Storage Design & Modeling Discussion

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December 11, 2024

Agenda

1. SOC Management & Capacity Awards (Volpe)
2. Biddable SOC Product (Svoboda)
3. Q&A

SOC Management & Capacity Awards

- **BRQ-4331: Include IRU/IRD in storage resource ASSOC constraint**
  - Include IRU in the ASSOC constraint that SOC be able to discharge to support minimum SOC plus upward AS and IRU;
  - Include IRD, in the ASSOC constraint that SOC be able to charge to support downward AS and IRD with charge efficiency that not exceed the maximum SOC
- **BRQ-4331A: Include IRU/IRD and RCU/RCD in storage resource ASSOC constraint**
  - Include IRU and RCU in the ASSOC constraint that SOC be able to discharge to support minimum SOC plus upward AS and IRU/RCU
  - Include IRD and RCD in the ASSOC constraint that SOC be able to charge to support downward AS and IRD/RCD with charge efficiency that not exceed the maximum SOC
- **BRQ-4332: Include attenuation from capacity IR/RC awards in SOC envelope constraint in MPM, IFM, RUC**
  - The day-ahead market will generate an upper and lower bound, or envelope, for SOC
  - The envelope could constrain operation for storage resources
  - The initial upper and lower bounds will be set to the initial day-ahead state of charge
  - The initial multiplier attached to the imbalance reserves in the envelope equation will be 0.85

SOC Management (cont'd)

- **BRQ-5144: Model State of Charge (SOC) constraints envelope and limits of LESR:**
  - Use RCU/RCD for energy charge/discharge SOC balance constraint, SOC limit constraint, attenuation factors and coverage factor apply to the AS and IR capacity awards

Summary:

- More restrictive on hitting ASSOC constraint (when awarded IRU/IRD)
- More limiting of Energy & A/S awards (when awarded IRU/IRD)
- Envelope equations tied to initial DA SOC
- IR awards rely on a multiplier
- Applies to DAM, MPM and RUC

Impact of IRU/IRD and RCU/RCD on Other Topics

Impact of Capacity Awards	Implementation Difficulty		
	Low	Medium	High
High or Medium		DEB Enhancements	Biddable SOC Re-optimization of A/S in RT
Little or no impact	OMS Enhancements	OMS Enhancements Foldback	Uplift Redesign

Questions

- How do we best accommodate for capacity products in other Storage Design & Modeling topics?
- As DAME is being implemented, what are some signs that IRU/IRD is too restrictive on storage (or not restrictive enough)?
- Is there an alternative to the envelope equations which would make for a more efficient market (e.g. biddable SOC product)?

What issues does biddable storage attempt to address?

- Enables market participants to price their opportunity cost of holding storage for future hours
- Allows CAISO to set minimum energy thresholds for storage available in future hours
- Enables real time exchange of storage capacity between batteries (which may or may not have day ahead awards)
- Potentially reduces or eliminates need for BCR due to MIO uneconomic charging, and may eliminate need for BCR in stressed conditions by reducing or eliminating need for exceptional dispatches to hold SOC
- Encourages use of end-of-hour target SOC range to address nonlinear behaviors (e.g., foldback limitations) near physical SOC limits

Current capabilities

- Market participants can set Target SOC max and min
- CAISO operators can issue ED to charge and ED to hold SOC instructions
- Biddable initial SOC (unpriced) is used in determining DA battery awards
- Biddable upper and lower charge limits are used as SOC limits in market processes unless OMS energy limits are more binding
- Telemetered SOC is used in determining whether ASSOC constraints are binding
- Market SOC limits are adjusted over market horizon based on regulation attenuation factors

Biddable SOC Product

A battery's biddable state of charge (RT upward for now) is defined as

Biddable SOC = Target SOC max – max(Target SOC min, Market SOC min)

Biddable SOC is constrained by a common K-hour energy ramp, e.g., 3 or 4 hours, where energy ramp is limited by discharge level and available duration: a 100 hour battery could provide 4 hours of biddable SOC, while a 2 hour battery could provide 4 hours of biddable SOC at half max output

Biddable SOC depends on estimated initial SOC in first FMM run based on telemetry, where target SOC is first seen in RT market processes

Biddable SOC bid takes the form of a bid or bid curve:

(Biddable SOC1, Price1), (Biddable SOC2, Price2) …

(Bid curve is adjusted to remove quantities above Biddable SOC and cap last quantity at Biddable SOC)

CAISO end of hour SOC requirement:

Sum(biddable SOC) >= SOC requirement, with marginal price set by shadow price

Implications of Biddable SOC

- CAISO market operators can set hourly SOC procurement targets, which can be satisfied by any battery bidding SOC availability. This potentially eliminates most cases in which ED to hold SOC might be needed, and allows pooling of SOC across batteries as well as end of day SOC buffer procurement.
- SOC awards above initial SOC will be satisfied in the same way that Target SOC limits are currently satisfied in RT markets
- Because the SOC bid can represent the opportunity cost of end of hour SOC, it potentially eliminates BCR concerns (buyback, MIO, SOC limits) except for economic unforced awards out of merit, which retain in-interval BCR eligibility
- While the constraints and hence the product is meaningful DA as well as RT, it may primarily be used for beginning and end of day constraints and could be used to guarantee deliverability of initial SOC bids.

Q&A