LOLE and PRM for Slice-of-Day Implementation

RA Reform Workshop

8/17/2022

RA Decision language on LOLE and PRM (D.22-06-050)

- LSEs must demonstrate sufficient capacity to meet their load requirements plus a PRM percentage in each hour ("Load+PRM").

- For initial implementation, one PRM will apply to all hours of the year.

- [C]onverting the results of the loss of load expectation (LOLE) study to the counting rules applicable to the 24-hour framework should await the refreshed LOLE outputs from the Integrated Resource Plan (IRP) proceeding.

- Once refreshed LOLE outputs are available, conversion of the outputs to the 24-hour framework counting rules needs to be completed, and the National Resources Defense Council's "proof of concept" template should be leveraged for the conversion.

Slice-of-Day PRM Setting

- PRM should be set such that the resulting RA showing portfolio meets annual reliability standards and is not larger than necessary
- Slice of day resource counting and excess capacity requirements should be implemented in Capacity Expansion (CE)
  - 24-hour PRM set in CE consistent with eventual requirement in Resource Adequacy program
  - Would ensure resulting portfolio to set PRM is least cost, operable and reliable
  - The final least cost resource portfolio that meets reliability requirements in LOLE determines the PRM requirement
- Resource assumptions should be consistent among RA counting, capacity expansion and production Cost Modeling (PCM)
  - If RA program analysis shows expected capacity contribution is correlated with load, that finding should be used for both RA and PCM
  - Use limited resource assumptions should also be aligned
- Analysis refreshed periodically (every two years according to the IRP cycle) to confirm PRM is appropriate
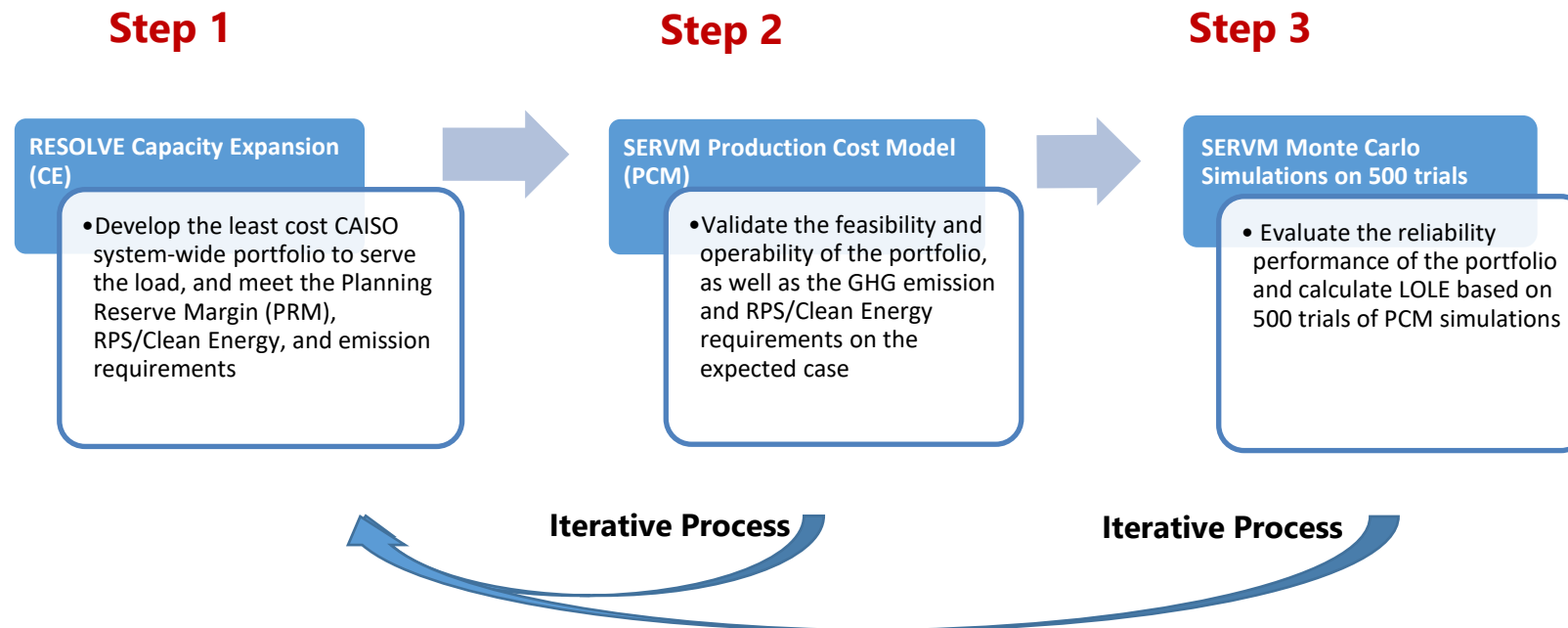
LOLE-Based Resource Portfolios

CPUC LOLE Inputs

- Base production cost simulation transmission and generator representations
  - Existing, planned and generic generation resources
  - Import and export assumptions
- Stochastic load
- Stochastic supply (VERs)
- Stochastic generator outage patterns (forced outages)
- Planned outages
- Required reserves

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CPUC LOLE Methods and Uses

- A single LOLE run can test the reliability of a given set of resources
  - Typically, with a fixed set of resources but can accommodate retirements and additions
  - Example: Used to evaluate the Adopted PSP
- An iterative LOLE process can find a portfolio that meets reliability standards
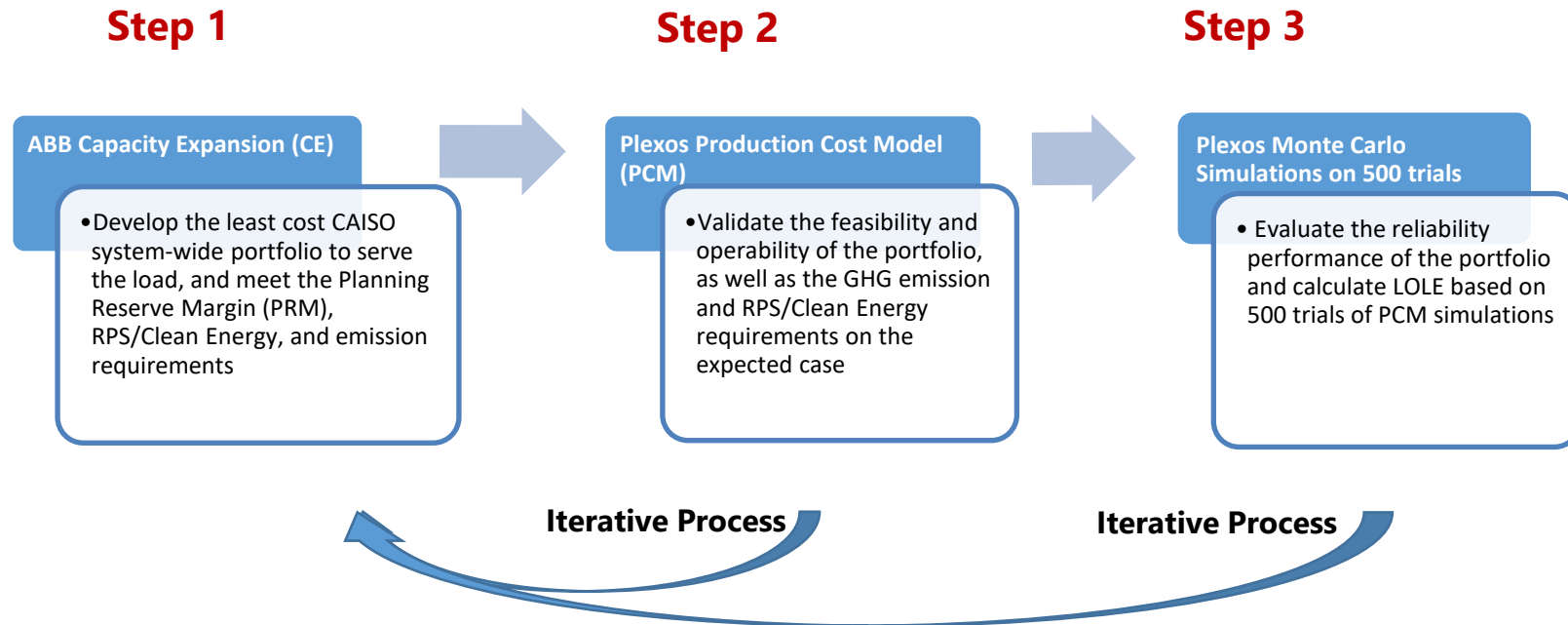 - Example: Used to determine resource needs in the IRP

CPUC Iterative LOLE Process (probably)

Step 1

RESOLVE Capacity Expansion (CE)

- Develop the least cost CAISO system-wide portfolio to serve the load, and meet the Planning Reserve Margin (PRM), RPS/Clean Energy, and emission requirements

Step 2

SERVM Production Cost Model (PCM)

- Validate the feasibility and operability of the portfolio, as well as the GHG emission and RPS/Clean Energy requirements on the expected case

Step 3

SERVM Monte Carlo Simulations on 500 trials

- Evaluate the reliability performance of the portfolio and calculate LOLE based on 500 trials of PCM simulations

Iterative Process

Iterative Process

CPUC Iterative LOLE Outputs

- Specific volume and mix of resources that can meet the reliability target set in LOLE

- Iterative Capacity Expansion and LOLE reliability studies can ensure the most economic resource mix to meet reliability and other requirements
  - Determined resources not the only mix that can satisfy constraints
  - Ideally, the volume and mix represents something near the minimum volume and cost to achieve policy goals but that depends on the quality of the associated Capacity Expansion system
  - Gap exists in the current IRP capacity expansion modeling with single hour PRM requirement
  - SCE is moving to Slice-of-Day resource counting in our Capacity Expansion system to better align our planning and RA forecasts and recommends the CPUC do so as well

SCE's Iterative CAISO-System Wide Modeling and Analysis

Step 1

Step 2

Step 3

ABB Capacity Expansion (CE)

- Develop the least cost CAISO system-wide portfolio to serve the load, and meet the Planning Reserve Margin (PRM), RPS/Clean Energy, and emission requirements

Plexos Production Cost Model (PCM)

- Validate the feasibility and operability of the portfolio, as well as the GHG emission and RPS/Clean Energy requirements on the expected case

Plexos Monte Carlo Simulations on 500 trials

- Evaluate the reliability performance of the portfolio and calculate LOLE based on 500 trials of PCM simulations

Iterative Process

Iterative Process

- The only change in the 2022 IRP process is the first step of Capacity Expansion, the RA 24-hourly Slice framework will be implemented in the ABB Capacity Expansion.

Modified Capacity Expansion of Implementing the 24-Hourly Slice of Day – Newly Adopted RA Approach

Modified Step 1 of SCE's CE Modeling

- **Emission, RPS target, Load and generation balance requirements are unchanged**

- **Replacing the single point PRM constraint with the 24-Hourly Slice of Day requirement :**
  - Forcing the hourly requirements on the "worst day" of year
  - Ensuring CAISO system has enough capacity to satisfy its load profile + PRM in all 24 hours, and making sure the energy sufficiency for all storage devices in the system
  - Based on the resource counting rule based on RA proposal
  - Feasibility test to ensure both capacity and energy are sufficient for the use-limited resources, e.g., hydro, and storage

Existing Step 1 of Traditional CE Modeling

- **Emission, RPS target, Load and generation balance requirements are unchanged**

- **Single point PRM constraint (capacity requirement during the peak load hour)**

  - Forcing the single hour PRM requirement during the peak load hour in that year
  - Ensuring CAISO system has enough capacity to satisfy its load profile + PRM during the single peak load hour
  - Resource counting rule based on NQCs or ELCCs depending on resource type
    - Solar/wind/storage contribution based on the current single-point annual ELCC methodology

Capacity expansion with 24-hour slice-of-the-day requirement identifies the least cost resource portfolio meeting the GHG and reliability requirements. The PRM% is determined in the final iteration of capacity expansion and LOLE validation process.

PRM Setting

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LOLE-based Reserve Margins

- Reserve margins are a function of required resource portfolio, resource counting, and load

- Total volume and mix of resources determined by iterative process is converted via a resource reliability capacity accreditation scheme

- Resource counting summed and typically compared with the managed peak
  - PRM = sum of capacity counting at managed peak / managed peak

PRM with Slice-of-Day

Need to stack resources within slice-of-day counting and showing rules

1. Determine volume and mix of resources that achieves reliability and other targets (Iterative LOLE process)

2. Convert nameplates and characteristics to slice-of-day counting (hourly ELCC, daily limitations, etc)

3. Create system-level 24-Hourly-Slice RA stack consistent with steps 1 and 2 that maximizes the PRM while satisfying slice-of-day requirements

   • Determine the highest September PRM that can be satisfied with the resource volume and mix from iterative LOLE using 24-hourly-slice counting rules

4. Compare the stacked supply at managed peak with the managed peak demand to determine required PRM

Impact of UCAP/UCAP lite

- Lowering counting will lower PRM
  - PRM = sum of capacity counting at managed peak / managed peak
  - Example: IRP PRM is negative 18% in 2030 due to relatively low resource counting
- Fair counting should lead to more stable reliability outcomes and more appropriate economic signals
  - In that spirit, if some resource types have unplanned derates and forced outages incorporated into their counting then all should

Back-up

Note on 24-hourly-slice resource counting

- Counting should represent the expected marginal contribution of resource in given hour of a given month
  - "What is reasonable to expect Resource X to contribute in hour Y of month Z"
  - Since we are looking at hourly contribution, this value would equal both the "first-in" and "last-in" marginal contribution since the expected capacity contribution isn't portfolio dependent
- Conditioning is probably appropriate
  - "What is reasonable to expect Resource X to contribute in hour Y of month Z, when hour Y is higher than normal for hour Y in month Z"
- Sample size issues could be addressed by using interval production or capacity offer data
  - Four data points for every hour
  - VER capacity varies within hours
  - Would help answer "What is reasonable to expect Resource X to contribute throughout hour Y of month Z"
  - Granularity is not a substitute for history, but in this case the granular data could also add to the quality of the estimates

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