3. Overview of Market Instruments

3.2 Ancillary Services Bids

Four types of Ancillary Services are used by CAISO in its markets – Regulation Up, Regulation Down, Spinning Reserve, and Non-Spinning Reserve. For Metered Sub-Systems (MSS) Load Following Up/Down is also handled through submission of Bids for Ancillary Service. Participating Generators and Dynamic System Resources are eligible to provide all Ancillary Services for which they are certified. Certified Non-Dynamic System Resources are eligible to provide Operating Reserves (Spinning Reserves and Non-Spinning Reserves) only\(^1\). Registered Proxy Demand Resources and Certified Participating Loads are only eligible to provide Non-Spinning Reserve.

SCs that wish to provide Ancillary Services to CAISO may either submit Ancillary Services Bids or Self-Provide Ancillary Services. A Bid to supply Ancillary Services specifies prices for MW amounts \(\text{(or in the case of Regulation Up and Down, prices for both Capacity and Mileage)}\) of each Ancillary Service to be supplied. However, there is no quantity in a Mileage bid, only price. A Submission to Self-Provide Ancillary Services is not a Bid. CAISO’s acceptance of Self-Provided Ancillary Services occur prior to Ancillary Service Bid evaluation in the relevant market.

SCs submit Bids for AS in both the DAM and the RTM. Bids for AS in the RTM are submitted incrementally from any DAM AS Awards. DAM AS Awards are binding commitments and cannot be reduced in RTM (with the exception of a reduction in available capacity as notified through SLIC).

Any Self-Provided AS are used to reduce the AS Obligation for the SC that Self-Provided those AS. Details of this are provided in the \textit{BPM for Settlements and Billing}.

Any Self-provided AS in excess of an SC’s Obligation are credited at the user rate for the respective AS. The \textit{BPM for Market Operations} specifies how the market prices for AS is determined.

The bidding rules for Ancillary Services are described in detail in Section 6 (Ancillary Services Bids).

6. Ancillary Services Bids

Welcome to the \textit{Ancillary Services Bids} section of the CAISO BPM for Market Instruments. In this section you will find the following information:

How CAISO procures Ancillary Services

\(^1\) Dynamic Resource-Specific System Resources are identified generating resources located outside of the CAISO Balancing Authority Area that can be dynamically controlled to maintain the frequency and net Interchange of the CAISO Balancing Authority Area. These Dynamic Resource Specific System Resources may be certified to supply Regulation Up and Regulation Down to the CAISO. A Non-Dynamic Resource-Specific System Resource is an identified generating resource located outside of the CAISO Balancing Authority Area that cannot be dynamically controlled. Dynamic and Non-Dynamic System Resources are System Resources which are not tied to specific generating resources, and which are subject to dynamic control (Dynamic System Resources) or not subject to dynamic control (Non-Dynamic System Resources).
How SCs can self-provide Ancillary Services

A description of the Ancillary Services Bid components

6.1 Procurement of Ancillary Services

This section is based on CAISO Tariff Sections 8.4.7.2, Bidding and Self-Provision of Ancillary Services and CAISO Tariff Section 30.5.2.6, Ancillary Services Bids (Not applicable for Virtual Bids).

SCs may submit an Economic Bid or a Bid for Self-Provided Ancillary Services (AS) from resources located within the CAISO Balancing Authority Area, submit Bids for AS from resources located outside CAISO Balancing Authority Area, or specify Inter-SC Trades of AS (covered in more detail in Section 9.2.) Ancillary Services in the DAM and the RTM are comprised of the following:

- Regulation Up, which must be synchronized and able to receive AGC signals
- Regulation Down, which must be synchronized and able to receive AGC signals
- Spinning Reserve (which must be synchronized, be available in 10 minutes, and be maintainable for two hours)
- Non-Spinning Reserve (which must be supplied within 10 minutes and be maintainable for two hours)

In HASP, only Operating Reserves (Spinning and Non-Spinning Reserves) are available.

Certified Participating Generators and Dynamic System Resources are eligible to provide all AS. Certified Non-Dynamic System Resources are eligible to provide Operating Reserves only. Certified Participating Loads and Proxy Demand Resources are eligible to provide Non-Spinning Reserve only.

The same resource capacity may be offered for more than one Ancillary Services into the same CAISO Market at the same time. SCs may submit Bids to provide Spinning Reserve or Non-Spinning Reserve from certified System Resources, including Dynamic System Resources. In the event that an AS Bid is invalid, the SC receives prompt notification of that invalidity.

CAISO operates a competitive DAM, the HASP, and RTM to procure AS. Bids for Regulation Up, Regulation Down, Spinning Reserve, and Non-Spinning Reserve in the DAM must be received no sooner than seven days prior to the Trading Day up to Market Close of the DAM (1000 hours on the day prior to the Trading Day). The Bids contain information for each of the 24 hour Trading Hours of the Trading Day.

Bids for DAM AS in support of Ancillary Services (AS) with Must Offer Obligation (MOO) will be enforced by the SIBR Rules in the DAM. The CAISO will utilize the certified AS capability of those RA Resources that are subject to AS MOO. Use Limited Resources such as hydro generating units and participating load resources will not be subject to AS MOO. The AS MOO is not dependent on whether the RA Capacity is subject to the Standard Capacity Product availability provisions.

In SIBR, if there is no AS Component in a Generating Resource Bid and the Generating Resource or a resource modeled as a Generating Resource specified in that Bid is registered as an RA Resource subject to the AS MOO for the Trading Day, if the resource is a Multi-Stage Generating Resource the
AS capacity is at the MSG Configuration that is bid in and each MSG Configuration has a specific AS Capacity certified to provide AS. An AS Bid Component must be generated with a Capacity equal to the highest available capacity not to exceed the registered Capacity. When Resource and Trading Day, and with a Price equal to the Default Ancillary Service Bid Price. The Contingency Dispatch Indicator in that Bid will be set to “Yes.” It is possible that if an AS component does exist, it may be extended if needed to meet the requirements. (Tariff Sections 40.6.1, 40.46.4, 40.6.4.3.2, 40.6.8)

Bids for AS in the RTM are submitted incrementally from any DAM AS Awards. DAM AS Awards are binding commitments and cannot be reduced in RTM. CAISO requires SCs to honor their DA AS Awards when submitting AS Bids in the RTM.

Bids for all four AS in the RTM processes must be received at least 75 minutes prior to the commencement of the Trading Hour. The Bids include information for only the relevant Trading Hour. Failure to provide information within the stated timeframes results in the Bids being declared invalid by CAISO.

Scheduling Coordinators submitting Ancillary Services Bids for System Resources to be used in the HASP or Real-Time Market must also submit an Energy Bid for the associated Ancillary Services Bid under the same Resource ID in the Real-Time Market. Otherwise, the bid validation rules in Section 30.7.6.1 of the CAISO Tariff will apply to cover any portion of the Ancillary Services Bid not accompanied by an Energy Bid. As described in Section 33.7 of the CAISO Tariff, if the resource is a Non-Dynamic Hourly System Resource, the CAISO will only use the Ancillary Services Bid in the HASP optimization and will not use the associated Energy Bid for the same Resource ID to schedule Energy from the Non-Dynamic Hourly System Resource in the HASP.

Scheduling Coordinators must also comply with the bidding rules associated with the must offer requirements for Ancillary Services specified in Section 40.6 of the CAISO Tariff. For Multi-Stage Generating Resources, the AS Bids shall be submitted at the MSG Configuration level.

### 6.2 Self Provided Ancillary Services

This section is based on CAISO Tariff Section 8.6, Obligations for and Self-Provision of Ancillary Services, and CAISO Tariff Section 30.5.2.6, Ancillary Services Bids.

SCs with submissions to self-provide an Ancillary Service supply all the same information as an AS Economic Bid, excluding the capacity price information for each AS offered by the SC.

**Resources that self-provide Regulation Up and Regulation Down do not explicitly self-provide Mileage. Instead, the system will insert a $0 Mileage bid covering the minimum Mileage associated with the self-provided Regulation Up or Down capacity (i.e. resource-specific minimum Mileage multiplier x Regulation capacity).**

Scheduling Coordinator must submit an Energy Bid that covers the self-provided capacity prior to the close of the Real-Time Market for the day immediately following the Day-Ahead Market in which the Ancillary Service Bid was submitted.
In addition, resources that have registered with a Metered Subsystem (MSS) that has elected the Load Following option may submit Self-Provision Bids for Load Following Up and Load Following Down.

NGRs may not self-provide Ancillary Services.

6.2.1 Load Following Up

The specific Load Following Up Bid components are the following:

Load Following Up capacity, expressed in MW.

6.2.2 Load Following Down

The specific Load Following Down Bid components are the following:

Load Following Down capacity, expressed in MW.

6.3 Ancillary Service Bid Components

This section is based on CAISO Tariff Section 30.5.2.6, Ancillary Services Bids.

The Bids for Ancillary Services contain both common components and components that are specific to each service. The same Bid components are included for both DAM and RTM Bids for AS, where the DAM includes information for each Trading Hour of the Trading Day and the RTM includes information for just the relevant Trading Hour.

The common components to the AS Bids are described in the Energy Bid component above in Section 5 (Energy Bids).

The following sections describe the specific Bid components for each type of AS.

6.3.1 Regulation Up

The specific Regulation Up Bid components are the following:

- Regulation Up capacity, expressed in MW
- Regulation Up capacity price, expressed as $/MW
- Regulation Up opportunity cost price, expressed in $/MW (optional, CAISO assumes zero if not submitted).
- Regulation Ramp Rate, expressed in MW/Min
- Regulation Up Mileage price, expressed in $/MW (CAISO will insert zero if not submitted).

Note, the resource does not bid in a specific Mileage quantity. The potential Mileage award is constrained by the product of the resource-specific minimum/maximum Mileage multiplier and the corresponding regulation capacity award. Refer to the BPM for Market Operations for more information.
6.3.2 **Regulation Down**

The specific Regulation Down Bid components are the following:

- Regulation Down capacity, expressed in MW
- Regulation Down capacity price, expressed as $/MW
- Regulation Up opportunity cost price, expressed in $/MW (optional, CAISO assumes zero if not submitted)
- Regulation Ramp Rate, expressed in MW/Min
- Regulation Down Mileage price, expressed in $/MW (CAISO will insert zero if not submitted).

6.3.3 **Spinning Reserve Capacity**

The specific Spinning Reserve Bid components are the following:

- Spinning Reserve capacity, expressed in MW
- Spinning Reserve price, expressed as $/MW
- Operating Reserve Ramp Rate, expressed in MW/Min

6.3.4 **Non-Spinning Reserve Capacity**

The specific Non-Spinning Reserve Bid components are the following:

- For Generating Units: (also Proxy Demand Resources)
  - Non-Spinning Reserve capacity, expressed in MW
  - Non-Spinning Reserve price, expressed as $/MW
  - Operating Reserve Ramp Rate, expressed in MW/Min
  - Contingency Dispatch Indicator

- For Participating Loads:
  - Non-Spinning Reserve capacity, expressed in MW
  - Non-Spinning Reserve price, expressed as $/MW
  - Operating Reserve Ramp Rate, expressed in MW/Min
  - Contingency Dispatch Indicator

10. **Reporting Information**

Welcome to the Reporting Information section of CAISO BPM for Market Instruments. In this section you will find the following information:

- A description of the reports that are available to SCs
### 10.1 Scope of CMRI Reports available to SCs

Exhibit 10.1 summarizes the reports that are available to SCs through the CAISO Market Results Interface (CMRI). Details of the report contents are provided in subsequent sections.

#### Exhibit 10-1.1: Summary of CMRI Reports

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<tr>
<td>Day-Ahead Generation Market Results</td>
<td>Day-Ahead Energy Schedules, Ancillary Services Awards, Load Following and RUC Capacity for Generating Units</td>
</tr>
<tr>
<td>Day-Ahead Demand Market Results</td>
<td>Day-Ahead Energy Schedules and Ancillary Services Awards of Participating Loads and Day-Ahead Energy Schedules for Non-Participating Loads</td>
</tr>
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</table>
| Day-Ahead Residual Unit Commitment (RUC) Capacity | RUC Capacity and RUC Awards from the Residual Unit Commitment process. **Posted hourly, the following values:**  
  - Capacity (total RUC capacity) – this is the positive difference between the RUC Schedule and the greater of the Day-Ahead Schedule and the Minimum Load level of a resource.  
  - Award (RUC Award portion) – this is the portion of the RUC capacity from resources eligible to receive RUC Availability Payments. |
<p>| Day-Ahead Import/Export Schedules | Day-Ahead Energy Schedules and Ancillary Services Awards at Intertie Scheduling Points |
| Day-Ahead Start-Up Instructions | Start-Up instructions resulting from the RUC process |
| Day-Ahead Ancillary Service Market Results | Resource-specific Ancillary Service Awards resulting from the Integrated Forward Market run |
| Day-Ahead Market Power Mitigation (MPM) Results | Segments of the “new” or mitigated Bid as a result of the Day-Ahead Market Power Mitigation Process (MPM) |
| Real-Time Market Power Mitigation (MPM) Results | Segments of the “new” or mitigated Bid as a result of the Real-Time Market Power Mitigation Process (MPM) |
| Default Energy Bid Curves | Independent Entity-supplied default Bid Curve data used in the Market Power Mitigation process |
| Day-Ahead Generation Commodity Prices | Day-Ahead resource-specific prices (for Energy Schedules, Ancillary Services Awards, RUC Awards) of Generating Units |
| Day-Ahead Demand Commodity Prices | Day-Ahead resource-specific prices for Energy Schedules and Ancillary Services Awards of Participating Loads; and resource-specific prices for Energy Schedules of Non-Participating Loads |
| Hour Ahead Scheduling Process (HASP) Schedules | Displays Hour-Ahead Scheduling Process results for the next Trading Hour. Posts the HASP Binding results relevant to Hourly Pre-Dispatched Resources. Posts HASP Advisory results relevant to the Non-Hourly Pre-Dispatch Resources. |
| Hour Ahead Scheduling Process (HASP) Schedule Prices | Displays Hour-Ahead Scheduling Process resource-specific prices for the next Trading Hour. Posts the HASP Binding results relevant to Hourly Pre-Dispatched Resources. Posts HASP Advisory results relevant to the Non-Hourly Pre-Dispatch Resources. |</p>
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<tr>
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<tr>
<td>Real-Time Unit Commitment (RTUC) Schedules</td>
<td>Displays RTUC results for the next 15-minute interval. RTUC schedules cover real time Ancillary Services Awards.</td>
</tr>
<tr>
<td>Real-Time Unit Commitment (RTUC) Schedule Prices</td>
<td>Displays RTUC resource-specific prices for the next 15-minute interval. Covers prices for Ancillary Services Awards.</td>
</tr>
<tr>
<td>Day Ahead Finally Qualified Load Following Capacity</td>
<td>Day-Ahead Finally Qualified Load Following Up and Down Capacity for Metered Subsystems (MSS) resources</td>
</tr>
<tr>
<td>Day-Ahead Unit Commitments</td>
<td>Resources that are self-committed or CAISO committed by the IFM or RUC process in the Day-Ahead Market</td>
</tr>
<tr>
<td>Default RMR Minimum Load &amp; Startup Cost Bid Curves</td>
<td>Displays the default minimum load and startup cost bid curves that will used for the Market Power Mitigation (MPM) Process. This information originates from an independent entity and applies to RMR units only.</td>
</tr>
<tr>
<td>Day-Ahead Import-Export Commodity Prices</td>
<td>Day-Ahead resource-specific prices (for Energy Schedules, Ancillary Services Awards, RUC Awards) of System Resources</td>
</tr>
<tr>
<td>Extremely Long Start Resource Startup Instructions</td>
<td>Startup instructions resulting from the Extremely Long Start Commitment (ELC) process. This report is not currently active.</td>
</tr>
<tr>
<td>Day-Ahead Reliability Must Run (RMR) Dispatches</td>
<td>RMR units that either have an Energy Schedule (from the IFM run) that is flagged as an RMR Dispatch and/or a Manual RMR Dispatch</td>
</tr>
<tr>
<td>Expected Energy Allocation Details</td>
<td>Displays the post-market Expected Energy results from the energy accounting process. Expected Energy is the sum total of all DA and RT market awards, Exceptional Dispatches and any other Dispatch Instructions, taking into account physical limitations (SLIC), disaggregated into their Settlement components.</td>
</tr>
<tr>
<td>Conformed Dispatch Notice (CDN)</td>
<td>Summary of the Day-Ahead and Real-Time Energy Schedules, Ancillary Service Awards, RMR Dispatches, Competitive Constraint Run results of RMR resources</td>
</tr>
<tr>
<td>Expected Energy</td>
<td>Post-market or after-the-fact energy accounting results for Settlement calculations. This report will contain the Total Expected Energy for Day Ahead, Real Time, Instructed and Total energy.</td>
</tr>
<tr>
<td>CAISO Commitment Cost Details</td>
<td>Includes Commitment Flags and Commitment Cost to validate the Bid Cost Recovery charge in Settlements</td>
</tr>
<tr>
<td>CRN</td>
<td>Reports the MW breakdown and CRN number market results for ETC/TOR Self-Schedules in the DAM and the RTM. These MWs breakdown are inputs used in the ETC/TOR balancing rights, and are not the final ETC/TOR balancing rights. RTM CRN reporting includes ETC/TOR schedule changes after the close of the RTM. Note: This report has limited functionality, and is only available in the GUI. The same results are posted to the CAISO SFTP site for downloading. Access to the CRN data through the SFTP site is managed through the AARF (Application Account Request Form) process.</td>
</tr>
<tr>
<td>Real-Time Pre-Dispatch (RTPD) Flexible Ramping Constraint Capacity</td>
<td>Reports the amount of upward ramping MW quantity of Flexible Ramping Constraint capacity awarded for each resource.</td>
</tr>
</tbody>
</table>
Convergence Bidding Reports

The following four Convergence Bidding reports are available through the CAISO Market Results Interface (CMRI). Reports 4.2, 4.3 and 4.4 are associated with the CRR Adjustment Settlement Rule. For additional details on the CRR Adjustment Settlement Rule, please see the BPM for Market Operations, Appendix F.

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<td>Day Ahead Convergence Bidding Awards</td>
<td>Displays the market Virtual Bidding supply and demand awards that were cleared in the day-ahead market for energy</td>
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<tr>
<td>Hourly Prices due to Convergence Bidding for CRR Adjustment Report</td>
<td>Displays the hourly prices that CAISO uses to calculate Congestion Revenue Rights (CRR) adjustments due to Virtual Bidding.</td>
</tr>
<tr>
<td>Binding Transmission Constraints due to Convergence Bidding for CRR Adjustment Report</td>
<td>Displays supporting data for settlement charges imposed on scheduling coordinators, as a result of the application of the CRR settlement rule - specifically CRR flow impact on award locations for each scheduling coordinator.</td>
</tr>
<tr>
<td>Flow Impact due to Convergence Bidding for CRR Adjustment Report</td>
<td>Displays supporting data for settlement charges imposed on scheduling coordinators, as a result of the application of the CRR settlement rule – specifically CRR flow impact aggregated by Entity, where the Entity is a Convergence Bidding Entity name that coincides with a CRR Holder.</td>
</tr>
</tbody>
</table>

12. Public Market Information

Welcome to the Public Market Information section of CAISO BPM for Market Instruments. These reports are based on the requirements detailed in the CAISO Tariff Section 6.5, CAISO Communications.

In this section you will find the following information:

List of Report Tabs provided on the CAISO OASIS site. (http://oasis.caiso.com)

Content of the reports included under those Report Tabs

Interface Specifications regarding the downloading of the OASIS data through an API can be found at:

http://caiso.com/235f/235fcbd556310.html

CAISO provides the following reports groups through OASIS listed by the Tab name as they appear on the CAISO OASIS web site:
12.1 Prices

CAISO provides information on prices to the public through the OASIS web page. The Price reports contain the following information:

**Locational Marginal Prices (LMP)** – Posts Hourly Locational Marginal Prices for all PNodes, APNodes and Scheduling Points in $/MWh, for the DAM and RUC market processes. Data fields are as follows:

LMP
- LMP Marginal Cost of Energy (MCE)
- LMP Marginal Cost of Congestion (MCC)
- LMP Marginal Cost of Losses (MCL)

Note: For the RUC prices, only the RUC price is posted. The three-component LMP breakdown is not applicable for RUC pricing.

**HASP Locational Marginal Prices (LMP)** – Posts hourly, the 4 15-minute Locational Marginal Prices in $/MWh, for the HASP hour. Posts the LMP, plus the Congestion, Loss and Energy Components that make up the LMP.

- Posts the HASP Binding LMP for PNodes and APNodes relevant to Hourly Pre-Dispatched Resources.
- Posts the HASP Advisory LMP for PNodes and APnodes relevant to the Non-Hourly Pre-Dispatch Resources.

Data fields are as follows:

LMP
- LMP Marginal Cost of Energy (MCE)
- LMP Marginal Cost of Congestion (MCC)
- LMP Marginal Cost of Losses (MCL)

**Interval Locational Marginal Prices (LMP)** – Posts the five-minute Locational Marginal Prices for PNodes and APNodes in $/MWh, for each five-minute interval Real-Time Economic Dispatch (RTED). Data fields are as follows:

LMP
- LMP Marginal Cost of Energy (MCE)
- LMP Marginal Cost of Congestion (MCC)
- LMP Marginal Cost of Losses (MCL)

**Contingency Dispatch Locational Marginal Prices (LMP)** – Similar to the Interval Locational Marginal Prices (LMP) report, but for Real Time Contingency Dispatch (RTCD) runs. Posts the ten-minute Locational Marginal Prices for PNodes and APNodes in $/MWh, for each ten-minute interval RTCD. Data fields are as follows:

LMP
- LMP Marginal Cost of Energy (MCE)
- LMP Marginal Cost of Congestion (MCC)
- LMP Marginal Cost of Losses (MCL)

**AS Clearing Prices** – Posts the Ancillary Services Marginal Price (ASMP) for all Ancillary Service types for all binding AS Regions. Posted hourly in $/MW for the DAM.

DAM - Hourly ASMP ($/MW)

**Interval AS Clearing Prices - Ancillary** Services Marginal Price (ASMP) for all Ancillary Service types for all binding AS Regions. Posts 15-Minute price relevant to the next 15 minute binding interval for RTM on a fifteen minute basis.

RTM - 15Min Binding ASMP ($/MW)

**Intertie Constraint Shadow Prices** – Posts the hourly constraint pricing at each Intertie-based Transmission Interface And Intertie Constraint, for each Market Process (DAM, HASP) in $/MWh, and the 15-Minute Shadow Price in $/MWh for the RTPD in RTM. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Nomogram/Branch Shadow Prices** – Posts the hourly constraint pricing at each binding Nomogram and Branch, for each Market Process (DAM, HASP) in $/MWh, and the 15-Minute Shadow Price in $/MWh for the RTPD in RTM. Report will also include an indication of whether...
the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Fuel Prices** – For each Gas Flow Day, lists the gas price in $/mmBTU by fuel region.

**Current Locational Marginal Price** – This report is available for download only. Five minute Locational Marginal Prices for all PNodes and APNodes for the current interval. (Returns the most recently posted interval only) This download is provided to allow Oasis users to quickly receive the most current LMP without any prior intervals included in the payload.

**Interval Intertie Constraint Shadow Prices** – Posts the 5-Minute constraint pricing at Transmission Interfaces and Intertie Constraints in $/MWh, for the RTD run in the RTM. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Contingency Dispatch Intertie Constraint Shadow Prices** – Similar to the Interval Intertie Constraint Shadow Prices report, but for Real Time Contingency Dispatch (RTCD) runs. Posts the 10-Minute constraint pricing at Transmission Interfaces and Intertie Constraints in $/MWh, for the RTCD run in the RTM. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Interval Nomogram/Branch Shadow Prices** - Posts the 5-Minute constraint pricing at each Nomogram and Branch in $/MWh, for the RTD run in the RTM. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Contingency Dispatch Nomogram/Branch Shadow Prices** - Similar to the Interval Nomogram/Branch Shadow Prices report, but for Real Time Contingency Dispatch (RTCD) runs. Posts the 10-Minute constraint pricing at each Nomogram and Branch in $/MWh, for the RTCD run in the RTM. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**Reference Prices** – Posts Quarterly Reference prices associated with each Virtual Bidding PNode and APNode for supply and demand.

**Nodal Group Constraints Shadow Prices** - This report displays the upper and lower MW limits, cleared MW value and associated hourly shadow prices for any binding Nodal Group Constraint. This report is triggered with the publication of the Day-Ahead results.

**Flexible Ramping Constraint Results** – Posts the following values for RTPD and RTD market runs, for intervals when the Flexible Ramping Constraint is enforced.

- **Ramp Up Capacity (MW)** - The required amount of total un-loaded capacity below maximum operating limits (that can be dispatched up) of the ramp-limited resources that is retained through the market optimization. The Flexible Ramping Constraint is enforced on a system level per market run and market interval.
**Ramp Up Shadow Price ($/MW)** - Shadow price of the ramping up constraint when binding in the relevant market run and in the binding market interval. Binding interval shadow price is the Ramp Up Shadow Price when “Market Run DateTime” = “Market Interval StartDateTime” or when “MKT_RUN_START_TIME” = “INT_START_TIME”.

Payment to resources providing the flexi-ramp capacity will be paid based on the following price: For each applicable fifteen-minute RTUC interval, the Flexible Ramping Constraint derived price will be equal to the lesser of: 1) $800/MWh; or 2) the greater of: (a) 0; (b) the Real-time Ancillary Services Marginal Price for Spinning Reserves for the applicable fifteen-minute RTUC interval; or (c) the Flexible Ramping Constraint Shadow Price minus seventy-five percent of the maximum of (i) zero (0); or (ii) the Real-Time System Marginal Energy Cost, calculated as the simple average of the three five-minute Dispatch Interval System Marginal Energy Costs in the applicable fifteen-minute RTUC interval.

The flexi-ramp cost for each binding RTPD interval can be estimated by the amount of procured Ramp Up Capacity multiplied by the price described above in that binding interval. If the flexi-ramping constraint is binding and feasible, the procured Ramp Up Capacity is equal to the flexi-ramping capacity requirement (Ramp Up Capacity or RAMP_UP_CAP_REQ). However, if the flexi-ramping constraint is infeasible, meaning that the RTPD market run is unable to procure the full required flexi-ramping capacity, the procured Ramp Up Capacity would be less than the flexi-ramping capacity requirement. On OASIS, the flexi-ramping capacity requirement not the procured amount is posted.

**MPM DA Locational Marginal Prices (LMP)** – Hourly Locational Marginal Prices from the Day-Ahead MPM run for all PNodes and APNodes associated with market resources with physical bids in $/MWh. Posts the LMP, including the competitive congestion component, non-competitive congestion component, loss and energy components that make up the LMP.

**MPM RT Locational Marginal Prices (LMP)** – Posts hourly, the 4 15-minute Locational Marginal Prices from the HASP MPM run for all PNodes and APNodes associated with market resources with physical bids in $/MWh. Posts the LMP, plus the competitive congestion component, non-competitive congestion component, loss and energy components that make up the LMP.

**MPM Nomogram/Branch Group Shadow Prices** – Posts the hourly constraint pricing at each binding nomogram and branch group, for each market process of the MPM run (DAM, HASP/RTM) in $/MWh. Report will also include an indication of whether the Constraints were binding because of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**MPM Nomogram/Branch Group Competitive Paths** – Posts the hourly results of the dynamic competitive path determination for the Day-Ahead MPM run, for nomograms and branches. Posts a flag indicating whether each binding constraint was competitive or not. For the time being this report covers the Day-Ahead market only. HASP/Real-time MPM uses static competitiveness values which are updated quarterly. See the CAISO.COM website for the latest static competitive path assessment.

**MPM Intertie Constraint Shadow Prices** – Posts the hourly constraint pricing at Transmission Interfaces and Intertie Constraints, for each market process of the MPM run (DAM, HASP/RTM) in $/MWh. Report will also include an indication of whether the Constraints were binding because...
of the base operating conditions or contingencies, and if caused by a Contingency, the identity of the specific Contingency.

**MPM Intertie Constraint Competitive Paths** – Posts the hourly results of the dynamic competitiveness constraint for the Day-Ahead MPM run, for interchanges, market scheduling limits, and branch groups. Posts a flag indicating whether each binding constraint was competitive or not. For the time being this report covers the Day-Ahead market only. Real-time MPM uses static competitiveness values which are updated quarterly. See the CAISO.COM website for the latest static competitive path assessment.

**MPM Reference Bus** – Posts the reference bus used in the MPM run. Posted hourly for the Day-Ahead and HASP markets. Note, the IFM, RUC, and regular HASP runs use a distributed reference bus.

**Greenhouse Gas Allowance Prices** – Posts the index price for the greenhouse gas allowance in $/allowance.

### 12.5 Ancillary Services

The Ancillary Services Report contains the following information:

**AS Requirements** – Lists the Ancillary Service capacity minimum and maximums per AS type, per AS Region, to be procured or self-provided in each Operating Hour. Posts for the 2-DA Forecast, DAM and HASP (RTPD).

- For the 2-DA Forecast, the Maximum requirement for Spin, Non-Spin and Regulation Up will be posted by Upward AS total. The Minimum values will be posted by individual AS product type.

- When encountering a max A/S limit of zero, please interpret this as “no limit” set.

**AS Results** – Ancillary Service Capacity awarded and self-provided, by AS type, posted for each AS Region. Also posts the sum of the procured and self-scheduled. Posts results for the Day-Ahead (DAM), and in 15 Minute (RTPD) intervals, by resource type. Also posts Total AS Cost for each AS Region, by AS Type.

- Results will only post for AS Regions that are binding for that market run.

**Actual Operating Reserves** – Lists total actual Demand, AS, and Operating Reserves maintained during delivery (as a % of Load).
**Instructed Mileage** – Lists average Instructed Mileage (MW) from the prior seven days for each hour of a trading day. Posted daily.