 0 + (3 – 0) MWh × $20/MWh = $60
        END LOOP (SEGMENT 2 is excluded)
    END IF
LOOP
```

Therefore, the total Hourly cost amount is $60 for cleared Virtual Supply Offer of 3 MW.

Second, consider the Virtual Supply Offer DA_SCHD of 35 MW for a Market Hour, which indicates all segments are considered; however, Segment 2 is partially considered because DA_SCHD (35 MW) is less than the sum of the two bid MWs (20 + 40). The logic used to calculate the Supply Cost Amount is outlined below.

```
DA_SCHD = 35 MW
COST = 0;
CURMW = 0;
USEDMW = 0;
FOR SEGMENT = I TO 2
        (For SEGMENT 1)
        CURMW = 0 + 20 = 20
        IF 20 <= 35 THEN
                COST = 0 + 20MWh × $20/MWh = $400
                USEDMW = 0 + 20 = 20
        END IF
        (For SEGMENT 2)
        CURMW = 20 + 40 = 60
        IF 60 <= 35 THEN
                FALSE
        ELSE
                COST = $400 + (35 – 20) MWh × $25/MWh = $775
                END LOOP
        END IF
LOOP
```

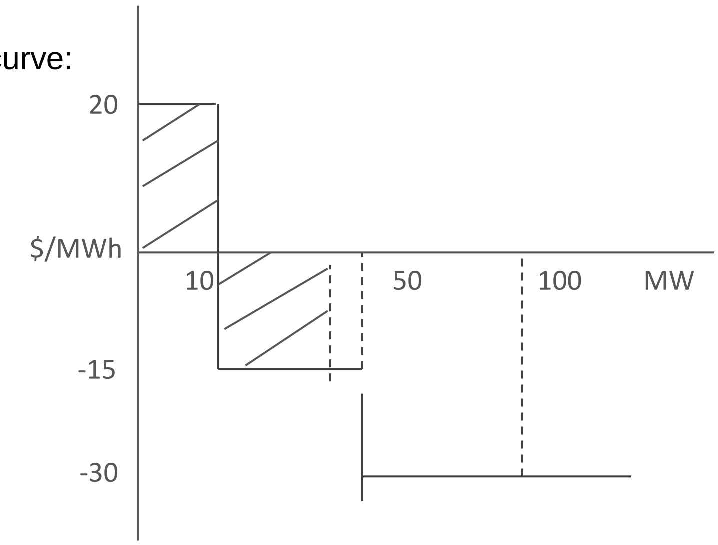
Therefore, the total Hourly cost amount is $775 for cleared Virtual Supply Offer of 45 MW.

4. Calculation Example for External Asynchronous Resources (EAR) Commercial Price Node Export Schedule MWP

The EAR Export Schedule Willingness-to-Pay calculation methodology is described in Section E.11.1 (Calculation Overview) in this document. This may apply to both Day-Ahead and Real-Time ELMP_MWP.

Consider the following bid curve:

EAR Demand Bid Curve		
Use Bid Slope		0
Segment	MW	Price
1	10	20
2	50	-15
3	100	-30



First, the Export Schedule cleared is 45 MWh in Day-Ahead Market and 60MWh in Real-Time Market. The Willingness-to-Pay amount in Day-Ahead Market is calculated as follows:
10MWh * $20/MWh + (45-10) MWh * (-$15/MWh) = $200 - $525 = -$325. The negative amount of willing-to-pay represents the credit of the Asset Owner for exporting (buying) 45MW energy in Day-Ahead Market.

In Real-Time Market, the MWP is evaluated from Day-Ahead Cleared Export energy to the Real-Time Cleared Export energy.

The Willingness-to-Pay amount in Real-Time Market is calculated as follows:
[10MWh * $20/MWh + (50-10) MWh * (-$15/MWh) + (60 – 50) MWh * (-$30/MWh)] - [10MWh * $20/MWh + (45-10) MWh * (-$15/MWh)]
= [$200 - $600 - $300] – [$200 - $525]
= -$700 + $325 = $375

This negative amount of Willingness-to-Pay represents the credit to the Asset Owner for exporting (buying) 15MW (60 – 45) net energy in Real-Time Market.

D.9 Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)

Resources committed DA or RT and are not otherwise eligible for a RT_RSG_MWP* are guaranteed recovery of their Incremental Energy and Operating Reserve Costs, providing they meet specified eligibility criteria. Since these Resources are either committed DA or RT Must-Run (RTMR), they are not eligible for Start-Up Cost or No-Load Cost.

A settlement calculation compares the sum of the Resource's eligible Real-Time Hourly Energy Revenue (RTORSGP_EN_REV_HR), Real-Time Hourly Operating Reserve Revenue (RTORSGP_ASM_REV_HR), and Real-Time Ramp Capability Revenue (RTORSGP_RC_REV_HR) to the sum of the RT_ASM_NRGA*, the eligible Incremental Energy Cost, and Operating Reserve Cost for each Hour. If the sum of RTORSGP_EN_REV_HR, RTORSGP_ASM_REV_HR, and RTORSGP_RC_REV_HR is less than the sum of the RT_ASM_NRGA*, Incremental Energy Cost, and Operating Reserve Cost, the difference is credited to the Market Participant as RTORSGP*. For more information regarding the Hourly settlement calculations of RTORSGP* please see Market Settlements Calculation Guide.

Resources are only eligible for RTORSGP* in Dispatch Intervals in which they:

- Have a DA CP and have NXE_i greater than the DA_SCHD*; or
- Have been committed as a RTMR and have NXE_i greater than their RT_ECON_MIN.

An EAR is only eligible for RTORSGP* in Dispatch Intervals where NXE_i is greater than the DA_SCHD*.

A DRR Type I Resource is only eligible for RTORSGP* in Dispatch Intervals where NXE_i is greater than zero (0) and it has a RTMR “on-line” Contingency Reserve Deployment Commitment.

D.9.1 Calculation Overview

On an hourly basis, the calculation is as follows. In the calculations below 'n' represents the number of eligible Dispatch Intervals within the Hour:

1. **Determine the Base Output (BO_i):** For RTMR Resources, the BO_i is equal to the RT_DISP_MIN of the Resource. For DA committed Resources, the BO_i is equal to the DA_SCHD*.
   IF RTMR **THEN**
   BO_i = RT_DISP_MIN
   ELSEIF DA Committed Resource **THEN**
   BO_i = DA_SCHD
   END IF
2. **Calculate the Real-Time ORSGP Incremental Energy Cost (RT_ORSGP_IE*)**: For each eligible Dispatch Interval in the Hour, the Incremental Energy Cost is equal to the RT Area Under the Offer Curve (AUC) between the BO_i and the NXE_i. The Dispatch Interval costs are then integrated over the Hour to arrive at the RT_ORSGP_IE*.

   RT_ORSGP_IE = $\sum_{i=1}^{n}\left(\int_{BO_i}^{NXE_i} RT\_Offer\_Curve \times {}^{1}\!/_{12}\right)$
3. **Calculate the Real-Time ORSGP Hourly Ancillary Services Cost (RT_AS_AC*):** For each eligible Dispatch Interval in the Hour, for each Ancillary Service (AS), the RT_AS_AC* is calculated as the positive imbalance for each AS between RT and DA, multiplied by the applicable RT Availability Offer (AVOF). The Dispatch Interval costs are then integrated over the Hour to arrive at the RT_AS_AC*. The Real-Time Regulation Reserve Ancillary Services Cost (RT_REG_AC) will also include the Additional Regulating Mileage (ADD_REG_MIL_VOL) multiplied by the RT Regulating Mileage Offer (MIL_OF).

$$\textbf{RT\_REG\_AC} = \{ \sum_{i=1}^{n} (\text{MAX} ((\text{REG\_MW} - \text{DA\_REG\_VOL}), 0) \times \text{REG\_AVOF}) \times 1/12 \} +$$

$$\{ = \sum_{i=1}^{n} (\text{ADD\_REG\_MIL\_VOL} \times \text{MIL\_OF}) \}$$

$$\textbf{RT\_SPIN\_AC} = \sum_{i=1}^{n} (\text{MAX} ((\text{SPIN\_MW} - \text{DA\_SPIN\_VOL}), 0) \times \text{SPIN\_AVOF}) \times 1/12 +$$

$$\sum_{i=1}^{n} (\text{MAX} ((\text{RT\_REG\_SPIN\_MW} - \text{DA\_REG\_SPIN\_VOL}), 0) \times \text{REG\_CAP\_AVOF}) \times 1/12$$

$$\textbf{RT\_SUPP\_AC} = \sum_{i=1}^{n} (\text{MAX} ((\text{SUPP\_MW} - \text{DA\_SUPP\_VOL}), 0) \times \text{SUPP\_AVOF}) \times 1/12$$

RT_AS_AC = RT_REG_AC + RT_SPIN_AC + RT_SUPP_AC

4. **Calculate the Real-Time ORSGP Hourly Energy Revenue (RTORSGP_EN_REV_HR):** The RTORSGP_EN_REV_HR is calculated as the Real-Time Eligible MWh (RT_ELIG_MWH*) times the RT_LMP_EN*. The RT_ELIG_MWH* is calculated as the hourly integration of the difference between the NXE_i and BO_i.

   RTORSGP_EN_REV_HR = RT_LMP_EN × RT_ELIG_MWH
   Where:

$$\text{RT\_ELIG\_MWH} = \sum_{i=1}^{n} (NXE_i - BO_i) \times 1/12$$

5. **Calculate the Real-Time ORSGP Hourly Ancillary Services Revenue (RTORSGP_AS_REV*)**: For each applicable Dispatch Interval in the Hour, for each AS, the RTORSGP_AS_REV* is calculated as the positive imbalance for each AS between RT and DA, multiplied by the applicable Dispatch Interval Real-Time Ancillary Service Market Clearing Price (RT_AS_MCP*). The Dispatch Interval revenues are then integrated over the Hour to arrive at the RTORSGP_AS_REV*. The RTORSGP Regulating Reserve Revenue (RTORSGP_REG_REV) will also include the Additional Regulating Mileage (ADD_REG_MIL_VOL) multiplied by the Dispatch Interval Real-Time Regulating Mileage Market Clearing Price (RT_REG_MIL_MCP**)

RTORSGP_REG_REV = { $\sum_{i=1}^{n}$ (MAX ((REG_MW – DA_REG_VOL) , 0) × REG_MCP) × 1/12 } + { $\sum_{i=1}^{n}$ (ADD_REG_MIL_VOL × RT_REG_MIL_MCP) }

RTORSGP_SPIN_REV = { $\sum_{i=1}^{n}$ (MAX ((SPIN _MW – DA_ SPIN _VOL) , 0) × SPIN _MCP) × 1/12 } +
{ $\sum_{i=1}^{n}$ (MAX ((RT_REG_SPIN_MW – DA_REG_SPIN_VOL) , 0) × SPIN_MCP) × 1/12 }

RTORSGP_SUPP_REV = $\sum_{i=1}^{n}$ (MAX ((SUPP _MW – DA_ SUPP _VOL), 0) × SUPP _MCP) × 1/12

RTORSGP_AS_REV = RTORSGP_REG_REV + RTORSGP_SPIN_REV + RTORSGP_SUPP_REV

6. **Calculate the Real-Time ORSGP Hourly Ramp Capability Revenue (RTORSGP_RC_REV*)**: For each applicable Dispatch Interval in the Hour, for both Down Ramp Capability, and Up Ramp Capability, the RTORSGP_RC_REV* is calculated as the positive imbalance between RT and DA, multiplied by the applicable Dispatch Interval Real-Time Ramp Capability Market Clearing Price (RT_DRC_MCP* or RT_URC_MCP*). The Dispatch Interval revenues are then integrated over the Hour.

RTORSGP_DRC_REV = $\sum_{i=1}^{n}$ (MAX ((RT_DRC_MW – DA_DRC_VOL) , 0) × RT_DRC_MCP) × 1/12

RTORSGP_URC_REV = $\sum_{i=1}^{n}$ (MAX ((RT_URC_MW – DA_URC_VOL) , 0) × RT_URC_MCP) × 1/12

RTORSGP_RC_REV = RTORSGP_DRC_REV + RTORSGP_URC_REV

7. **Calculate the Real-Time Hourly Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)**: The RTORSGP* is the calculated as the minimum of (1) the difference between (a) the sum of (i) the RTORSGP_EN_REV_HR, the (ii) RT_AS_REV*, and the (iii) RTORSGP_RC_REV* and (b) the sum of (i) RT_ORSGP_IE* and (ii) the RTORSGP_AS_AC* and (i) RT_ASM_NRGA* and (2) zero.

   RTORSGP = MIN { [(RTORSGP_EN_REV_HR + RT_AS_REV + RTORSGP_RC_REV) –
   (RT_ORSGP_IE + RTORSGP_AS_AC + RT_ASM_NRGA)], 0}

D.9.2 Eligibility Rules

Resources may be eligible for RTORSGP* provided they satisfy the specified eligibility criteria. The following subsections describe the eligibility criteria for a Day-Ahead Commitment Period and a Real-Time Must-Run Commitment Period.

D.9.2.1.1 Eligibility for a DA CP

A Resource is eligible for the RTORSGP* during a DA CP, providing that:

- The RT Offer Curve must be equal to the DA Offer Curve for each Hour in the CP
  - Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.
- The RT Economic, Emergency and Regulation Minimum Limits must be equal to the DA Economic, Emergency and Regulation Minimum Limits, respectively
- The RT Economic, Emergency and Regulation Maximum Limits must be greater than the RT Economic, Emergency and Regulation Minimum Limits plus 1, respectively.
  - Note: Not performed for Dispatchable Intermittent Resources.
- The RT Regulating Capacity, Regulating Mileage, Spinning and Supplemental Availability Offers must be equal to the DA Regulating Capacity, Regulating Mileage, Spinning and Supplemental Availability Offers
- The Resource does not have the Failure to Follow Dispatch Flag (FFDF*) equal to true (1 or ‘Y’)

  - Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.
- The limits used by the Unit Dispatch System (UDS) must have a dispatch range of greater than 1 MW
- The Resource is Dispatchable (DISP)
  - Eligibility failure occurs if the Resource fails this criterion in 4 or more consecutive Dispatch Intervals in an Hour.
- The DA Ramp Capability Dispatch Status must be Economic (EC).
- The RT Ramp Capability Dispatch Status must be Economic (EC).
- The DA Ramp Rate (DA_RR) must be greater than 0.5 MW/minute
- The RT Ramp Rate (RT_RR) must be greater than 0.5 MW/minute
- The RT_RR must be greater than or equal to the DA_RR unless the DA_RR is greater than 0.5% of the RT Economic Maximum (RT_ECON_MAX), in which case the RT_RR can be modified provided that:
  - Note: Not performed for Dispatchable Intermittent Resources.
  - If the Achievable Megawatt (ACH_MW) is greater than or equal to 90% of the RT_ECON_MAX, then the RT_RR must be greater than 50% of the DA_RR
  - If the ACH_MW is less than or equal to the RT_ECON_MIN plus 10% of the RT_ECON_MAX, then the RT_RR must be greater than 50% of the DA_RR.
    - Note: Not performed for Dispatchable Intermittent Resources.
  - If the ACH_MW is between the RT_ECON_MIN plus 10% of the RT_ECON_MAX and 90% of the RT_ECON_MAX, and the resource is Regulating Reserve qualified and is offering Regulating Reserve, then the RT_RR must be greater than the DA_RR minus 0.5 MW.
    - Note: Not performed for Dispatchable Intermittent Resources.
- Eligibility failure occurs if the Resource fails any Ramp Rate criterion described above in 4 or more consecutive Dispatch Intervals in an Hour.

The above requirements are verified for each Dispatch Interval within the DA CP sequentially. In the event that a Resource fails the above eligibility criteria, it is ineligible for RTORSGP* in the Hour the failure occurs and all subsequent Hours of the CP.

In addition, the DA Offer must satisfy the following conditions, if there is a non-zero DA_SCHD in the prior Hour. These conditions will be evaluated for each Hour of the CP, as long as it is not the first Hour of the CP:

- The offer price for the DA_SCHD in the current Hour must not increase by more than ten percent (10%) from the offer price for the DA_SCHD in the prior Hour.
- The DA Economic Maximum Limit (DA_ECON_MAX) in the current Hour must not decrease, by more than five (5) times the DA_RR, from the minimum of DA_SCHD or DA_ECON_MAX in the prior Hour.

In the event that a Resource fails the above DA Offer eligibility criteria, it is ineligible for RTORSGP* in the given failure Hour.

The following logic details the eligibility criteria listed above regarding prior Hour and current Hour comparisons for DA Offers:

IF ($IE\_OFFER\_PRICE_{CurrentHour}$ – $IE\_OFFER\_PRICE_{PrioHour}$) >
  ABS ($IE\_OFFER\_PRICE_{PriorHour}$ × 10 %)
  THEN RT_ORSGP_FL*= 0
END IF

IF $DA\_ECON\_MAX_{CurrentHour}$ <
  [**MIN** ($DA\_SCHD_{PriorHour}$, $DA\_ECON\_MAX_{PriorHour}$) - (DA_RR × 5)]
  THEN RT_ORSGP_FL*= 0
END IF

D.9.2.1.2 Eligibility for a RTMR CP

A Resource is eligible for the RTORSGP* during a RTMR CP, providing that:

- The following Offer parameters must be the same as the prior Hour for each Hour in the RTMR CP, as long as it is not the first Hour of the RTMR CP:
    - Offer Curve

Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour or for DRR Type I Resource.

- Regulating, Spinning and Supplemental Availability Offers
- Hourly Economic, Emergency and Regulation Minimum Limits
  - *Note: Not performed for DRR Type I Resource.*

- The offer data of the first Hour of the RTMR CP must be the same as the previous hour if there is a CP in the previous hour
- The RT Economic, Emergency and Regulation Maximum Limits must be greater than the RT Economic, Emergency and Regulation Minimum Limits plus 1, respectively
  - *Note: Not performed for DRR Type I Resource.*
  - Note: Not performed for Dispatchable Intermittent Resources.
- The Resource does not have the Failure to Follow Dispatch Flag (FFDF*) equal to true (1 or 'Y')

  Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.
- The limits used by the UDS must have a dispatch range of greater than 1 MW
  - *Note: Not performed for DRR Type I Resource.*
- The Resource is Dispatchable (DISP)

  Note: Not performed for DRR Type I Resource.
  - Eligibility failure occurs if the Resource fails this criterion in 4 or more consecutive Dispatch Intervals in an Hour.
- The RT Ramp Capability Dispatch Status must be Economic (EC).
- The RT_RR must be greater than 0.5 MW/minute
  - *Note: Not performed for DRR Type I Resource.*
- The RT_RR must be greater than 0.5% of the RT_ECON_MAX and non-decreasing except in the instance that:
  - *Note: Not performed for DRR Type I Resource.*
  - Note: Not performed for Dispatchable Intermittent Resources.
  - The ACH_MW is greater than or equal to 90% of the RT_ECON_MAX, in which case the RT_RR only has to be greater than 0.5 MW/minute.
    - Note: Not performed for Dispatchable Intermittent Resources.

- o The ACH_MW is less than or equal to RT_ECON_MIN plus 10% of RT_ECON_MAX, in which case the RT_RR only has to be greater than 0.5 MW/minute.
  - Note: Not performed for Dispatchable Intermittent Resources.
- Eligibility failure occurs if the Resource fails any Ramp Rate criterion described above in 4 or more consecutive Dispatch Intervals in an Hour.

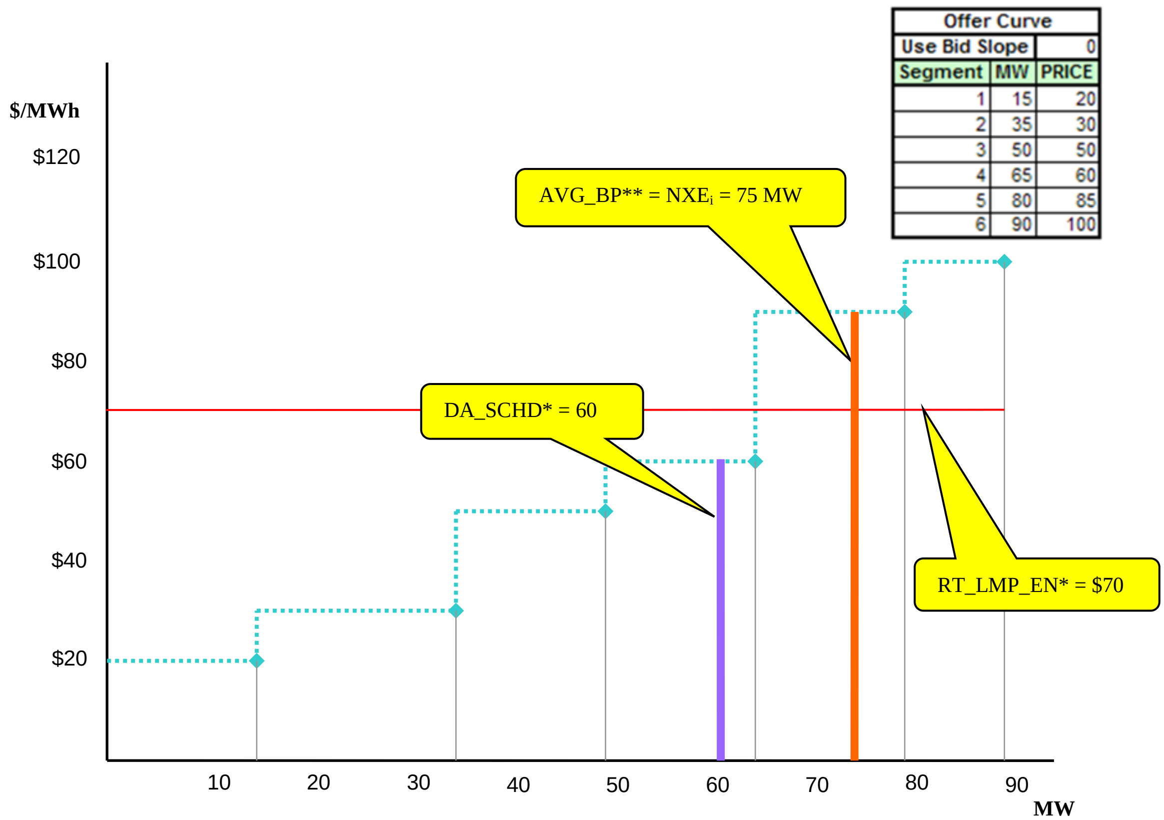
The above requirements are verified for each Dispatch Interval within RTMR CP sequentially. In the event that a Resource fails the above eligibility criteria, it is ineligible for RTORSGP* in the Hour the failure occurs and all subsequent Hours of the CP.

D.9.3 Offer Determination

For RTORSGP* the RT As-Dispatched Offer data is used exclusively.

D.9.4 Calculation Example

Consider a Resource with the following Offer Curve and DA_SCHD*. In the RT, the Resource is dispatched above the DA_SCHD* to the AVG_BP** with an NXE_i of 75 MW. Due to Price Volatility, the RT_LMP_EN* is $70. Assume that this scenario is same for all Dispatch Intervals in the Hour.


Offer Curve
Use Bid Slope 0
Segment MW PRICE
1 15 20
2 35 30
3 50 50
4 65 60
5 80 85
6 90 100
$/MWh
$120
$100
$80
$60
$40
$20
AVG_BP** = NXE$_i$ = 75 MW
DA_SCHD* = 60
RT_LMP_EN* = $70
10
20
30
40
50
60
70
80
90
MW

All offer parameters for the Resource remain unchanged. Therefore the following variables are defined:

Variable Definitions

DA_SCHD = 60	DA_REG_VOL = 5	REG_AVOF = 30	DA_SPIN_VOL = 10
SPIN_AVOF = 7	DA_SUPP_VOL = 0	REG_MW = 7	REG_MCP = 40
SPIN_MW = 15	SPIN_MCP = 10	RT_SUPP = 0	AVG_BP = 75
NXE_i = 75	RT_ECON_MAX = 60	DFE_T = 34	RT_LMP_EN* = 65
ADD_REG_MIL_VOL = 3	RT_REG_MIL_MCP = 3	DA_REG_SPIN_VOL = 8	RT_REG_SPIN_MW = 11
MIL_OF = 2	REG_CAP_AVOF = 25		

1. **Determine the Base Output (BO_i):** Since this resource has a DA CP.

   BO_i = DA_SCHD

   BO_i = 60

2. **Calculate the Real-Time ORSGP Incremental Energy Cost (RT_ORSGP_IE*):**

$$RT\_ORSGP\_IE = \sum_{i=1}^{n}\left(\int_{BO_i}^{NXE_i} RT\_Offer\_Curve \times {}^{1}\!/_{12}\right)$$

$$RT\_ORSGP\_IE = \sum_{i=1}^{12}\left(\int_{60}^{75} RT\_Offer\_Curve \times {}^{1}\!/_{12}\right) = \$1,150.00$$

3. **Calculate the Real-Time ORSGP Hourly Ancillary Services Cost (RT_AS_AC*):**

$$\textbf{RT\_REG\_AC} = \{ \sum_{i=1}^{n} (MAX ((REG\_MW - DA\_REG\_VOL) , 0) \times REG\_AVOF) \times 1/12 \}$$

$$+ \{ \sum_{i=1}^{n} (ADD\_REG\_MIL\_VOL \times MIL\_OF)$$

$$\textbf{RT\_REG\_AC} = \{ \sum_{i=1}^{12} (MAX ((7 - 5) , 0) \times 30) \times 1/12 \} + \{ \sum_{i=1}^{12} (3 \times 2) \} = \textbf{\$132.00}$$

$$\textbf{RT\_SPIN\_AC} = \{ \sum_{i=1}^{n} (MAX ((SPIN\_MW - DA\_SPIN\_VOL) , 0) \times SPIN\_AVOF) \times 1/12 \} +$$

$$\{ \sum_{i=1}^{n} (MAX ((REG\_SPIN\_MW - DA\_REG\_SPIN\_VOL) , 0) \times REG\_CAP\_AVOF) \times 1/12 \}$$

$$\textbf{RT\_SPIN\_AC} = \{ \sum_{i=1}^{12} (\mathrm{MAX} ((15 - 10) , 0) \times 7) \times 1/12 \} + \{ \sum_{i=1}^{12} (\mathrm{MAX} ((11 - 8) , 0) \times 25) \times 1/12 \} = \mathbf{\$110.00}$$

$$\textbf{\textit{RT\_SUPP\_AC}} = \sum_{i=1}^{n} (MAX ((SUPP\_MW - DA\_SUPP\_VOL) , 0) \times SUPP\_AVOF) \times 1/12$$

$$\textbf{RT\_SUPP\_AC} = \sum_{i=1}^{12} (\mathrm{MAX} ((0 - 0) , 0) \times 0) \times 1/12 = \mathbf{\$0.00}$$

RT_AS_AC = *RT_REG_AC + RT_SPIN_AC + RT_SUPP_AC*
RT_AS_AC = \$132.00 + \$110.00 + \$0.00 = **\$242.00**

4. **Calculate the Real-Time ORSGP Hourly Energy Revenue (RTORSGP_EN_REV_HR):**

$$\textbf{\textit{RT\_ELIG\_MWH}} = \sum_{i=1}^{n} (NXE_i - BO_i) \times 1/12$$

$$\textbf{RT\_ELIG\_MWH} = \sum_{i=1}^{n} (75 - 60) \times 1/12 = 15$$

RTORSGP_EN_REV_HR = RT_LMP_EN × RT_ELIG_MWH
RTORSGP_EN_REV_HR = 70 × 15 = \$1,050.00

5. **Calculate the Real-Time ORSGP Hourly Ancillary Services Revenue (RTORSGP_AS_REV*)**:

$$\textbf{\textit{RTORSGP\_REG\_REV}} = \{ \sum_{i=1}^{n} (MAX ((REG\_MW - DA\_REG\_VOL) , 0) \times REG\_MCP) \times 1/12 \} + \{ \sum_{i=1}^{n} (ADD\_REG\_MIL\_VOL \times RT\_REG\_MIL\_MCP) \}$$

$$\textbf{RTORSGP\_REG\_REV} = \{ \sum_{i=1}^{12} (\mathrm{MAX} ((7 - 5) , 0) \times 40) \times 1/12 \} + \{ \sum_{i=1}^{12} (3 \times 3) \} = \mathbf{\$188.00}$$

$$\boldsymbol{RTORSGP\_SPIN\_REV} = \{ \sum_{i=1}^{n} (MAX ((SPIN\_MW - DA\_SPIN\_VOL) , 0) \times SPIN\_MCP) \times 1/12 \}$$

$$+ \{ \sum_{i=1}^{n} (MAX ((RT\_REG\_SPIN\_MW - DA\_REG\_SPIN\_VOL) , 0) \times SPIN\_MCP) \times 1/12 \}$$

$$\mathbf{RTORSGP\_SPIN\_REV} = \{ \sum_{i=1}^{12} (MAX ((15 - 10) , 0) \times 10) \times 1/12 \}$$

$$+ \{ \sum_{i=1}^{12} (MAX ((11 - 8) , 0) \times 10) \times 1/12 \} = \mathbf{\$80.00}$$

$$\boldsymbol{RTORSGP\_SUPP\_REV} = \sum_{i=1}^{n} (MAX ((SUPP\_MW - DA\_SUPP\_VOL) , 0) \times SUPP\_MCP) \times 1/12$$

$$\mathbf{RTORSGP\_SUPP\_REV} = \sum_{i=1}^{12} (MAX ((0 - 0) , 0) \times 0) \times 1/12 = \mathbf{\$0.00}$$

RTORSGP_AS_REV = *RTORSGP_REG_REV* + *RTORSGP_SPIN_REV* + *RTORSGP_SUPP_REV*
RTORSGP_AS_REV = $188.00 + $80.00 + $0.00 = **$268.00**

6. **Calculate the Real-Time Hourly Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)**:
   Assume that while the Resource cleared Regulating Reserve, the REG_DEPL** is zero, and therefore the RT_ASM_NRGA* for the Hour is also zero.
   RTORSGP = MIN { [(RTORSGP_EN_REV_HR + RT_AS_REV) –
   (RT_ORSGP_IE + RTORSGP_AS_AC + RT_ASM_NRGA)], 0}
   RTORSGP = MIN { [($1,050.00 + $268.00) – ($1,150.00 + $242.00 + 0)], 0}
   RTORSGP = MIN { [$1,318 – $1,392] , 0} = $-74.00

Therefore the Resource receives a RTORSGP* credit of $-74.00.

D.10 Day-Ahead Margin Assurance Payment (DA_MAP*)

Resources with a DA CP may be dispatched in RT below their DA Schedule (DA_SCHD*) and settled at an RT_LMP_EN* or Real-Time Ancillary Service Market Clearing Price (RT_AS_MCP*), eroding their DA margin. This may be caused by different market factors, including but not limited to, Manual Re-dispatch and Price Volatility. If a Resource is derated in RT, the DA_SCHD*, Day-Ahead Ancillary Services Volume (DA_AS_VOL*), and Day-Ahead Up Ramp Capability Volume (DA_URC_VOL*) are adjusted based on the logic defined below. For more information regarding the Hourly settlement calculations of DA_MAP* please *s*ee Market Settlements Calculation Guide.

D.10.1Calculation Overview

For each Dispatch Interval, the calculation is as follows:

1. **Calculate the Adjusted Day-Ahead Energy Volume ($ADJ\_DA\_EN_i$), the Adjusted Day-Ahead Ancillary Services Volume ($ADJ\_DA\_AS_i$), and the Adjusted Day-Ahead Up Ramp Capability Volume ($ADJ\_DA\_URC_i$) in the event of a de-rate:**
    a. **Calculate the Reduction Total (RED_TOT_i):** The RED_TOT_i is the maximum of (1) the difference between (a) sum of the DA_SCHD*, DA_AS_VOL*, and DA_URC_VOL and (b) the RT_DISP_MAX or (2) zero. If the RED_TOT_i is zero (no de-rate), then the $ADJ\_DA\_EN_i$, the $ADJ\_DA\_AS_i$, and the $ADJ\_DA\_URC_i$ are equal to the DA_SCHD*, the DA_AS_VOL*, and the DA_URC_VOL*, respectively; skip to the "Calculate Dispatch Interval Day-Ahead Margin Assurance Payment Energy Contribution ($DAMAP\_EN\_CON_i$)" step:

    IF MRD_FL = 1 **THEN**

    RED_TOTi = MAX (DA_SCHD + DA_AS_VOL + DA_URC_VOL – MIN (DA_SCHD + DA_AS_VOL + DA_URC_VOL , RT_ECON_MAX) , 0)

    ELSE

    RED_TOT_i = MAX (DA_SCHD + DA_AS_VOL + DA_URC_VOL - RT_DISP_MAX, 0)

    END IF

    IF MAX (DA_SCHD + DA_AS_VOL + DA_URC_VOL - RT_ECON_MAX, 0) = 0

THEN
  $ADJ\_DA\_EN_i$ = DA_SCHD **AND**
  $ADJ\_DA\_AS_i$ = DA_AS_VOL **AND**
  $ADJ\_DA\_URC_i$ = DA_URC_VOL
END IF

b. **Calculate the Potential Reduction of Energy ($POT\_RED\_EN_i$), Potential Reduction of Ancillary Services ($POT\_RED\_AS_i$), Potential Reduction of Up Ramp Capability ($POT\_RED\_URC_i$), and Potential Reduction Total ($POT\_RED\_TOT_i$):** The $POT\_RED\_EN_i$, $POT\_RED\_AS_i$ for each ancillary product, and $POT\_RED\_URC_i$ is the maximum of (1) the difference between (a) the DA_SCHD*, DA_AS_VOL*, or DA_URC_VOL and (b) the AVG_BP**, AS_MW**, or RT_URC_MW** or (2) zero. The $POT\_RED\_TOT_i$ is equal to the sum of the $POT\_RED\_EN_i$, the $POT\_RED\_AS_i$, and then $POT\_RED\_URC_i$. These calculations are defined as follows:

$POT\_RED\_EN_i$ = MAX (DA_SCHD - AVG_BP , 0)
$POT\_RED\_AS_i$ = MAX (DA_AS_VOL - AS_VOL , 0)
$POT\_RED\_URC_i$ = MAX (DA_URC_VOL – RT_URC_MW , 0)
$POT\_RED\_TOT_i$ = $POT\_RED\_EN_i$ + $POT\_RED\_AS_i$ + $POT\_RED\_URC_i$

c. **Calculate the Reduction of Energy (RED_EN_i), Reduction of Ancillary Service (RED_AS_i), and Reduction of Up Ramp Capability (RED_URC_i):** If the $POT\_RED\_EN_i$, $POT\_RED\_AS_i$, or $POT\_RED\_URC_i$ for a given product is zero, then the RED_EN_i, r RED_AS_i, or RED_URC_i for that product is zero. Otherwise, the RED_EN_i, RED_AS_i for each product, and RED_URC_i is the RED_TOT_i multiplied by the applicable $POT\_RED\_EN_i$, $POT\_RED\_AS_i$, or $POT\_RED\_URC_i$ value, divided by the $POT\_RED\_TOT_i$:

RED_EN_i =
IF $POT\_RED\_EN_i$ = 0 **THEN**
  RED_EN_i = 0
ELSE
  RED_EN_i = RED_TOT_i × ($POT\_RED\_EN_i$ / $POT\_RED\_TOT_i$)
END IF

RED_AS_i =
IF $POT\_RED\_AS_i$ = 0 **THEN**

$RED\_AS_i = 0$
ELSE
$RED\_AS_i = RED\_TOT_i \times (POT\_RED\_AS_i / POT\_RED\_TOT_i)$
END IF

$RED\_URC_i =$
IF $POT\_RED\_URC_i = 0$ **THEN**
$RED\_URC_i = 0$
ELSE
$RED\_URC_i = RED\_TOT_i \times (POT\_RED\_URC_i / POT\_RED\_TOT_i)$
END IF

d. **Calculate the $ADJ\_DA\_EN_i$, $ADJ\_DA\_AS_i$, and $ADJ\_DA\_URC_i$ values:** The $ADJ\_DA\_EN_i$, $ADJ\_DA\_AS_i$ for each product, and $ADJ\_DA\_URC_i$ is the applicable DA_SCHD*, DA_AS_VOL*, or DA_URC_VOL value less the applicable RED_EN_i, RED_AS_i, or RED_URC_i value:
$ADJ\_DA\_EN_i = DA\_SCHD - RED\_EN_i$
$ADJ\_DA\_AS_i = DA\_AS\_VOL - RED\_AS_i$
$ADJ\_DA\_URC_i = DA\_URC\_VOL - RED\_URC_i$

2. **Calculate the Dispatch Interval Day-Ahead Margin Assurance Payment Energy Contribution ($DAMAP\_EN\_CON_i$):**
   a. If the Dispatch Interval Average Basepoint (AVG_BP**) and Dispatch Interval Non-Excessive Energy (NXE_i), are less than the $ADJ\_DA\_EN_i$ then the $DAMAP\_EN\_CON_{i(a.)}$ is equal to the difference between 1) the as-offered deviation charge and 2) the charge of settling at the AVG_BP**. The as-offered deviation charge is equal to the greater of (I) the difference between 1) the DA Area Under the Offer Curve (AUC) from zero to the $ADJ\_DA\_EN_i$ and 2) the DA AUC zero to the greater of a) the NXE_i and b) the Deficiency Energy Threshold (DFE_T) and (II) the difference between 1) the RT Area Under the Offer Curve (AUC) from zero to the $ADJ\_DA\_EN_i$ and 2) the RT AUC zero to the greater of a) the NXE_i and b) the Deficiency Energy Threshold (DFE_T). The charge of settling at the AVG_BP** is equal to the product of 1) the difference between a) the $ADJ\_DA\_EN_i$ and b) the maximum of the i) NXE_i and ii) the DFE_T and 2) the hourly RT_LMP_EN*.

$DAMAP\_EN\_CON_{i(a.)}$ =
IF AVG_BP < $ADJ\_DA\_EN_i$ **AND** NXE_i < $ADJ\_DA\_EN_i$ **THEN**
$DAMAP\_EN\_CON_{i(a.)}$ =

$$\text{MAX}\left[\left(\int_0^{ADJ\_DA\_EN_i} DA\_Offer\_Curve - \int_0^{MAX(NXE_i, DFE\_T)} DA\_Offer\_Curve\right),\right.$$

$$\left.\left(\int_0^{ADJ\_DA\_EN_i} RT\_Offer\_Curve - \int_0^{MAX(NXE_i, DFE\_T)} RT\_Offer\_Curve\right)\right] -$$

$$[\,(ADJ\_DA\_EN_i - MAX(NXE_i, DFE\_T)) \times RT\_LMP\_EN\,]$$

END IF

Note: If the AVG_BP is less than the $ADJ\_DA\_EN_i$, but the NXE_i is greater than the $ADJ\_DA\_EN_i$, the $DAMAP\_EN\_CON_{i(a.)}$ is zero.

b. If the AVG_BP** and NXE_i are greater than or equal to the $ADJ\_DA\_EN_i$ then the $DAMAP\_EN\_CON_{i(b.)}$ is equal to greater of 1) the difference between a) the charge of settling at the AVG_BP** and b) the as-offered deviation charge and 2) zero. The charge of settling at the AVG_BP** is equal to the product of 1) the difference between a) the NXE_i and b) the $ADJ\_DA\_EN_i$ multiplied by 2) the RT_LMP_EN*. The as-offered deviation charge is equal to the difference between 1) RT AUC from zero to the NXE_i and 2) RT AUC from zero to the $ADJ\_DA\_EN_i$.

$DAMAP\_EN\_CON_{i(b.)}$ =
IF AVG_BP >= $ADJ\_DA\_EN_i$ **AND** NXE_i >= $ADJ\_DA\_EN_i$ **THEN**
$DAMAP\_EN\_CON_{i(b.)}$ =

$$\text{MAX}\left\{[\,(NXE_i - ADJ\_DA\_EN_i) \times RT\_LMP\_EN\,] - \left(\int_0^{NXE_i} RT\_Offer\_Curve - \int_0^{ADJ\_DA\_EN_i} RT\_Offer\_Curve\right), 0\right\}$$

END IF

Note: If AVG_BP is greater than the $ADJ\_DA\_EN_i$, but the NXE_i is less than the $ADJ\_DA\_EN_i$, the $DAMAP\_EN\_CON_{i(b.)}$ is zero.

3. **Calculate the Dispatch Interval Day-Ahead Margin Assurance Payment Ancillary Service Contribution ($DAMAP\_AS\_CON_i$):**

   a. If the RT Ancillary Service Cleared MW Volume (AS_MW**) for a given AS is less than the $ADJ\_DA\_AS_i$ for that same product, then the $DAMAP\_AS\_CON_{i(a.)}$ is equal to the difference between 1) the as-offered deviation charge and 2) the charge of settling at the AS_MW**. The as-offered deviation charge is equal to the product of 1) the difference between a) the $ADJ\_DA\_AS_i$ and b) the AS_MW** and 2) the DA Availability Offer or DA Availability Regulating Reserve Capacity Offer for Regulating Reserve substituted for Spinning Reserve (AVOF). The charge of settling at the AS_MW** is equal to the product of 1) the difference between a) the $ADJ\_DA\_AS_i$ and b) the AS_MW** and 2) the Ancillary Service Market Clearing Price (AS_MCP**). Regulating Reserve substituted for Spinning Reserve (REG_SPIN_VOL**) is paid the Spinning Reserve Market Clearing Price (SPIN_MCP**).

      $DAMAP\_AS\_CON_{i(a.)}$ =
      IF $AS\_MW < ADJ\_DA\_AS_i$ **THEN**
      $DAMAP\_AS\_CON_{i(a.)}$ =
      $MAX [(ADJ\_DA\_AS_i – AS\_MW) \times DA\_AS\_AVOF, (ADJ\_DA\_AS_i – AS\_MW) \times AS\_AVOF] – [(ADJ\_DA\_AS_i – AS\_MW) \times AS\_MCP]$
      END IF

   b. If the AS_MW** for a given AS is greater than or equal to the $ADJ\_DA\_AS_i$ for that same product then the $DAMAP\_AS\_CON_{i(b.)}$ is equal to the greater of 1) the difference between a) the charge of settling at the AS_MW** and b) the as-offered deviation charge and 2) zero. The charge of settling at the AS_MW** is equal to the product of 1) the difference between a) the AS_MW** and b) the $ADJ\_DA\_AS_i$ and 2) the AS_MCP**. The as-offered deviation charge is equal to the product of 1) the difference between a) the AS_MW** and b) the $ADJ\_DA\_AS_i$ and 2) the RT AVOF.

      $DAMAP\_AS\_CON_{i(b.)}$ =
      IF $AS\_MW >= ADJ\_DA\_AS_i$ **THEN**
      $DAMAP\_AS\_CON_{i(b.)}$=
      $MAX \{ [(AS\_MW – ADJ\_DA\_AS_i) \times AS\_MCP] – [(AS\_MW – ADJ\_DA\_AS_i) \times AS\_AVOF], 0 \}$
      END IF

4. **Calculate the Dispatch Interval Day-Ahead Margin Assurance Payment Up Ramp Capability Contribution ($DAMAP\_URC\_CON_i$):**
   a. If the RT Up Ramp Capability Cleared MW Volume (RT_URC_MW**) is less than the $ADJ\_DA\_URC_i$, then the $DAMAP\_URC\_CON_{i(a.)}$ is equal to the product of 1) the difference between a) the $ADJ\_DA\_URC_i$ and b) the RT_URC_MW** and 2) the RT Up Ramp Capability Market Clearing Price (RT_URC_MCP**). The Up Ramp Capability Contribution for a SER is always set equal to zero.

      $DAMAP\_URC\_CON_{i(a.)}$ =
      IF $RT\_URC\_MW_i < ADJ\_DA\_URC_i$ **THEN**
      $DAMAP\_URC\_CON_{i(a.)}$ =
      $(RT\_URC\_MW_i - ADJ\_DA\_URC_i) \times RT\_URC\_MCP$
      END IF

   b. If the RT_URC_MW** is greater than or equal to the $ADJ\_DA\_URC_i$, then the $DAMAP\_URC\_CON_{i(b.)}$ is equal to the greater of 1) the difference between a) the RT_URC_MW** and b) the $ADJ\_DA\_URC_i$, multiplied by the RT_URC_MCP** and 2) zero.

      $DAMAP\_URC\_CON_{i(b.)}$ =
      IF $RT\_URC\_MW_i >= ADJ\_DA\_URC_i$ **THEN**
      $DAMAP\_URC\_CON_{i(b.)}$=
      $MAX [(RT\_URC\_MW_i - ADJ\_DA\_URC_i) \times RT\_URC\_MCP , 0]$
      END IF

5. **Calculate the Dispatch Interval Day-Ahead Margin Assurance Payment Down Ramp Capability Contribution ($DAMAP\_DRC\_CON_i$):**
   a. If the RT Down Ramp Capability Cleared MW Volume (RT_DRC_MW**) is less than the DA_DRC_VOL, then the $DAMAP\_DRC\_CON_{i(a.)}$ is equal to the product of 1) the difference between a) the DA_DRC_VOL and b) the RT_DRC_MW** and 2) the RT Down Ramp Capability Market Clearing Price (RT_DRC_MCP**). The Down Ramp Capability Contribution for a SER is always set equal to zero.

$DAMAP\_DRC\_CON_{i(a.)}$ =
IF $RT\_DRC\_MW_i$ < DA_DRC_VOL **THEN**
$DAMAP\_DRC\_CON_{i(a.)}$ =
($RT\_DRC\_MW_i$ – DA_DRC_VOL) × RT_DRC_MCP
END IF

b. If the RT_DRC_MW** is greater than or equal to the $ADJ\_DA\_URC_i$, then the $DAMAP\_URC\_CON_{i(b.)}$ is equal to the greater of 1) the difference between a) the RT_DRC_MW** and b) the DA_DRC_VOL, multiplied by the RT_DRC_MCP** and 2) zero.

$DAMAP\_DRC\_CON_{i(b.)}$ =
IF $RT\_DRC\_MW_i$ >= DA_DRC_VOL **THEN**
$DAMAP\_DRC\_CON_{i(b.)}$=
MAX [($RT\_DRC\_MW_i$ - DA_DRC_VOL) × RT_DRC_MCP , 0]
END IF

6. **Calculate the DA_MAP* for the Hour:**

a. The Hourly Day-Ahead Margin Assurance Payment Energy Contribution (DAMAP_EN_CON_HR*) is equal to the sum of the $DAMAP\_EN\_CON_{i(a.)}$ and $DAMAP\_EN\_CON_{i(b.)}$ for each eligible Dispatch Interval in the Hour, divided by 12.

$$DAMAP\_EN\_CON\_HR = \sum_{i=1}^{n} [(DAMAP\_EN\_CON_{i(a.)} + DAMAP\_EN\_CON_{i(b.)})] \times 1/12$$

Note: In the calculation above ‘n’ represents the number of eligible Dispatch Intervals within the Hour.

b. The Hourly Day-Ahead Margin Assurance Payment Ancillary Service Contribution (DAMAP_AS_CON_HR*) is equal to the sum of the $DAMAP\_AS\_CON_{i(a.)}$ and $DAMAP\_AS\_CON_{i(.b)}$ for each AS, for each eligible Dispatch Interval in the Hour, divided by 12. The DAMAP_REG_CON_HR also includes the margin from Additional Regulating Mileage. The margin from Additional Regulating Margin is equal to the product of 1) the maximum of a) the difference between i) the $RT\_REG\_MIL\_MCP_i$ and ii) MIL_OF_h and b) zero and 2) the $ADD\_REG\_MIL\_VOL_i$. The DAMAP_SPIN_CON_HR also includes the contribution from Regulating Reserve substituted for Spinning Reserve.

$$DAMAP\_REG\_CON\_HR = \{ \sum_{i=1}^{n} [DAMAP\_REG\_CON_{i(.a)} + DAMAP\_REG\_CON_{i(b.)}] \times 1/12 \} + \{ \sum_{i=1}^{n} MAX (RT\_REG\_MIL\_MCP_i - MIL\_OF_h, 0) \times ADD\_REG\_MIL\_VOL_i \}$$

$$DAMAP\_SPIN\_CON\_HR = \{ \sum_{i=1}^{n} [DAMAP\_SPIN\_CON_{i(.a)} + DAMAP\_SPIN\_CON_{i(b.)}] \times 1/12 \} + \{ \sum_{i=1}^{n} [DAMAP\_REG\_SPIN\_CON_{i(.a)} + DAMAP\_REG\_SPIN\_CON_{i(b.)}] \times 1/12 \}$$

$$DAMAP\_SUPP\_CON\_HR = \sum_{i=1}^{n} [DAMAP\_SUPP\_CON_{i(.a)} + DAMAP\_SUPP\_CON_{i(b.)}] \times 1/12$$

Note: In the calculations above 'n' represents the number of eligible Dispatch Intervals within the Hour.

c. The Hourly Day-Ahead Margin Assurance Payment Ramp Capability Contribution (DAMAP_RC_HR*) is equal to the sum of the $DAMAP\_RC\_CON_{i(a.)}$ and $DAMAP\_RC\_CON_{i(.b)}$ for each Ramp Capability product, for each eligible Dispatch Interval in the Hour, divided by 12.

$$DAMAP\_URC\_CON\_HR = \{ \sum_{i=1}^{n} [DAMAP\_URC\_CON_{i(.a)} + DAMAP\_URC\_CON_{i(b.)}] \times 1/12 \}$$

$$DAMAP\_DRC\_CON\_HR = \{ \sum_{i=1}^{n} [DAMAP\_DRC\_CON_{i(.a)} + DAMAP\_DRC\_CON_{i(b.)}] \times 1/12 \}$$

Note: In the calculations above 'n' represents the number of eligible Dispatch Intervals within the Hour.

d. DA_MAP* is equal to the minimum of (1) the sum of (a) the DAMAP_EN_CON_HR* and (b) the DAMAP_REG_CON_HR* and (c) the DAMAP_SPIN_CON_HR* and (d) the DAMAP_SUPP_CON_HR* and (e) the DAMAP_URC_CON_HR* and (f) the DAMAP_DRC_CON_HR*, or (2) zero.

DA_MAP = MIN [(DAMAP_EN_CON_HR + DAMAP_REG_CON_HR +

DAMAP_SPIN_CON_HR + DAMAP_SUPP_CON_HR +
DAMAP_URC_CON_HR + DAMAP_DRC_CON_HR), 0]

A negative DA_MAP* indicates the DA margin was eroded and the Market Participant will receive a DA_MAP* credit in that Hour. A positive DA_MAP* indicates the DA margin was not eroded and the Market Participant will not receive a DA_MAP* in that Hour.

D.10.2 Eligibility Rules

Resources are only eligible for DA_MAP* in Dispatch Intervals in which all of the following apply:

- The Resource has a DA CP.
- The RT Economic, Emergency and Regulation Maximum Limits must be greater than the RT Economic, Emergency and Regulation Minimum Limits plus 1, respectively.
  - *Note: Not performed for Dispatchable Intermittent Resources or if a given Resource is Manually Re-Dispatched in the Hour.*
- The limits used by the Unit Dispatch System (UDS) must have a dispatch range of greater than 1 MW
  - *Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.*
- The DA Ramp Capability Dispatch Status must be Economic (EC).
- The RT Ramp Capability Dispatch Status must be Economic (EC).
- The Resource is Dispatchable (DISP)
  - *Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.*
  - Eligibility failure occurs if the Resource fails this criterion in 4 or more consecutive Dispatch Intervals in an Hour.
- The Resource does not have the Failure to Follow Dispatch Flag (FFDF*) equal to true (1 or ‘Y’)
  - *Note: Not performed if a given Resource is Manually Re-Dispatched in the Hour.*
- The RT Ramp Rate (RT_RR) must be greater than 0.5 MW/minute

- The RT_RR must be greater than or equal to the DA_RR unless the DA_RR is greater than 0.5% of the RT Economic Maximum (RT_ECON_MAX), in which case the RT_RR can be modified provided that:
  - *Note: Not performed for Dispatchable Intermittent Resources.*
  - If the Achievable Megawatt (ACH_MW) is greater than or equal to 90% of the RT_ECON_MAX, then the RT_RR must be greater than 50% of the DA_RR.
    - *Note: Not performed for Dispatchable Intermittent Resources.*
  - If the ACH_MW is less than or equal to the RT_ECON_MIN plus 10% of the RT_ECON_MAX, then the RT_RR must be greater than 50% of the DA_RR.
    - *Note: Not performed for Dispatchable Intermittent Resources.*
  - If the ACH_MW is between the RT_ECON_MIN plus 10% of the RT_ECON_MAX and 90% of the RT_ECON_MAX, and the resource is Regulating Reserve qualified and is offering Regulating Reserve, then the RT_RR must be greater than the DA_RR minus 0.5 MW.
    - *Note: Not performed for Dispatchable Intermittent Resources.*
- Eligibility failure occurs if the Resource fails any Ramp Rate criterion described above in 4 or more consecutive Dispatch Intervals in an Hour.

The above requirements are verified for each Dispatch Interval within the Hour except in those intervals in which a given Resource has been Manually Re-Dispatched to 0 MW. In those instances that a Resource is Manually Re-Dispatched to zero, we do not check any eligibility criteria. In the event that a Resource fails any these eligibility criteria in an Hour, it is ineligible for DA_MAP* in that Hour.

In addition, the DA Offer must satisfy the following conditions, if there is a non-zero DA_SCHD in the prior Hour. These conditions will be evaluated for each Hour of the CP, as long as it is not the first Hour of the CP:

- The offer price for the DA_SCHD in the current Hour must not decrease by more than ten percent (10%) from the offer price for the DA_SCHD in the prior Hour.

- The maximum of the following current Hour values: 1) DA_ECON_MIN, or 2) the As-Committed Self-Schedule MW for instances where the Energy Dispatch Status is self-schedule, must not increase by more than five (5) times the DA_RR, from the maximum of the following prior Hour values: 1) DA_SCHD, 2) DA_ECON_MIN, or 3) As-Committed SS MW for instances where the Energy Dispatch Status is self-schedule.

In the event that a Resource fails the above DA Offer eligibility criteria, it is ineligible for DA_MAP* in the given failure Hour.

The following logic details the eligibility criteria listed above regarding prior Hour and current Hour comparisons for DA Offers:

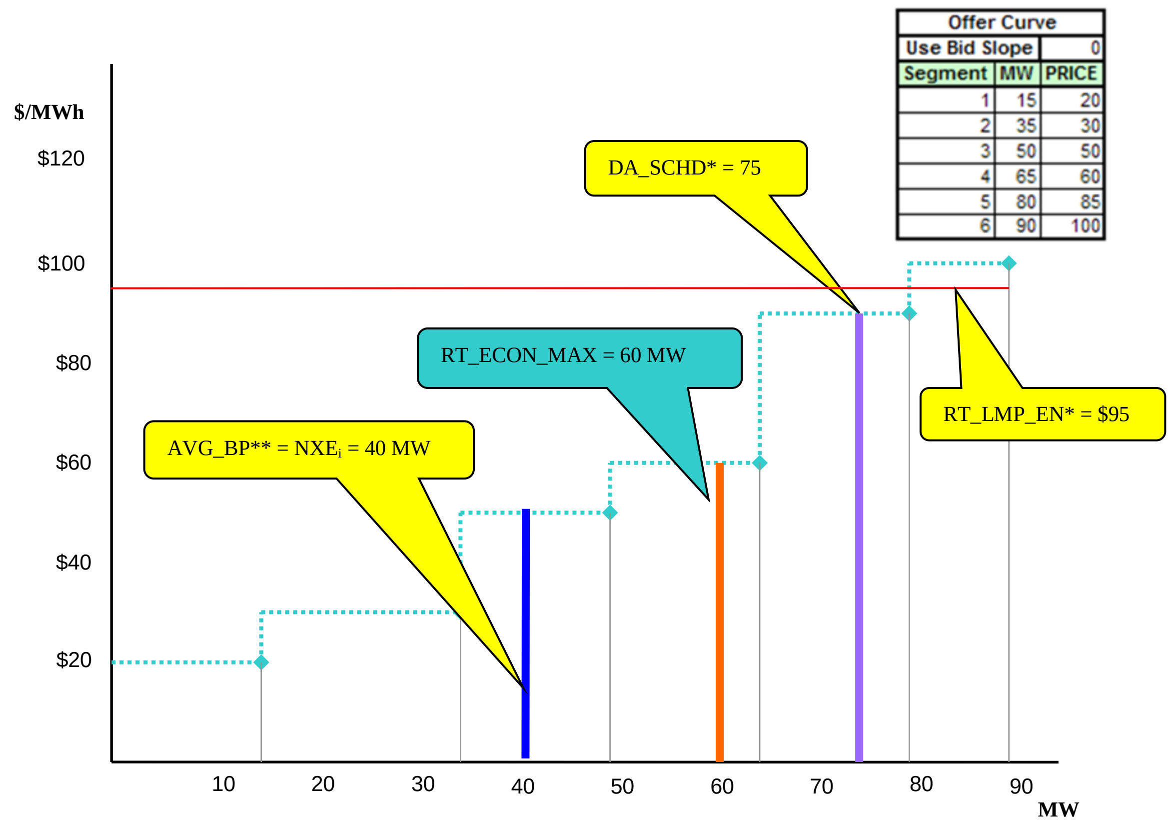
IF ($IE\_OFFER\_PRICE_{PriorHour}$ – $IE\_OFFER\_PRICE_{CurrentHour}$) >
ABS ($IE\_OFFER\_PRICE_{PriorHour}$ × 10 %)
THEN DA_MAP_FL* = 0
END IF

IF $DA\_MIN\_LIMIT_{CurrentHour}$ >
[**MAX** ($DA\_MIN\_LIMIT_{PriorHour}$, $DA\_SCHD_{PriorHour}$) + (DA_RR × 5)]
THEN DA_MAP_FL* = 0
END IF

Where:
DA_MIN_LIMIT = **MAX** (DA_ECON_MIN, **IF** (DA_ENERGY_DISP_STATUS = ‘SS’, THEN ENERGY_SS_MW, **ELSE** 0))

D.10.3Calculation Example

Consider a Resource with the following Offer Curve, DA_SCHD*, and DA_ECON_MAX. In the RT, the Resource is derated to an RT_ECON_MAX of 60 MW and the AVG_BP** and NXE_i are 40 MW. Due to Price Volatility, the RT_LMP_EN* is $95.



Other than the RT_ECON_MAX change to 60 MW, all other offer parameters for the Resource remain unchanged. Therefore the following variables are defined:

Variable Definitions

DA_SCHD = 75	DA_REG_VOL = 5	DA_REG_AVOF = 30	DA_SPIN_VOL = 10
DA_SPIN_AVOF = 7	DA_SUPP_VOL = 0	REG_MW = 2	REG_MCP = 40
SPIN_MW = 7	SPIN_MCP = 10	RT_SUPP = 0	AVG_BP = 40
NXE_i = 40	RT_ECON_MAX = 60	DFE_T = 34	RT_LMP_EN = 95
ADD_REG_MIL_VOL = 3	MIL_OF = 5	MIL_MCP= 2	DA_REG_CAP_AVOF = 16
DA_REG_SPIN_VOL = 0	REG_SPIN_MW = 0	REG_AVOF = 20	REG_CAP_AVOF = 16
SPIN_AVOF = 5			

Applying the calculations steps outlined above:

1. **Calculate the Adjusted Day-Ahead Energy Volume ($ADJ\_DA\_EN_i$) and the Adjusted Day-Ahead Ancillary Services Volume ($ADJ\_DA\_AS_i$) in the event of a de-rate:**

   1.a Calculate the RED_TOT_i:

   RED_TOT_i = MAX (DA_SCHD + DA_AS_VOL – RT_ECON_MAX, 0)

   RED_TOTi = MAX(75 + 5 +0+ 10 + 0 – 60 , 0) = 30

   1.b Calculate the $POT\_RED\_EN_i$ and $POT\_RED\_AS_i$ for each product:

   $POT\_RED\_EN_i$ = MAX (DA_SCHD – AVG_BP, 0)

   POT_RED_ENi = MAX (75 – 40 , 0) = 35

   $POT\_RED\_AS_i$ = MAX (DA_AS_VOL - AS_VOL , 0)

   $POT\_RED\_REG_i$ = MAX (5 – 2, 0) = 3

   $POT\_RED\_REG\_SPIN_i$ = MAX (0 – 0, 0) = 0

   $POT\_RED\_SPIN_i$ = MAX (10 – 7, 0) = 3

   $POT\_RED\_SUPP_i$ = MAX (0 – 0, 0) = 0

   $POT\_RED\_TOT_i = POT\_RED\_EN_i + POT\_RED\_AS_i$

   $POT\_RED\_TOT_i$ = 35 + 3 + 0 + 3 + 0 = 41

1.c Calculate the RED_EN_i and RED_AS_i for each product:

$RED\_EN_i = RED\_TOT_i \times (POT\_RED\_EN_i / POT\_RED\_TOT_i)$

$RED\_EN_i = 30 \times (35 / 41) = 25.6$

$RED\_AS_i = RED\_TOT_i \times (POT\_RED\_AS_i / POT\_RED\_TOT_i)$

$RED\_REG_i = 30 \times (3 / 41) = 2.2$

$RED\_REG\_SPIN_i = 30 \times (0 / 41) = 0$

$RED\_SPIN_i = 30 \times (3 / 41) = 2.2$

$RED\_SUPP_i = 0$ (Since $POT\_RED\_SPIN_i = 0$)

1.d Calculate the $ADJ\_DA\_EN_i$ and $ADJ\_DA\_AS_i$ for each product:

$ADJ\_DA\_EN_i = DA\_SCHD - RED\_EN_i$

$ADJ\_DA\_EN_i = 75 – 25.6 = 49.4$

$ADJ\_DA\_AS_i = DA\_AS\_VOL – RED\_AS_i$

$ADJ\_DA\_REG_i = 5 – 2.2 = 2.8$

$ADJ\_DA\_REG\_SPIN_i = 0 – 0 = 0$

$ADJ\_DA\_SPIN_i = 10 – 2.2 = 7.8$

$ADJ\_DA\_SUPP_i = 0 – 0 = 0$

2. **Calculate the $DAMAP\_EN\_CON_i$:**

2.a Since the AVG_BP and NXE_i are less than the $ADJ\_DA\_EN_i$:**

$DAMAP\_EN\_CON_{i(.a)} =$

$$MAX \left[\left(\int_0^{ADJ\_DA\_EN_i} DA\_Offer\_Curve - \int_0^{MAX(NXE_i, DFE\_T)} DA\_Offer\_Curve \right), \left(\int_0^{ADJ\_DA\_EN_i} RT\_Offer\_Curve - \int_0^{MAX(NXE_i, DFE\_T)} RT\_Offer\_Curve \right) \right] -$$

$$[(ADJ\_DA\_EN_i – MAX (NXE_i, DFE\_T)) \times RT\_LMP\_EN]$$

$DAMAP\_EN\_CON_{i(a.)} = MAX [(1620 – 1150) , (1620 – 1150)] – [(49.4 – MAX (40, 34)) \times 95] = - 423$

2.b Not Applicable, as the AVG_BP and NXE_i are not greater than or equal to $ADJ\_DA\_EN_i$.**

3. **Calculate the $DAMAP\_AS\_CON_i$:**

3.a Since the $REG\_MW < ADJ\_DA\_REG_i$:

$$DAMAP\_REG\_CON_{i(a.)} = MAX\ [\ (\ ADJ\_DA\_REG_i - REG\_MW\ ) \times DA\_REG\_AVOF,\ (\ ADJ\_DA\_REG_i - REG\_MW\ ) \times REG\_AVOF\ ] - [\ (\ ADJ\_DA\_REG_i - REG\_MW\ ) \times REG\_MCP\ ]$$

$$DAMAP\_REG\_CON_{i(a.)} = MAX\ [\ (\ 2.8 - 2\ ) \times 30,\ (\ 2.8 - 2) \times 20\ ] - [\ (\ 2.8 - 2\ ) \times 40\ ] = -8$$

3.b $SPIN\_MW < ADJ\_DA\_SPIN_i$:

$$DAMAP\_SPIN\_CON_{i(a.)} = \{\ MAX\ [\ (\ ADJ\_DA\_SPIN_i - SPIN\_MW\ ) \times DA\_SPIN\_AVOF,\ (\ ADJ\_DA\_SPIN_i - SPIN\_MW\ ) \times SPIN\_AVOF\ ] - [\ (\ ADJ\_DA\_SPIN_i - SPIN\_MW\ ) \times SPIN\_MCP\ ]\ \} + \{\ MAX\ [\ (\ ADJ\_DA\_REG\_SPIN_i - REG\_SPIN\_MW\ ) \times DA\_REG\_CAP\_AVOF,\ (\ ADJ\_DA\_REG\_SPIN_i - REG\_SPIN\_MW\ ) \times REG\_CAP\_AVOF\ ] - [\ (\ ADJ\_DA\_REG\_SPIN_i - REG\_SPIN\_MW\ ) \times SPIN\_MCP\ ]\ \}$$

$$DAMAP\_SPIN\_CON_{i(a.)} = \{\ MAX\ [\ (\ 7.8 - 7\ ) \times 7,\ (7.8 - 7\ ) \times 5\ ] - [\ (\ 7.8 - 7\ ) \times 10\ ]\ \} + \{\ MAX\ [\ (\ 0 - 0\ ) \times 16,\ (\ 0 - 0\ ) \times 16\ ] - [\ (\ 0 - 0\ ) \times 10\ ]\ \} = -2.40$$

3.c Since the $SUPP\_MW >= ADJ\_DA\_SUPP_i$:

$$DAMAP\_AS\_CON_{i(b.)} = MAX\ \{\ [\ (\ AS\_MW - ADJ\_DA\_ASi\ ) \times AS\_MCP\ ] - [\ (\ AS\_MW - ADJ\_DA\_AS_i\ ) \times AS\_AVOF\ ],\ 0\ \}$$

$$DAMAP\_SUPP\_CON_{i(b.)} = MAX\ \{\ [\ (\ 0 - 0\ ) \times 0\ ] - [\ (\ 0 - 0\ ) \times 0\ ],\ 0\}= 0$$

4. **Calculate the DA_MAP*:**

(Assume all variables remain constant for every Dispatch Interval in the Hour)

4.a

$$DAMAP\_EN\_CON\_HR = \sum_{i=1}^{n} [\, DAMAP\_EN\_CON_{i(a.)} + DAMAP\_EN\_CON_{i(b.)} \,] \times 1/12$$

DAMAP_EN_CON_HR = [(-5076 + 0)] × 1/12 = - 423

4.b

$$DAMAP\_REG\_CON\_HR = \{ \sum_{i=1}^{n} [\, DAMAP\_REG\_CON_{i(.a)} + DAMAP\_REG\_CON_{i(b.)} \,] \times 1/12 \} + \{ \sum_{i=1}^{n} MIN\,(RT\_REG\_MIL\_MCP_i - MIL\_OF_h,\, 0) \times ADD\_REG\_MIL\_VOL_i \}$$

DAMAP_REG_CON_HR = { [-96 + 0] × 1/12 } + { [MAX (2-5, 0) × 3] × 12 } = - 8

$$DAMAP\_SPIN\_CON\_HR = \sum_{i=1}^{n} [\, DAMAP\_SPIN\_CON_{i(a.)} + DAMAP\_SPIN\_CON_{i(b.)} \,] \times 1/12$$

DAMAP_SPIN_CON_HR = [- 28.8 + 0] × 1/12 = - 2.4

$$DAMAP\_SUPP\_CON\_HR = \sum_{i=1}^{n} [\, DAMAP\_SUPP\_CON_{i(a.)} + DAMAP\_SUPP\_CON_{i(b.)} \,] \times 1/12$$

DAMAP_SUPP_CON_HR = [0 + 0] × 1/12 = 0

4.c

DA_MAP_HR = MIN [(DAMAP_EN_CON_HR + DAMAP_REG_CON_HR + DAMAP_SPIN_CON_HR + DAMAP_SUPP_CON_HR), 0]

DA_MAP_HR = MIN [(-423 + -8 + -2.4 + 0), 0] = - 433.40

Therefore the Resource would receive a DA_MAP* credit of -$433.40.

D.11 Regulating Mileage Payment and Measurement

Regulation Mileage is the amount of up and down movement from a Resource in response to Regulation Deployment. This section will provide the formulations for how Regulation Mileage is paid and how it is measured both for payment and for performance.

D.11.1Dispatch Interval Stepped Contingency Reserve Deployment Volume (CRD_DPL_VOL**)

The Contingency Reserve Deployment Volume (CRD_DPL_VOL) is the average of the 4-second Stepped Contingency Reserve Deployment instruction in a given Dispatch Interval. It is used to calculate the Instructed Energy Mileage. The default value is zero.

$$CRD\_DPL\_VOL_i = \sum_{j=1}^{n} (CRD\_DPL\_VOL_j) \times 1 / n$$

Where:

n = the number of 4-second intervals in a given Dispatch Interval

j = the given 4-second interval

i = the given Dispatch Interval

D.11.2Dispatch Interval Begin Control Mode (CMODE**)

The Dispatch Interval Begin Control Mode is the Control Mode at the beginning of each Dispatch Interval for a Resource derived from the 1-minute ICCP samples. If it does not exist, it is replaced with the next available sample within the Dispatch Interval, otherwise, a default value of 2 is used. This value is used in the determination of the Failure Mileage Performance Test Flag (FMPTF).

D.11.3ICCP Delay

In order to account for the delay between the time that MISO sends out an ICCP signal and the time that MISO sees the movement from a Resource in response to the ICCP signal, certain Regulating Mileage calculations need to account for the delay by using a time offset.

When MISO sends out an ICCP signal, there will be an amount of time before the sampled TEL_VOL would reflect the ICCP signal. This delay could differ by LBA, Resource, or Day, but should be relatively constant for each Resource for each Operating Day. The time offset, or ICCP Delay, will be applied to those calculations that use the TEL_VOL, specifically the calculation of Desired Mileage (DESIRED_MIL) and Actual Mileage (ACT_MIL).

In order to determine the appropriate ICCP Delay for each Resource for each Operating Day, MISO will compare the difference between the DESIRED_MIL and ACT_MIL using 3 different ICCP Delay values of 8 seconds, 16 seconds and 24 seconds.

$$\text{DESIRED\_ACT\_MIL\_DIFF}_{d(\Delta)} = \sum_{i=1}^{d} \textbf{ABS} \left(\text{DESIRED\_MIL}_{i(\Delta)} - \text{ACT\_MIL}_{i(\Delta)} \right)$$

Where:
i = the given Dispatch Interval in the Operating Day
d = the given Operating Day
Δ = the given ICCP Delay

The ICCP Delay value that results in the minimum difference between the DESIRED_MIL and ACT_MIL for a given Operating Day will be used in the calculation of the DESIRED_MIL and ACT_MIL for use in all subsequent calculations.

$$\text{ICCP\_DELAY}_{d} = \textbf{MIN} \left(\text{DESIRED\_ACT\_MIL\_DIFF}_{d(8)}, \text{DESIRED\_ACT\_MIL\_DIFF}_{d(16)}, \text{DESIRED\_ACT\_MIL\_DIFF}_{d(24)} \right)$$

Where:
d = the given Operating Day
8, 16, 24 = the given ICCP Delay (in seconds)

D.11.4Dispatch Interval Desired Mileage (DESIRED_MIL**)

The DESIRED_MIL** is the amount of mileage a Resource is expected to provide in each Dispatch Interval in response to the Setpoint. DESIRED_MIL** is only calculated in those Dispatch Intervals that a Resource is committed to provide Regulation Reserve, as determined by the Mileage Qualify Flag (MQF**).

The Desired Setpoint (DESIRED_SP) is set equal to the TEL_VOL of the Resource at the beginning of each Dispatch Interval. This provides the Resource with an opportunity to provide the requested amount of mileage in each Dispatch Interval, regardless of how well the Resource had followed its setpoint in the prior Dispatch Interval.

Because the DESIRED_SP is set equal to the TEL_VOL for the first 4-second interval in the Dispatch Interval, the DESIRED_MIL calculation will considered the ICCP Delay by adjusting the TEL_VOL by the ICCP Delay. Please refer to the 'ICCP Delay' section of this document for more information.

The DESIRED_MIL is calculated as:

IF MQF_i = "Y" **THEN**
IF *no ICCP data exits for more than ½ of a given Dispatch Interval* **THEN**
$DESIRED\_MIL_i = 5 \times RT\_BI\_RR_i$
ELSEIF j = *the first 4-second interval in the Dispatch Interval* **THEN**
$DESIRED\_SP_j = TEL\_VOL_{j+\Delta}$
ELSEIF $STEPPED\_SP_{j+1} >= DESIRED\_SP_j$ **THEN**
$DESIRED\_SP_{j+1}$ = **MIN** ($DESIRED\_SP_j + 4 \times RT\_BI\_RR_i / 60$, $STEPPED\_SP_{j+1}$)
ELSE
$DESIRED\_SP_{j+1}$ = **MAX** ($DESIRED\_SP_j - 4 \times RT\_BI\_RR_i / 60$, $STEPPED\_SP_{j+1}$)
END IF
END IF

Where:

j = the given 4-second interval

j + 1 = the next 4-second interval

Δ = the ICCP Delay

i = the given Dispatch Interval

If the 4-second $STEPPED\_SP_j$ or/and $DESIRED\_SP_j$ is missing, replace it with the corresponding TEL_VOL_j, otherwise, use a default zero.

The $DESIRED\_MIL_i$ is equal to the sum of the net positive value of the difference between the $DESIRED\_SP_j$ in the next 4-second interval minus the $DESIRED\_SP_j$ in the current 4-second interval for all 4-second intervals in a given Dispatch Interval.

$$DESIRED\_MIL_i = \sum_{j=1}^{n} \textbf{ABS}\ (DESIRED\_SP_{j+1} - DESIRED\_SP_j)$$

Where:

n = the number of 4-second intervals is a given Dispatch Interval

j = the given 4-second interval

D.11.5 Dispatch Interval Instructed Total Mileage (INST_TOT_MIL**)

The Dispatch Interval Instructed Total Mileage is total amount of up and down movement from a Resource in a given Dispatch Interval calculated as:

IF MQF = “Y” **THEN**

IF *no ICCP data exits for more than ½ of a given Dispatch Interval* **THEN**

$INST\_TOT\_MIL = DESIRED\_MIL_i$

ELSE

D.11.6 $INST\_TOT\_MIL_i = \sum_{j=1}^{n}$ ABS ($RAMPED\_SP_{j+1} - RAMPED\_SP_j$)

END IF

END IF

Where:

j = the given 4-second interval

i = the given Dispatch Interval

n = the number of available 4-second RAMPED_SP values in the Dispatch Interval

If an adjacent 4-scond $RAMPED\_SP_j$ value is missing, then it is replaced with the corresponding TEL_VOL_j.

D.11.6.1 Dispatch Interval Instructed Energy Mileage (INST_ENG_MIL**)

The Dispatch Interval Instructed Energy Mileage is equal to the amount of up and down movement by a Resource in response to the Resource's Dispatch Target for Energy (i.e., Basepoint) or a Contingency Reserve Deployment, calculated as:

IF MQF = "Y" **THEN**

IF *no ICCP data exits for more than ½ of a given Dispatch Interval* **THEN**

INST_ENG_MIL = ABS (E_i – E_0)

ELSEIF E_1 >= S_0 **THEN**

IF S_0 > E_0 THEN

EXP_ENG_MIL = E_i – S_0

ELSE

EXP_ENG_MIL = **MAX** (E_1– E_0, 0)

END IF

INST_ENG_MIL = **MIN** (EXP_ENG_MIL, MAX [$RAMPED\_SP_{j\ in\ i}$] – S_0)

ELSE

IF E_0 > S_0 **THEN**

EXP_ENG_MIL =S_0 – E_1

ELSE

EXP_ENG_MIL =**MAX** (E_0 – E_1, 0)

END IF

INST_ENG_MIL = **MIN** (EXP_ENG_MIL, S_0 –MIN [$RAMPED\_SP_{j\ in\ i}$])

END IF

END IF

Where:

E_0 = BP + CRD_DPL_VOL for the previous Dispatch Interval

E_1 = BP + CRD_DPL_VOL for the current Dispatch Interval

S_0 = the RAMPED_SP at the end of previous Dispatch Interval or, if missing, TEL_VOL

EXP_ENG_MIL = the expected energy mileage for the current Dispatch Interval

i = the given Dispatch Interval

j = the given 4-seoncd interval

D.11.7 Dispatch Interval Instructed Regulating Mileage (INST_REG_MIL)

The Dispatch Interval Instructed Regulating Mileage is the amount of up and down movement from a Resource in response to Regulation Deployment, calculated as the difference between the Instructed Total Mileage and the Instructed Energy Mileage.

$INST\_REG\_MIL_i = \mathbf{MAX}\ (INST\_TOT\_MIL_i – INST\_ENG\_MIL_i, 0)$

D.11.8 Dispatch Interval Actual Mileage (ACT_MIL**)

The Dispatch Interval Actual Mileage (ACT_MIL) is the accumulation of the MW movement toward the Stepped Setpoint in a given Dispatch Interval. The MW movement toward the Stepped Setpoint is positive mileage and the MW movement away from the Stepped Setpoint is negative mileage. This value is used to determine the Failure Mileage Performance Test Flag (FMPTF**).

The ACT_MIL calculation will consider the ICCP Delay by adjusting each TEL_VOL value by the ICCP Delay. Please refer to the 'ICCP Delay' section of this document for more information.

The ACT_MIL is calculated as:

IF MQF = "Y" **THEN**

IF *no ICCP data exits for more than ½ of a given Dispatch Interval* **THEN**

$ACT\_MIL_i = DESIRED\_MIL_i$

ELSEIF $STEPPED\_SP_{j+1}$ >= $TEL\_VOL_{j+\Delta}$ **AND** $STEPPED\_SP_{j+1}$ >= $TEL\_VOL_{(j+1)+\Delta}$ **THEN**

$$ACT\_MIL_i = ACT\_MIL_i + TEL\_VOL_{j+1+\Delta} - TEL\_VOL_{j+\Delta}$$

ELSEIF $STEPPED\_SP_{j+1} < TEL\_VOL_{j+\Delta}$ **AND** $STEPPED\_SP_{j+1} < TEL\_VOL_{(j+1)+\Delta}$ **THEN**

$$ACT\_MIL_i = ACT\_MIL_i + TEL\_VOL_{j+\Delta} - TEL\_VOL_{(j+1)+\Delta}$$

ELSEIF $STEPPED\_SP_{j+1}$ >= $TEL\_VOL_{j+\Delta}$ **AND** $STEPPED\_SP_{j+1} < TEL\_VOL_{(j+1)+\Delta}$ **THEN**

$$ACT\_MIL_i = ACT\_MIL_i + (STEPPED\_SP_{j+1} - TEL\_VOL_{j+\Delta}) - (TEL\_VOL_{(j+1)+\Delta} - STEPPED\_SP_{j+1})$$

ELSE

$$ACT\_MIL_i = ACT\_MIL_i + (TEL\_VOL_{j+\Delta} - STEPPED\_SP_{j+1}) - (STEPPED\_SP_{j+1} - TEL\_VOL_{(j+1)+\Delta})$$

END IF

END IF

Where:

- i = the given Dispatch Interval
- j = the given 4-seoncd interval
- $j + 1$ = the next 4-second interval
- Δ = the given ICCP Delay

D.11.9 Dispatch Interval Failure Mileage Performance Test Flag (FMPTF**) and Follow Percent (FOLLOW_PER**)

The Dispatch Interval FMPTF is the determination of whether or not a Resource has adequately responded to its Setpoint Instruction. The FOLLOW_PER is the measurement of what percentage a Resource has followed its Setpoint Instruction.

IF MQF = “Y” **THEN**

IF { $ACT\_MIL_i > [70\% \times DESIRED\_MIL_i]$ } **OR** { $ACT\_MIL_i > [DESIRED\_MIL_i - MIL\_TOL]$ } **THEN**

FMPTF = 0 **AND** FOLLOW_PER = 1

ELSE

FMPTF = 1

IF DESIRED_MIL >= 0.01 **AND** ACT_MIL > 0 **THEN**
FOLLOW_PER = **MAX** { **MIN** (ACT_MIL / DESIRED_MIL , 1), 0 }
ELSE
FOLLOW_PER = 0
END IF
END IF
ELSE
FMPTF = 0
FOLLOW_PER = 0
END IF

Where:
MIL_TOL = **MIN**{1.5 × RT_BI_RR, MAX (4MW, 1% x AVG_BP) }

D.11.10 Hourly Failure Mileage Performance Test Flag (FMPTF*)

The hourly FMPTF is determined from the Dispatch Interval FMPTF** and Dispatch Target for Regulating Reserve.

IF 4 or more consecutive Dispatch Interval FMPTF = 1 **AND** REG_MW_0 > 0 **THEN**
FMPTF = 1
ELSE
FMPTF = 0
END IF

Where:
REG_MW_0 = the REG_MW in the first Dispatch Interval of the Dispatch Intervals in question

D.11.11 Dispatch Interval Target Regulating Mileage (TARGET_REG_MIL)

The Dispatch Interval Target Regulating Mileage (TARGET_REG_MIL) is the Instructed Regulating Mileage adjusted to reflect the TEL_VOL at the beginning of a Dispatch Interval, calculated as:

IF MQF = “Y” **THEN**

IF REG_MW > 0 **THEN**
TARGET_REG_MIL = **MIN** (INST_REG_MIL, DESIRED_MIL)
ELSE
TARGET_REG_MIL = 0
END IF
END IF

D.11.12 Market-Wide Regulating Mileage Deploy Ratio (REG_MIL_DPL_RATIO)

The Market-wide Regulating Mileage Deployment Ratio (REG_MIL_DPL_RATIO) is the ratio of the Target Regulating Mileage and the Real-Time cleared Regulating Reserve.

The REG_MIL_DPL_RATIO is studied each month for the upcoming month to reflect changes in actual regulating deployment. The study will use data from the 15th day of the previous month to the 15th day of the current month to calculate the Market-wide REG_MIL_DPL_RATIO that is effective starting the first day of the upcoming month for calculation of Additional Regulating Mileage and Undeployed Regulating Mileage volumes.

This Ratio shall be published on MISO website and notification shall be sent to Market Participants when it is ready.

REG_MIL_DPL_RATIO is equal to the average of the ratio between the Target Regulating Mileage ($TARGET\_REG\_MIL_i$) in a Dispatch Interval and the Real-Time cleared Regulating Reserve (REG_MW_i) in that Dispatch Interval for all Resources for all Dispatch Intervals with non-zero Real-Time cleared Regulating Reserves.

$$REG\_MIL\_DPL\_RATIO^* = (1/n) \times [\sum_{i=1}^{n} (TAGRET\_REG\_MIL_i/REG\_MW^{**}_i)]$$

Where:
i = the given Dispatch Interval
n = the number of Dispatch Intervals having $REG\_MW^{**}_i$ greater than zero (0) for a given month

D.11.13 Additional Regulating Mileage (ADD_REG_MIL_VOL)

The Dispatch Interval Additional Regulating Mileage (ADD_REG_MIL_VOL) is the Target Regulating Mileage above the Real Time cleared Regulation Reserve (REG_MW**) adjusted by the Regulating Mileage Deploy Ratio (REG_MIL_DPL_RATIO).

IF MQF = “Y” **THEN**
$ADD\_REG\_MIL\_VOL_i$ = **MAX** (TARGET_REG_MIL – REG_MW** × REG_MIL_DPL_RATIO, 0)
END IF

Where:
i = the given Dispatch Interval

The Hourly Additional Regulating Mileage (ADD_REG_MIL_VOL*) is the sum of Dispatch Interval Additional Regulating Mileage.

$$ADD\_REG\_MIL\_VOL = \sum_{i=1}^{12} (ADD\_REG\_MIL\_VOL_i)$$

D.11.14 Real-Time Regulating Mileage MCP (RT_REG_MIL_MCP*/**)

The Hourly Real-Time Regulating Mileage MCP (RT_REG_MIL_MCP*) is equal to the quantity-summed Dispatch Interval Real-Time Regulating Mileage MCP (RT_REG_MIL_MCP*). That is, the Hourly RT_REG_MIL_MCP* is equal to the sum of all intervals in the Hour for the product of 1) the Dispatch Interval RT_REG_MIL_MCP** and 2) the Dispatch Interval Additional Regulating Mileage (ADD_REG_VOL) divided by the Hourly Additional Regulating Mileage (ADD_REG_MIL_VOL*).

$$RT\_REG\_MIL\_MCP = \sum_{i=1}^{12} \{ (RT\_REG\_MIL\_MCP_i \times ADD\_REG\_MIL\_VOL_i) / ADD\_REG\_MIL\_VOL_h \}$$

Where:
i = the given Dispatch Interval
h = the given Hour

D.11.15 Self Schedule Regulating Reserve substituted for Spinning Reserve (REG_SPIN_SS_MW)

The Self Schedule Regulating Reserve substituted for Spinning Reserve (REG_SPIN_SS_MW) is the amount of Regulating Reserve that was substituted for Spinning Reserve that is considered self scheduled.

REG_SPIN_SS_MW = **MIN** [REG_SPIN_MW, **MAX** (REG_SS_MW – REG_MW, 0)]

Where:
REG_SS_MW = the corresponding Day Ahead or Real-Time Self Schedule for Regulating Reserve
REG_SPIN_MW = the Regulating Reserve substituted for Spinning Reserve MW
REG_MW = the corresponding Day Ahead or Real Time Regulation Reserve MW

D.11.16 Hourly Undeployed Regulating Mileage Volume (REG_MIL_UNDP_VOL*)

The Hourly Undeployed Regulating Mileage Volume (REG_MIL_UNDP_VOL) is equal to the sum of the Dispatch Interval Regulating Mileage Undeployed Volumes ($REG\_MIL\_UNDP\_VOL_i$). The $REG\_MIL\_UDPL\_VOL_i$ is the positive difference between 1) the product of Real-Time Regulating Reserve Volume (REG_MW_i) and Regulating Mileage Deploy Ratio (REG_MIL_DPL_RATIO), and 2) the Target Regulating Mileage ($TARGET\_REG\_MIL_i$) for any Dispatch Interval where the Mileage Qualify Flag is true.

IF MQF = “Y” **THEN**
$REG\_MIL\_UNDP\_VOL_i = \mathbf{MAX}\ (REG\_MW_i \times REG\_MIL\_DPL\_RATIO - TARGET\_REG\_MIL_i, 0)$
END IF

Where:
i = the given Dispatch Interval

The hourly Regulating Mileage Undeployed Volume (REG_MIL_UNDP_VOL *) is sum of the Dispatch Interval Regulating Mileage Undeployed Volumes.

$$REG\_MIL\_UNDP\_VOL = \sum_{i=1}^{12} REG\_MIL\_UNDP\_VOL_i$$

Where:
i = the given Dispatch Interval

D.11.17 Real Time Hourly Undeployed Regulating Mileage Amount (REG_MIL_UNDP_AMT*)

The Regulating Mileage Undeployed Amount is a charge to a Regulating qualified Resource based on Regulating Mileage Marginal Clearing Price (RT_REG_MIL_MCP).

$$REG\_MIL\_UNDP\_AMT = \sum_{i=1}^{n} (RT\_REG\_MIL\_MCP_i \times REG\_MIL\_UNDP\_VOL_i)$$

Where:
i = the given Dispatch Interval
n = the number of Dispatch Intervals in the Hour

D.11.18 Mileage Charge Amount (MIL_CHARGE_AMT*)

The Mileage Charge Amount (MIL_CHARGE_AMT) is the dollar amount charged to a Regulating qualified Resource that fails the Mileage Performance Test. The Dispatch Interval Mileage Charge Amount ($MIL\_CHARGE\_AMT_i$) is calculated as:

IF $FMPTF_i = 1$ **THEN**
MIL_CHARGE_AMT =
RT_REG_MIL_MCP × ADD_REG_MIL_VOL × (1 - FOLLOW_PER)
END IF

The Hourly Mileage Charge Amount (MIL_CHARGE_AMT*) is the sum of the Dispatch Interval Mileage Charge Amounts ($MIL\_CHARGE\_AMT_i$) for all the Dispatch Intervals in an Hour.

$$MIL\_CHARGE\_AMT = \sum_{i=1}^{12} MIL\_CHARGE\_AMT_i$$

D.11.19 Real Time Regulating Mileage Total Make Whole Payment (RT_MIL_TOT_MWP)

This Real-Time Regulating Mileage Total Make Whole Payment (RT_MIL_TOT_MWP) ensures that Resource with undeployed Regulating Mileage are kept whole to their offer costs when they charge the Regulating Mileage MCP for undeployed Regulating Mileage. Day Ahead and Real Time costs, revenues and margins are evaluated independently and then summed to determine the RT_MIL_TOT_MWP.

D.11.19.1 Calculated the Day Ahead Undeployed Mileage (DA_UNDP_MIL_VOL) and Real-Time Undeployed Mileage (RT_UNDP_MIL_VOL)

The first step in calculating the RT_MIL_TOT_MWP is to determine the amount of undeployed Regulating Mileage associated with the Day Ahead Market (DA_UNDP_MIL_VOL) and the Real Time Market (RT_UNDP_MIL_VOL). This determination is calculated as:

$$DA\_UNDP\_MIL\_VOL_i = \textbf{MIN}\ \{\ \textbf{MAX}\ (\ DA\_REG\_VOL - DA\_REG\_SS\_VOL\ ,\ 0\ )\ ,\ DA\_UNDP\_MIL\_NOSS\_VOL_i \}$$

$$RT\_UNDP\_MIL\_VOL_i = \textbf{MIN}\ \{\ \textbf{MAX}\ [\ REG\_VOL_i - REG\_SS\_VOL\ ,\ 0\ ]\ ,\ [\ REG\_MIL\_UNDP\_VOL_i - DA\_UNDP\_MIL\_NOSS\_VOL_i\ ]\ \}$$

Where:

$$DA\_UNDP\_MIL\_NOSS\_VOL_i = \textbf{MAX}\ \{\ REG\_MIL\_UNDP\_VOL_i - \textbf{MAX}\ (\ REG\_VOL_i - DA\_REG\_VOL\ ,\ 0\ )\ ,\ 0\ \}$$

i = the given Dispatch Interval

D.11.19.2 Calculate the Day Ahead Potential Make Whole Payment (DA_MIL_POT_MWP*)

The Hourly Day Ahead Potential Make Whole Payment (DA_MIL_POT_MWP) is equal to the sum of the Dispatch Interval difference between the Regulating Mileage MCP and Regulating Mileage Offer times the Day Ahead Undeployed Mileage, calculated as:

DA_MIL_POT_MWP =

$$\sum_{i=1}^{12} \text{MAX}\left[\left\{ \left(RT\_REG\_MIL\_MCPi - MIL\_OF \right) \times DA\_UNDP\_MIL\_VOL_i \right\}, 0 \right]$$

Where:
i = the given Dispatch Interval

D.11.19.3 Calculate the Day Ahead Unused Net Positive Margin (DA_UNUSED_MARGIN*)

The Hourly Day Ahead Net Positive Margin is equal to the sum of the net positive margin a Resource receives for Energy and Operating Reserves in any Dispatch Interval with Day Ahead Undeployed Mileage, calculated as:

IF $DA\_UNDP\_MIL\_VOL_i > 0$ **THEN**

$$DA\_UNUSED\_MARGIN_i = \textbf{MAX} \{ [(DA\_SCHD \times DA\_LMP) + (DA\_AS\_VOL \times DA\_AS\_MCP)] - [\int_0^{DA\_SCHD} DA\_Offer\_Curve] + (DA\_AS\_VOL \times DA\_AS\_AVOF) + NL\_COST + SU\_COST] , 0 \} / 12$$

ELSE

$DA\_UNUSED\_MARGIN_i = 0$

END IF

$$DA\_UNUSED\_MARGIN = \sum_{i=1}^{12} DA\_UNUSED\_MARGIN_i$$

Where:

i = the given Dispatch Interval

NL_COST = the Hourly No Load Cost for Resources with a DA_RSG_ELIGIBILITY = 1

SU_COST = the Hourly pro-rated Start Up Cost for Resources with a DA_RSG_ELIGIBILITY = 1

** Note: The Commitment Period Start Up Costs will be pro-rated to each Hour based on the number of hours in the Commitment Period*

D.11.19.4 Calculate the Day Ahead Mileage Make Whole Payment (DA_MIL_MWP)

The Hourly Day Ahead Mileage Make Whole Payment (DA_MIL_MWP) is equal to the net positive difference between the Day Ahead Mileage Potential Make Whole Payment (DA_MIL_POT_MWP) and the Day Ahead Net Positive Margin (DA_UNUSED_MARGIN).

DA_MIL_MWP = **MAX** (DA_MIL_POT_MWP – DA_UNUSED_MARGIN , 0)

D.11.19.5 Calculate the Real Time Potential Make Whole Payment (RT_MIL_POT_MWP*)

The Hourly Real Time Potential Make Whole Payment (RT_MIL_POT_MWP) is equal to the sum of the Dispatch Interval difference between the Regulating Mileage MCP and Regulating Mileage Offer times the Real Time Undeployed Mileage, calculated as:

$$RT\_MIL\_POT\_MWP = \sum_{i=1}^{12} MAX\left[\left\{\left(RT\_REG\_MIL\_MCPi - MIL\_OF\right) \times RT\_UNDP\_MIL\_VOL_i\right\}, 0\right]$$

D.11.19.6 Calculate the Real Time Net Positive Margin (RT_UNUSED_MARGIN*)

The Hourly Real Time Net Positive Margin is equal to the sum of the net positive margin a Resource receives for the Real Time imbalance of Energy and Operating Reserves in any Dispatch Interval with Real Time Undeployed Mileage, calculated as:

IF $RT\_UNDP\_MIL\_VOL_i > 0$ **THEN**

$RT\_UNUSED\_MARGIN_i =$

$$(\mathbf{MAX} \{ [(NXE - DA\_SCHD) \times RT\_LMP\_EN] + (RTN\_AS\_VOL \times RT\_AS\_MCP) \} - [\int_{DA\_SCHD}^{NXE} RT\_Offer\_Curve + (RTN\_AS\_VOL \times RTN\_AS\_AVOF) + NL\_COST + SU\ COST] , 0 \} / 12)$$

ELSE

$RT\_UNUSED\_MARGIN_i = 0$

END IF

$$RT\_UNUSED\_MARGIN = \sum_{i=1}^{12} RT\_UNUSED\_MARGIN_i$$

Where:

i = the given Dispatch Interval

NL_COST = the pro-rated No Load Cost for Resources with a RT_RSG_ELIGIBILITY = 1

SU_COST = the pro-rated Start Up Cost for Resources with a RT_RSG_ELIGIBILITY = 1

** Note: The No Load Costs will be pro-rated based on the number of minutes the Resource is committed in the Hour. The Commitment Period Start Up Costs will be pro-rated to each hour based on the number of hours in the Commitment Period, adjusted for partial Hour commitments.*

D.11.19.7 Calculate the Real Time Mileage Make Whole Payment (RT_MIL_MWP)

The Hourly Real Time Mileage Make Whole Payment (RT_MIL_MWP) is equal to the net positive difference between the Real Time Mileage Potential Make Whole Payment (RT_MIL_POT_MWP) and the Real Time Net Positive Margin (RT_UNUSED_MARGIN).

RT_MIL_MWP = **MAX** (RT_MIL_POT_MWP – RT_UNUSED_MARGIN , 0)

D.11.19.8 Calculate the Real Time Mileage Total Make Whole Payment (RT_MIL_TOT_MWP)

The Hourly Real Time Mileage Total Make Whole Payment (RT_MIL_TOT_MWP) is equal to the sum of the Day Ahead Mileage Make Whole Payment (DA_MIL_MWP) and the Real Time Mileage Make Whole Payment (RT_MIL_MWP), calculated as:

RT_MIL_TOT_MWP = DA_MIL_MWP + RT_MIL_MWP

E. Special Topics

E.1 Failure to Follow Dispatch Flag (FFDF*)

The Failure to Follow Dispatch Flag (FFDF*) is an hourly flag which is set for any Resource that has Dispatch Interval Excessive Energy (EXE_i) or Dispatch Interval Deficient Energy (DFE_i) in four or more consecutive Dispatch Intervals in a given Hour.

Market Interval Begin in Eastern Standard Time (MKT_INT_BEG_EST**) 00:00:00 (hh24:mi:ss) through MKT_INT_BEG_EST** 00:55:00 (hh24:mi:ss) are considered to be the Dispatch Intervals associated to Market Hour Ending 1. Dispatch Interval(s) in which the Excessive Energy Exemption Flag (EEEF*/**) is set to true will result in zero $EXE*/_i$ or $DFE*/_i$ and will be treated accordingly by the determination of the FFDF*.

E.2 Excessive Energy Exemption Flag (EEEF*/**) and Hourly Real Time RSG Distribution Exemption Flag (RSG_XMPT*)

The EEEF*/** is set for all the Dispatch Intervals in the hour for the following reasons:

- If a Resource has an Intermittent classification
- Emergencies
- Test mode of a Resource
- Start-Up or Shut-Down mode of the Resource
- The hour when a Resource trips and goes Off-Line
- Market-wide exemption due to significant electric grid anomalies such as disturbances from major storms or blackouts, or when the availability of RT Resource instruction data is questionable,

- Manual Re-Dispatch

Please see document *RTO-OP-010 Generator Operator Communication with MISO*, for more information.

When a Resource has the EEEF*/** set for the reasons listed above, it will result in the EEEF*/** being set to true for both the applicable Dispatch Intervals in the Hour, and at the hourly level.

The EEEF** is set for the affected Resource(s) / Dispatch Intervals for the following reason:

- A Contingency Reserve Deployment (CRD).

The Real Time RSG_XMPT* flag is set for the affected Resource(s) / Market Hours for the following reasons:

- Emergencies;
- Market-Wide exemption;
- Manual Re-Dispatch;
- A Contingency Reserve Deployment (CRD)

E.3 Common Bus Substitution

For the purposes of calculating Dispatch Interval Excessive Energy (EXE_i) and Dispatch Interval Deficient Energy (DFE_i), Excessive/Deficient Energy Deployment Charge (EDEDC*), and Contingency Reserve Deployment Failure Charge (RT_ASM_CRDFC*), all Resources owned by a specific Market Participant and located at the same electrical bus can be registered as a Common Bus. Common Buses will be registered as part of the Network Model update process. These Resources will not be aggregated for any other purpose, including, but not limited to, offering, commitment, clearing, dispatching, pricing, and instructing.

E.3.1 Contingency Reserve Deployment Failure Charge (RT_ASM_CRDFC*)

If one or more Resources at a Common Bus fails the RT_ASM_CRDFC* tests for a specific event, the output of all Resources deploying Spinning Reserve and/or

Supplemental Reserve at the Common Bus for a specific event will be aggregated together and the test will be re-executed based on the aggregated values. If the aggregated Resources pass, all Resources associated to the applicable Common Bus shall pass. If the aggregated calculation at the Common Bus fails, then the pre-aggregation pass/fail status and, if applicable, calculated shortfalls and caps will apply.

E.3.2 Excessive / Deficient Energy Calculation

In a given Dispatch Interval, if one or more Resources at a Common Bus has EXE_i or DFE_i, the inputs for all Resources associated to a given Common Bus with EEEF* set to false will be aggregated to determine the EXE_i or DFE_i. The Excessive Energy Threshold (EXE_T) and Deficiency Energy Threshold (DFE_T) will be calculated by summing the Average Basepoint (AVG_BP**) and Ramped Regulation Deployment (REG_DEPL**) and then applying the logic defined in the “Excessive/Non-Excessive/Deficient Energy” section of this document. If the aggregated Resource calculation at the Common Bus has EXE_i or DFE_i for the Dispatch Interval, then the pre-aggregation EXE_i and DFE_i will apply.

E.3.3 Excessive / Deficient Energy Deployment Charge (EDEDC*)

The Hourly Failure to Follow Dispatch Flag (FFDF*) is set based on four or more consecutive Dispatch Intervals in an Hour with either EXE_i or DFE_i. The EXE_i and DFE_i as calculated in the section above shall be used to determine the FFDF*. Therefore, should the Common Bus check yield EXE_i equal to zero and DFE_i equal to zero, then EXE_i and DFE_i for every Resource associated to the Common Bus shall be equal to zero, and as such, the applicable Dispatch Interval does not count toward the four consecutive Dispatch Interval check for any of the Resource associated to the Common Bus. Should the Common Bus check yield a non-zero EXE_i and DFE_i, the pre-aggregation EXE_i and DFE_i will apply, with the four Dispatch Interval check determined for each individual Resource.

E.4 Expected Output

The Expected Output (EO) is a calculated value that is an input into the determination of Contingency Reserve Deployment Compliance (CRDC). For a detailed overview of the determination of CRDC please see the BPM 002 Energy and Operating Reserve Markets BPM.

The EO is an input into two of the CRDC checks. The EO is set equal to the actual output of a given Resource at the start of a Contingency Reserve Deployment (CRD) event. The EO is then calculated every four seconds during the CRD event. The four second calculation of EO is as follows:

E.4.1 Calculation Overview

IF SP(t'') < EO(t') **THEN**
  EO(t'') = MAX { EO(t') - ((t'' - t') / 60) × (ApplicableDownRampRate(t)) , SP(t'') }
ELSEIF {SP(t'') > EO(t')} **THEN**
  EO(t'') = MIN { EO(t') + ((t'' - t') / 60) × (ApplicableUpRampRate(t)) , SP(t'')}
ELSE
  EO(t'') = SP(t'')
END IF

Where:
SP = AVG_SP + CRD

E.4.2 Calculation Example

The following is an example of how the EO is calculated during a CRD event for a given Resource.

Beginning assumptions:
- CRD event start time = 10:15:15
- CRD event stop time = 10:25:15
- The Resource has an up, down, and bi-directional ramp rate of 2 MW/Minute (reference as ‘RR’ in the following diagrams)

- During the CRD event the Resource is not cleared for Regulating Reserve and is therefore not deployed for Regulation

E.4.2.1 Dispatch Interval begin 10:15

Assumptions:

- At 10:15:15 the Resource actual output is 100 MW
- The Resource has 2 MW of CRD
- At 10:15:00 the BP is 97
- Therefore at 10:15:15, after applying the 2 MW of CRD, the SP = 99

So, applying the logic above, the EO is as follows:

Expected Output Calculation Example
Dispatch Interval begin 10:15

Time	SP	EO	RR
10:15:15	99	100	2
10:15:19	99	99.8667	2
10:15:23	99	99.7333	2
10:15:27	99	99.6000	2
10:15:31	99	99.4667	2
10:15:35	99	99.3333	2
10:15:39	99	99.2000	2
10:15:43	99	99.0667	2
10:15:47	99	99	2
↓			
10:20:00	99	99	2

E.4.2.2 Dispatch Interval begin 10:20

Assumptions:

- The UDS issues a BP at 10:20:00 with a target time of 10:25:00 of 104
- Therefore the SP from 10:20:00 until 10:25:00 is 106 (104 + 2 MW of CRD)

So, applying the logic above, the EO is as follows:

Expected Output Calculation Example
Dispatch Interval begin 10:20

Time	SP	EO	RR
10:20:03	106	99.1333	2
10:20:07	106	99.2667	2
10:20:11	106	99.4000	2
10:20:15	106	99.5333	2
10:20:19	106	99.6667	2
10:20:23	106	99.8000	2
10:20:27	106	99.9333	2
10:20:31	106	100.0667	2
10:20:35	106	100.2000	2
↓			
10:23:27	106	105.9330	2
10:23:31	106	106	2
↓			
10:24:59	106	106	2

E.4.2.3 Dispatch Interval begin 10:25

Assumptions:

- The UDS issues a BP at 10:25:00 with a target time of 10:30:00 of 102
- Therefore the SP from 10:25:00 until 10:25:15 is 104 (102 + 2 MW of CRD)

So, applying the logic above, the EO is as follows:

Expected Output Calculation Example
Dispatch Interval begin 10:25

Time	SP	EO	RR
10:25:03	104	106	2
10:25:07	104	105.7333	2
10:25:11	104	105.6000	2
10:25:15	104	105.4667	2

E.4.2.4 Expected Output Result and CRDC Impact

Therefore the EO at the end of the CRD event is = 105.4667. The change in the EO across the CRD event is equal to 5.4667, which is calculated as the difference between the EO at the end of the event (105.4667) minus the EO at the beginning of the event (100).

E.5 Ramped Regulation Deployment (REG_DEPL**)

Resources cleared for Regulating Reserve may be deployed for Regulation. A Resource can be deployed for Regulation in either an upward or downward direction by MISO in order to maintain frequency and reliable operations. Ramped Regulation Deployment (REG_DEPL**) is an input into the determination of the Excessive Energy Threshold (EXE_T) and Deficiency Energy Threshold (DFE_T), and is also an input into the calculation of the Net Regulation Adjustment Amount (RT_ASM_NRGA*).

Since Regulation signals are provided by MISO in a ‘stepped’ manner, it is necessary to calculate a Ramped Regulation Deployment value, so as to avoid undue charges for Resources that follow MISO signals.

E.5.1 Calculation Overview

The description below explains the way in which REG_DEPL** is calculated.

REG_DEPL Calculation and Variable Definition**

UDS_DTP	The intended UDS deployment time interval for Regulating Reserve (the expected value for this variable is 5 minutes)
REG_CLR_{i}	The current Dispatch Interval cleared Regulating Reserve
REG_RD_{t}	Ramped Regulation Deployment value
REG_RD_{t-1}	Ramped Regulation Deployment value of the prior time interval’s calculation
REG_TRD	Current Target Regulation Deployment
REG_CLR_{i-1}	The previous Dispatch Interval cleared Regulation Reserve
RR	Ramp Rate used in the calculation of REG_RD
SCAN_RATE	Time interval duration between calculations. This value is currently set to 4 seconds

The logic and calculations below are calculated every four seconds. The resultant REG_RD_{t} is then scanned every 3 seconds and averaged over each Dispatch Interval from HH:00:00 (not inclusive) to HH:05:00 (inclusive) to determine the Dispatch Interval REG_DEPL**.

The first step is to determine the Ramp Rate (RR) that will be used to calculate the REG_RD. For a given Resource the following logic is used to calculate the RR:

IF REG_CLR_i < ABS(REG_RD_{t-1}) **THEN**
  RR = REG_CLR_{i-1} / UDS_DTP
ELSE
  RR = REG_CLR_i / UDS_DTP
END IF

Once the RR has been determined, the following logic is used to calculate REG_RD_t:
IF RR = 0 **THEN**
  $REG\_RD_t = 0$
ELSE
  IF REG_TRD > REG_RD_{t-1} **THEN**
    REG_RD_t = MIN { REG_TRD , [REG_RD_{t-1} + (SCAN_RATE × RR / 60)] }
  ELSEIF REG_TRD < REG_RD_{t-1} **THEN**
    REG_RD_t = MAX { REG_TRD , [REG_RD_{t-1} – (SCAN_RATE × RR / 60)] }
  ELSE
    $REG\_RD_t = REG\_RD_{t-1}$
  END IF
END IF

E.5.2 Calculation Example

The following is an example that depicts the REG_DEPL** calculation for a given Resource.

E.5.2.1 Dispatch Interval begin 15:35

Assumptions:
- The Resource has a REG_RD_t of zero at the beginning of the Dispatch Interval
- The Resource clears zero MW of Regulating Reserve
- Therefore REG_RD_t for the entire Dispatch Interval = 0 and the Dispatch Interval REG_DEPL** = 0

E.5.2.2 Dispatch Interval begin 15:40

Assumptions:

- The Resource has a REG_RD_t of zero at the beginning of the Dispatch Interval
- The Resource clears 10 MW of Regulating Reserve for the Dispatch Interval
- The UDS_DTP is 5 (Minutes)
- The Resource has a REG_TRD of -2 MW for the first 3 minutes and a REG_TRD of +10 MW for the remaining 2 minutes of the Dispatch Interval.

So, applying the logic above, the RR for the Dispatch Interval is as follows:

IF 10 < 0 **THEN**
RR = 0 / 5
ELSE
RR = 10 / 5
END IF

In this case, the **ELSE** clause applies so the RR = 2.

Now that the RR has been determined for the Dispatch Interval, we will calculate the $REG\_RD_{t:}$

REG_DEPL Calculation Example**
Dispatch Interval begin 15:40

Time Interval	REG_RD_t	REG_RD_{t-1}	REG_TRD	RR	SCAN_RATE
15:40:00	0.0000	0.0000	0	0	4
15:40:04	-0.1333	0.0000	-2	2	4
15:40:08	-0.2667	-0.1333	-2	2	4
15:40:12	-0.4000	-0.2667	-2	2	4
15:40:16	-0.5333	-0.4000	-2	2	4
↓					
15:40:48	-1.6000	-1.4667	-2	2	4
15:40:52	-1.7333	-1.6000	-2	2	4
15:40:56	-1.8667	-1.7333	-2	2	4
15:41:00	-2.0000	-1.8667	-2	2	4
↓					
15:42:56	-2.0000	-2.0000	-2	2	4
15:43:04	-1.8667	-2.0000	10	2	4
15:43:08	-1.7333	-1.8667	10	2	4
15:43:12	-1.6000	-1.7333	10	2	4
↓					
15:44:48	1.6000	1.4667	10	2	4
15:44:52	1.7333	1.6000	10	2	4
15:44:56	1.8667	1.7333	10	2	4
15:45:00	2.0000	1.8667	10	2	4

5-Minute Dispatch Interval REG_DEPL	-0.9867

In this example, the REG_DEPL** for Dispatch Interval begin 15:40 is equal to -0.9867.

E.5.2.3 Dispatch Interval begin 15:45

Assumptions:

- The Resource has a REG_RD_t of 2 at the beginning of the Dispatch Interval
- The Resource clears 0 MW of Regulating Reserve for the Dispatch Interval
- The UDS_DTP is 5 (Minutes)
- The Resource has a REG_TRD of 0 MW for the entire Dispatch Interval.

So, applying the logic above, the RR for the Dispatch Interval is as follows:

IF 0 < 2 **THEN**

RR = 10 / 5

ELSE

RR = 0 / 5

END IF

In this case, the REG_CLR_i < ABS(REG_RD_{t-1}) so the RR = 2.

Now that the RR has been determined for the Dispatch Interval, we will calculate the REG_RD_t:

REG_DEPL Calculation Example**

Dispatch Interval begin 15:45

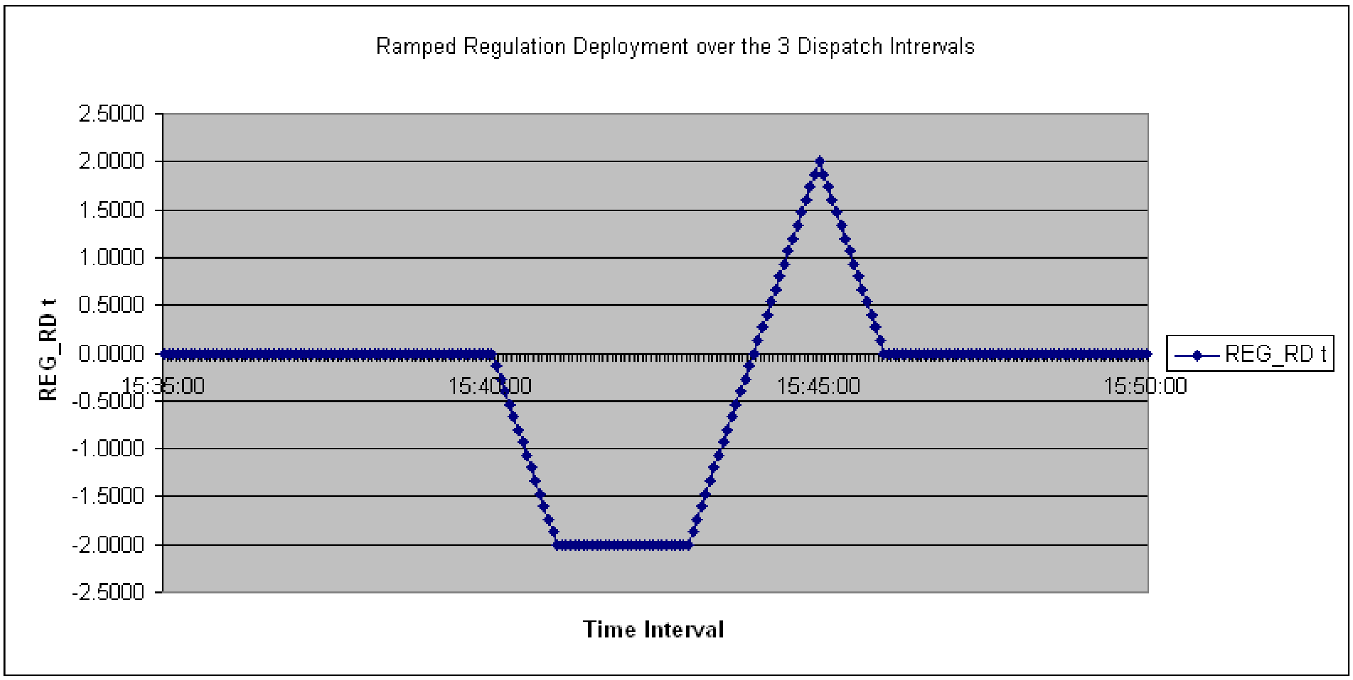
Time Interval	REG_RD_t	REG_RD_{t-1}	REG_TRD	RR	SCAN_RATE
15:45:00	2.0000	1.8667	10	2	4
15:45:04	1.8667	2.0000	0	2	4
15:45:08	1.7333	1.8667	0	2	4
15:45:12	1.6000	1.7333	0	2	4
15:45:16	1.4667	1.6000	0	2	4
↓					
15:45:48	0.4000	0.5333	0	2	4
15:45:52	0.2667	0.4000	0	2	4
15:45:56	0.1333	0.2667	0	2	4
15:46:00	0.0000	0.1333	0	2	4
15:46:04	0.0000	0.0000	0	2	4
↓					
15:49:56	0.0000	0.0000	0	2	4
15:50:00	0.0000	0.0000	0	2	4

5-Minute Dispatch Interval REG_DEPL	0.1867

In this example, the REG_DEPL** for Dispatch Interval begin 15:45 is equal to 0.1867.

The following is a graphical representation of the REG_DEPL** over the 3 Dispatch Intervals addressed above:

REG_DEPL Calculation Example**
Graphical Representation of the 3 Dispatch Intervals



E.6 Energy Management System (EMS) Data Sampling and Integration

The POP samples and integrates a number of different data points from the EMS that are used as an input into different POP calculations. The sampled and integrated data points are:

EMS Data Sample Frequency and Overview

Value	Quality Codes	Scan Frequency
Telemetry (IN)	YES	4 Seconds
EMS BP (OUT)	YES	10 Seconds
EMS State Estimator	NO	1 Minute
Ramped Regulation Deployment (REG_DEPL**)	NO	4 Seconds

E.6.1 Quality Codes

The EMS State Estimator and Ramped Regulation Deployment (REG_DEPL**) do not have Quality Codes because they are calculated by the EMS. The EMS evaluates the different inputs into each calculation, including the quality of each input, and determines the best possible result. Therefore, there is no need to determine if these values are “GOOD” or “BAD”, they are simply sampled and integrated over each Resource / Dispatch Interval.

Telemetry and Dispatch Target for Energy both have Quality Codes associated to them. The Quality Codes are used to determine if a given Resource / Dispatch Interval value is “GOOD” or “BAD”. Each scan of these two data elements includes a timestamp, MW value, and four EMS quality codes (GOOD, REPLACED, GARBAGE, and SUSPECT). Scan-level data is associated to a given Dispatch Interval, such that if it’s greater than HH:00:00 and less than or equal to HH:05:00, it is associated to Market Interval Begin 00 for the given Hour (HH).

Of the four EMS quality codes, GOOD and REPLACED represent “GOOD” values and GARBAGE and SUSPECT represent “BAD” values. For a given scan of data, it is only possible to have one and only one of the four EMS quality codes set equal to true.

In order for a given Resource/Dispatch Interval to be considered “GOOD”, it must have at least 50% of the scans be either GOOD or REPLACED. In the event that at least 50% of the applicable scans are either GOOD or REPLACED, the MW values associated only to those scans with GOOD or REPLACED quality codes are integrated, and the Dispatch Interval is considered “GOOD”.

In the event that more than 50% of the applicable scans are either GARBAGE or SUSPECT, the Dispatch Interval is considered “BAD”, and therefore, the MW value is replaced using the Data Substitution Hierarchy, defined below.

The following is an example of the logic above:

EMS Data Dispatch Interval Quality Code Determination and Integration

				"GOOD"		"BAD"	
	Time Stamp	CPNode	MW Value	Good	Replaced	Suspect	Garbage
	10:00:00	Node1	100	1	0	0	0
Dispatch Interval Begin 10:00:00	10:01:00	Node1	110	0	1	0	0
	10:02:00	Node1	100	0	0	1	0
	10:03:00	Node1	105	0	0	0	1
	10:04:00	Node1	120	1	0	0	0
	10:05:00	Node1	115	1	0	0	0
	10:06:00	Node1	115	0	1	0	0
			Average	40%	20%	20%	20%
			Total	60%		40%	

MKT_INT_BEGIN	CPNode	MW	Quality
10:00:00	Node1	115	GOOD

E.6.2 Data Substitution Hierarchy

In the event that a given Resource / Dispatch Interval is “BAD” (which is also the case if it is missing), the “BAD” value is replaced with the next best value in the data substitution hierarchy for that data element. The following explains the data substitution hierarchy for each data element.

E.6.2.1 Telemetry Volume (TEL_VOL**)

IF Telemetry Quality = “GOOD” **THEN**
  TEL_VOL = Telemetry
ELSEIF EMS State Estimator Quality = “GOOD” **THEN**
  TEL_VOL = EMS State Estimator
ELSE
  TEL_VOL = LMP State Estimator

END IF

Note: The LMP State Estimator is the State Estimator value as an input into the LMP Case for a given Dispatch Interval. This data is received from the DART system, not the EMS, and is therefore not discussed further in this section.

In addition, since a DRR Type-I resource does not have EMS data available, the SCADA Basepoint Value is substituted by the Hourly Targeted Demand Reduction MW, and its Regulation Deployment MW is always assumed to be 0.

*For Combined Cycle (CC) aggregate Resources, since there is no EMS data available, both the BP and REG_DEPL** at the aggregate level is the sum of corresponding values of its CC child Resources.*

E.6.2.2 Basepoint (BP**)

IF EMS BP Quality = "GOOD" **THEN**
  BP = EMS BP
ELSE
  BP = UDS BP
END IF

Note: The UDS BP is the BP that cleared in the UDS in the DART. This data is received from the DART system, not the EMS, and is therefore not discussed further in this section.

*In the event that both the EMS BP and UDS BP are missing, the BP** is substituted with the last GOOD BP** value. Furthermore, in the event that UDS cases are not being approved, the EMS BP and UDS BP will persist with the last approved case value until a new case is approved. While the BP** is sampled from the EMS and has a data substitution hierarchy, the concept of using the last GOOD BP** value and/or the persistence of the BP** in the event that values are missing or cases are not being approved, also applies to the cleared AS volumes; RT_AS_VOL.*

E.7 Combined Cycle Resources

Combined Cycle Resources require special logic associated to the calculations in this document. The following information details the special logic used in each applicable calculation contained in this document.

E.7.1 Resource Load Profiled Volume

The Resource Load Profiled Volume (RES_LP_VOL**) of a Combined Cycle (CC) aggregate Resource is calculated as the sum of the RES_LP_VOL** of the CC child Resources. The RES_LP_VOL** of the CC child Resources is calculated using the difference between the Alternate Total Energy (ATE) and Real-Time Metered Billable Volume (RT_BLL_MTR*) of the CC aggregate Resource. Each CC child Resource Dispatch Interval Telemetry Volume (TEL_VOL**) is adjusted based on a Normalized Weighting Factor (NWF) of the applicable CC child Resource TEL_VOL** compare to the sum of the CC child Resources TEL_VOL** for a given CC aggregate Resource multiplied by the difference between the ATE and RT_BLL_MTR* of the CC aggregate Resource.

For example, consider the following exhibit which shows a CC Resource with both Generation and Load in a given market hour, and the resultant RES_LP_VOL** of the CC aggregate Resource:

CC RES_LP_VOL Calculation Example**

Hourly Inputs

	C1	C2	Parent
ATE	-111.67	31.67	-80
RT_ACT_MTR	NA	NA	-82
RT_ACT_MTR - ATE	NA	NA	-2

Interval Inputs

Interval	TEL_VOL C1	TEL_VOL C2	All Positive C1	All Positive C2	NWF C1	NWF C2	RES_LP_VOL C1	RES_LP_VOL C2	RES_LP_VOL CC Aggregate
1	-100	-80	100	80	0.42	0.34	-100.85	-80.68	-181.53
2	-100	-100	100	100	0.42	0.42	-100.85	-100.85	-201.70
3	-115	-70	115	70	0.49	0.30	-115.98	-70.59	-186.57
4	-115	-105	115	105	0.49	0.45	-115.98	-105.89	-221.87
5	-120	-90	120	90	0.51	0.38	-121.02	-90.76	-211.78
6	-120	0	120	0	0.51	0.00	-121.02	0.00	-121.02
7	-110	100	110	100	0.47	0.42	-110.93	99.15	-11.78
8	-115	500	115	500	0.49	2.12	-115.98	495.76	379.78
9	-120	115	120	115	0.51	0.49	-121.02	114.02	-6.99
10	-100	105	100	105	0.42	0.45	-100.85	104.11	3.26
11	-110	115	110	115	0.47	0.49	-110.93	114.02	3.09
12	-115	-110	115	110	0.49	0.47	-115.98	-110.93	-226.91

E.7.2 Real-Time Net Ancillary Service Volumes (RTN_AS_VOL*) and Real-Time Ancillary Service Market Clearing Prices (RT_AS_MCP*)

If a CC Resource is committed as a CC aggregate Resource, the Ancillary Service Cleared Megawatt Volume (AS_MW**) of the CC aggregate Resource is used in calculating the Real-Time Net Cleared Ancillary Service Volume (RTN_AS_VOL*). If the CC Resource is committed as a set of CC child Resources, the AS_MW** of the CC aggregate Resource is equal to the sum of the CC child Resources' cleared AS_MW**. The CC aggregate Resource Ancillary Services Market Clearing Prices (AS_MCP**) are used for the calculation of Real-Time Ancillary Service Market Clearing Price (RT_AS_MCP*). CC Resources can only be committed as either a CC aggregate Resource or set of CC child Resources in both the DA and RT Energy and Operating Reserve Market for a given Operating Day (OD).

E.7.3 Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*)

For a CC Resource committed as a CC aggregate Resource, the calculation of Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*) is the same as for all other Resources. For a CC Resource committed as a CC child Resource, all eligible CC child Resources will be evaluated based on the steps in the “Hourly Net Regulation Adjustment (RT_ASM_NRGA*)” of the “Calculations” section in this document , but using CC aggregate Resource RT_LMP_EN*. The RT_ASM_NRGA* for the CC aggregate Resource is the sum of the eligible CC child Resources.

E.7.4 Excessive/Non-Excessive/Deficient Energy

For CC Resources, Dispatch Interval Excessive Energy (EXE_i) and Dispatch Interval Deficient Energy (DFE_i) are calculated at the CC aggregate Resource level. The AVG_BP** and REG_DEPL** values used in this calculation are equal to the sum of the CC child Resources.

E.7.5 Excessive Energy Price (EXP*)

For a CC Resource committed as a CC aggregate Resource, the calculation of the EXP* is the same as all other Resources. For CC Resources committed as a CC child Resource, the Offer@AVG_BP is determined for each committed CC child Resource. Then the Offer@AVG_BP of each committed CC child Resource is quantity-weighted by the AVG_BP** of each CC child Resource. Then the quantity-weighted Offer@AVG_BP is summed to determine the Offer@AVG_BP of the CC aggregate Resource. The EXP_i of the CC aggregate Resource is equal to the lesser of 1) the quantity-weighted Offer@AVG_BP of the CC aggregate Resource and 2) the RT_LMP_EN* of the CC aggregate Resource.

E.7.6 Failure to Follow Dispatch Flag

For a CC Resource, the Failure to Follow Dispatch (FFDF*) is first calculated at the aggregate level. Then both the CC aggregate and/or CC child Resources inherit the FFDF* of the CC aggregate Resource.

E.7.7 Excessive Energy Exemption Flag

For a CC Resource, an EEEF*/** at either the CC aggregate Resource or CC child Resource level will result in both the CC aggregate Resource and CC child Resource receiving EEEF*/** for the applicable Dispatch Intervals and/or Hours.

E.7.8 Day-Ahead Revenue Sufficiency Guarantee Make Whole Payment (DA_RSG_MWP*)

DA_RSG_MWP* is calculated the same for a CC aggregate Resource as any other Resource outlined in the “Day-Ahead and Real-Time Revenue Sufficiency Guarantee” section of this document. If a CC Resource is committed as a set of CC child Resources, then the Total Production Costs for the CC aggregate Resource is the sum of the Total Production Costs of all eligible CC child Resources plus the market value of all ineligible CC child Resources.

For example, a CC Resource with two CC child Resources is committed as a set of CC child Resources (C1 and C2). C1 is economically committed in the DA for HE 8-10 and clears 50 MW of Energy and 5 MW of Spinning Reserve. C2 is Must-Run in the DA for HE 8-10 and clears 50 MW of Energy. The tables below show the resulting values.

	HE	Start-Up	No Load	Energy MW	Energy Offer	Spin MW	Spin Offer	Production Costs
C1	8	200	400	50	30	5	20	2200
	9	200	400	50	30	5	20	2200
	10	200	400	50	30	5	20	2200

	HE	Energy MW	DA LMP	Market Value
C2	8	50	20	1000
	9	50	20	1000
	10	50	20	1000

	HE	Production Costs	Energy MW	RT LMP	Spin MW	Spin MCP	Market Value
Parent	8	3200	100	25	5	10	2550
	9	3200	100	25	5	10	2550
	10	3200	100	25	5	10	2550
	Total	9600				Total	7650

This example results in the CC aggregate Resource receiving a DA_RSG_MWP* of -$1,950.00 since the Total Production Costs of the CC child Resources are greater than the market value of the CC aggregate Resource.

E.7.9 Real-Time Revenue Sufficiency Guarantee Make Whole Payment (RT_RSG_MWP*)

RT_RSG_MWP* is calculated the same for a CC aggregate Resource as any other Resource as outlined in the “Day-Ahead and Real-Time Revenue Sufficiency Guarantee” section of this document. If a CC Resource is committed as a set of CC child Resources, then the Total Production Costs for the CC aggregate Resource is the sum of the Total Production Costs of the eligible CC child Resources. The market value of an ineligible CC child Resources is not factored into the Total Production Costs of the

CC aggregate Resource for RT_ASOF_MWP*. The summed Total Productions Costs of the eligible CC child Resources are evaluated against the market value of the CC aggregate Resource using the RSG_ELIG_MWH*. If the Total Production Costs are greater than the market value, then the CC aggregate Resource will receive a RT_ASOF_MWP*.

E.7.10 Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)

RTORSGP* is calculated the same for a CC aggregate Resource as any other Resource as outlined in the "Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)" section of this document. If a CC Resource is committed as a CC child Resource, then Energy Cost and Operating Reserve Cost for the CC aggregate Resource is the sum of Energy Cost and Operating Reserve Cost of the eligible CC child Resources. The market value of an ineligible CC child Resource is not factored into the Energy Cost and Operating Reserve Cost of the CC aggregate Resource for RTORSGP*. The summed Energy Cost and Operating Reserve Cost of the eligible CC child Resources are evaluated against the market value of the CC aggregate Resource using the ELIG_MWH* volume. If the Energy Cost and Operating Reserve Cost are greater than the market value, then the CC aggregate Resource will receive a RTORSGP*.

E.7.11 Day-Ahead Margin Assurance Payment (DA_MAP*)

DA_MAP* is calculated the same for a CC aggregate Resource as any other Resource as outlined in the "Day-Ahead Margin Assurance Payment (DA_MAP*)" section of this document. If a CC Resource is committed as a CC child Resource, then the contribution costs for the CC aggregate Resource is the sum of the contribution costs of the eligible CC child Resources.

E.7.12 Hourly Real Time Economic Minimum and Maximum Dispatch

If a CC Resource is committed as a CC aggregate Resource, the calculation of the CC aggregate Resource RT Dispatch Interval Economic Minimum/Maximum dispatch is the same as all other Resources. If a CC Resource is committed as a CC Child Resource, the CC aggregate Resource RT Dispatch Interval Economic Minimum/Maximum dispatch are equal to the sum of the committed CC child Resources' corresponding results.

E.7.13 Hourly Real Time Economic Minimum/Maximum Limit at Notification Deadline

If a CC Resource is committed as a CC aggregate Resource, the CC aggregate Resource NDL_ECON_MAX* and NDL_ECON_MIN* are set to its own values, respectively. If a CC Resource is committed as CC child Resource, the CC aggregate Resource NDL_ECON_MAX* and NDL_ECON_MIN* are calculated as the sum of committed children's NDL_ECON_MAX* and NDL_ECON_MIN*, respectively.

E.8 Stored Energy Resource (SER)

Stored Energy Resources (SER) are Resources capable of supplying Regulating Reserve, but not Energy or Contingency Reserve, through the short-term storage and discharge of Energy in response to Setpoint Instructions. The following information details the special logic used in each applicable calculation in POP contained in this document.

E.8.1 Hourly Net Regulation Adjustment Amount (RT_ASM_NRGA*)

Since a SER does not provide an Incremental Energy offer, RT_ASM_NRGA* is not calculated for SERs and is therefore always equal to zero.

E.8.2 Excessive Energy Threshold and Deficient Energy Threshold

Since a SER could have a negative AVG_SP_i, the absolute value of AVG_SP_i is used to calculate the Excessive/Deficient Energy Thresholds.SER EXE_T_i and DFE_T_i are calculated as follows:

$$EXE\_Ti = AVG\_SP_i + MIN (MAX ((ABS (AVG\_SP_i) \times TOL\_\%) + RAMP\_ADD , TOL\_MIN) , TOL\_MAX) – MIN (RAMP\_ADJ , 0)$$

$$DFE\_T_i = AVG\_SP_i – MIN (MAX ((ABS (AVG\_SP_i \times TOL\_\%) + RAMP\_ADD , TOL\_MIN), TOL\_MAX) – MAX (RAMP\_ADJ , 0)$$

E.8.3 Excessive Energy Price (EXP*)

Since a SER does not provide an Incremental Energy offer, the SER Excessive Energy Price (EXP*) is always equal to the applicable Hourly Real-Time LMP.

E.8.4 Day-Ahead Revenue Sufficiency Guarantee Make Whole Payment (DA_RSG_MWP*)

DA_RSG_MWP does not apply to SERs because SERs do not receive Day-Ahead economic commitments.

E.8.5 Real-Time Revenue Sufficiency Guarantee Make Whole Payment (RT_RSG_MWP*)

RT_RSG_MWP does not apply to SERs because SERs do not receive Real-Time economic commitments.

E.8.6 Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*)

RTORSGP does not apply to SERs because SERs do not provide an energy offer.

E.8.7 Day-Ahead Margin Assurance Payment (DA_MAP*)

Day-Ahead Margin Assurance Payment (DA_MAP*) for SERs is calculated as follows:

1) The Energy Contribution ($DAMAP\_EN\_CON_{i(b.)}$) is equal to zero (0) because a SER does not provide an energy offer.
2) The Contingency Reserve Contributions (Spinning and Supplemental Reserve) are equal to zero (0) because a SER cannot provide Spinning or Supplemental Reserves.
3) The Day-Ahead Adjustment for Energy, Spinning, and Supplemental Reserve for a SER are not calculated and are equal to 0.
4) The Day-Ahead Adjustment for Regulating Reserve is calculated using the Regulating Reserve Maximum Limit (REG_MAX) instead of the Economic Maximum Limit (ECON_MAX).
5) The Regulating Reserve Contribution (DAMAP_REG_CONi) is only calculated for Dispatch Intervals where dispatch limitations are due to reduced Energy storage capability, represented by a non-zero SER Energy Adjustment (SER_ENERGY_ADJ) value. Otherwise, the $DAMAP\_REG\_CON_i$ is equal to zero (0), and the Dispatch Interval DA_MAP is therefore also equal to zero (0).

Since DA Economic Unit commitment information does not exist for SERs, “The Resource has a DA CP” eligibility criterion is not performed for SER DAMAP eligibility.

E.9 Product Substitution

Product substitution is a mechanism that allows the substitution of a given higher quality Ancillary Service (AS) product for a lower quality AS product in order to meet the Operating Reserve requirements in a least cost manner for a given Interval (both Day-Ahead Hourly and Real-Time 5-minute). Product substitution happens in both the Day-Ahead and Real-Time Markets.

Regulating Reserve can be substituted for Spinning Reserve and/or Supplemental, and Spinning Reserve can be substituted for Supplemental. Pre-substitution values are referred to as “cleared” quantities while post-substitution values are referred to as “operation” quantities.

A difference between “cleared” and “operation” quantities represents an occurrence of Product Substitution. For instance, for a given Resource Interval, if the “cleared” Regulating Reserve is 10 MW, and the corresponding “operation” Regulating Reserve is 6 MW, then the 4 MW (10 – 6) of Regulating Reserve is substituted for Spinning Reserve and/or Supplemental Reserve. If the “cleared” Spinning Reserve is 5 MW, and the corresponding “operation” Spinning Reserve is 4 MW, then the 1 MW (5 – 4) of Spinning Reserve is substituted only for Supplemental Reserve.

In general, for a given Resource Interval, if the “operation” AS quantity is not equal to zero and the difference between the “cleared” and the corresponding “operation” quantities for either Regulating Reserve or Spinning Reserve is not equal to zero, product substitution occurred for that Resource Interval.

1) Real Time Dispatch Interval Product Substitution (RT_PROD_SUBST_FL)**

IF (OP_REG_MW > 0 AND (REG_MW <> OP_REG_MW)) OR
(OP_SPIN_MW > 0 AND (SPIN_MW – OP_SPIN_MW <> 0)) **THEN**
RT_PROD_SUBST_FL = 1
ELSE
RT_PROD_SUBST_FL = 0
END IF

2) Day-Ahead Hourly Product Substitution (DA_PROD_SUB_FL*)

```
IF ( DA_OP_REG_VOL > 0 AND ( DA_REG_VOL <> DA_OP_REG_VOL ) ) OR
  ( DA_OP_SPIN_VOL > 0 AND ( DA_SPIN_VOL – DA_OP_SPIN_VOL <> 0 ) ) THEN
    DA_PROD_SUB_FL = 1
ELSE
    DA_PROD_SUB_FL = 0
END IF
```

E.10 RTORSGP* and DA_MAP* Ramp Rate Eligibility Decision Logic

The following logic further explains the way in which RTORSGP* and DA_MAP* Ramp Rate (RR) eligibility is determined for a given Dispatch Interval. The following logic initially defines a Dispatch Interval as being ineligible. Once a given set of criteria is met, the Dispatch Interval is considered to be eligible, denoted as ‘Eligible → EXIT’ in the logic below.

RTORSGP* and DA_MAP* RR eligibility check for Resources committed in the DA Energy and Operating Reserve Market:

```
IF DA_RR > .5 AND RT_RR > .5 THEN
  IF RT_RR >= DA_RR THEN
    Eligible → EXIT
  ELSIF RT_RR > ( RT_ECON_MAX × .005 ) THEN
    IF ( ACH_MW >= ( RT_ECON_MAX × .90 ) ) OR
       ( ACH_MW <= ( RT_ECON_MIN + ( RT_ECON_MAX × .10 ) ) ) THEN
      IF RT_RR > ( DA_RR × .50 ) THEN
        Eligible → EXIT
      END IF
    ELSE
      IF REG_QUALFIED = ‘Yes’ AND REG_DISP_STATUS = ‘EC’ AND
          RT_RR > DA_RR - .50 THEN
        Eligible → EXIT
```

END IF

END IF

END IF

END IF

RTORSGP* RR eligibility check for Resources committed in the RT Energy and Operating Reserve Market:

IF RT_RR > .5 **THEN**

IF (ACH_MW >= (RT_ECON_MAX × .90)) **OR**

(ACH_MW <= (RT_ECON_MIN + (RT_ECON_MAX × .10))) **THEN**

Eligible → **EXIT**

ELSE

IF RT_RR > (RT_ECON_MAX × .005) **AND**

RT_RR >= RT_RR (Prior Dispatch Interval) **THEN**

Eligible → **EXIT**

END IF

END IF

END IF

E.11 Area Under the Offer Curve (AUC)

Throughout this document multiple calculations call for the calculation of the Area Under the Offer Curve (AUC). AUC has a common calculation annotation of $\int_0^{MW_i} Offer\_Curve$. Certain calculations contain the annotation of $\int_{MW\_2_i}^{MW\_1_i} Offer\_Curve$ which is equal to $\int_0^{MW\_1_i} Offer\_Curve -$ $\int_0^{MW\_2_i} Offer\_Curve$. This section will define the calculation of the AUC and provide an example of the calculation.

E.11.1 Calculation Overview

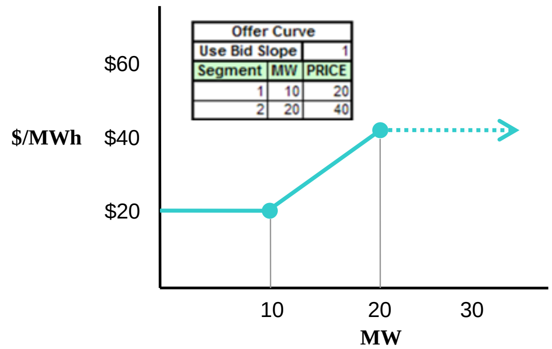
For an Offer Curve containing ‘n’ segments (SEGMENT) with an associated MW (BidMW) and PRICE (BidPRICE) for each SEGMENT and Use Bid Slope (UBS) of either 1 or 0, the AUC for a given MW is calculated as:

```
AUC = 0
FOR SEGMENT = 1 to SEGMENT = n
  IF SEGMENT = 1 THEN
    CurMW = BidMW_n
    CurPRICE = BidPRICE_n
    IF CurMW > MW THEN
      AUC = ( MW × CurPRICE )
    ELSE
      AUC = ( CurMW × CurPRICE )
    END IF
  ELSE
    LastPRICE = CurPRICE
    LastMW = CurMW
    CurMW = BidMW_n
    CurPRICE = BidPRICE_n
    IF LastMW <= MW THEN
      IF MW > CurMW THEN
        ThisMW = CurMW – LastMW
      ELSE
        ThisMW = MW – LastMW
      END IF
      IF UBS = 0 THEN
        ThisPRICE = CurPRICE
      ELSE
        ThisPRICE = { LastPRICE +
                      [ LastPRICE + ( ThisMW ×
                      ( CurPRICE – LastPRICE ) / ( CurMW – LastMW ) ) ] } / 2
      END IF
      AUC = AUC_n-1 + ( ThisMW × ThisPRICE )
    END IF
  END IF
LOOP
IF MW > CurMW THEN
```

AUC = $AUC_{\sum LOOP}$ + [(MW – CurMW) × CurPRICE]
END IF

E.11.2 Calculation Example

Consider the following Offer Curve:



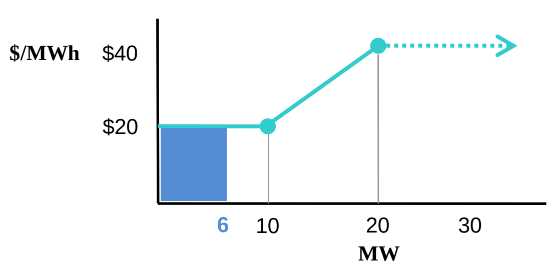
First, consider all MW values between 0 and the upper bound of the first SEGMENT, 10 MW. This logic is used to determine the AUC for the first SEGMENT

CurMW = $BidMW_n$
CurPRICE = $BidPRICE_n$
IF CurMW > MW **THEN**
AUC = (MW × CurPRICE)
ELSE
AUC = (CurMW × CurPRICE)
END IF

Consider calculating the AUC of the first SEGMENT for a MW value of 6MW. Since the CurMW (10) is greater than the MW (6):

AUC = (6 × 20) = $120

This is represented by the following graph:

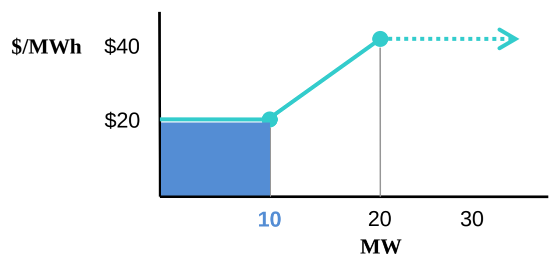


For a MW value of 6, the total AUC is $120, and no further calculation is required.

Now, consider calculating the AUC of the first SEGMENT for a MW value of 15 MW. Since the CurMW (10) is less than the MW (15):

AUC = (10 × 20) = $200

This is represented by the following graph:



For a MW value of 15 MW, the AUC for the first SEGMENT is $200.

Note: The general concept above can be applied to every subsequent SEGMENT of an Offer Curve in which the UBS = 0, as defined in the calculation overview above. Additionally, the example below illustrates the revised calculation when the UBS = 0.

In this instance, we need to LOOP to the second SEGMENT to determine the AUC for the remaining 5 MW. Since the LastMW is less than or equal to the MW, the MW is less than the CurMW, and the UBS equals 1, the simplified equation is as follows:

LastPRICE = CurPRICE
LastMW = CurMW
CurMW = BidMW_n
CurPRICE = BidPRICE_n
ThisMW = MW – LastMW

ThisPRICE = { LastPRICE + [LastPRICE +
(ThisMW × (CurPRICE – LastPRICE) / (CurMW – LastMW))] } / 2

$AUC = AUC_{n-1} + (ThisMW \times ThisPRICE)$

Using the information from the first SEGMENT calculation and the second SEGMENT:

LastPRICE = 20

LastMW = 10

CurMW = 20

CurPRICE = 40

ThisMW = 15 – 10 = 5

ThisPRICE = { 20 + [20 + (5 × (40 – 20) / (20 – 10))] } / 2 = 25

AUC = 200 + (5 × 25) = $325

For a MW value of 15, the total AUC is $325, and no further calculation is required.

If the UBS = 0, the calculation is slightly different, as described in the Calculation Overview section. The revised calculation for this same scenario is as follows:

LastPRICE = CurPRICE

LastMW = CurMW

$CurMW = BidMW_n$

$CurPRICE = BidPRICE_n$

ThisMW = MW – LastMW

ThisPRICE = CurPRICE

$AUC = AUC_{n-1} + (ThisMW \times ThisPRICE)$

Using the information from the first SEGMENT calculation and the second SEGMENT:

LastPRICE = 20

LastMW = 10

CurMW = 20

CurPRICE = 40

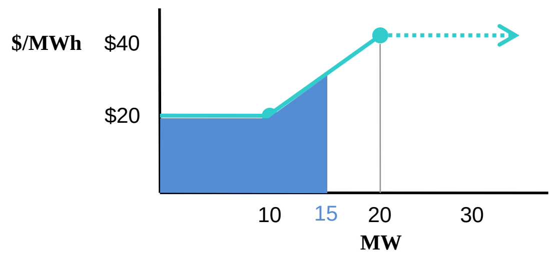
ThisMW = 15 – 10 = 5

ThisPRICE = 40

AUC = 200 + (5 × 40) = \$400

For a MW value of 15, the total AUC is \$400, and no further calculation is required.

This is represented by the following graph:



Now, consider a MW value of 25. The AUC of the first SEGMENT remains \$200. Since the LastMW is less than or equal to the MW, the MW is greater than the CurMW, and the UBS equals 1, the simplified equation is as follows:

LastPRICE = CurPRICE
LastMW = CurMW
CurMW = $BidMW_n$
CurPRICE = $BidPRICE_n$
ThisMW = CurMW – LastMW
ThisPRICE = { LastPRICE + [LastPRICE +
(ThisMW × (CurPRICE – LastPRICE) / (CurMW – LastMW))] } / 2

AUC = AUC_{n-1} + (ThisMW × ThisPRICE)

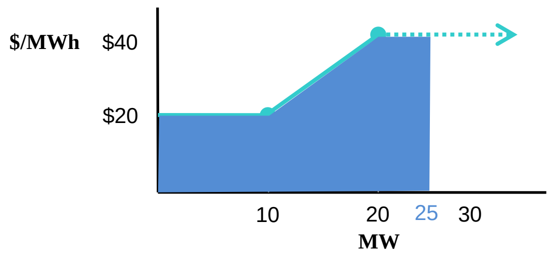
Using the information from the first SEGMENT calculation and the second SEGMENT:
LastPRICE = 20
LastMW = 10
CurMW = 20
CurPRICE = 40
ThisMW = 20 – 10 = 10
ThisPRICE = { 20 + [20 + (10 × (40 – 20) / (20 – 10))] } / 2 = 30
AUC = 200 + (10 × 30) = \$500

Since the MW is greater than the CurMW:
AUC = $AUC_{\sum LOOP}$ + [(MW – CurMW) × CurPRICE]

Using the information from all the SEGMENT values above:
AUC = $500 + [(25 – 20) × 40] = $700

For a MW value of 25, the total AUC is $700, and no further calculation is required.

This is represented by the following graph:



E.12 Intermittent Resources

Intermittent Resources are not eligible for RT_RSG_MWP*, RTORSGP* or DA_MAP*. However, they are eligible for DA_RSG_MWP* should MISO commit the Resource. These Resources are not subject to Excessive/Deficient Energy Deployment Charge (EDEDC*) and will receive a setpoint equal to their output in the previous state estimator solution. Please see BPM 010 Network and Commercial Models BPM and BPM 002 Energy and Operating Reserve Markets BPM for additional information on Intermittent Resources.

E.13 Mitigation of Make Whole Payment Costs

E.13.1 Mitigation of RT_RSG_MWP and DA_RSG_MWP for Economic Commitment Periods

DA_RSG_MWP* and RT_RSG_MWP* may be mitigated by Resource by Operating Day (OD) when Total Production Costs exceed the Independent Market Monitor's pre-determined reference tolerances Commitment Period Real-Time Mitigated RSG Production Cost Amount (RT_PC_AMT_MIT_CP). MISO employs an Independent Monitor to monitor and potentially mitigate RSG Total Production Costs. When the Independent Market Monitor takes action, the mitigated amounts appear on the Market Settlements statement. For more information on the Hourly Settlement Calculations of the Independent Market Monitor Make Whole Payment (IMM_MWP*), please see the Market Settlements Calculation Guide. For more information regarding mitigation as an input into the SCED, please see BPM 009 Market Monitoring and Mitigation.

E.13.2 Mitigation of RT_RSG_MWP and DA_RSG_MWP for Voltage and Local Reliability Commitment Periods

DA_RSG_MWP* and RT_RSG_MWP* may be mitigated by Resource by Operating Day for Generation Resources committed for the reason of Voltage and Local Reliability. The mitigation for economic withholding of Generation Resources needed for Voltage and Local Reliability commitment periods can occur when Total Production Costs, Economic Minimum, and/or Minimum Run Time values exceed the Independent Market Monitor’s pre-determined reference tolerances.

The Hourly IMM Production Costs are calculated using the same methodology as described in Section D.8; however, the IMM-supplied Generation Offers will be substituted for the existing As-Committed or As-Dispatched Offers in the calculation. In the event a Resource is mitigated due to Economic Minimum, and /or Minimum Run Time values, the following exception may apply:

- If a resource is mitigated for Economic Minimum and/or Minimum Run Time values, the DA_IMM_RSG_MWH* is used to calculate Incremental Energy and DA_RSG_EN_VAL_TOTAL for a Day-Ahead VLR Commitment Period. The RT_IMM_RSG_MWH* is used to calculate Incremental Energy and RT_MKT_EN_VAL for a Real-Time VLR Commitment Period.

When the Independent Market Monitor takes action, the mitigated amounts appear on the Market Settlements statement. For more information on the Hourly Settlement Calculations of the Independent Market Monitor Voltage and Local Reliability Make Whole Payment (IMM_MWP*), please see the Market Settlements Calculation Guide. For more information regarding mitigation for Voltage and Local Reliability, please see BPM 009 Market Monitoring and Mitigation.

E.14 Impact of Self-Schedule Ancillary Services on the Make Whole Payment Calculations

Day-Ahead Revenue Sufficiency Guarantee Make Whole Payment (DA_RSG_MWP*), Real-Time Revenue Sufficiency Guarantee Make Whole Payment (RT_RSG_MWP*), Real-Time Offer Revenue Sufficiency Guarantee Payment (RTORSGP*), and Day-Ahead Margin Assurance Payment (DA_MAP*) all employ special logic in determining the costs associated to each Ancillary Service (AS), in the event that a Resource Self-Schedules a given AS.

For DA_RSG_MWP*, only Day-Ahead Ancillary Services Volume (DA_AS_VOL*) greater than the Day-Ahead Ancillary Services Self-Schedule Volume (DA_AS_SS_VOL) for a given AS is multiplied by the Availability Offer of the given product to calculate the associated cost. In the event that a given DA_AS_VOL* is less than the DA_AS_SS_VOL, the MW input to the calculation of that product's cost is equal to zero.

DA_AS_VOL = MAX (DA_AS_VOL – DA_AS_SS_VOL , 0)

For RT_RSG_MWP*, only Ancillary Service Cleared Megawatt Volume (AS_MW**) greater than the Real-Time Ancillary Services Self-Schedule Volume (RT_AS_SS_VOL) for a given AS is multiplied by the Availability Offer of the given product to calculate the associated cost. In the event that a given AS_MW** is less than the RT_AS_SS_VOL, the MW input to the calculation of that product's cost is equal to zero.

AS_MW = MAX (AS_MW – RT_AS_SS_VOL , 0).

For RTORSGP*, the Real-Time Ancillary Services Availability Cost (RT_AS_AC*), is calculated using the net positive AS_MW** greater than the RT_AS_SS_VOL and DA_AS_VOL*.

$$\sum_{i=1}^{n} \{ \text{MAX} [\text{AS\_MW} - \text{MAX} (\text{RT\_AS\_SS\_VOL}, \text{DA\_AS\_VOL}) , 0] \times \text{AS\_AVOF} \} \times 1/12$$

For DA_MAP*, if the RT Ancillary Service Cleared MW Volume (AS_MW**) for a given AS is less than the Adjusted Day-Ahead Schedule for Ancillary Services ($ADJ\_DA\_AS_i$), the calculation of Dispatch Interval Day-Ahead Margin Assurance Payment Ancillary Services Contribution ($DAMAP\_AS\_CON_{i(a)}$), is unchanged due to DA_AS_SS_VOL or RT_AS_SS_VOL.

If the AS_MW** for a given AS is greater than or equal to $ADJ\_DA\_AS_i$, the calculation of Dispatch Interval Day-Ahead Margin Assurance Payment Ancillary Services Contribution, ($DAMAP\_AS\_CON_{i(b)}$), is calculated using only net positive AS_MW** greater than the RT_AS_SS_VOL and $ADJ\_DA\_AS_i$.

$DAMAP\_AS\_CON_{i(b.)}$=

$$\text{MAX} \{ [(\text{AS\_MW} - \text{ADJ\_DA\_AS}_i) \times \text{AS\_MCP}] - [\text{MAX} (\text{AS\_MW} - \text{MAX} (\text{RT\_AS\_SS\_VOL}, \text{ADJ\_DA\_AS}_i) , 0) \times \text{AS\_AVOF}] , 0 \}$$

E.15 Hourly Production Costs as Calculated by Dispatch Interval

Hourly Production Costs are calculated for each Dispatch Interval in the Commitment Period (CP). Below, are five examples of how the Dispatch Interval calculation is performed to derive the Hourly Production Costs. For simplicity, Operating Reserve Cost is excluded from the examples. However, the calculation and integration concepts for No-Load Cost and Incremental Energy Cost are the same for Operating Reserve Cost.

Scenario 1: Resource On-Line prior to CP Start Time and Off-Line after CP Stop Time

The Resource has a RT MISO economic CP from 10:00 until 11:00. The Resource is On-Line at 9:52. Therefore, NXE_i representative of injection exists for the 9:50 MKT_INT_BEG_EST**.

The Resource continues to receive and follow MISO Setpoints throughout the CP. The Resource runs through the end of its CP. The Resource is Off-Line at 11:08. As a result of being On-Line prior to the CP Start Time and going Off-Line after the CP Stop Time, Hourly Production Costs are calculated for the entire duration of the CP.

The Resource has a one segment bid curve, Use Bid Slope equal to 1, and a No-Load Cost of $100. For this CP the Resource has $3,413.75 of Incremental Energy Cost and $100 of No-Load Cost.

Dispatch Interval Calculation: Scenario 1

Bid Data

Market Hour	10:00

Bid Slope	1

Case	SEGMENTID	MW	PRICE	Case	MWs	Inc Energy$	Effective Minutes (EM)	IE*EM/60	No Load	NL*EM/60
0	1	50	75	0	42.5	3187.5	5	265.625	100	8.33
1	1	50	75	1	44.5	3337.5	5	278.125	100	8.33
2	1	50	75	2	48.8	3660	5	305	100	8.33
3	1	50	75	3	50	3750	5	312.5	100	8.33
4	1	50	75	4	48.8	3660	5	305	100	8.33
5	1	50	75	5	46.5	3487.5	5	290.625	100	8.33
6	1	50	75	6	47.6	3570	5	297.5	100	8.33
7	1	50	75	7	44.5	3337.5	5	278.125	100	8.33
8	1	50	75	8	44.5	3337.5	5	278.125	100	8.33
9	1	50	75	9	45.9	3442.5	5	286.875	100	8.33
10	1	50	75	10	42.6	3195	5	266.25	100	8.33
11	1	50	75	11	40	3000	5	250	100	8.33
							Total	3413.75	Total	100

LMP Case Interval Data

Effective Start	Effective Stop	Market Hour	NXE	EM
1/1/2006 9:50	1/1/2006 9:55	1/1/2006 9:00	25	5
1/1/2006 9:55	1/1/2006 10:00	1/1/2006 9:00	40	5
1/1/2006 10:00	1/1/2006 10:05	1/1/2006 10:00	42.5	5
1/1/2006 10:05	1/1/2006 10:10	1/1/2006 10:00	44.5	5
1/1/2006 10:10	1/1/2006 10:15	1/1/2006 10:00	48.8	5
1/1/2006 10:15	1/1/2006 10:20	1/1/2006 10:00	50	5
1/1/2006 10:20	1/1/2006 10:25	1/1/2006 10:00	48.8	5
1/1/2006 10:25	1/1/2006 10:30	1/1/2006 10:00	46.5	5
1/1/2006 10:30	1/1/2006 10:35	1/1/2006 10:00	47.6	5
1/1/2006 10:35	1/1/2006 10:40	1/1/2006 10:00	44.5	5
1/1/2006 10:40	1/1/2006 10:45	1/1/2006 10:00	44.5	5
1/1/2006 10:45	1/1/2006 10:50	1/1/2006 10:00	45.9	5
1/1/2006 10:50	1/1/2006 10:55	1/1/2006 10:00	42.6	5
1/1/2006 10:55	1/1/2006 11:00	1/1/2006 10:00	40	5
1/1/2006 11:00	1/1/2006 11:05	1/1/2006 11:00	25	5
1/1/2006 11:05	1/1/2006 11:10	1/1/2006 11:00	5	5
1/1/2006 11:10	1/1/2006 11:15	1/1/2006 11:00	0	5
1/1/2006 11:15	1/1/2006 11:20	1/1/2006 11:00	0	5

General Commitment Information

Commitment Period	10:00 until 11:00
Breaker Close with .5 MWs of Injection	9:52
Breaker Open	11:08
Hourly No Load in Dollars	100

NXE Injection associated to the Real Time Midwest ISO Commitment Period

Scenario 2: Resource On-Line AFTER CP Start Time and Off-line after CP Stop Time

The Resource has a RT MISO economic CP from 10:00 until 11:00. The Resource is On-Line at 10:12. Therefore, NXE representative of injection exists for the 10:10 MKT_INT_BEG_EST**.

The Resource continues to receive and follow MISO Setpoints throughout the CP. The Resource runs through the end of its CP. The Resource opens its breaker at 11:08. As a result of being On-Line AFTER the CP Start Time and running through the end of its CP, Hourly Production Costs are calculated for the 10:10 until 11:00 portion of the CP.

The Resource has a one segment bid curve, Use Bid Slope equal to 1, and a No-Load Cost of $100. For this CP, the Resource has $2,372.50 of Incremental Energy Cost and $83.33 of No-Load Cost.

Dispatch Interval Calculation: Scenario 2

Bid Data

Market Hour	10:00

Bid Slope	1

Case	SEGMENTID	MW	PRICE	Case	MWs	Inc Energy$	Effective Minutes (EM)	IE*EM/60	No Load	NL*EM/60
0	1	50	75	0	0	0	0	0	100	0
1	1	50	75	1	0	0	0	0	100	0
2	1	50	75	2	5	375	5	31.25	100	8.333333333
3	1	50	75	3	25	1875	5	156.25	100	8.333333333
4	1	50	75	4	40	3000	5	250	100	8.333333333
5	1	50	75	5	44.5	3337.5	5	278.125	100	8.333333333
6	1	50	75	6	47.6	3570	5	297.5	100	8.333333333
7	1	50	75	7	44.5	3337.5	5	278.125	100	8.333333333
8	1	50	75	8	44.5	3337.5	5	278.125	100	8.333333333
9	1	50	75	9	45.9	3442.5	5	286.875	100	8.333333333
10	1	50	75	10	42.6	3195	5	266.25	100	8.333333333
11	1	50	75	11	40	3000	5	250	100	8.333333333
							Total	2372.5	Total	83.33

LMP Case Interval Data

Effective Start	Effective Stop	Market Hour	NXE	EM
1/1/2006 10:10	1/1/2006 10:15	1/1/2006 10:00	5	5
1/1/2006 10:15	1/1/2006 10:20	1/1/2006 10:00	25	5
1/1/2006 10:20	1/1/2006 10:25	1/1/2006 10:00	40	5
1/1/2006 10:25	1/1/2006 10:30	1/1/2006 10:00	44.5	5
1/1/2006 10:30	1/1/2006 10:35	1/1/2006 10:00	47.6	5
1/1/2006 10:35	1/1/2006 10:40	1/1/2006 10:00	44.5	5
1/1/2006 10:40	1/1/2006 10:45	1/1/2006 10:00	44.5	5
1/1/2006 10:45	1/1/2006 10:50	1/1/2006 10:00	45.9	5
1/1/2006 10:50	1/1/2006 10:55	1/1/2006 10:00	42.6	5
1/1/2006 10:55	1/1/2006 11:00	1/1/2006 10:00	40	5
1/1/2006 11:00	1/1/2006 11:05	1/1/2006 11:00	25	5
1/1/2006 11:05	1/1/2006 11:10	1/1/2006 11:00	5	5
1/1/2006 11:10	1/1/2006 11:15	1/1/2006 11:00	0	5
1/1/2006 11:15	1/1/2006 11:20	1/1/2006 11:00	0	5

General Commitment Information

Commitment Period	10:00 until 11:00
Breaker Close with .5 MWs of Injection	10:12
Breaker Open	11:08
Hourly No Load in Dollars	100

NXE Injection associated to the Real Time Midwest ISO Commitment Period

Scenario 3: Resource On-Line prior to CP Start Time and Off-Line PRIOR to CP Stop Time

The Resource has a RT MISO economic CP from 10:00 until 11:00. The Resource is On-Line at 9:52. Therefore, NXE_i representative of injection exists for the 9:50 MKT_INT_BEG_EST**.

The Resource continues to receive and follow MISO Setpoints throughout the CP. The Resource goes Off-Line at 10:39, PRIOR to the CP Stop Time. As a result of being On-Line prior to the CP Start Time, but going Off-Line prior to the CP Stop Time, Hourly Production Costs are calculated for the 10:00 until 10:40 portion of the CP.

The Resource has a one segment bid curve, Use Bid Slope equal to 1, and a No-Load Cost of $100. For this CP the Resource has $2,254.38 of Incremental Energy Cost and $66.67 of No-Load Cost.

Dispatch Interval Calculation: Scenario 3

Bid Data

Market Hour	10:00

Bid Slope	1

Case	SEGMENTID	MW	PRICE	Case	MWs	Inc Energy$	Effective Minutes (EM)	IE*EM/60	No Load	NL*EM/60
0	1	50	75	0	42.5	3187.5	5	265.625	100	8.333333333
1	1	50	75	1	44.5	3337.5	5	278.125	100	8.333333333
2	1	50	75	2	48.8	3660	5	305	100	8.333333333
3	1	50	75	3	50	3750	5	312.5	100	8.333333333
4	1	50	75	4	48.8	3660	5	305	100	8.333333333
5	1	50	75	5	46.5	3487.5	5	290.625	100	8.333333333
6	1	50	75	6	47.6	3570	5	297.5	100	8.333333333
7	1	50	75	7	32	2400	5	200	100	8.333333333
8	1	50	75	8	0	0	5	0	100	0
9	1	50	75	9	0	0	0	0	100	0
10	1	50	75	10	0	0	0	0	100	0
11	1	50	75	11	0	0	0	0	100	0
							Total	2254.38	Total	66.67

LMP Case Interval Data

Effective Start	Effective Stop	Market Hour	NXE	EM
1/1/2006 9:50	1/1/2006 9:55	1/1/2006 9:00	25	5
1/1/2006 9:55	1/1/2006 10:00	1/1/2006 9:00	40	5
1/1/2006 10:00	1/1/2006 10:05	1/1/2006 10:00	42.5	5
1/1/2006 10:05	1/1/2006 10:10	1/1/2006 10:00	44.5	5
1/1/2006 10:10	1/1/2006 10:15	1/1/2006 10:00	48.8	5
1/1/2006 10:15	1/1/2006 10:20	1/1/2006 10:00	50	5
1/1/2006 10:20	1/1/2006 10:25	1/1/2006 10:00	48.8	5
1/1/2006 10:25	1/1/2006 10:30	1/1/2006 10:00	46.5	5
1/1/2006 10:30	1/1/2006 10:35	1/1/2006 10:00	47.6	5
1/1/2006 10:35	1/1/2006 10:40	1/1/2006 10:00	32	5
1/1/2006 10:40	1/1/2006 10:45	1/1/2006 10:00	0	5
1/1/2006 10:45	1/1/2006 10:50	1/1/2006 10:00	0	5
1/1/2006 10:50	1/1/2006 10:55	1/1/2006 10:00	0	5
1/1/2006 10:55	1/1/2006 11:00	1/1/2006 10:00	0	5
1/1/2006 11:00	1/1/2006 11:05	1/1/2006 11:00	0	5
1/1/2006 11:05	1/1/2006 11:10	1/1/2006 11:00	0	5
1/1/2006 11:10	1/1/2006 11:15	1/1/2006 11:00	0	5
1/1/2006 11:15	1/1/2006 11:20	1/1/2006 11:00	0	5

General Commitment Information

Commitment Period	10:00 until 11:00
Breaker Close with .5 MWs of Injection	9:52
Breaker Open	10:39
Hourly No Load in Dollars	100

NXE Injection associated to the Real Time Midwest ISO Commitment Period

Scenario 4: CP Start Time and CP Stop Time not equal to a MKT_INT_BEG_EST** value

The Resource has a RT MISO economic CP from 10:03 until 10:56. The Resource is On-Line at 9:52. Therefore, NXE_i representative of injection exists for the 9:55 MKT_INT_BEG_EST**.

The Resource continues to receive and follow MISO Setpoints throughout the CP. The Resource runs through the end of its CP. The Resource is Off-Line at 11:08. As a result of being On-Line prior to the CP Start Time and going Off-Line after the CP Stop Time, Hourly Production Costs are calculated for the entire duration of the CP.

The Resource has a one segment bid curve, Use Bid Slope equal to 1, and a No-Load Cost of $100. For this CP the Resource has $3,054.38 of Incremental Energy Cost and $88.33 of No-Load Cost.

Dispatch Interval POP Calculation – Scenario 4

Bid Data

Market Hour	10:00

Bid Slope	1

Case	SEGMENTID	MW	PRICE	Case	MWs	Inc Energy$	Effective Minutes (EM)	IE*EM/60	No Load	NL*EM/60
0	1	50	75	0	42.5	3187.5	2	106.25	100	3.333333333
1	1	50	75	1	44.5	3337.5	5	278.125	100	8.333333333
2	1	50	75	2	48.8	3660	5	305	100	8.333333333
3	1	50	75	3	50	3750	5	312.5	100	8.333333333
4	1	50	75	4	48.8	3660	5	305	100	8.333333333
5	1	50	75	5	46.5	3487.5	5	290.625	100	8.333333333
6	1	50	75	6	47.6	3570	5	297.5	100	8.333333333
7	1	50	75	7	44.5	3337.5	5	278.125	100	8.333333333
8	1	50	75	8	44.5	3337.5	5	278.125	100	8.333333333
9	1	50	75	9	45.9	3442.5	5	286.875	100	8.333333333
10	1	50	75	10	42.6	3195	5	266.25	100	8.333333333
11	1	50	75	11	40	3000	1	50	100	1.666666667
							Total	3054.38	Total	88.33

LMP Case Interval Data

Effective Start	Effective Stop	Market Hour	NXE	EM	
1/1/2006 9:50	1/1/2006 9:55	1/1/2006 9:00	25	5	
1/1/2006 9:55	1/1/2006 10:00	1/1/2006 9:00	40	5	
1/1/2006 10:00	1/1/2006 10:05	1/1/2006 10:00	42.5	2	*= Effective Stop - Call On*
1/1/2006 10:05	1/1/2006 10:10	1/1/2006 10:00	44.5	5	
1/1/2006 10:10	1/1/2006 10:15	1/1/2006 10:00	48.8	5	
1/1/2006 10:15	1/1/2006 10:20	1/1/2006 10:00	50	5	
1/1/2006 10:20	1/1/2006 10:25	1/1/2006 10:00	48.8	5	
1/1/2006 10:25	1/1/2006 10:30	1/1/2006 10:00	46.5	5	
1/1/2006 10:30	1/1/2006 10:35	1/1/2006 10:00	47.6	5	
1/1/2006 10:35	1/1/2006 10:40	1/1/2006 10:00	44.5	5	
1/1/2006 10:40	1/1/2006 10:45	1/1/2006 10:00	44.5	5	
1/1/2006 10:45	1/1/2006 10:50	1/1/2006 10:00	45.9	5	
1/1/2006 10:50	1/1/2006 10:55	1/1/2006 10:00	42.6	5	
1/1/2006 10:55	1/1/2006 11:00	1/1/2006 10:00	40	1	*= Call Off - Effective Stop*
1/1/2006 11:00	1/1/2006 11:05	1/1/2006 11:00	25	5	
1/1/2006 11:05	1/1/2006 11:10	1/1/2006 11:00	5	5	
1/1/2006 11:10	1/1/2006 11:15	1/1/2006 11:00	0	5	
1/1/2006 11:15	1/1/2006 11:20	1/1/2006 11:00	0	5	

General Commitment Information

Commitment Period	10:00 until 11:00
Breaker Close with .5 MWs of Injection	9:52
Breaker Open	11:08
Hourly No Load in Dollars	100

NXE Injection associated to the Real Time Midwest ISO Commitment Period

Scenario 5: Resource has NXE_i different from RES_LP_VOL**

The Resource has a RT MISO economic CP 8:00 until 14:00. The Resource is On-Line at 7:52. Therefore, NXE_i representative of injection exists for the 7:50 MKT_INT_BEG_EST**.

The Resource does not following MISO Setpoint during Hour Ending 11 of the CP. The Resource Incremental Energy Cost is calculated based on the NXE_i, which may be different from the RES_LP_VOL**. The Resource runs through the end of its CP. The Resource is Off-Line at 14:08.

The Resource has a one segment bid curve, Use Bid Slope equal to 1, and a No-Load Cost of $100. For this CP the Resource has $2,851.04 of Incremental Energy Cost and $100 of No-Load Cost.

Dispatch Interval Calculation – Scenario 5

Bid Data

Market Hour	10:00

Bid Slope	1

Case	SEGMENTID	MW	PRICE	Case	MWs	Inc Energy$	Effective Minutes (EM)	IE*EM/60	No Load	NL*EM/60
0	1	50	75	0	35.49	2662.087928	5	221.8406606	100	8.33
1	1	50	75	1	37.16	2787.362654	5	232.2802211	100	8.33
2	1	50	75	2	40.76	3056.703314	5	254.7252762	100	8.33
3	1	50	75	3	41.76	3131.86815	5	260.9890125	100	8.33
4	1	50	75	4	40.76	3056.703314	5	254.7252762	100	8.33
5	1	50	75	5	38.84	2912.63738	5	242.7197816	100	8.33
6	1	50	75	6	39.75	2981.538479	5	248.4615399	100	8.33
7	1	50	75	7	37.16	2787.362654	5	232.2802211	100	8.33
8	1	50	75	8	37.16	2787.362654	5	232.2802211	100	8.33
9	1	50	75	9	38.33	2875.054962	5	239.5879135	100	8.33
10	1	50	75	10	35.58	2668.351664	5	222.3626387	100	8.33
11	1	50	75	11	33.41	2505.49452	5	208.79121	100	8.33
							Total	2851.04	Total	100

LMP Case Interval Data

Effective Start	Effective Stop	Market Hour	Telemetry MWs	NXE	EM
1/1/2006 9:50	1/1/2006 9:55	1/1/2006 9:00	44	44.00	5
1/1/2006 9:55	1/1/2006 10:00	1/1/2006 9:00	43	43.00	5
1/1/2006 10:00	1/1/2006 10:05	1/1/2006 10:00	42.5	35.49	5
1/1/2006 10:05	1/1/2006 10:10	1/1/2006 10:00	44.5	37.16	5
1/1/2006 10:10	1/1/2006 10:15	1/1/2006 10:00	48.8	40.76	5
1/1/2006 10:15	1/1/2006 10:20	1/1/2006 10:00	50	41.76	5
1/1/2006 10:20	1/1/2006 10:25	1/1/2006 10:00	48.8	40.76	5
1/1/2006 10:25	1/1/2006 10:30	1/1/2006 10:00	46.5	38.84	5
1/1/2006 10:30	1/1/2006 10:35	1/1/2006 10:00	47.6	39.75	5
1/1/2006 10:35	1/1/2006 10:40	1/1/2006 10:00	44.5	37.16	5
1/1/2006 10:40	1/1/2006 10:45	1/1/2006 10:00	44.5	37.16	5
1/1/2006 10:45	1/1/2006 10:50	1/1/2006 10:00	45.9	38.33	5
1/1/2006 10:50	1/1/2006 10:55	1/1/2006 10:00	42.6	35.58	5
1/1/2006 10:55	1/1/2006 11:00	1/1/2006 10:00	40	33.41	5
1/1/2006 11:00	1/1/2006 11:05	1/1/2006 11:00	45	45.00	5
1/1/2006 11:05	1/1/2006 11:10	1/1/2006 11:00	44	44.00	5
1/1/2006 11:10	1/1/2006 11:15	1/1/2006 11:00	45	45.00	5
1/1/2006 11:15	1/1/2006 11:20	1/1/2006 11:00	44	44.00	5

General Commitment Information

Commitment Period	8:00 until 14:00
Breaker Close with .5 MWs of Injection	7:52
Breaker Open	14:08
Hourly No Load in Dollars	100

Telemetry Injection associated to the Real Time Midwest ISO Commitment Period
NXE Injection associted to HE11 of Real Time Midwest ISO Commitment Period

E.15.1 Partial Hour Commitment Period (CP)

RT_RSG_MWP*, RTORSGP*, and DA_MAP* support the existence of a partial Hour CP. A partial Hour CP is defined as a CP with a CP Start Time or CP Stop Time that is not equal to the top of the Hour (i.e. 08:00:00 or 22:00:00). In the event that a partial Hour CP is eligible for RT_RSG_MWP*, RTORSGP*, or DA_MAP*, applicable No-Load Cost, Incremental Energy Cost and Operating Reserve Costs and market value will only be calculated between the CP Start Time and CP Stop Time of the CP.

For example, consider Scenario 4 in the "Hourly Production Costs as Calculated by Dispatch Interval" section of this document. The Resource has a CP Start Time of 10:03 and a CP Stop Time of 10:56. Therefore, the applicable Hourly Production Costs and market value are calculated between 10:03 and 10:56. The eligible Hourly Production Cost is equal to $3,142.71. The RT_ASM_NXE* is equal to 45.5 MW, however the hourly integrated NXE_i for the CP (also defined as RSG_ELIG_MWH*) is 40.7MW. Therefore, the market value for this CP is equal to the RSG_ELIG_MWH* (40.7 MW) multiplied by the RT_LMP_EN*.

E.16 Rounding and Precision

All of the calculations within this document use a common set of rules pertaining to the rounding and precision of the input variables, intermediate variables, and outputs of each calculations. Therefore, the following rules apply:

Variable Type	Rounding and Precision Logic
Megawatts (MW) and Megawatt Hours (MWh)	Rounded to 3 decimal places
Dollars ($) and Dollars per a given variable ($/x)	Rounded to 2 decimal places
Factors and decimal multipliers (i.e. Normalized Weighting Factor (NWF))	Rounded to 8 decimal places

E.17 Emergency Demand Response Make Whole Payment

The Emergency Demand Response (EDR) provisions are designed to encourage parties that have demand response capabilities to offer such capabilities for use by MISO during specified Emergency conditions. Such demand response capabilities include Market Participants that are able to either reduce Load during Emergency conditions (e.g., through existing demand response programs) or to operate back-up generation resources (also referred to as “behind-the-meter” generation) to the same effect. Market Participants with demand response capabilities are encouraged through compensation provisions in the EDR procedures to submit standing offers to either reduce Load or to increase generation during EEA2 or EEA3 events.

Once EDR Offers have been received, during an EEA2 or EEA3 event, MISO can issue an EDR Dispatch Instruction which will contain details regarding when the demand reduction will begin, the demand reduction amount, and necessary duration of the demand reduction. EDR Participants that reduce demand in response to an EDR Dispatch Instruction will be compensated the greater of RT_LMP_END* or the EDR Offer Cost for the amount of verifiable demand reduction provided.

E.17.1 Calculation Overview

This section provides an example of an EDR Make Whole Payment. EDR’s eligible Offer Costs are calculated based on the EDR Dispatch Instruction period. The Offer Costs of an EDR are compared to the total revenue of the EDR Dispatch Instruction period. If the total revenue is less than the Offer Costs, the sum of the differences within the day will be made whole and will be allocated in a single Real-Time Miscellaneous Amount (RT_MISC*).

Below is an example of how total revenue is compared to Offer Cost to determine the EDR Make Whole Payment.

EDR with CP of 6 Hours

	"Total Revenue (TR)"			EDR Offer Costs			
HE	MW	LMP	TR	Shut-Down Cost	MWh Offer Cost	Total Offer Costs	Net
4	30	$17.23	$516.90	$274.56	$600.00		
5	30	$17.32	$519.60		$600.00		
6	30	$17.63	$528.90		$600.00		
7	30	$18.19	$545.70		$600.00		
8	30	$19.28	$578.40		$600.00		
9	30	$19.86	$595.80		$600.00		
Totals			$3,285.30		$3,600.00	$3,874.56	($589.26)

In this example, the EDR is given an EDR Dispatch Instruction with a Call On of 3:00 and a Call Off of 9:00 with a targeted demand reduction of 30 MW. For the purposes of this example, the EDR has an actual demand reduction of 30 MWh per hour. The EDR Make Whole Payment Amount of -$589.26 will be allocated in the form of a RT_MISC* to the Asset Owner.

E.17.2 Demand Reduction Data

In this example, the "MW" column represents the EDR Demand Reduction. Market Participants provide the Demand Reduction to MISO either as part of the registration process or via the portal in the form of an XML file.

EDR Demand Reduction data is to be provided for all 24 hours of a day in which there is an EDR Dispatch Instruction. In the event that an EDR instruction spans multiple days, an EDR Demand Reduction file must be submitted for each Operating Day (OD) for which there exists an EDR Dispatch Instruction. If the EDR Demand Reduction data is not provided to MISO within 53 days of the EDR Dispatch Instruction OD, for a given EDR Dispatch Instruction, the EDR Make Whole Payment will be zero.

In order for an EDR to be eligible for an EDR Make Whole Payment, the EDR must have an EDR Dispatch Instruction and EDR Demand Reduction data for each Hour of the EDR Dispatch Instruction. The EDR Dispatch Instruction data is provided to Market Settlements from the Real-Time Operations group within one week of the EEA2 or EEA3 event.

E.17.3 EDR Make Whole Payment Settlement

EDR Make Whole Payments are uplifted to the location in which the EEA2 or EEA3 event occurs. Therefore, the uplift of payments will either go to Load Ratio Share (LRS), or to the Load Commercial Pricing Nodes in the affected Area. Both the payment for EDR Make Whole Payments and the associated uplift will be reflected as RT_MISC*. EDR Make Whole Payments for a given OD will be summed for the OD, and provided in a one RT_MISC* charge. If an EDR Dispatch Instruction spans multiple days, the total EDR Make Whole Payment will be summed for all Hours of the EDR Dispatch Instruction and then equally allocated to each Hour of the EDR Dispatch Instruction duration, and then summed for each affected OD. An equal and opposite RT_MISC* will be created to uplift the EDR Make Whole Payments for the OD.

The RT_MISC* that result from EDR Make Whole Payments and the associated uplift will be initially calculated on the S55 Settlement Statement. Should an error be found in the calculation of the EDR Make Whole Payment or uplift, the necessary adjustments to the RT_MISC* will be reflected on the S105 Settlement Statement.

E.18 Load Modifying Resources Penalty and Uplifted Allocation

Load Modifying Resource (LMR) is classified as either a Demand Resource (DR) or Behind the Meter Generation (BTMG), and must be available for use during an Emergency declared by MISO if the LSE intends to use the resource as part of its Resource Plan.

The LSE associated with an LMR is subject to penalties if the LMR fails to respond in an amount greater than or equal to the target level of Load reduction for DRs or target level of generation increase for BTMG. However, the Transmission Provider will not assign LMR penalties to those LMRs also defined as EDR resources that have already been assessed penalties under Schedule 30 of the Tariff.

The LMR penalties are calculated for each hour in which a LMR fails to respond in an amount greater than or equal to the target level of Load reduction for DR or generation increase for BTMG as the sum of: (1) the product of (a) the shortfall MW and (b) the LMP at the CPNode associated with the LMR; and (2) RSG Charges. The shortfall MW is equal to the greater of: (1) the difference between (a) the target level of the Transmission Provider Instruction and (b) the actual MW that the LMR provides; and (2) zero. The RSG Charges are equal to the product of: (1) the shortfall MW; and (2) the RSG First Pass Distribution rate for the applicable Hour.

The LMR penalties and uplift will be allocated to the applicable LSE in a single Real-Time Miscellaneous Amount (RT_MISC*).

The revenues from the LMR penalties resulting from LMRs that fail to respond the Transmission Provider Instruction shall be allocated, pro rata, on the metered Load Ratio Share, to Market Participants representing LSEs in the Local Balancing Authority Area(s) that experienced the Emergency.

The RT_MISC* that result from LMR penalties and the associated uplift will be initially calculated on the S55. If an error is found in the LMR penalty or uplift calculations, the necessary adjustments to the RT_MISC* will be reflected on the S105 Settlement Statement.

E.19 Dispatchable (DISP)

The Dispatchable (DISP) flag represents whether a given Resource is able to be dispatched by the Unit Dispatch System (UDS). In order for a Resource to be Dispatchable, it must have a Real-Time Unit Dispatch System Control Status (RT_UDS_CS) of either 1 or 2, have a difference between Operating Limits of greater than 1 MW, and a non-zero ramp rate. The following calculation demonstrates the way in which DISP is calculated for each Dispatch Interval:

IF RT_UDS_CS = 1 **AND** RT_ECON_MAX > RT_ECON_MIN + 1 **AND** UDS_RR > 0
THEN
  DISP = 1
ELSIF RT_UDS_CS = 2 **AND** RT_REG_MAX > RT_REG_MIN + 1 **AND** UDS_RR > 0
THEN
  DISP = 1
ELSE
  DISP = 0
END IF

The RT_UDS_CS is described in detail in Attachment D of the Energy and Operating Reserve Markets BPM. Fixed Dispatch is another concept described in detail in Attachment D of the Energy and Operating Reserve Markets BPM. When a Resource is Fixed Dispatch, it is considered non-dispatchable, , resulting in a DISP of zero.

E.20 Multiple Approved UDS Cases in a Single Dispatch Interval

For a given Dispatch Interval, it is possible to have more than one approved UDS Case. When more than one UDS Case is approved, the POP will attempt to utilize the information in all approved cases for the given Dispatch Interval to arrive at a single set of Dispatch Interval values. UDS values include: Dispatch Targets for Energy and Regulating, Spinning and Supplemental Reserves; generator limits; Dispatchable flag; and Real-Time Ramp Rates.

The POP applies a different approach to arrive at a single set of Dispatch Interval UDS values depending on the data element being evaluated and amount of time each approved UDS case is effective. Dispatch Targets for Energy and Regulating, Spinning and Supplemental Reserves (Dispatch Targets) apply a time-weighted, average approach. Generator Limits, Dispatchable flag, Mitigation Schedules, and Real-Time Ramp Rates (Operating Parameters) apply a maximum-of approach. The approved UDS Case value is sampled every 10 seconds, resulting in a total potential of 30 samples per 5-minute Dispatch Interval. Only approved UDS cases with 2 or more samples (20 seconds of effectiveness) are considered in the calculation.

If the number of samples for a given Dispatch Interval is less than ½ of the total potential samples (15 samples or 2:30 minutes), Dispatch Targets are equal to the straight-average of all approved UDS Cases and Operating Parameters are equal to the maximum-of all approved UDS Cases. If the total number of Dispatch Interval samples is greater than or equal to ½ the total potential samples (15 samples or 2:30 minutes), Dispatch Targets are equal to the time-weighted average of all approved UDS Cases and Operating Parameters are equal to the maximum-of all approved UDS Cases. The following calculation demonstrates the way in which Dispatch Targets and Operating Parameters are calculated for each Dispatch Interval:

IF Approved UDS Case Samples >=15 and a > 0 **THEN**

$$\text{Dispatch Targets} = \sum_{j=1}^{a} \text{Dispatch Target}_j \times c_j/m$$

Operating Parameters = MAX (Operating Parameter$_i$)

ELSE

$$\text{Dispatch Targets} = \sum_{i=1}^{n} (\text{Dispatch Target}_i) \times 1/n$$

Operating Parameters = MAX (Operating Parameter$_i$)

END

Where:
Dispatch Targets = Dispatch Target for Energy and Regulating, Spinning and Supplemental Reserve
Operating Parameters = Generator Limits, Dispatchable flag, Mitigation Schedules, and Real-Time Ramp Rates

n = Number of Approved UDS Cases for a given Dispatch Interval
m = Total number of samples for Approved UDS Cases having samples >= 2 and existing in both DART and SCADA system for a given Dispatch Interval
a = Number of distinct Approved UDS Case IDs having samples >= 2 and existing in both DART and SCADA system for a given Dispatch Interval
i = Specific Approved UDS Cases sample for a given Dispatch Interval
c_j = Number of Approved UDS Case samples for a given Approved Case j having samples >= 2 and existing in both DART and SCADA system for a given Dispatch Interval.

E.20.1 Calculation Example

Suppose that for a given Dispatch Interval there are 4 approved UDS Cases. The UDS values and POP integration results are displayed in the tables below.

Approved UDS Cases and Data

			Dispatch Targets				Operating Parameters			
Disp Int	UDS Case ID	# Samples	Energy	Reg	Spin	Supp	DISP	RT_RR	ECON_MAX	ECON_MIN
1	1	2	70	8	10	5	0	4	350	126
1	2	7	68	6	8	3	0	1	330	116
1	3	20	60	4	4	1	0	3	325	125
1	4	1	71	7	9	4	1	5	360	128

POP Integration Results

Dispatch Interval	Basepoint	Reg_MW	Spin_MW	Supp_MW	Dispatchable Flag	Ramp Rate	Econ_Max	Econ_Min
1	62.6	4.8	5.5	1.8	0	4	350	126

In this example, the Dispatch Interval has 4 approved UDS cases with a total of 30 samples (2+7+20+1). Since the number of samples is greater than or equal to 15, the time weighted method is applied for Dispatch Targets and the maximum-of method is applied for Operating Parameters. Because UDS Case ID ‘4’ only has 1 sample, it is ignored when calculating the single set of Dispatch Interval UDS Case values.

E.21 Demand Response Resources and Contingency Reserve Deployment

The measurement and verification of Demand Response Type I Resource output is captured and calculated in the Demand Response Tool. The CRD shortfall MW value and the adjusted Real-Time Dispatch Interval contingency reserves MW value for DRR-Type I Resources are calculated based on the inputs from the Demand Response Tool.

E.21.1 CRD Shortfall MW Calculation

For a DRR Resource, when Contingency Reserve Deployment (CRD) Event exists, the CRD Shortfall MW value is calculated below:

IF CRDC_PASS_TEST = “False” **THEN**
CRD Shortfall_MW = **MAX** (CRD_INST_MW – **MAX** (Meter_Before – Meter_After, 0), 0)
ELSE
CRD Shortfall_MW = 0
END IF

Where:
Meter_Before = Metered value at the beginning of a given Contingency Reserve Deployment event
Meter_After = Metered value 10 minutes after the beginning of a given Contingency Reserve Deployment event
CRD_INST_MW = MW value requested in response to a Contingency Reserve Deployment event

E.21.2 Real Time Dispatch Interval Cleared Contingency Reserves Calculation

When a DRR has a non-zero CRD Shortfall MW in an Hour, the Dispatch Interval cleared contingency reserves shall be adjusted for that Hour and all remaining Hours in the Operating Day.

FOR Each CRD_Event
IF CRD Shortfall_MW <>0 **THEN**
FOR *each Dispatch Interval impacted*
SPIN_MW = MIN (SPIN_MW, CR_DEPL_ACT);
SUPP_MW = MIN (SUPP_MW, CR_DEPL_ACT);
END FOR
END IF
END FOR

Where:
Meter_Before = Metered value at the beginning of a given Contingency Reserve Deployment event

Meter_After = Metered value 10 minutes after the beginning of a given Contingency Reserve Deployment event

CR_DEPL_ACT = MAX (Meter_Before – Meter_End, 0)

E.21.3 DRR-Type II Host Load Zone Removal

The removal of DRR-Type II Host Load Zones results in a model utilizing a single CP node, the DRR-Type II Resource, which is dispatched over a negative economic dispatch range and paid according to a negative offer curve.

In implementing this negative generation model for DRR-Type II Resources, the DA/RT Operating Systems were modified so that they could handle the economic dispatching of negative generation DRR-Type II Resources. The existing POP logic will utilize negative Generation Offer Curve data, Setpoint, and Economic Limit data, converted so that they are formatted like the Offer Curve, Setpoint, and Economic Limit data for all other Generation Resources. The algorithms for implementing these conversions are presented below (the outputs of these conversions will be used in current system calculations like Excessive / Deficient Energy and offer pricing):

The following example demonstrates the conversion of negative generation Economic Limits:

CONVERTING UNIT DISPATCH LIMITS

$ECON\ MAX_{OUTPUT} = ECON\ MIN_{INPUT} * -1$

Using example data:

$75 = -75 * -1$

$ECON\ MIN_{OUTPUT} = ECON\ MAX_{INPUT} * -1$

Using example data:

$0 = 0 * -1$

NEGATIVE GENERATION DRR II ECON LIMITS	
ECON MIN	ECON MAX
-75	0

DRR II ECON LIMITS (CONVERTED)	
ECON MIN	ECON MAX
0	75

The following example illustrates the conversion of offer megawatts in negative generation offer/price segments to positive values:

CONVERTING MEGWATTS IN OFFER SEGMENTS

$OFFER\ MWS_{OUTPUT} = ECON\ MAX_{OUTPUT} + OFFER\ MWS_{INPUT}$

SEGMENT	NEG. GEN. OFFER MWS	CONVERTED	
1	-68	75+(-68) =	7
2	-52	75+(-52) =	23
3	-44	75+(-44) =	31
4	-37	75+(-37) =	38
5	0	75+(0) =	75

The following example illustrates the conversion of negative generation Basepoint / Setpoint values to positive values:

CONVERTING NEG. GEN. BASEPOINTS VOLUMES

$BP_{OUTPUT} = ECON\ MAX_{OUTPUT} + BP_{INPUT}$

BP_{INPUT}	$ECON\ MAX_{OUTPUT}$	BP_{INPUT}	CONVERSION
-60	75	15	15 = 75 + (-60)

The following example illustrates the conversion of negative generation Telemetry (net load) volumes to the corresponding injection volumes:

CONVERTING NEG. GEN. TELEMETRY VOLUMES FROM NET LOAD TO GEN.

$TEL\_VOL_{OUTPUT} = TEL\_VOL_{INPUT} + ECON\ MAX_{OUTPUT}$

TEL_VOL_{OUTPUT}	TEL_VOL_{INPUT}	$ECON\ MAX_{OUTPUT}$	CONVERSION
-15	60	75	-15 = 60 - 75

E.21.4 Multi-Part Operating Reserve Offers for Demand Response Resources

Demand Response Resource Operating Reserves may be offered into the market in up to 3 segments for each qualified Operating Reserve product. For Regulation-qualified DRR-Type II Resources, multi-part Regulating, Spinning, Offline Supplemental, and Online Supplemental Reserve offers may be submitted. A multi-part Regulating Reserve offer only refers to Regulating Capacity offers, not Regulating Mileage offers. For non-

Regulation-qualified DRR-Type II and for DRR-Type I Resources, multi-part Spinning, Offline Supplemental and Online Supplemental Reserve offers may be submitted.

Market Participants who submit multi-part Demand Response Resource Operating Reserve offers can choose between having the prices interpreted as either a stepped function, or as a piece-wise linear function via the Use Bid Slope (UBS) value of either 1 or 0. This option is applicable to each product offer.

The Production Cost calculation performed for Operating Reserve offers will employ the same Area Under the Offer Curve (AUC) cost calculation methodology currently used for Energy offers. The following algorithms, previously covered in this guide under the treatments for ELMP, DAMAP, and RTORSGP, demonstrate how each component will differ for DRR-Type II Resources which submit multi-part Operating Reserve offers.

Must-Run Resource Ancillary Service Product Cost – Components of DA MR_ELMP_MWP

Hourly Day-Ahead Regulating Reserve Cost (MR_REG_COST)

The Hourly Day-Ahead Regulating Reserve Cost (MR_REG_COST) for a Must-Run Resource is calculated as follows:

$$\sum_{i=1}^{n}\left(\int_{DA\_REG\_SS\_VOL}^{DA\_REG\_VOL} DA\_REG\_Offer\_Curve x 1/12\right)$$

Hourly Day-Ahead Spinning Reserve Service Cost (MR_SPIN_COST)

The Hourly Day-Ahead Spinning Reserve Service Cost (MR_SPIN_COST) for a Must-Run Resource is calculated as follows:

$$\sum_{i=1}^{n}\left(\int_{DA\_SPIN\_SS\_VOL}^{DA\_SPIN\_VOL} DA\_SPIN\_Offer\_Curve x 1/12\right)$$

$$+$$

$$\sum_{i=1}^{n}\left(\int_{DA\_SPIN\_SS\_VOL}^{DA\_SPIN\_VOL} DA\_REG\_CAP\_Offer\_Curve x 1/12\right)$$

Hourly Day-Ahead Supplemental Reserve Service Cost (MR_SUPP_COST)

The Hourly Day-Ahead Supplemental Reserve Service Cost (MR_SUPP_COST) for a Must-Run Resource is calculated as follows:

IF DA_CONTROL_STATUS = 0 THEN

$$\sum_{i=1}^{n}\left(\int_{DA\_SUPP\_OFF\_SS\_VOL}^{DA\_SUPP\_VOL} DA\_SUPP\_OFF\_Offer\_Curve x 1/12\right)$$

ELSE

$$\sum_{i=1}^{n}\left(\int_{DA\_SUPP\_ON\_SS\_VOL}^{DA\_SUPP\_VOL} DA\_SUPP\_ON\_Offer\_Curve x 1/12\right)$$

END IF

RTORSGP – Real-Time Hourly Ancillary Services Availability Cost (RT_AS_AC*) Components

Real-Time Regulating Reserve Availability Cost (RT_REG_AC)

RT_REG_AC =

$$\sum_{i=1}^{n}\left(\int_{DA\_REG\_VOL}^{REG\_MW} RT\_REG\_Offer\_Curve \times {}^{1}\!/_{12}\right)$$

+

$$\sum_{i=1}^{n} \text{(ADD\_REG\_MIL\_VOL × MIL\_OF) \}}$$

Real-Time Spinning Reserve Availability Cost (RT_SPIN_AC)

RT_SPIN_AC =

$$\sum_{i=1}^{n}\left(\int_{DA\_SPIN\_VOL}^{SPIN\_MW} RT\_SPIN\_Offer\_Curve \times {}^{1}\!/_{12}\right)$$

+

$$\sum_{i=1}^{n}\left(\int_{DA\_REG\_SPIN\_VOL}^{RT\_REG\_SPIN\_MW} RT\_REG\_CAP\_Offer\_Curve \times {}^{1}\!/_{12}\right)$$

Real-Time Spinning Reserve Availability Cost (RT_SPIN_AC)

RT_SUPP_AC =

$$\sum_{i=1}^{n}\left(\int_{DA\_SUPP\_VOL}^{SUPP\_MW} RT\_SUPP\_Offer\_Curve \times {}^{1}\!/_{12}\right)$$

Day-Ahead Margin Assurance Payment Ancillary Services Contribution (DAMAP_AS_CONi) for a Dispatch Interval, for a given Ancillary Services Product

(a) AS_MW < ADJ_DA_AS$_i$

DAMAP_AS_CON$_{i(a.)}$ =
IF AS_MW < ADJ_DA_AS$_i$ **THEN**
DAMAP_AS_CON$_{i(a.)}$ =
MAX [

$$\left(\int_{AS\_MW}^{\text{ADJ\_DA\_ASi}} \{AS\_Product\_DA\_Offer\_Curve\right),$$

$$\left(\int_{AS\_MW}^{\text{ADJ\_DA\_ASi}} \{AS\_Product\_RT\_Offer\_Curve\right))$$

] – [(ADJ_DA_AS$_i$ – AS_ MW) × AS_MCP]
END IF

(b) AS_MW >= ADJ_DA_AS$_i$

DAMAP_AS_CON$_{i(b.)}$ =
IF AS_MW >= ADJ_DA_AS$_i$ **THEN**
DAMAP_AS_CON$_{i(b.)}$=
MAX { [(AS_ MW – ADJ_DA_AS$_i$) × AS_MCP] –

$$\left(\int_{\text{ADJ\_DA\_ASi}}^{AS\_MW} \{AS\_Product\_RT\_Offer\_Curve\right))$$

], 0 }
END IF

E.22 External Asynchronous Resource (EAR) Import Schedule for Energy Settlement

While importing energy and participating in the Ancillary Services market, an EAR could export energy from the MISO Markets. This section explains the necessary changes to settle the EAR Import Schedule for energy and Ancillary Services. Other settlements of energy and Ancillary Services for EAR Import Schedule will follow the regular Resource settlement methodologies described in this document.

In general, for any market hour in the Day-Ahead Market, or Dispatch Interval in Real-Time Market, when the EAR exports energy outside of the MISO Market, all billing determinants associated with energy are set to 0 (zero).

The DA_ECON_MIN*, RT_ECON_MIN*, NDL_ECON_MIN*, and AC_ECON_MIN* values will be set to zero if the value is less than zero.

For additional information concerning the EAR export schedule settlement, please refer to the Market_Settlements_Calculation_Guide (MS-OP-029).

E.22.1 EAR Import Schedule in Day-Ahead Market

For a market hour, if an EAR's cleared Day-Ahead schedule volume represents energy export (DA_SCHD* > 0), the resulting settlement logic will set the EAR's Day-Ahead Schedule Volume to 0 (zero). Additionally, the Start-up and No-Load Costs are excluded from the Hourly Production Costs calculation as a component of the Day-Ahead Revenue Sufficiency Guarantee Make Whole Payment charge type.

E.22.1.1 EAR Import Schedule in Real-Time Market

For a Dispatch Interval, if an EAR's Basepoint represents energy export (BP** > 0), the settlement logic will set all of the relevant billing determinants (ATE, RES_LP_VOL, AVG_BP, EXE_T, DFE_T, EXE, DFE, and, NXE) to 0 (zero).

E.23 Real-Time Net Ramp Capability Volumes (RTN_RC_VOL*) and Real-Time Ramp Capability Market Clearing Prices (RT_RC_MCP*)

Real-Time Net Ramp Capability Volumes (RTN_RC_VOL*) are the integration of the difference between the Real-Time Dispatch Interval Ramp Capability Volume (RT_RC_MW**) and the Day-Ahead Ramp Capability Volumes (DA_RC_VOL*) and are calculated separately for each Resource per Ramp Capability product (RC). The RT_RC_MCP* is the quantity-weighted average of Dispatch Interval Ramp Capability Market Clearing Prices (RC_MCP**) and are calculated separately for each Resource per Ramp Capability product.

E.23.1 Calculation Overview

The calculation of RTN_RC_VOL* is defined below:

$$RTN\_RC\_VOL = \left(\sum_{i=1}^{12} RC\_MW - DA\_RC\_VOL \right) / 12$$

The calculation of the RT_RC_MCP* is defined below:

$$RT\_RC\_MCP = \sum_{i=1}^{12}\left[\left(RTN\_RC\_VOL_i \Big/ \sum_{i=1}^{12}(RC\_MW - DA\_RC\_VOL)\right)\times RC\_MCP\right]$$

Note: The RT_RC_MCP for a given product is zero if the RTN_RC_VOL* is zero.*

F. References

- BPM 002 Energy and Operating Reserve Markets
- BPM 005 Market Settlements
- BPM 009 Market Monitoring and Mitigation
- BPM 010 Network and Commercial Models
- Energy and Operating Reserve Market Tariff
- MS-OP-029 Market Settlements Calculation Guide

G. Disclaimer

This document is prepared for informational purposes only, to support the application of the provisions of the Tariff and the services provided thereunder. MISO may revise or terminate this document at any time at its discretion without notice. While every effort will be made by MISO to update this document and inform its users of changes as soon as practicable, it is the responsibility of the user to ensure use of the most recent version of this document in conjunction with the Tariff and other applicable documents, including, but not limited to, the applicable NERC Standards. Nothing in this document shall be interpreted to contradict, amend, or supersede the Tariff. MISO is not responsible for any reliance on this document by others, or for any errors or omissions or misleading information contained herein. In the event of a conflict between this document, including any definitions, and either the Tariff, NERC Standards, or NERC Glossary, the Tariff, NERC Standards, or NERC Glossary shall prevail. In the event of a conflict between the Tariff and the NERC Standards, or NERC Glossary, the Tariff shall prevail until or unless the Federal Energy Regulatory Commission ("FERC") orders otherwise. Any perceived conflicts or questions should be directed to the Legal Department.

H. Revision History

Doc Number	Description	Revised by:	Effective Date
MS-OP-031-r26	Annual Review completed. No changes needed.	E. Fjellman	DEC-02-2017
MS-OP-031-r25	Annual Review completed. No changes needed.	E. Fjellman	DEC-08-2016
MS-OP-031-r24	- Modifications to Sections D.8, D.9, and D.10 (Make-Whole Payments) to incorporate the provisions related to the Ramp Capability products in Docket No. ER14-2156-000. - Addition of new Section E.23 and acronyms for the Settlement inputs associated with Ramp Capability. - Minor revisions to other areas of the document to clean up formatting issues.	A. Alewine	MAY-01-2016
MS-OP-031-r23	Annual Review completed. No changes needed.	E. Fjellman	DEC-11-2015
MS-OP-031-R22	- Added ELMP Settlement Changes - Added Section E.22 EAR Bi-Directional Offer Settlement Changes - Added Sections E.21.3 and E.21.4 as a result of FERC Order 719. - Clarified Section D.4 Non-Excessive / Excessive / Deficient Energy for the calculation of EXE_Ti and DFE_Ti when the EEEF** is activated (this methodology has been in effect since 01/06/2009). - Clarified the RES_LP_VOL** calculation	P. Wang L.Hall A. Alewine	MAR-01-2015
MS-OP-031-r21	- Removed RT_ECO_MAX and MIN from Acronym table. - Updated definition of RT_ECON_MAX and MIN - Replaced all usage of RT_ECO_MAX and MIN with RT_ECON_MAX and MIN - Updated step 2a of calculation example in DAMAP section - Clarified language in Section D.8.3.1.2 (Real-Time Start-Up Eligibility) - Updated steps 3 and 4 of the calculation example in Section D.10 (DAMAP). Annual Review completed	J. Howard A. Alewine E. Fjellman	DEC-09-2014
MS-OP-031-r20	-Updated logic in section D.5 Annual Review completed	J. Howard	DEC-09-2013
MS-OP-031-r19	- Modifications to Sections D.8, D.9, and D.10 (Make Whole Payments), per 10/16/13 Section 205 Filing, Docket No. ER14-106-000. Rearranged the Acronym list into alphabetical order.	A. Alewine	OCT-17-2013
MS-OP-031-r18	- Modification to Section D.10.1.3.a, DAMAP Ancillary Services Contribution calculation, per	A. Alewine	Mar-01-2013

	2/28/13 Section 205 Filing ER13-1004-000 - Correction to the DAMAP_REG_CON_HR calculation		
MS-OP-031-r17	Modifications to some terminologies of Regulating Mileage Credit and charge calculations Added Market-Wide Hourly Regulating Mileage Deploy Rate Added an example in Section E.11 Area Under the Curve (AUC) to describe calculation differences when the UBS = 0 Minor edits to Section D.9 regarding RTORSGP eligibility rules Updated Disclaimer Annual review completed Effective date remains DEC-17-2012 per FERC Order No. 755, Regulating Mileage Payment	P. Wang A. Alewine	Dec-17-2012
MS-OP-031-r16	Modifications made to comply with FERC Order No. 755, Regulating Mileage Payment. - Modification to Multiple Approved UDS Cases in Single Dispatch Interval - Added a section for re-calculation of DRR resources CRD shortfall MW and Dispatch Interval cleared Contingency Reserves - Corrected determinant name for RT product substitution flag - Clarification of Initial On Hours (IOH) calculation	P. Wang	DEC-17-2012
MS-OP-031-r15	Modification to Section E. 9 Product Substitution and add the Product Substitution flags for both Day-Ahead and real-Time Markets Added Mitigated RSG Make-Whole Payment information for Generation Resource Voltage and Local Reliability commitments per 12/22/2011 Section 205 Filing ER-12-679-000. These calculation changes will be effective 9/1/2012 per the FERC order received on 3/30/12 accepting and suspending these revisions for five months.	R. Leonard	Apr-01-2012
MS-OP-031-r14	- Change calculation of RT Min/Max DSP to align with the calculation	J. Yang	JAN-13-2012
MS-OP-031-r13	- Add Dispatch Target interval UDS case integration logic language - Add AC ECON MIN/MAX to NDL MIN/MAX section - Update DAMAP section in regards to Manual Re-Dispatch	P. Wang	JUN-01-2011
MS-OP-031-r12	- Clarification of Notification Deadline Econ Min/Max proration. - Clarification of Initial On Hours Rounding	M. Dawson	JUN-01-2011

	- Updated to DAMAP Energy Contribution calculation due to 5/13/2011 Section 205 Filing		
MS-OP-031-r11	Add Dispatchable Intermittent Resources Real-Time Economic Maximum Dispatch Calculation to comply with the Tariff	P. Wang	JUN-01-2011
MS-OP-031-r10	Add the RT RSG allocation Redesign language; Add “Manual Re-Dispatch” criteria for EEEF flag determination	P. Wang	APR-01-2011
MS-OP-031-r9	Clarification of RT_DISP_MIN and RT_DISP_MAX in regards to Intermittent Resources due to the FERC Order on RSG Exemptions	M. Dawson	AUG-30-2010
MS-OP-031-r8	-Corrected language for RSG MWP Start-Up Cost allocation (retroactive to 9/23/2009)	A. Alewine	Mar-01-2010
MS-OP-031-r7	Removal of Dispatch Bands - Change to Tolerance Bands - Change to Calculation of FFDF, EEEF, EXE*, DFE*, and EDEDC - Change to ORSGP and DAMAP eligibility checks	P. Wang	Mar-01-2010
MS-OP-031-r6	- Add Stored Energy Resource Settlement language - Add DRR Type I Unit Eligibility for RT ORSGP - Removed old BPM document numbers from Reference section per Controlled Documents	P. Wang	FEB-01-2010
MS-OP-031-r5	-Add Load Modifying Resource Penalty -Modification of Real-Time Economic Minimum/Maximum Dispatch - Restored complete revision history to document and removed Issue Date column per Controlled Documents request	P. Wang	JAN-06-2009
MS-OP-031-r4	- Reference to Initial Energy Output for ACH_MW - Added calculation definition for Dispatchable (DISP)	R. Leonard	JAN-06-2009
MS-OP-031-r3	- Correction to RT_AS_MCP formulation to correctly represent an integration - Correction to the RT_DSP_MIN / RT_DSP_MAX calculation to account for the effect of self-schedule values on the RT_DSP_MAX	R. Leonard	JAN-06-2009
MS-OP-031-r2	Updated		JAN-06-2009
MS-OP-031-r1	- EXE/DFE calculation when RESG_LP_VOL = 0 - Setting of EEEF for CRD events for Resources associated to a common bus - Setting of EEEF for disabling dispatch bands - Update to impact of Self-Schedule AS on MWP -Certain corrections to align BPM with Tariff for DAMAP and ORSGP eligibility	R. Leonard	JAN-06-2009

MS-OP-031	- Establish separate Controlled Document instead of BPM Attachment C; Update for ASM with the following: - Added new Definitions -Updated RT_DSP_MIN / RT_DSP_MAX section to comply with the Tariff - Clarification of RT RSG Hourly Production Cost language - Removed misleading language from RTORSGP description - Update ORSGP and DAMAP eligibility to include Dispatchable - Correction to DAMAP Calculation Example - Update EEEF section to comply with the Tariff - Correction to REG_DEPL Calculation Example - New Section explaining impact of Self-Scheduled Ancillary Services on Make Whole Payment Calculations -Updated scan frequency for EMS data -Update RTOSGP and DAMAP to align with the Tariff using the RT_DSP_MIN and RT_DSP_MAX values -Removed the language from NRGA, no longer impacted by EEEF	R. Leonard	JAN-06-2009