**Appendix A**

**- Charging Constraint**

A constraint that reflects a storage resource’s election not to charge beyond the output of its co-located Variable Energy Resource.

**8.4.1.1 Regulation**

A resource offering Regulation must have the following operating characteristics and technical capabilities:

(a) it must be capable of being controlled and monitored by the CAISO EMS by means of the installation and use of a standard CAISO direct communication and direct control system, a description of which and criteria for any temporary exemption from which, the CAISO shall publish on the CAISO Website;

(b) it must be capable of achieving at least the Ramp Rates (increase and decrease in MW/minute) stated in its Bid for the full amount of Regulation capacity offered;

(c) the Regulation capacity offered must not exceed the maximum Ramp Rate (MW/minute) of that resource times ten (10) minutes;

(d) the resource to CAISO Control Center telemetry must, in a manner meeting CAISO standards, include indications of whether the resource is on or off CAISO EMS control at the resource terminal equipment;

(e) the resource must be capable of the full range of movement within the amount of Regulation capability offered without manual resource operator intervention of any kind;

(f) each Ancillary Service Provider must ensure that its CAISO EMS control and related SCADA equipment for its resource are operational throughout the time period during which Regulation is required to be provided;

(g) Regulation capacity offered must be dispatchable on a continuous basis for at least sixty (60) minutes in the Day-Ahead Market and at least thirty (30) minutes in the Real-Time Market after issuance of the Dispatch Instruction. The CAISO will measure continuous Energy from the time a resource reaches its award capacity. In the Real-Time Market, where a storage resource using the Non-Generator Resource model will not have sufficient State of Charge to meet its Ancillary Services Schedule, the CAISO will dispatch the storage resource to have sufficient State of Charge to meet its Ancillary Services Schedule. Scheduling Coordinators for Non-Generator Resources located within the CAISO Balancing Authority Area that require Energy from the Real-Time Market to offer their full capacity as Regulation may request the use of Regulation Energy Management as described in Section 8.4.1.2. Consistent with the requirements of this Section, the CAISO will use all reasonable efforts to commit, schedule, and dispatch Non-Generator Resources providing Regulation while recognizing the impact of Regulation Awards on their State of Charge in the Day-Ahead and Real-Time Markets; and

(h) Regulation capacity offered must meet or exceed the minimum performance threshold of twenty-five (25) percent measured accuracy as specified in Section 8.2.3.1.1.

### 11.5.6 Settlement Amounts for RTD Instructed Imbalance Energy from Exceptional Dispatch

…

**11.5.6.1 Settlement for FMM Instructed Imbalance Energy or RTD Instructed Imbalance Energy from Exceptional Dispatches used for System Emergency Conditions, for a Market Disruption, to Mitigate Overgeneration or to Prevent or Relieve Imminent System Emergencies**

…

**11.5.6.1.2 Settlement for Instructed Imbalance Energy from Exceptional Dispatches to Storage Resources to Hold State of Charge**

The CAISO will settle storage resources that receive an Exceptional Dispatch to hold a State of Charge pursuant to Sections 11.5.6 and 11.5.6.1 for any FMM Instructed Imbalance Energy or RTD Instructed Imbalance Energy to move to the targeted State of Charge plus the resource’s opportunity cost for holding the State of Charge. The CAISO will calculate this opportunity cost from the first Operating Interval the resource followed the Exceptional Dispatch through the end of the Operating Day. The opportunity cost will equal the difference between the resource’s maximum potential RTM Energy revenues without the Exceptional Dispatch to hold the State of Charge and the resource’s maximum potential RTM revenues with the Exceptional Dispatch to hold State of Charge. The CAISO will calculate the resource’s opportunity costs based on its Master File characteristics, Bids, State of Charge, Day-Ahead Schedules, and the applicable Locational Marginal Prices.

11.8.4 RTM Bid Cost Recovery Amount …

**11.8.4.2 RTM Market Revenue Calculations**

**11.8.4.2.1** For each Settlement Interval in a CAISO Real-Time Market Commitment Period, the RTM Market Revenue for a Bid Cost Recovery Eligible Resource is the algebraic sum of the elements listed below in this Section. For Multi-Stage Generating Resources the RTM Market Revenue calculations will be made at the Generating Unit level.

(a) The sum of the products of the FMM or RTD Instructed Imbalance Energy (including Minimum Load Energy of the Bid Cost Recovery Eligible Resource committed in RUC and where for Pumped-Storage Hydro Units and Participating Load operating in the pumping mode or serving Load, the MWh is negative), except Standard Ramping Energy, Residual Imbalance Energy, Exceptional Dispatch Energy, Derate Energy, MSS Load following Energy, Ramping Energy Deviation and Regulation Energy, with the relevant FMM and RTD LMP, for each Dispatch Interval in the Settlement Interval. These amounts are subject to the Real-Time Performance Metric and the Persistent Deviation Metric as described in Sections 11.8.4.4 and 11.17, respectively. For storage resources that receive an Exceptional Dispatch to hold a State of Charge, the RTM Market Revenue will include revenues from the opportunity cost to hold the State of Charge but not the Exceptional Dispatch Energy to reach the State of Charge.

(b) The product of the Real-Time Market AS Award from each accepted Real-Time Market AS Bid in the Settlement Interval with the relevant ASMP, divided by the number of fifteen (15)-minute Commitment Intervals in a Trading Hour (4), and prorated to the duration of the Settlement Interval.

(c) The relevant tier-1 No Pay charges for that Bid Cost Recovery Eligible Resource in that Settlement Interval.

(d) The Forecasted Movement and Uncertainty Awards Settlement Amounts as calculated pursuant to Section 11.25 are included in the RTM Market Revenues calculation, not including:

(1) the amounts rescinded pursuant to Section 11.25.3;

(2) Forecasted Movement revenue when there are changes in Self-Schedules across consecutive Trading Hours; and

(3) Forecasted Movement revenue when there are changes in EIM Base Schedules across consecutive Trading Hours without Economic Bids.

**27.13 Aggregate Capability Constraint**

At the request of the Interconnection Customer or Pseudo-Tie Generating Facility, the CAISO may enforce an Aggregate Capability Constraint for Generating Facilities with Co-located Resources that reflects a Generating Facility’s maximum and minimum capability or a portion of that capability for purposes of Day-Ahead Market Awards, Real-Time Market Awards, and Real-Time Dispatch as described in the CAISO’s Business Practice Manuals. If the combined PMax of Co-located Resources associated with a single Generating Facility would exceed the Interconnection Service Capacity of that Generating Facility, the Interconnection Customer may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints at the Generating Facility as described in the CAISO’s Business Practice Manuals. If the Interconnection Customer requests that the CAISO enforce multiple Aggregate Capability Constraints, the CAISO will enforce an Aggregate Capability Constraint at the Generating Facility level and subordinate Aggregate Capability Constraints at the level of Resource IDs.

If the Interconnection Customer does not elect an Aggregate Capability Constraint(s), the combined PMax of the Co-located Resources registered in the Master File for that Generating Facility may not exceed the Generating Facility’s Interconnection Service Capacity. EIM Participating Resource Scheduling Coordinators also may request that the CAISO enforce an Aggregate Capability Constraint or multiple Aggregate Capability Constraints for Co-located Resources, subject to the prior written approval of the applicable EIM Entity Balancing Authority that enforcing an Aggregate Capability Constraint(s) for Co-located Resources does not create a threat to safety or reliability.

As described in the CAISO’s Business Practice Manuals the CAISO may relax enforcement of subordinate Aggregate Capability Constraints in its Real-Time Market prior to relaxing enforcement of the system energy-balance constraint specified in Sections 27.4.3.3.4 to ensure there is sufficient Supply to meet the CAISO Forecast of CAISO Demand.

Notwithstanding Section 34.13, a Generating Facility whose Co-located Resources, including Variable Energy Resources, do not comply with Dispatch Instructions such that their output exceeds the Interconnection Service Capacity of the Generating Facility, will be ineligible for the Aggregate Capability Constraint. In such cases, the CAISO will adjust the PMaxes of those Co-located Resources proportionate to each Generating Unit’s capacity such that the sum of the PMax values equals the Interconnection Service Capacity of the Generating Facility, or as requested by the Interconnection Customer so long as the total value does not exceed the Interconnection Service Capacity of the Generating Facility.

Similar to other Generating Facilities with multiple Resource IDs, the CAISO will have no liability with respect to Co-located Resources or their Scheduling Coordinators if Co-located Resources do not comply with Dispatch Instructions and infringe on Interconnection Service Capability used by other Co-located Resources at a Generating Facility.

In the event that Co-located Resources in an EIM Entity Balancing Authority area do not comply with Dispatch Instructions such that their output exceeds the interconnection service capacity for the Co-located Resources, the CAISO will ask the applicable EIM Entity Balancing Authority whether it will revoke its prior approval of enforcing the Aggregate Capability Constraint for such Co-located Resources.

The following resources are not eligible to use the Aggregate Capability Constraint: Multi-Stage Generators, Proxy Demand Response, Pumped Storage Hydro Units, Metered Subsystems, and Use-Limited Resources.

Scheduling Coordinators may not offer or self-provide Ancillary Services into the CAISO’s Markets or receive Uncertainty Awards from Generating Units that are subject to Aggregate Capability Constraints until the CAISO issues a Market Notice stating this restriction will no longer apply. The Pricing Node for the Generating Units or EIM Participating Resources subject to an Aggregate Capability Constraint will be their Point of Interconnection.

**27.14 Charging Constraint**

At the request of the Interconnection Customer of Co-Located Resources, the CAISO will enforce a Charging Constraint that reflects a storage resource’s election not to charge beyond the output of its co-located Variable Energy Resource(s). Where a storage resource has a Charging Constraint, the CAISO will issue neither Day-Ahead Schedules for Energy less than the negative value of the co-located Variable Energy Resource’s Day-Ahead Schedules, nor FMM Schedules for Energy less than the negative value of the co-located Variable Energy Resource’s Dispatch Operating Target, in the same Operating Intervals. The CAISO will not observe Charging Constraints in Operating Intervals where the storage resource receives Schedules to provide Regulation or where the storage resource elects to use Regulation Energy Management.

**30.5.2.7 Ancillary Service Bids**

There are four distinct Ancillary Services: Regulation Up, Regulation Down, Spinning Reserve and Non-Spinning Reserve. A resource shall be eligible to provide Ancillary Service if it has complied with the CAISO’s certification and testing requirements as contained in Appendix K and the CAISO’s Operating Procedures. Scheduling Coordinators may use Dynamic System Resources to Self-Provide Ancillary Services as specified in Section 8. All System Resources, including Dynamic System Resources and Non-Dynamic System Resources, will be charged the Shadow Price as prescribed in Section 11.10, for any awarded Ancillary Services. A Scheduling Coordinator may submit Ancillary Services Bids for Regulation Up, Regulation Down, Spinning Reserve, and Non-Spinning Reserve for the same capacity by providing a separate price in $/MW per hour as desired for each Ancillary Service. The Bid for each Ancillary Services is a single Bid segment. Only resources certified by the CAISO as capable of providing Ancillary Services are eligible to provide Ancillary Services and submit Ancillary Services Bids. In addition to the common elements listed in Section 30.5.2.1, all Ancillary Services Bid components of a Supply Bid must contain the following: (1) the type of Ancillary Service for which a Bid is being submitted; (2) Ramp Rate (Operating Reserve Ramp Rate and Regulation Ramp Rate, if applicable); and (3) Distribution Curve for Physical Scheduling Plant or System Unit. A Scheduling Coordinator may only submit an Ancillary Services Bid or Submission to Self-Provide an Ancillary Service for Multi-Stage Generating Resources for the Ancillary Service for which the specific MSG Configurations are certified. For any such certified MSG Configurations the Scheduling Coordinator may submit only one Operating Reserve Ramp Rate and Regulation Ramp Rate. An Ancillary Services Bid or Submission to Self-Provide an Ancillary Service submitted to the Day-Ahead Market when submitted to the Day-Ahead Market may be, but are not required to be, accompanied by an Energy Bid that covers the capacity offered for the Ancillary Service. Notwithstanding any other provision, storage resources, including without limitation Non-Generator Resources and Hybrid Resources, must submit accompanying Energy Bids in the Real-Time Market that cover at least half the capacity awarded for Ancillary Services from the Day-Ahead Market. Covering Energy Bids must be the opposite direction of the Ancillary Service, namely, to discharge for Regulation Up, Spinning Reserve, and Non-Spinning Reserve; and to charge for Regulation Down.. If a Scheduling Coordinator’s Submission to Self-Provide an Ancillary Service is qualified as specified in Section 8.6, the 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. Except as provided below, the Self-Schedule for Energy need not include a Self-Schedule for Energy from the resource that will be self-providing the Ancillary Service. If a Scheduling Coordinator is self-providing an Ancillary Service from a Short Start Unit, no Self-Schedule for Energy for that resource is required. If a Scheduling Coordinator proposes to self-provide Spinning Reserve, the Scheduling Coordinator is obligated to submit a Self-Schedule for Energy for that particular resource, unless as discussed above the particular resource is a Short Start Unit. When submitting Ancillary Service Bids in the Real-Time Market, Scheduling Coordinators for resources that either have been awarded or self-provide Spinning Reserve or Non-Spinning Reserve capacity in the Day-Ahead Market must submit an Energy Bid for at least the awarded or self-provided Spinning Reserve or Non-Spinning Reserve capacity, otherwise the CAISO will apply the Bid validation rules described in Section 30.7.6.1.

As provided in Section 30.5.2.6.4, a Submission to Self-Provide an Ancillary Service shall contain all of the requirements of a Bid for Ancillary Services with the exception of Ancillary Service Bid price information. In addition, Scheduling Coordinators must comply with the Ancillary Services requirements of Section 8. Scheduling Coordinators submitting Self-Schedule Hourly Blocks for Ancillary Services Bids for the Real-Time Market must also submit an Energy Bid for the associated Ancillary Services Bid under the same Resource ID, otherwise the bid validation rules in Section 30.7.6.1 will apply to cover any portion of the Ancillary Services Bid not accompanied by an Energy Bid. As described in Section 34.2.3, if the resource submits a Self-Scheduled Hourly Block, the CAISO will only use the Ancillary Services Bid in the RTM optimization and will not use the associated Energy Bid for the same Resource ID to schedule Energy from the Non-Dynamic System Resource in the RTM. Scheduling Coordinators must also comply with the bidding rules associated with the must offer requirements for Ancillary Services specified in Section 40.6.

**34.11.1 System Reliability Exceptional Dispatches**

The CAISO may issue a manual Exceptional Dispatch for all types of Generating Units (including without limitation Participating Generators, Non-Generator Resources, and Hybrid Resources), System Units, Participating Loads, Proxy Demand Resources, Reliability Demand Response Resources, Dynamic System Resources, RMR Resources, and Condition 2 Legacy RMR Units pursuant to Section 41.9 in Appendix H, in addition to or instead of resources with a Day-Ahead Schedule dispatched by RTM optimization software during a System Emergency, or to prevent an imminent System Emergency or a situation that threatens System Reliability and cannot be addressed by the RTM optimization and system modeling. To the extent possible, the CAISO shall utilize available and effective Bids from resources before dispatching resources without Bids. To deal with any threats to System Reliability, the CAISO may also issue a manual Exceptional Dispatch in the Real-Time for Non-Dynamic System Resources that have not been or would not be selected by the RTM for Dispatch, but for which the relevant Scheduling Coordinator has received a HASP Block Intertie Schedule. The CAISO also may issue Exceptional Dispatches to storage resources to reach or hold a State of Charge for expected threats to System Reliability later in the Operating Day.

**34.13.3 Co-located Resources and Dispatch Instructions**

Co-located Resources that are Non-Generator Resources may deviate from Dispatch Instructions only pursuant to this Section. A Co-located Resource that is a Non-Generator Resource may deviate from a Dispatch Instruction where a co-located Eligible Intermittent Resource at the same Generating Facility is producing above its Dispatch Operating Target due to meteorological conditions such that the Co-located Resources’ combined output would exceed the Interconnection Service Capacity of the Co-located Resources, or otherwise threaten reliability or safety. Such deviations may only occur through proper control technologies that ensure the combined output of all Co-located Resources does not exceed the Generating Facility’s Interconnection Service Capacity.

Co-located Resources that are Non-Generator Resources may deviate from Dispatch Instructions to observe their registered Charging Constraints pursuant to Section 27.14.

All deviations from Dispatch Instruction will be subject to Uninstructed Imbalance Energy. A Co-located Resource that is a Non-Generator Resource may not deviate from a Dispatch Instruction pursuant to this section if it is providing Ancillary Services in the same Dispatch Interval.

**39.7.1.8 Storage Resource Option**

For storage resources participating as Non-Generator Resources, the storage resource option will calculate the Default Energy Bid by selecting the maximum of (1) the sum of the expected energy cost and the variable storage operation cost and, (2) the storage opportunity cost. The calculation is completed by adding ten percent (10%) to the value. To calculate the Default Energy Bid, the CAISO will use the PMin, PMax, Run Times, and other charging and discharging parameters registered in the Master File.

The expected energy cost represents the average cost to procure the amount of energy needed to charge the resource during the lowest-priced continuous block of time such that the resource can discharge completely, accounting for the resource’s charging duration and round-trip efficiency, and excluding losses. To calculate this component in the Day-Ahead Market, the CAISO will use the average price of Energy during the lowest priced hours based upon the final Energy Supply Bids from the MPM process at the relevant PNode, not to be below $0/MWh. To calculate this component in the Real-Time Market, the CAISO will use the average price of Energy during the lowest priced hours based upon the LMP from the IFM at the relevant PNode on the Trading Day, not to be below $0/MWh.

The variable storage operation cost represents the variable costs of operating a storage resource beyond its designed daily cycling range, submitted by the Scheduling Coordinator in $/MWh. The CAISO will validate the storage operation cost based on manufacturer warranty, available data, and supporting documentation submitted by the Scheduling Coordinator. The storage opportunity cost represents the opportunity cost of being dispatched during lower-priced intervals, equal to the cost of Energy the resource could discharge during the highest-priced continuous block, accounting for the resource’s discharge duration. To calculate this component, the CAISO will use the lowest price of Energy during the highest priced period over which the resource could have discharged, based upon the LMP from the IFM at the relevant PNode on the Trading Day.