



Ancillary Service State of Charge Constraint

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ANCILLARY SERVICE STATE OF CHARGE CONSTRAINT (ASSOC)

The ISO requires resources be able to provide ancillary services when awarded

- All resources providing ancillary services must meet continuous energy requirements in the day-ahead and real-time market
- The ISO market optimization includes a constraint to ensure that energy storage resources always have sufficient state of charge
 - In the day-ahead market these constraints ensure storage resources have one hour of state of charge
 - In the real-time market the constraints ensure storage resources have 30 minutes of state of charge

The ASSOC constraint ensures storage maintain sufficient state of charge to support AS awards in RT

$$SOC_{i,t} \geq \underline{SOC}_{i,t} + 0.5 * RU_{i,t} + 0.5 * SR_{i,t} + 0.5 * NR_{i,t}$$
$$SOC_{i,t} \leq \overline{SOC}_{i,t} - 0.5 * RD_{i,t}$$

- $SOC_{i,t}$: State of charge
- $\underline{SOC}_{i,t}$: Minimum state of charge
- $RU_{i,t}$: Regulation up award
- $SR_{i,t}$: Spinning reserve award
- $NR_{i,t}$: Non-spinning reserve award
- $\overline{SOC}_{i,t}$: Maximum state of charge
- $RD_{i,t}$: Regulation down award

All variables are applicable for resource i at time t

Simple Examples

+/- 100 MW storage resource; 0 MWh to 400 MWh state of charge range

- Suppose this resource has a 50 MW award for regulation up during a particular hour
 - The constraint ensures that the resource can discharge at least 25 MWh of energy
- Suppose this resource has a 100 MW award for regulation down during a particular hour
 - The constraint ensures that the resource can charge 50 MWh; i.e. the state of charge is not greater than 350 MWh ($400 \text{ MWh} - 0.5 * 100 \text{ MWh}$)

Current ancillary service state of charge constraint and bid cost recovery rules could result in significant uplift

- The constraint can force the storage resource to charge or discharge
 - If instructions are uneconomic, they could result in significant uplift payments

Example:

- A storage resource is providing regulation down, and is just at the maximum level of state of charge
- Providing any regulation down results in a state of charge above the constraint, this then results in an energy award to discharge the resource
- If the resource is bidding at above prevailing locational marginal prices, then the resource is paid uplift
 - I.e. \$1,000/MWh bids are awarded uplift of \$1,000 – LMP, when discharged

Prices to buy/sell energy to stay compliant with current ancillary service rules should be captured in AS bids

- When discharged to meet ancillary service requirements storage is eligible to receive the higher of the bid price (through uplift) or the LMP
- Reducing uplift payments will improve overall market efficiency
- It may be more expensive for storage to provide ancillary services than their current bids suggest
 - Incurring additional costs to charge or discharge may result in some storage resources increasing bids for ancillary services

TARIFF LANGUAGE

FERC Filing

- ISO filed tariff revisions this morning
- Requested FERC waive the notice period so revisions become effective tomorrow
 - Will receive an order on normal ~60-day schedule

Tariff Revisions

- Section 8 (Ancillary Services)

- (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

Tariff Revisions

- Section 8 (Ancillary Services)

8.4.3 Ancillary Service Capability Standards

The providers of Ancillary Services under this CAISO Tariff must comply with the following capability standards for Spinning Reserve and Non-Spinning Reserve Capability. Each resource or external import of a System Resource scheduled to provide Spinning Reserve and each resource providing Non-Spinning Reserve must be capable of converting the full capacity reserved to Energy production within ten (10) minutes after the issue of the Dispatch Instruction by the CAISO. Each resource scheduled to provide Spinning Reserve and each resource scheduled to provide Non-Spinning Reserve must be capable of maintaining that output or scheduled Interchange for at least thirty (30) minutes from the point at which the resources 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.](#)

Tariff Revisions

- Section 11 (Settlements)

resource as Measured Demand. Where Scheduling Coordinators elect to submit end-of-hour state-of-charge targets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the two hours preceding the scheduled Operating Hour. Where Scheduling Coordinators elect to submit Self-Schedules in the CAISO Real-Time Markets, storage resources participating as Non-Generator Resources will be ineligible for RTM Bid Cost Shortfalls in the hour preceding the scheduled Operating Hour. [Where the CAISO dispatches storage resources participating as Non-Generator Resources to charge or discharge pursuant to Sections 8.4.1.1\(g\) or 8.4.3 for the Real-Time Market, they will be ineligible for RTM Bid Cost Shortfalls.](#)

NEXT STEPS

Next Steps

- This marks the start of the ancillary service state of charge constraint stakeholder initiative
- There will be a (likely brief) series of ISO proposals and stakeholder meetings to discuss potential alternative solutions
- That stakeholder process may result in amendments to the rules around the ancillary service state of charge constraint