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California Public Utilities Commission

Production Cost Modeling Process to Review Integrated Resource Plan Portfolios

An Energy Division Staff Proposal

September 18, 2017

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I. Introduction

This document proposes an analytical framework for using production cost modeling to evaluate the Reference System Plan and Preferred System Plan portfolios being considered in the CPUC's Integrated Resource Plan (IRP) rulemaking (R.16-02-007). This proposal describes a potentially durable modeling process that could be replicated in future IRP cycles, as well as describing some workarounds to make the process fit within the tight schedule of this first IRP cycle.

The analytical framework described here also serves as a set of guidelines for other parties to develop their own production cost modeling based assessment of IRP portfolios. To the extent other parties wish to compare their assessments with CPUC staff's, they should adhere as closely as possible to the assumptions, methods, and conventions used by CPUC staff. This document and the package of data associated with the Reference System Plan adopted by the Commission are intended to be a complete set of modeling guidance. Unless superseded by a specific guideline called out in this document or the Commission-adopted Reference System Plan, CPUC staff and other parties should follow the guidelines in the ALJ Ruling Directing Production Cost Modeling Requirements¹ issued in the IRP proceeding on September 23, 2016.

II. Reference System Plan Production Cost Modeling

This section describes production cost modeling that CPUC staff will conduct as a higher fidelity assessment of the Reference System Plan. Staff will use the SERVM² production cost model to evaluate operational performance and verify satisfaction of the Planning Reserve Margin³ (PRM) requirement. This is the same model as used in the Resource Adequacy proceeding to calculate Effective Load Carrying Capability (ELCC). Staff will also use the SERVM model to calculate marginal ELCC values intended for use by individual Load Serving Entities (LSEs) to develop their respective IRP filings. Staff will also rely on this same production cost modeling framework to evaluate the Preferred System Plan, as described later in this document.

In this IRP cycle, staff intends to complete and vet the production cost modeling results with stakeholders in Q1 of 2018, in parallel with the LSEs developing their IRP filings. This parallelization of processes permits incorporation of the 2017 IEPR demand forecast. Staff proposes that this staging of processes as the most efficient way to accomplish the necessary modeling within the tight schedule of this IRP cycle. Staff expects stakeholders to have an opportunity for formal comment on the modeling

¹ <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442451199>

² Strategic Energy Risk Valuation Model – developed by and commercially licensed through Astrape Consulting

³ Refers to the system Resource Adequacy requirement based on each LSE's peak demand forecast plus a 15% planning reserve margin. See: <http://www.cpuc.ca.gov/General.aspx?id=6307>

results in Q1 of 2018 in addition to opportunities for informal feedback during the modeling process via the Modeling Advisory Group.⁴

Production cost modeling of the Reference System Plan serves several important purposes:

1. Benchmark the SERVVM model's representation of the system with the RESOLVE model's representation and characterize differences (e.g. differences in model granularity and common metrics). This distinguishes fundamental differences between RESOLVE and SERVVM representation of the Reference System Plan from any additional differences that could be observed later when comparing SERVVM studies of the Reference System Plan and the Preferred System Plan.
2. Evaluate the Reference System Plan's operational performance in greater detail and under a wider distribution of conditions⁵ than was modeled in RESOLVE and verify satisfaction of the PRM system reliability requirement (using Qualifying Capacity and average portfolio ELCC accounting as described later). This evaluation serves to establish the Reference System Plan as a reliable standard for comparison with the Preferred System Plan.
3. Repeat this evaluation of operational performance and verification of PRM satisfaction on an alternative RESOLVE case, for example the 50% RPS Default case,⁶ such that it is available for use in other planning processes that could be directed by the CPUC or other entities.
4. Reevaluate the performance of the Reference System Plan (and any other alternative RESOLVE case) after incorporation of the 2017 IEPR demand forecast (expected to be adopted by the California Energy Commission (CEC) in January 2018) or any other data update that may be warranted. SERVVM modeling *without incorporating* the 2017 IEPR is still required to be able to benchmark with RESOLVE cases because RESOLVE modeling relied on the previous IEPR (2016 IEPR Update demand forecast). SERVVM modeling *incorporating* the 2017 IEPR is also required because the LSEs will be building the Preferred System Plan based on the 2017 IEPR.
5. Determine the marginal ELCCs of new wind and solar resources implied by the Reference System Plan and provide these values to LSEs to guide the design of their respective IRP filings.

As staff is responsible for providing marginal ELCCs to LSEs to guide the design of their respective IRP filings, this specific deliverable must be completed by early 2018 in order to be useful to LSEs. This may not be possible if Reference System Plan production cost modeling and results are being vetted with stakeholders in Q1 of 2018. As an interim solution for this IRP cycle, staff proposes to provide to LSEs marginal ELCCs derived from the RESOLVE model so that they can proceed with developing their respective IRP filings without waiting for production cost modeling-based marginal ELCCs.

⁴ Modeling Advisory Group (MAG) notices are emailed to the proceeding service list – there is no separate list. Previous meetings and materials are posted here: <http://www.cpuc.ca.gov/General.aspx?id=6442453968>

⁵ For example in SERVVM: all 8760 hours of a year are modeled, the CAISO area is modeled as four transmission zones, individual generating units are modeled, and the tails of weather distributions are explicitly modeled.

⁶ The RESOLVE model case representing achievement of a 50% RPS in 2030 and no further procurement driven by firm GHG reduction goals.

Modeling Scope and Conventions

The following describes the scope and conventions that staff will use for production cost modeling of IRP system plans with the SERVM model.

- A. Study years: 2022, 2030. The RESOLVE cases explicitly provide results for years 2018, 2022, 2026, and 2030. Staff has limited resources and time to conduct modeling so a compromise is production cost modeling of two of the four years from the RESOLVE cases.
- B. Loss-of-load event definitions and counting conventions, and operating reserve targets⁷ shall be consistent with those used in the Resource Adequacy proceeding's production cost modeling with SERVM for ELCC calculations unless superseded by this document. Multiple loss-of-load events occurring within one day shall count as one event for purposes of counting events towards a reliability target. The loss-of-load event occurs when regulation up/down (1.5% of hourly forecast load) or spinning reserves (3.0% of hourly forecast load) cannot be maintained.
- C. For ELCC calculations, use an annual loss-of-load-expectation (LOLE) reliability target range of 0.095 to 0.105 in total covering the four summer months of the year (June through September) where the vast majority of events are expected to occur. No effort will be made to surface events outside of the four summer months, and each of the summer months will be calibrated to an equal LOLE (each month will be calibrated until there is about 0.025 LOLE in each of the four summer months). This is consistent with the "Levelized monthly LOLE" approach used in the Resource Adequacy proceeding's ELCC calculations and is expected to reveal more types of potential events than calibrating to a simple annual target.
- D. For ELCC calculations, the calibration of the system under study to the LOLE reliability target range may involve removing or adding generation.
 - Removal of generation to surface LOLE events in overbuilt systems shall follow an order of removal described below. Conventional thermal generators that have announced their retirement will be removed first. If LOLE remains below the target level, additional conventional thermal generation will be removed from CAISO areas ranked by age of the facility. The oldest one will be removed first, continuing in order of age. No hydro generation or renewable generation will be removed.
 - Addition of generation to reduce LOLE events in underbuilt systems shall use perfect capacity as additions. Perfect capacity is a modeling proxy for generation with no operating constraints, e.g. always available, starts instantly, infinite ramp rate, no minimum operating level.
 - Although the calibration step alters the system under study, this is a typical way of performing ELCC calculations and is not expected to significantly affect the ELCC measurement.

⁷ As a percent of hourly forecast load, regulation up/down is 1.5% each, load following up is 2.5%, load following down is 1.5%, spinning reserves is 3.0%, non-spinning reserves is 3.0%.

- E. BTM PV will be explicitly modeled as generation, rather than part of the load forecast, consistent with its treatment in the RESOLVE model. Avoided transmission and distribution loss effects are accounted for.
- F. Average portfolio ELCC calculations will include all existing and new wind, utility-scale solar, and BTM PV together. The calculation will treat all of these resources as if they were fully deliverable.
- G. For reserve margin calculations, the counting of effective capacity shall use the conventions in the following table:

Component	Counting convention
Peak demand	IEPR 1-in-2 annual peak consumption forecast adjusted for load-modifier impacts but excluding BTM PV impact
Existing non-wind, non-solar	Use current Net Qualifying Capacity values
New non-wind, non-solar	Use same conventions as the RESOLVE model
Wind and solar (including BTM PV), existing and new	Calculate the average portfolio ELCC of these resources combined. Discount this value by the ratio of fully-deliverable capacity to total capacity.

- H. Hourly load shapes will be built up from fundamental consumption load shapes and shapes for various load modifiers such as AAEE, TOU rates, and EV charging patterns. Avoided transmission and distribution loss effects are accounted for.
- I. SERVM will be run using hourly time-steps.
- J. Reporting of operational performance will include at least: LOLE probabilistic reliability level, emissions (including estimating emissions from starts and stops), RPS generation, curtailment patterns, production cost, import/export flows, and frequency of load following reserve shortages.

Modeling Steps

The following describes the steps that staff will use for production cost modeling of IRP system plans with the SERVM model. In the steps below, “study” or “studies” means production cost modeling runs.

- A. Calibrate RESOLVE’s Reference System Plan representation and SERVM’s representation (e.g. total system portfolio, topology, operational constraints)
 - 1. Produce a report comparing the RESOLVE and SERVM models and inputs, characterizing areas of alignment and differences. This report should include detailed documentation of inputs in tabular form for transparency and to guide other parties’ modeling activities.
 - 2. Post the SERVM dataset representing the Reference System Plan
 - 3. Post the SERVM dataset representing the alternative RESOLVE case
- B. Conduct Reference System Plan studies for years 2022 and 2030
 - 1. Evaluate operational performance, including quantifying the LOLE level before any calibration (addition or removal of generation)

2. Benchmark key metrics from SERVVM with equivalent metrics from RESOLVE as a check on input or modeling differences and their projected impact on results
 3. Calibrate the Reference System Plan to the desired LOLE level for calculating ELCC values and report the quantity of generation added or removed in MW
 4. Calculate the average portfolio ELCC of wind and solar (utility-scale + BTM PV)
 5. Calculate the reserve margin and verify satisfaction of the PRM system reliability requirement
 6. Repeat of B1-B5 for the alternative RESOLVE case
 7. Calculate the marginal (not average) ELCC values of the following to guide LSE Plan development:
 - 1,000 MW block of new wind facilities
 - 1,000 MW block of new solar (utility-scale) facilitiesValues for only one location (the CAISO balancing area), one solar technology type (single-axis tracking), and two years (2022, 2030) will be calculated. Future IRP cycles may consider additional technology/location granularity and years. The RESOLVE model is also capable of producing estimates of marginal ELCC of wind and solar for modeled years. These can be benchmarked with the marginal ELCC values produced using the SERVVM model as a sanity check.
- C. Update the SERVVM dataset to incorporate the 2017 IEPR demand forecast⁸
1. Post the updated SERVVM dataset representing the Reference System Plan
 2. Post the updated SERVVM dataset representing the alternative RESOLVE case
- D. Conduct updated Reference System Plan studies for years 2022 and 2030
1. Repeat all studies in B. using the 2017 IEPR demand forecast
- E. Staff may consider running additional sensitivities of any of the studies above (e.g. use different reserve requirements or net exports constraints). One priority sensitivity to consider is step B1 (operational performance) studies for year 2022 with Diablo Canyon Power Plant offline to assess its impact on emissions, or alternatively directly running a 2026 study. Examination of year 2026 may also be important given the expected significant changes in the grid between 2022 and 2030.

In the evaluation of operational performance (B1) step, staff will be reporting the key metric of GHG emissions (including estimating emissions from starts and stops). Total CAISO balancing area annual emissions will be the primary measure of whether the Reference System Plan meets emissions requirements. California and WECC-wide emissions can also be reported from the model.

⁸ Note that the portfolios presented as part of the Reference System Plan package will not be recreated in RESOLVE based on the 2017 IEPR demand forecast. Thus only the load and demand-side resources will be updated in the SERVVM model to align with the 2017 IEPR.

In the calibration (B3) step, if generation had to be added, the quantity added would be noted and reconsidered during the evaluation of the Preferred System Plan. This is because the Preferred System Plan may introduce other system changes that effectively reduce or increase the quantity of generation that must be added to achieve the target probabilistic reliability level range. The quantity added may be compared to the reserve margin calculation step as an indication of the level of alignment between the reliability target level used for ELCC calculations and the PRM reliability planning framework. Note that while this exercise may be useful in characterizing any shortfall in meeting a probabilistic reliability target, the analysis actually determining whether any system reliability-driven additional procurement is necessary is step B5 on the Preferred System Plan, the reserve margin calculation and verification of PRM satisfaction, as described later in this document.

III. Preferred System Plan Production Cost Modeling

This section describes production cost modeling that CPUC staff will conduct to evaluate the Preferred System Plan. Staff will use the SERVVM production cost model to evaluate operational performance and verify satisfaction of the PRM requirement. Staff will follow the same modeling scope and conventions as will be used to evaluate the Reference System Plan, and will follow a similar set of modeling steps, explained below.

Modeling Steps

The following describes the steps that staff will use for production cost modeling of IRP system plans with the SERVVM model. In the steps below, “study” or “studies” means production cost modeling runs. All studies will use the 2017 IEPR demand forecast.

- A. Aggregate the individual LSE Plans into the Preferred System Plan SERVVM dataset
 1. Map the resources in each individual LSE Plan to resources in SERVVM’s representation of the Reference System Plan and create new LSE resource types in the SERVVM dataset as needed
 2. Organize the SERVVM dataset such that each LSE Plan can be swapped in and out of the Preferred System Plan in an automated fashion
 3. Produce a report documenting SERVVM inputs in tabular form for transparency and to guide other parties’ modeling activities
 4. Post the SERVVM dataset representing the Preferred System Plan
- B. Conduct Preferred System Plan studies for years 2022 and 2030
 1. Evaluate operational performance, including quantifying the LOLE level before any calibration (addition or removal of generation)
 2. Compare and report results of step B(1) with the equivalent study of operational performance performed with the Reference System Plan
 3. Calibrate the Preferred System Plan to the desired LOLE level for calculating ELCC values and report the quantity of generation added or removed in MW

4. Calculate the average portfolio ELCC of wind and solar (utility-scale + BTM PV)
 5. Calculate the reserve margin and verify satisfaction of the PRM system reliability requirement
- C. Quantify any shortfall in satisfying the PRM system reliability requirement
- D. Staff may consider running additional sensitivities of any of the studies above as time allows and needs dictate

In the aggregation (A1) step, the process must ensure that no resources are double-counted or under-counted, and that the aggregate of new resources selected by LSEs does not exceed the available resource potential. This step may require staff to make additional data requests to LSEs to resolve any issues. The resources of each LSE Plan in the SERVIM dataset must be organized in such a way that permits systematic sequential studies of the Preferred System Plan with an LSE Plan included or excluded. This provides a mechanism to isolate the effects of an individual LSE Plan on the operational performance of the Preferred System Plan, should such an analysis be necessary.

In the evaluation of operational performance (B1) step, staff will be reporting the key metric of GHG emissions (including estimating emissions from starts and stops). Total CAISO balancing area annual emissions will be the primary measure of whether the Preferred System Plan meets emissions requirements. California and WECC-wide emissions can also be reported from the model.

In the calibration (B3) step, if generation had to be added, the quantity added would be noted and may be compared to the reserve margin calculation step as an indication of the level of alignment between the reliability target level used for ELCC calculations and the PRM reliability planning framework. Note that while this exercise may be useful in characterizing any shortfall in meeting a probabilistic reliability target, the analysis actually determining whether any system reliability-driven additional procurement is necessary is step B5, the reserve margin calculation and verification of PRM satisfaction.

If step C is necessary then staff would quantify the shortfall in MW of effective capacity.

IV. Data Requirements

This section supplements the portion of the May 16, 2017 IRP Staff Proposal⁹ describing the data that LSEs must provide within a staff-provided data template and include with their Standard IRP filings. The required content is updated as follows:

1. A list of the existing and planned resources that the LSE owns or contracts with, along with various key attributes such as online date and size. This includes all resource types, both renewable and conventional. “Existing” means online as of Dec 31, 2017 and “planned” means not yet online but already contracted (i.e. sunk decisions). This list does not overlap with the

⁹ Available at: http://www.cpuc.ca.gov/irp_proposal/.

requested list of “new” resources below. To the extent possible, each existing or planned resource should be mapped to a RESOLVE resource or portion of a RESOLVE resource. There is an option to select “Other_Existing” if the LSE’s existing or planned resource does not match with any pre-defined RESOLVE resource type.

2. A list of new resources that the LSE proposes to own or contract with, along with various key attributes such as online dates and size. “New” means this is a candidate resource selected by the LSE as part of its IRP optimal new build. This list does not overlap with the requested list of “existing” and “planned” resources above. To the extent possible, each new resource should be mapped to a candidate RESOLVE resource or portion of a candidate RESOLVE resource (that the LSE selected to match with or replace). There is an option to select “Other_New” if the LSE’s new resource does not match with any pre-defined candidate RESOLVE resource type.
3. The LSE's projection of fixed costs from the LSE's existing investments.
4. The LSE's projection of fixed costs from the list of new resources that the LSE proposes to own or contract with, including fixed costs from any new transmission necessitated by the LSE's chosen new resources.
5. The LSE's annual peak load and average energy forecast including any impacts from load modifying resources. There is an optional worksheet for LSEs to provide their projected hourly load shapes which will be used to model all future years. If LSEs do not provide this data, CPUC staff will assume the LSEs’ hourly load shapes are the same as the aggregate system load shape or use their most recent submittal to the CEC for Resource Adequacy forecasting.

(End of Attachment E)