**Voltage and Local Reliability Commitment Allocation Study and Commercially Significant VLR Issue Study**

The Voltage and Local Reliability Allocation Study and the Commercially Significant VLR Issue Study shall be conducted in the manner described below.

**A. Voltage and Local Reliability (VLR) Allocation Study**

The VLR Commitment Allocation Study determines the share of Day-Ahead and Real-Time Revenue Sufficiency Guarantee (RSG) Make-whole Payments (MWP) attributable to VLR Commitments. The VLR Allocation Study will be conducted quarterly using the data from the prior twelve months in order to reflect changes to the system that may affect the VLR Allocation Ratio. The VLR Allocation Ratio will be updated on the first of the month following the completion of the study. The Study shall be completed in four steps. The first step shall map all Hours Resources are committed in any RAC or the LAC process to a reason – Capacity commitments, Active Transmission Constraint commitments or VLR Commitments. Step two shall calculate the historical headroom available and the Capacity commitment need. The third step shall estimate the Production Costs for available, similar Resources to those committed for VLR Commitments and then determine the most efficient Capacity based commitments and calculate the RSG cost savings. Step four shall determine the VLR Allocation Ratio using the VLR Commitments RSG Credits and the Capacity Resource commitments substitute RSG Credits.

1. Step One: Commitment Type Mapping

    a. Effective on September 1, 2012, the Transmission Provider Real-Time operations shall use a call-on reason code to specifically designate a given commitment as a VLR Commitment. Prior to September 1, 2012, VLR Commitments were designated Active Transmission Constraint commitments, including the selection of a constraint name. After September 1, 2012, the Transmission Provider Real-Time operations analyzed each Active Transmission Constraint commitment and based on the constraint name identified the VLR Commitment(s).

b. For each Hour (h), for each VLR Commitment, the Resource VLR Revenue Sufficiency Guarantee Credit (i.e., make-whole payment) (VLR_RES_MWP) is equal to:

   i. the hourly Real-Time Revenue Sufficiency Guarantee Credit, if the VLR Commitment was made in the Real-Time Energy and Operating Reserve Market; or
   ii. the hourly Day-Ahead Revenue Sufficiency Guarantee Credit, if the VLR Commitment was made in the Day-Ahead Energy and Operating Reserve Market.

c. For each Hour (h), the VLR Capacity Committed (VLR_CAP_COM) is equal to the integrated sum of all VLR Commitments' Real-Time Hourly Economic Maximum Limit (RT_ECO_MAX):

$$\text{VLR\_CAP\_COM}_h = \sum_{\text{Transmission Provider}} \text{RT\_ECO\_MAX} \times (1/12)$$

2. Step Two: Headroom and Capacity Need Calculation

a. For each Dispatch Interval (i), calculate the headroom available on each Resource using the Unit Dispatch System ("UDS") data. A Resource is considered to be online and injecting energy if (i) the Dispatch Target for Energy, or Basepoint (BP), is greater than zero; and (ii) its Dispatch Interval Actual Energy Injection, or Resource Load Profiled Volume (RES_LP_VOL), is greater than zero. If the Resource is online and injecting energy the Resource Headroom (RES_HR) is equal to the positive difference between the adjusted Hourly Real-Time Economic Maximum Limit (RT_ECO_MAX) and the sum of the Dispatch Target for Energy BP, Dispatch Target for Regulating Reserve (REG_MW), Dispatch Target for Spinning Reserve (SPIN_MW), and Dispatch Target for Supplemental Reserve (SUPP_MW). If the Resource is not online or not injecting energy, the RES_HR is set to zero. The following formula shows how the RES_HR is calculated:

**IF** ( BP > 0 **AND** RES_LP_VOL > 0 ) **THEN**
RES_HR = MAX [RT_ECO_MAX – ( BP + REG_MW + SPIN_MW + SUPP_MW ), 0]
**ELSE**
RES_HR = 0
**END IF**

b. The RES_HR is then integrated for all Resources to calculate the hourly Headroom Available (HR_AVAIL):

$$HR\_AVAIL = \sum_{\text{Transmission Provider}} RES\_HR \times (1/12)$$

c. Next the Operations Headroom Need (HR_NEED) is calculated as the greater of: (1) the Unloaded Capacity Requirement, or (2) 60% of the hourly Load change. The hourly Load change is equal to the greater of (i) the difference between the Transmission Provider next Hour (Transmission Provider_Next_Hour) Load (measured as the total generation needed to meet the Load) plus Net Actual Interchange ("NAI") and the Transmission Provider current Hour Load plus NAI and (ii) 0. The total generation needed to meet the Load considers the Actual Energy Injections for Resources, or the Real-Time Billable Meter ($RT\_BLL\_MTR_{GEN}$).

$$HR\_NEED = MAX \{ \text{Unloaded Capacity Requirement}, [ 60\% \times MAX ( \sum_{\text{Transmission Provider\_Next\_Hour}} MAX ( RT\_BLL\_MTR_{GEN} + NAI, 0 ) - \sum_{\text{Transmission Provider\_Current\_Hour}} MAX ( RT\_BLL\_MTR_{GEN} + NAI, 0 ) ) ] \}$$

d. The Capacity MW Needed (CAP_MW_NEED), adjusted for constraints on the system, is then calculated as the HR_AVAIL minus the HR_NEED minus the VLR_CAP_COM.

$$CAP\_MW\_NEED = HR\_AVAIL - HR\_NEED - VLR\_CAP\_COM$$

e. For each Hour (h), if the CAP_MW_NEED is negative, it represents an Hour in which there was a Capacity-related commitment needed in that Hour. If the CAP_MW_NEED is positive, it represents an Hour in which there was no need for a Capacity-related commitment. Therefore, for a given Hour (h), the Capacity Commitment Needed (CAP_COM_NEED) is 1 (or True) when the CAP_MW_NEED is negative or zero and the CAP_COM_NEED is 0 (or False) when the CAP_MW_NEED is positive.

**IF** $CAP\_MW\_NEED_h > 0$ **THEN**
$CAP\_COM\_NEED_h = 1$
**ELSE**
$CAP\_COM\_NEED_h = 0$
**END IF**

3. Step Three: Capacity Resource Commitment Logic

a. For the purposes of this study, all Commitment Periods are bounded by a given Operating Day. For each VLR Commitment, determine the set of Hours in which there exists a Capacity Commitment Need (*i.e.*, CAP_COM_NEED = 1). For each VLR Commitment, the Capacity Resource Commitment Analysis Period (CAP_RES_COM_AP) will be from the earliest to the latest hour within the VLR Commitment for which the CAP_COM_NEED is 1 (*i.e.*, True).

b. The next step is to identify those Resources that would have been committed for Capacity, had they been selected on a least-cost basis, rather than those that had been selected for VLR Commitment. For each CAP_RES_COM_AP, the list of potential Resources available for commitment meets the following criteria:

i. For evaluating potential Capacity Resources that could have replaced VLR Commitments made in the Real-Time Energy and Operating Reserve Market:

(1) Economically available in the Real-Time Energy and Operating Reserve Market for each Hour of the CAP_RES_COM_AP

(2) Does not have a commitment for any Hour in the Operating Day

(3) The Hourly Real-Time Economic Maximum Limit (RT_ECO_MAX) of the potential Capacity Resource (CAP_MAX) is similar to the RT_ECO_MAX of the VLR Committed Resource (VLR_MAX) for the CAP_RES_COM_AP
CAP_MAX > MAX ( 50% × VLR_MAX, VLR_MAX – 50 MW )
**AND** CAP_MAX < MIN ( 150% × VLR_MAX, VLR_MAX + 50 MW)

(4) Has a Maximum Runtime greater than or equal to the number of hours in the CAP_RES_COM_AP

(5) Has a Minimum Runtime less than or equal to the number of hours in the CAP_RES_COM_AP

(6) All startup times plus notification times (hot, intermediate, and cold) are less than or equal to 1 hour

(7) Has all startup times plus notification times less than or equal to the difference between the call on time and commitment decision time of the CAP_RES_COM_AP

$\text{Startup Time}_{\text{Type}} + \text{Notification Time}_{\text{Type}} <= \text{Call On Time} –$ CAP_RES_COM_AP

ii. For evaluating potential Capacity Resources that could have replaced VLR Commitments made in the Day-Ahead Energy and Operating Reserve Market:

(1) Economically available in the Day-Ahead Energy and Operating Reserve Market for each Hour of the CAP_RES_COM_AP

(2) Does not have a commitment for any Hour in the Operating Day

(3) The Day-Ahead Hourly Economic Maximum Limit (DA_ECO_MAX) of the potential Capacity Resource (CAP_MAX) is similar to the DA_ECO_MAX of the VLR Committed Resource (VLR_MAX) for the CAP_RES_COM_AP

CAP_MAX > MAX ( 50% × VLR_MAX, VLR_MAX – 50 MW ) **AND** CAP_MAX < MIN (150% × VLR_MAX, VLR_MAX + 50 MW)

(4) Has a Maximum Runtime greater than or equal to the number of hours in the CAP_RES_COM_AP

(5) Has a Minimum Runtime less than or equal to the number of hours in the CAP_RES_COM_AP

(6) Has all startup times plus notification times (hot, intermediate, and cold) less than or equal to the difference between the call on time and the time of posting of the Day-Ahead Schedules.

Startup TimeType + Notification TimeType <= Call On Time – Posting of the DA Schedules Time

c. The Capacity Commitment Cost (CAP_COM_COST) for each potential Resource is calculated for the CAP_RES_COM_AP. The CAP_COM_COST is equal to the cold startup cost plus No Load Cost plus Incremental Energy Cost up to the Capacity Resource hourly:

i. Real-Time Hourly Economic Minimum Limit (CAP_MIN), for VLR Commitments made in the Real-Time Energy and Operating Reserve

Market during the CAP_RES_COM_AP; or

ii. Day-Ahead Hourly Economic Minimum Limit (CAP_MIN), for VLR Commitments made in the Day-Ahead Energy and Operating Reserve Market during the CAP_RES_COM_AP.

$CAP\_COM\_COST_{CAP\_RES\_COM\_AP} = [\text{ Cold StartupCost} + \sum_{CAP\_RES\_COM\_AP} (\text{ NoLoadCost} + \sum_{0}^{CAP\_MIN} \text{IncrementalEnergyCost }) ]$

d. To determine the cost per unit of Capacity, the CAP_COM_COST are then divided by the sum of:

i. the Real-Time Hourly Economic Maximum Limits (ECO_MAX), for VLR Commitments made in the Real-Time Energy and Operating Reserve Market for the CAP_RES_COM_AP; or

ii. the Day-Ahead Hourly Economic Maximum Limits (ECO_MAX), for VLR Commitments made in the Day-Ahead Energy and Operating Reserve Market for the CAP_RES_COM_AP.

$CAP\_COM\_COST_{MW} = CAP\_COM\_COST / \sum_{CAP\_RES\_COM\_AP} ECO\_MAX$

e. The Resource with the smallest CAP_COM_COST per MW of Capacity is selected as the VLR Replacement Resource (VLR_RR). The Capacity Commitment MWP (CAP_COM_MWP) for the VLR_RR is calculated for the CAP_RES_COM_AP, for both the Incremental Energy Cost and the revenue, using:

i. the Real-Time Hourly Economic Minimum Limit, for VLR_RR resulting from VLR Commitments made in the Real-Time Energy and Operating Reserve Market; or

ii. the Day-Ahead Hourly Economic Minimum Limit, for VLR_RR resulting from VLR Commitments made in the Day-Ahead Energy and Operating Reserve Market.

To calculate the revenue;

i. the Hourly Ex Post LMP (LMP) will be used for VLR_RR resulting from VLR Commitments made in the Real-Time Energy and Operating Reserve Market; and

ii. the Day-Ahead LMP (LMP) will be used for VLR_RR resulting from VLR Commitments made in the Day-Ahead Energy and Operating

Reserve Market.

$$CAP\_COM\_MWP = MAX\ [\ CAP\_COM\_COST - \sum_{CAP\_RES\_COM\_AP} (\ CAP\_MIN * LMP\ )\ ,\ 0\ ]$$

4. Step Four: VLR Allocation Ratio Calculation

a. For each Hour, the Capacity Commitment Need (CAP_COM_NEED) and VLR Replacement Resource (VLR_RR) are used to determine the Capacity Contribution (CAP_CON) and VLR Contribution (VLR_CON). For any Hour where the CAP_COM_NEED = 0 the VLR_CON is equal to the VLR_RES_MWP. For any Hour where the CAP_COM_NEED = 1 and a VLR_RR does not exist, the CAP_CON is equal to the VLR_RES_MWP. In any Hour where the CAP_COM_NEED = 1 and the VLR_RR exists, , the CAP_CON is equal to the lesser of the VLR_RES_MWP or CAP_COM_MWP and the VLR_CON is equal to the positive difference between the VLR_RES_MWP and the CAP_COM_MWP.

**IF** CAP_COM_NEED = 0
**THEN** VLR_CON = VLR_RES_MWP
**ELSE IF** CAP_CON_NEED = 1 AND VLR_RR **NOT EXIST**
**THEN** CAP_CON = VLR_RES_MWP
**ELSE** CAP_CON = MIN ( VLR_RES_MWP , CAP_COM_MWP )
VLR_CON = MAX ( VLR_RES_MWP – CAP_COM_MWP , 0 )
**END IF**

b. For the allocation study time period, the amount attributable to VLR Commitment (*i.e.*, the VLR Allocation Ratio) is equal to the total VLR_CON divided by the sum of the total VLR_CON plus the CAP_CON.

$$\text{VLR Allocation Ratio} = \sum_{\text{Transmission Provider}} VLR\_CON\ /\ (\sum_{\text{Transmission Provider}} VLR\_CON + \sum_{\text{Transmission Provider}} CAP\_CON\ )$$

**B. Commercially Significant VLR Issue Study**

VLR Commitments will be studied yearly and quarterly using the data from the prior twelve months in order to determine if a new Commercially Significant VLR Issue has developed or if a previously designated Commercially Significant VLR Issue is no longer commercially significant. Local Balancing Authorities (LBAs) and other interested parties can request reoccurring VLR Commitments be studied to determine if they meet the criteria of a Commercially Significant VLR Issue and those requests will be handled as part of the quarterly study process. The study shall be completed in eight steps. Step one shall collect the VLR Commitments for the given study period. The second step shall determine the occurrence frequency and monetary impact for each VLR Issue. Step three shall identify the Commercially Significant VLR Issues. The fourth step shall add the Commercial Significance designation. Step five shall notify Transmission Provider Real-Time operations a VLR Issue has been designated as a Commercially Significant VLR Issue and allows for an interface to be built to support the issue. The sixth step shall determine the Load Commercial Pricing Nodes impacted by each Commercially Significant VLR Issue based on the identified Elemental Nodes. Step seven shall calculate the LBA share for each Commercially Significant Issue. The eighth step shall allow for the posting of the results of the study.

1. Step One: Collect VLR Commitments

    a. The VLR Commitments, as determined in step one of the Voltage and Local Reliability Allocation Ratio Study shall be used to conduct this study.

    b. The Transmission Provider shall provide a unique VLR Issue name for all VLR Commitments which will be used to evaluate the significance of a group of VLR Commitments.

2. Step Two: Determine Occurrence Frequency and Monetary Impact per VLR Issue

    a. The occurrence frequency will be determined by counting the number of days for which Resources were committed to relieve a specific VLR Issue using the compiled VLR Commitment data.

    b. DA and RT RSG MWPs paid to Resources called on to relieve a VLR Issue will be summed per VLR Issue. This will be used to determine the monetary impact of a VLR Issue.

3. Step Three: Identify the Commercially Significant VLR Issues

    a. The number of days for which a VLR Issue has a Resource committed to relieve the VLR Issue exceeds 90 days in a year or 15 days in 2 out of 4 quarters of the year; or

    b. The sum of DA and RT RSG MWPs paid to Resources to relieve a VLR Issue exceeds $800,000 in a year or $200,000 in 2 out of 4 quarters of the year.

    c. An LBA or an interested Market Participant may request a VLR Issue be evaluated for designation as commercially significant. All VLR Issues must meet the established criteria in order to be designated as a Commercially Significant VLR Issue.

4. Step Four: Add Commercial Significance

    a. VLR Issues that meet the established criteria will be considered Commercially Significant VLR Issues.

    b. Each Commercially Significant VLR Issue will retain the Commercially Significant designation indefinitely and will continue to be studied.

5. Step Five: Build an Interface Constraint

    a. The Transmission Provider shall determine the Elemental Nodes that impact a voltage or local reliability constraint by developing an Interface constraint that best represents the most limiting constraint for the Commercially Significant VLR Issue.

    b. The Interface constraint will be established by using online and offline operational studies to examine the cause of the Commercially Significant VLR Issue and identify the load and generation that are impacted by the Interface constraint.

    c. Once the Interface is determined, the interface will be built into the Transmission Provider Energy Management System model during the quarterly model update process.

6. Step Six: Determine the Impacted Load Commercial Pricing Nodes

    a. Prior to the last business day of the month prior to a Commercial Model update, the Transmission Provider shall activate the interface constraint in an offline copy of the production environment using a base case of the upcoming quarterly Energy Management System model.

b. A list of all elemental Nodes impacted by the Interface will be prepared based on the resultant Generation Shift Factors for each elemental Node.

c. The elemental Nodes will be used to identify the Elemental Pricing Nodes (EP Nodes). Using the Daily Load Weighting Factor (DLWF) for the EP Nodes, the Yearly Average Load Weighting Factor (YR_AVG_FCT) will be calculated for the Study Period (SP).

   i. The DLWF is calculated daily based on the prior seven days of State Estimator data. The YR_AVG_FCT will then be summed for all EP Nodes associated with a given Commercial Pricing Node (CP Node) and LBA to determine the CP Node-LBA Load Factor (CPL_FCT). The YR_AVG_FCT of a given EP Node is assigned to the LBA that physically includes the identified EP Node.

   $$\text{YR\_AVG\_FCT}_{\text{EP NODE}} = \sum \text{DLWF}_{\text{EP NODE}} \times (1/\text{ Days in the Year})$$

   $$\text{CPL\_FCT}_{\text{CP NODE-LBA}} = \sum \text{YR\_AVG\_FCT}_{\text{EP NODE}}$$

7. Step Seven: Calculate the LBA Shares

a. The Yearly Average Monthly Peak (YAM_PEAK) will be calculated for each CP Node impacted by the Commercially Significant VLR Issue (*i.e.*, non-zero CPL_FCT(s)), based on the Actual Energy Withdrawals (AEW) for each CP Node.

   i. For each Month, the monthly peak will be equal to the maximum hourly Actual Energy Withdrawal value during that Month.

   $$\text{Monthly\_PEAK}_{\text{CP NODE}} = \text{MAX(AEW, 0)}$$

   ii. The YAM_PEAK will be equal to the average of the monthly peak values.

   $$\text{YAM\_PEAK}_{\text{CP NODE}} = \sum \text{Monthly\_PEAK}_{\text{CP NODE}} \times (1/12)$$

b. For each CP Node-LBA, the YAM_PEAK is multiplied by the CPL_FCT to calculate an Adjusted Load Volume (ADJ_LD_VOL). The ADJ_LD_VOL is summed by LBA for the CP Nodes in that LBA(CP Node-LBA).

$$\text{ADJ\_LD\_VOL}_{\text{CP NODE-LBA}} = \text{YAM\_PEAK} * \text{CPL\_FCT\_}_{\text{CP NODE-LBA}}$$

$$ADJ\_LD\_VOL_{LBA} = \sum ADJ\_LD\_VOL_{CP\ NODE\text{-}LBA}$$

c. An LBA's percentage Share (LBA_SHARE) for a given Commercially Significant VLR Issue is equal to the ADJ_LD_VOL for that LBA divided by the total ADJ_LD_VOL for all LBAs impacted by the Commercially Significant VLR Issue.

$$LBA\ \_SHARE_{VLR\ ISSUE} = ADJ\_LD\_VOL_{LBA} \ / \sum ADJ\_LD\_VOL_{LBA}$$

8. Step Eight: Post the Results

a. The Transmission Provider shall publicly post a list of the Commercially Significant VLR Issues along with each LBA's corresponding LBA share.

**C. Participation in Studies**

LBAs and interested Market Participants may participate in the above studies and request that reoccurring VLR Commitments be studied. Each study involves the use of Confidential Information, potentially also including Critical Energy Infrastructure Information (CEII), but subject to the execution of appropriate non-disclosure agreements, an LBA or interested Market Participant may be granted access to the study's assumptions and outputs, to the extent necessary to verify MISO's VLR calculations pertaining to the charges of an LBA or Market Participant. The Transmission Provider will conduct at least one stakeholder meeting per study period regarding VLR Issues that meet the Commercially Significant VLR Issue criteria described in Step 3.