DR QC Workplan (DRAFT)

DEMAND RESPONSE QUALIFYING CAPACITY PROPOSED METHODOLOGY TESTING WORKPLAN

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CALIFORNIA ENERGY COMMISSION

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Introduction

This report details two proposed incentive-based methodologies for quantifying and evaluating the QC of DR participating in the RA program jointly administered by the CPUC and CAISO. In both proposals, DR providers use their discretion to estimate their future portfolios' capabilities, with an incentive mechanism to impose discipline by assessing penalties for ex-post underperformance. The proposals differ primarily in their evaluation of ex post "demonstrated" capacity that is used to compare actual performance to capacity commitments.

Both proposals will utilize the same input data from DRPs and the CAISO (see Figure 1) but differ in how ex-post performance is rated. The first, the Bid Alignment Metric-Performance Alignment Metric or (BAM-PAM) assesses how accurately a DRP bids its ex-ante capacity and separately assess how accurately the provider meets dispatches from the CAISO. The BNLI method instead attempts to characterize a DRP's performance on each individual event by normalizing the ex-post demonstrated load impacts to variations in bids and dispatch instructions from the CAISO. Both methods compare load impacts to a DRP's ex-ante claimed capacity to define an aggregate performance rating for an entire portfolio. That rating is then used as an input for the capacity shortfall penalty (CSP) which will incentivize DRPs to accurately predict ex-ante load impacts.

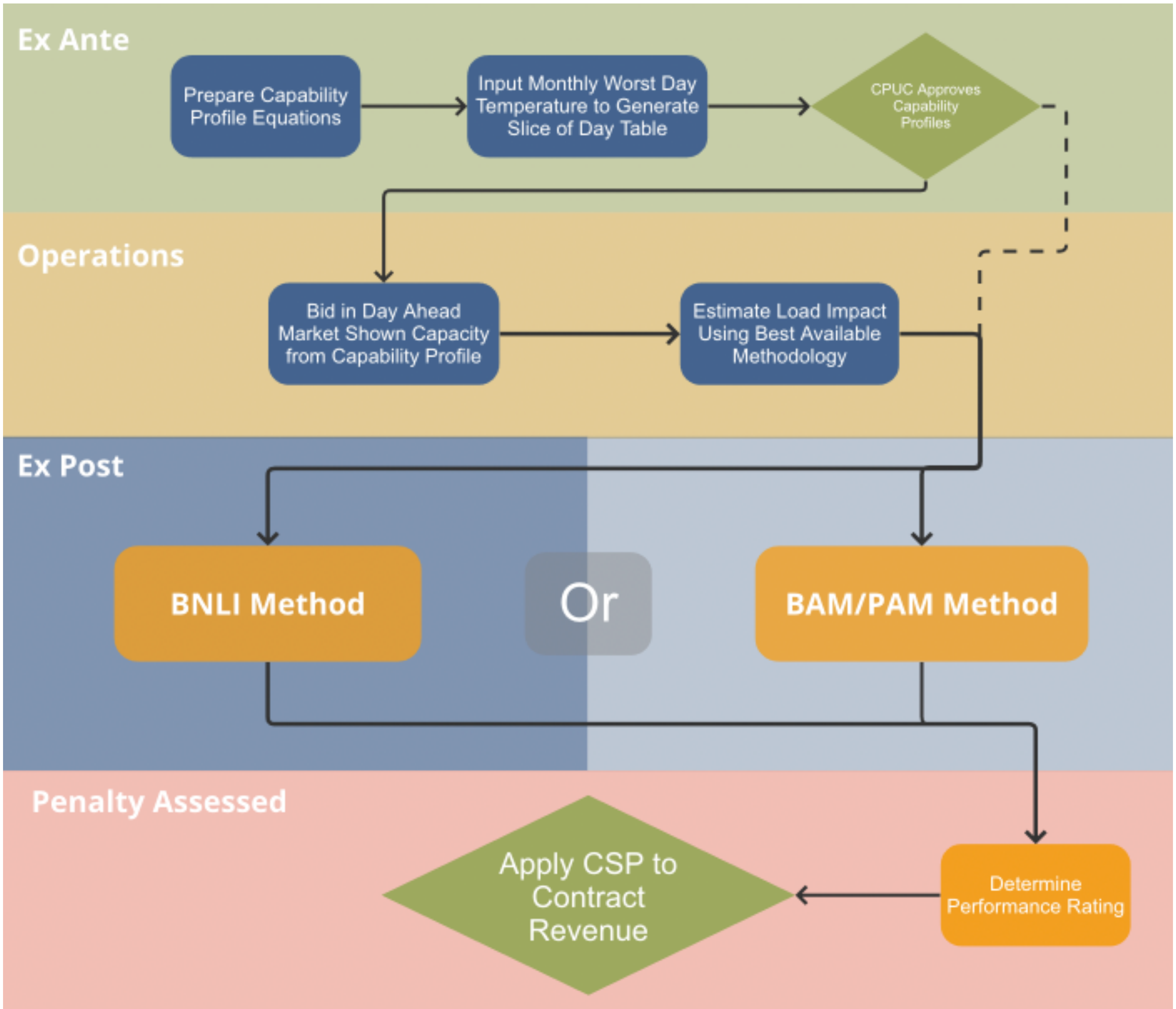


Figure 1. Methodology Flowchart

This workplan serves as a reference for how staff are planning to conduct both methods in the testing phase of DR QC working group. Staff recognize that a retrospective analysis cannot reflect changes in how DR providers might operate and perform under these proposals. Accordingly, staff will devise slight changes to the methodology that would more likely predict future performance. These alternatives are meant to be informative but cannot definitely predict future performance.

To complete these analyses with real data from 2022, staff also outline data requests from DRPs below. DRPs interested in seeing their portfolio's assessment from 2022 via the two incentive-based approaches outlined here will have the opportunity to discuss their results with staff. Adjustments to both proposals will be made throughout 2024 before a finalized approach is recommended to the CPUC.

Data Collection and Cleaning

To generate testing examples for either method, data is required from DR providers, CAISO, and NOAA. RA year 2022 will be used for testing.

CAISO Data

The CEC has made a data request from CAISO for program year 2022 that will be used across all test analyses. This dataset includes bid, schedule, and settlement data at the Resource ID level.

DR Provider Data

To successfully complete testing, two data sets are required from DR providers: capability profiles and event-level ex-post load impacts.

Capability profiles are a set of formulas that express the expected performance of a program or portfolio under varying conditions. This information has also been represented as a Time Temperature Matrix (TTM) throughout the working group process; for simplicity, DR providers are asked to submit formulas in a single format, which will be used to the requisite inputs for either method. In most cases, these will be derived from recent LIP filing models used to determine ex-ante capacity on the monthly 1-in-2 peak day.

Ex-post load impacts may be submitted if more accurate estimates than CAISO settlement values are available. Typically, these values are calculated through the LIP process and in most cases should already exist. Load impact values should be aggregated at least to the Resource ID level but may be combined further to include multiple Resource IDs with similar underlying customer characteristics within a single sub-LAP (an "aggregation" of Resource IDs, defined later).

CPUC and CEC staff recognize that this data is considered confidential and will not be shared beyond the staff at the CEC and CPUC. Staff will share DR provider-specific results with each provider and may aggregate results across DR providers to illustrate general findings publicly.

Weather Data

While DR providers will submit all information relevant to expected load impact via their ex-ante model for 2022, all relevant ex-post information will come from a separate CAISO data request.

Temperature information will be gathered from NOAA and will be used across all tests. Relevant weather stations will be matched to CAISO zip codes to define the average between daily maximum and minimum temperatures. These two data sources will define the ex-post conditions that are necessary for program/portfolio performance.

Temperature is defined as the average of daily high (TMax) and low (TMin) averaged across customers within an aggregation dispatched on a given day. The daily high and low temperatures for a given customer are defined as those values from the weather station matching the DR Registration System (DRRS) customer ZIP code in the California ISO "NOAA Station to Zip Mapping" file.[1] The temperature (Temp) value for aggregation *a* (which may consist of one or more Resource IDs within a single sub-LAP) on date *d* is defined as:

$$Temp_{a,d} = \frac{\sum_{s=1}^{p} \frac{1}{2}\left(TMax_{s,d} + TMin_{s,d}\right)}{p}$$

where *s* is the index for customer sites dispatched on date *d* and *p* is the number of sites. Equivalently, this value can be determined from counts of sites by ZIP code *z*:

$$Temp_{a,d} = \frac{\sum_{z=1}^{q} \frac{p_{z,d}}{2}\left(TMax_{z,d} + TMin_{z,d}\right)}{\sum_{z=1}^{q} p_{z,d}}$$

where *q* is the number of zip codes and *p* is the number of dispatched sites in each ZIP code.

[1] http://www.caiso.com/Documents/NOAA-Station-to-Zip-Mapping.xlsx

Ex-Ante

The ex-ante process is equivalent under both proposals under consideration, which are centered on a recurring cycle of ex-ante capacity projection and commitment followed by ex-post capacity measurement. Ex-ante capacity is determined by applying a set of monthly planning assumptions (including but not limited to the "worst day" temperature as defined in the RA program) to a set of linear equations referred to as "capability profiles" that predict the load impacts (MWh) of a DR aggregation in a given interval under any set of conditions.

These capability profiles are defined by the DR provider during the ex-ante capacity phase. The CPUC will retain the role of reviewing capacity claims for reasonableness but will focus its review on the specifications of the capability profiles and associated planning assumptions rather than the coefficients and parameters themselves. The resulting QC can then be contracted to LSEs and committed in the RA capacity market via RA supply showings ("committed" capacity).

The following describes the entire ex-ante process as it would occur under the RA program. For purposes of testing, CPUC and CEC staff will support DR providers in developing reasonable capability profiles and planning assumptions, but no formal reasonableness determination will be made.

1. **DR providers define resource aggregations:**

   DR providers create aggregations, which are groups of CAISO Resource IDs within a single sub-LAP. Aggregations are the unit of analysis under the proposed methodologies. Aggregations may be individual Resource IDs, all Resource IDs within a single sub-LAP, or a custom aggregation of Resource IDs with similar characteristics within a sub-LAP.

2. **DR providers develop capability profiles:**

   DR providers develop a set of linear equations that define each aggregation's expected performance under all conditions a resource could be called under. DR providers may use any methods and data available to them to develop. For example, they may use simple linear regression (the same that will be used to calculate demonstrated capacity) or more advanced machine learning techniques, they may use one or multiple years of historical data, they may use data across different sub-LAPs, and they may drop data points that are not reflective of current capabilities. Capability profiles may include the following types of data, though this list is not intended to be exhaustive:

   a. Month or months (e.g., a "summer" season defined as June–September)
   b. Hour of day or hour of event
   c. Temperature, including variants such as heating and cooling degree-days relative to a fixed change point
   d. Day or days of week (e.g., weekend vs. weekday) or holiday

   Interactions between these variables may be included as appropriate. For example, a resource may have a different relationship temperature depending on the month, hour of day or event, and day of the week.

For example, the portfolio analyzed in "Ex ante and TTM Model Example 1" prepared by Demand Side Analytics can be reformatted as a set of equations with linear terms for each aggregation (in this case, all Resource IDs within each sub-LAP), as summarized in Figure 2. The capability profile of the aggregation includes interactions between temperature and each of hour of day, hour of event, and weekday/weekend.

Figure 2. Sample Capability Profiles for Sub-LAP Level Aggregations

SubLAP/ Aggregation	Intercept	avgtemp	event_hour =2	event_hour =3	event_hour =4	hour=18	hour=19	hour=20	hour=21	weekday=1	event_hour=2: avgtemp	event_hour=3: avgtemp	event_hour=4: avgtemp	hour=18: avgtemp	hour=19: avgtemp	hour=20: avgtemp	hour=21: avgtemp	weekday=1: avgtemp
01	-4.469	0.068	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
02	-5.070	0.080	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
03	-3.032	0.051	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
04	-2.282	0.040	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
05	-5.736	0.091	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
06	-0.125	0.004	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
07	0.663	0.008	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
08	-2.257	0.039	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
09	-1.964	0.038	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
10	-2.997	0.049	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
11	-1.452	0.028	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
12	-1.689	0.031	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
13	0.662	-0.008	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
14	-3.546	0.058	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
15	-2.979	0.049	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005
16	-4.916	0.075	0.436	0.477	0.303	0.411	1.133	1.341	1.214	-0.354	-0.009	-0.012	-0.010	-0.006	-0.015	-0.019	-0.019	0.005

Polynomials, logarithms, and other non-linear functions of these variables, particularly temperature, may also be included. That is, while the capability profile must eventually be represented as a set of linear equations, the independent variables do not need to be linear.

If desired, all permutations of expected conditions may be applied to each capability profile and expressed as a time-temperature matrix.

3. **DR providers determine monthly growth factors:**

DR providers projecting growth in their portfolios may submit monthly growth factors to reflect the increase in expected capacity over time while maintaining the relationship with temperature and other external factors. Growth factors may be unitless multipliers (e.g., 1.1 represents 10 percent growth relative to the unadjusted capability profile), or they may reflect underlying resources (e.g., number of enrolled customers if capability profiles are represented on a per-customer basis, or total MW of battery storage). If no growth factors are provided, a fixed growth factor of 1 will be assumed across all months.

4. **Apply planning assumptions to derive monthly and hourly claimed capacity:**

   DR providers apply the set of "worst day" planning assumptions as defined in the RA program to each aggregation's capability profile for each month, including the "worst day" temperature for each sub-LAP. Planning assumptions may also include additional inputs such as day of the week (e.g., to assume a non-holiday weekday or Saturday if resources are not obligated to be available on Sundays or holidays). For example, the "TTM Example 1" described above accounts for 4 event hours and 5 hours of day. The DR provider would need to decide whether the 4 event hours coincide with HE 17–20 or 18–21.

   Multiply the values in each month by monthly growth factors. The resulting value of the capability profiles under the planning assumptions and adjusted for projected growth is a claimed capacity value for each month and hour. These monthly and hourly claimed capacity values can be summarized in a "slice-of-day table," as illustrated in Figure 3

   Figure 3: Example Slice-of-Day Table

Hour Ending	January	February	March	April	May	June	July	August	September	October	November	December
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	39.5	54.2	91.8	101.6	42.4	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	22.6	35.6	59.8	66.1	28.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	13.8	21.5	35.7	39.4	17.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	9.3	15.0	24.7	27.3	12.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	-11.6	-17.6	-27.7	-30.4	-14.4	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	-0.2	-0.4	-0.6	-0.6	-0.3	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

5. **CPUC staff reviews capability profile specifications and planning assumptions for reasonableness:**

   Under an incentive-based approach, the primary role of CPUC staff is to determine whether the capability profile reasonably translates into capacity value for the grid, not to assess the reasonableness of the resultant capacity values themselves. For example, an aggregation with capability that increases linearly up to the highest planning temperature but falls to zero beyond this temperature could mathematically be awarded high capacity values but have no capacity obligation during especially hot periods when the need for capacity is greatest. Such a capacity profile would likely be deemed unreasonable, but this determination would be made by CPUC staff. Similarly, a resource with nonzero capabilities only on Thursday and submits a planning assumption of the "worst day" occurring on a Thursday would likely be deemed unreasonable.

Submissions deemed unreasonable should have their capability profile specifications and planning assumptions updated and resubmitted.

6. **CPUC staff award QC using accepted capability profiles and planning assumptions:**

   Once capability profiles and their associated planning assumptions are deemed reasonable, monthly and hourly capacity values can be unambiguously calculated. CPUC staff verify and award these values as QC. While the primary role of CPUC staff is to assess the reasonableness of the specifications that determine QC, CPUC staff reserve the right to reduce claimed capacity in extreme situations by adjusting growth factors when awarding QC.

7. **DR providers contract QC with LSEs, which commit DR capacity to the CAISO on RA supply showings:**

   DR providers may contract up to the amount awarded by the CPUC in each month and hour. However, it is possible that not all that capacity will be contracted and shown on CAISO supply plans for RA. Only the shown capacity is considered "committed," which is the value against which demonstrated capacity will be compared in the ex-post process.

Following the ex-post process, including claiming, awarding, contracting, and committing capacity for RA, DR providers will demonstrate their capacity value in the operational space by participating in the CAISO wholesale market.

Ex-post

This chapter details the two different proposed ex-post methodologies for measuring performance against a capacity commitment.

Following the completion of a season within the RA year, load impacts for each individual site should be calculated using the best available method to determine each counterfactual load profile. The counterfactual may be the same as used in CAISO settlement where appropriate but may include other regression- or comparison group-based baseline approaches. If using the same baseline approach as for CAISO settlement, LI may be calculated as the sum of Demand Response Energy Measurement[2] from CAISO settlement data over the 12 5-minute intervals in each hour.

BAM-PAM Method

The Bid Alignment Metric-Performance Alignment Metric (BAM-PAM) method assesses the extent to which DR providers bid amounts commensurate with their capacity commitments (bid alignment), then deliver when dispatched by the CAISO (performance alignment). A performance metric is defined for each step: the bid alignment metric (BAM) and the performance alignment metric (PAM). Overall performance is defined as the product of these metrics.

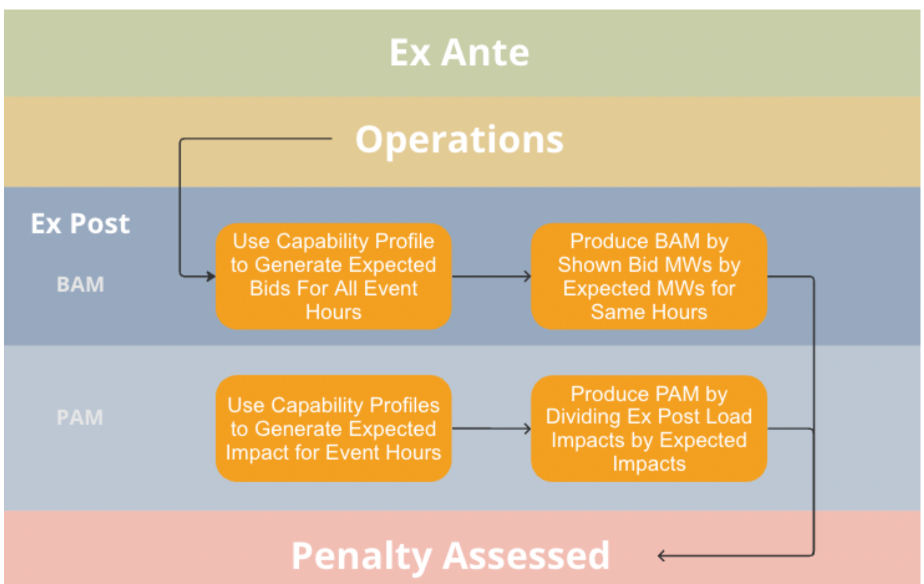


Figure 2. BAM/PAM Process Flowchart

[2] METER_QUANTITY

1. **Calculate the Bid Alignment Metric:**

The BAM reflects the extent to which bids during the RA period align with the values from the capability profiles. The metric will be calculated as a ratio between the bid quantity values and the capability profiles during the top 100 net load hours for each year as a proxy for when DR resources are most needed. A ratio of 1.0 indicates full alignment between operations and planning, a value greater than 1.0 means that the bid values were greater than the capability forecasted by the ex-ante model, and a value less than 1.0 would indicate that the bid values are lower than the values indicated by the planning model.

For all months and hours in which an aggregation has a capacity commitment, three data points are required: actual DAM bid values, full-duration dispatch capability values, and sub-LAP LMPs. First, filter ex-post bid data, including all variables in the capability profile, to the months and hours in which each aggregation has a capacity commitment.

In the DAM, each resource's bids will be compared to its expected capability (as reflected in the ex-ante capability profile) under a full-duration dispatch, meaning the full resource is dispatched across all hours with a capacity commitment. For example, if a resource is shown from HE18 through HE21, the capability value should reflect a 4-hour dispatch beginning in HE18. For each day and hour with a capacity commitment, calculate the corresponding capability profile value by inputting variables such as temperature and day of the week into the relevant capability profile equations. Match each interval to the DAM sub-LAP LMP.

After the bid, capability, and LMP values are collected for all relevant aggregations, calculate the LMP-weighted portfolio-level BAM according to the following formula, where *r* is a row in the filtered data set representing a unique combination of aggregation, date, and time, and *n* is the number of rows:

$$BAM = \frac{\sum_{r=1}^{n} Bid_r LMP_r}{\sum_{r=1}^{n} Capability_r LMP_r}$$

2. **Calculate the Performance Alignment Metric:**

The PAM reflects the extent to which actual performance during operations aligns with the forecasted capability used for planning (ex-ante impacts). It is defined as the ratio between the ex-post load impacts and the ex-ante capability values submitted for hours in which an aggregation received a DAM dispatch. A ratio of 1.0 indicates perfect alignment between performance and planning, a value greater than 1.0 would indicates overperformance relative to the capability profile, and a value less than 1.0 indicates underperformance.

For all intervals in which any resource within an aggregation receives a DAM dispatch, three data points are required: actual load impact values, dispatch-duration capability values, and sub-LAP LMPs. First, filter ex-post load impact data, including all variables in the capability profile, to the intervals in which each aggregation receives a DAM dispatch.

For PAM, the conditions ex-post dispatch conditions should be used to select the capability profile values in the same way as for BAM, but only for the hours receiving a dispatch in the DAM. If the example resource above receives a dispatch for HE19 through HE21 but not HE18, the capability profile value would reflect a 3-hour dispatch starting in HE19. (Note that these values may or may not differ from the 4-hour dispatch depending on whether the hour of day, dispatch duration, or both are specified in the capability profile.) Match each interval to the DAM sub-LAP LMP.

After the load impact (LI), capability, and LMP values are collected for all relevant aggregations, calculate the LMP-weighted portfolio-level PAM according to the following formula, where *r* is a row in the filtered data set representing a unique combination of aggregation, date, and time, and *n* is the number of rows:

$$PAM = \frac{\sum_{r=1}^{n} LI_r LMP_r}{\sum_{r=1}^{n} Capability_r LMP_r}$$

3. **Multiply BAM and PAM to determine the final performance rating:**

The two metrics are then used to calculate a performance rating for each DR provider. The overall rating is defined as BAM multiplied by PAM (e.g., 95% * 95% = 90.75%). Performance ratings less than 100 percent will be subject to the capacity shortfall penalty described in the following chapter.

BNLI Regression

The ex-post process begins once all required data, including the most accurate estimates of event-level performance, is available for all months of the RA year in which a DR provider had committed capacity. First, individual events are adjusted to estimate total capability in cases where an aggregation received a partial dispatch. Next, a linear regression is run for each aggregation using the same parameters to re-estimate the coefficients that determine that aggregation's capabilities under varying conditions. Then the same planning assumptions are applied to the resulting set of linear equations resulting from the model to determine the ex-post "demonstrated" capacity. These monthly and hourly demonstrated capacity values are compared to committed capacity, then aggregated to determine an overall performance rating, which is used to apply the CSP covered in the final chapter.

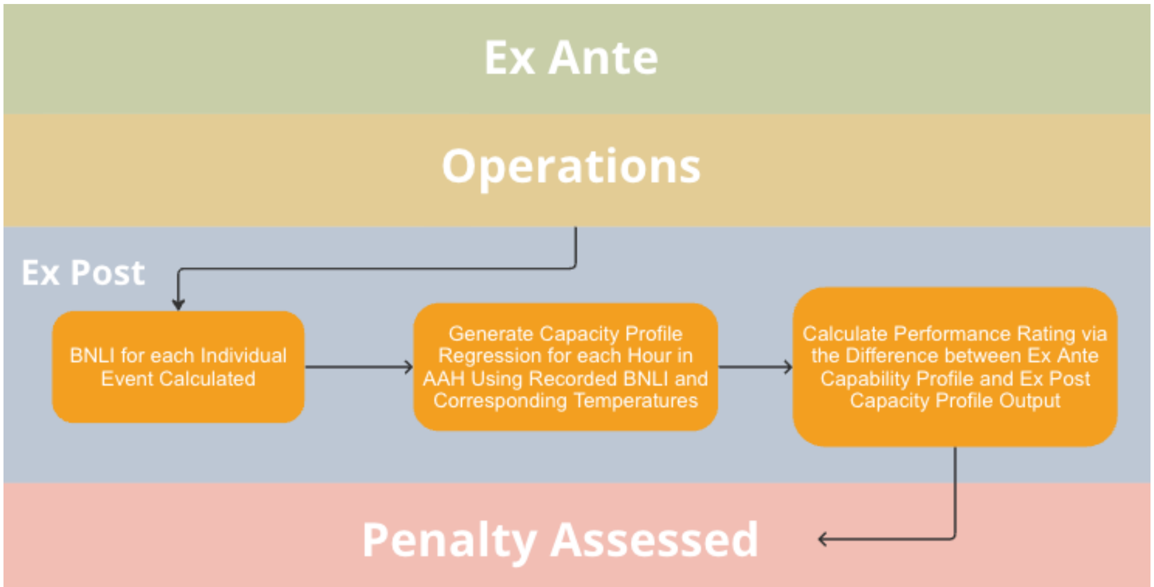


Figure 3. BNLI Process Flowchart

1. **Calculate Aggregation-Level Input Values:**
   The BNLI regression capacity measurement relies on the inputs listed below, each of which must be aggregated to the hourly level for each aggregation. These data streams and the aggregation required for each include the following:
   - **Offer:** The offer value is defined as bid quantity (MW) (at a price no greater than $600/MWh) plus Self-Schedules (MW) in the real-time market during each hour. Self-schedules reflect schedules in response to DAM bids. The offer value for aggregation *a* (consisting of *n* Resource IDs[3] *r,* where n≥1) in a specific interval (date[4] *d*, hour[5] *h*) is defined as:

$$Offer_{a,d,h} = \sum_{r=1}^{n} RTM\_BID\_QUANTITY_{r,d,h} + RTM\_SELFCHEDMW_{r,d,h}$$

     where RTM_BID QUANTITY refer to the total bid quantities with RTM_BID_PRICE ≤$600/MWh. Offer values of zero will be excluded from analysis unless the sub-LAP LMP ≥$600, such that resources that have no schedules when the price cap is reached receive an Offer value of zero.
   - **Load Impact (LI):** LI is the hourly delivered energy value (MWh). The LI value for aggregation *a* (consisting of *n* Resource IDs *r* where n≥1, each of which consists of *m* sites *s* where *m*≥1) in date *d* and hour *h* is defined as:

[3] RESOURCE_NAME in CAISO data

[4] TRADE_DATE

[5] TRADE_HOUR

$$LI_{a,d,h} = \sum_{r=1}^{n}\sum_{s=1}^{m} LI_{s,d,h}$$

- **Total Expected Energy (TEE):** TEE is the total amount of energy (MWh) a Resource ID is expected to deliver in the CAISO based on its real-time market schedules. The TEE value for aggregation *a* (consisting of *n* Resource IDs *r*, where *n*≥1) in hour h over the twelve 5-minute intervals *i* is defined as:

$$TEE_{a,d,h} = \sum_{r=1}^{n}\sum_{i=1}^{12} EXP\_ENRGY\_QUANTITY_{r,d,h,i}$$

2. **Calculate Bid-Normalized Load Impact (BNLI):**

Hourly load impacts are adjusted relative to the amount offered, and dispatched according to the following definition of bid-normalized load impacts (BNLI) for each aggregation *a* in each interval (date *d*, hour *h*):

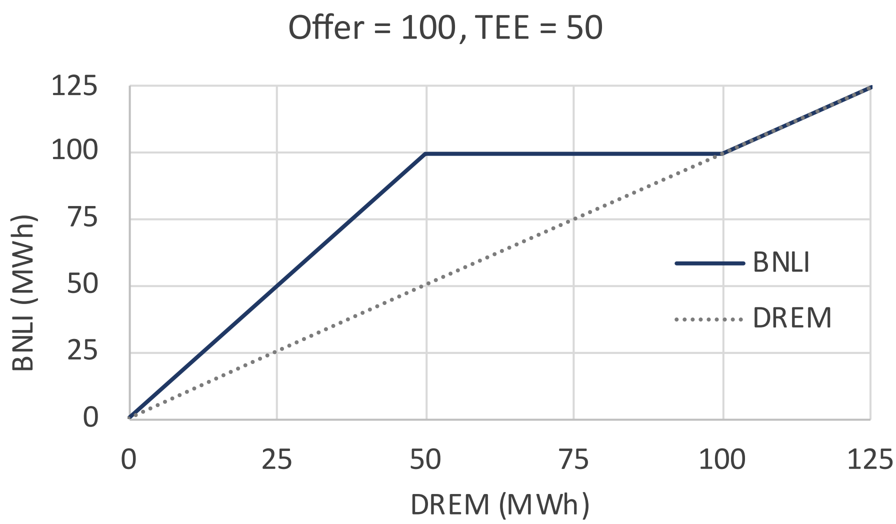
$$BNLI_{a,d,h} = \max\left(Offer_{a,d,h}\left(\frac{\min\left(LI_{a,d,h}, TEE_{a,d,h}\right)}{TEE_{a,d,h}}\right), LI_{a,d,h}\right)$$

where Offer, LI, and TEE are the hourly aggregation-level values as defined above. BNLI will only be calculated if TEE > 0 (implying Offer > 0) or if the sub-LAP LMP ≥$600, such that resources that have no schedules when the bid cap is reached receive a BNLI value of zero. If TEE < 0.2Offer in an hour, the event shall also be omitted from the calculation of demonstrated capacity.

Intervals in which a DR resource has a must-offer obligation (that is, has a slice-of-day capacity showing for that hour in that month) but does not bid will be assigned a BNLI value of zero.

Figure 4 illustrates bid-normalized load impacts as a function of actual LI. When TEE is greater than or equal to Offer, for example, because the resource received a dispatch on capacity bid above $600/MWh, BNLI will always be equal to DREM.

Figure 4: Example Bid-Normalized Load Impacts (BNLI) for Offer = 100 MWh and TEE = 50 MWh



Source: CEC staff analysis

3. **Apply capability profile specification to estimate ex-post performance profiles:**

   Estimate the ex-post performance profiles by linear regression using BNLI as the dependent variable to be estimated. Each ex-post regression must include the same set of independent variables submitted in the ex-ante capability profile, such as season, time, and temperature, and any variations thereof. Accordingly, for every linear coefficient submitted in the ex-ante capability profile, the regression will estimate a corresponding coefficient in the ex-post performance profile.

4. **Determine demonstrated capacity by apply "worst day" planning assumptions to performance profiles:**

   Apply the "worst day" conditions determined in the RA program to estimate demonstrated capacity. Demonstrated capacity reflects the average resource performance conditional on the planning assumptions such as temperature and whether the event took place on a weekday. The result is a demonstrated capacity value for each month and hour in which capacity was committed.

5. **Total demonstrated capacity values across the resource portfolio and calculate slice-of-day performance ratings relative to committed capacity:**

   Sum the capacity values for each month and hour across all aggregations in all sub-LAPs to determine portfolio-level monthly and hourly demonstrated capacity. (For local capacity obligations, include only resources within the relevant local area.) For each month and hour, calculate demonstrated capacity as a percentage of committed capacity. Constrain this value to between 0 and 120 percent, such that demonstrated capacity values less than zero receive a performance value of zero percent and values higher than 120 percent receive a value of 120 percent.

6. **Determine portfolio-level performance rating:**

   Calculate take a weighted average of performance across months and hours, using the monthly capacity price and number of events called within each hour as weights, so that months with higher capacity needs and hours with more events receive greater weight in the ultimate performance calculation. Weighted performance rating *R* is defined as:

$$R = \frac{\sum_{m=1}^{q} \sum_{h=1}^{r} R_{m,h} E_h P_m}{\sum_{m=1}^{q} \sum_{h=1}^{r} EP}$$

   where $R_{m,h}$ is the performance rating in month *m* and hour *h,* E_h is the number of events in hour *h,* and P_m is the contract price for month *m*. E and P are the total number of events and the sum of monthly contract prices.

   The result is a single performance rating as a percentage of committed capacity. Performance ratings less than 100 percent will be subject to the capacity shortfall penalty described in the following chapter.

Alternatives for Testing

Staff plan to test a sensitivity scenario with a BNLI "price cap" of $999.99/MWh, in contrast to the $600/MWh as proposed, to simulate the results as if DR providers were responding to the incentives embedded in the BNLI Regression proposal. As staff understand, bids at $1,000/MWh typically reflect bids that are required under the MOO (and often subject to RAAIM) but are often expected to be unattainable under typical operating conditions. The BNLI Regression relieves DR providers of this requirement, so staff believe that unattainable bids will not be made, but the proposal also incentivizes bidding most capacity at or below $600/MWh, which is not expected under the status quo. Adjusting the "price cap" to just below $1,000/MWh will avoid penalizing ex-post performance in the historical data that was not subject to the price cap.

Capacity Shortfall Penalty

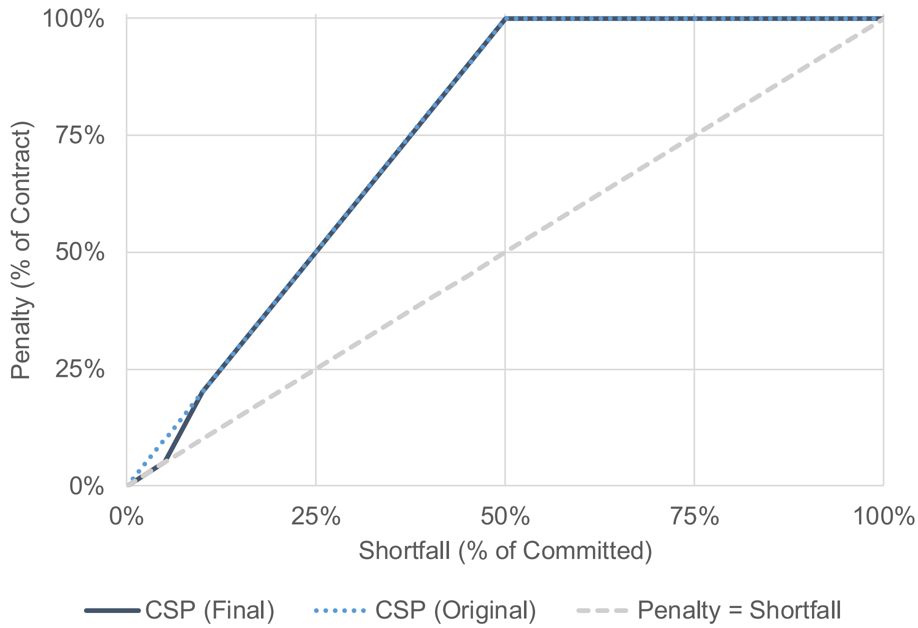
Both methods ultimately result in a single performance metric expressed as a percentage of committed capacity. If performance is less than 100 percent, the capacity shortfall penalty (CSP) is calculated as a function of the shortfall, defined as 100 percent minus performance. The CSP is defined by the formula summarized in Table 1.

Table 1: Capacity Shortfall Penalty Formula

Shortfall (S)	**Penalty (% of contract)**
0% < S ≤ 5%	S
5% < S ≤ 10%	5% + 3(S – 5%)
10% < S ≤ 50%	2S
S > 50%	100%

Graphically, the CSP is represented by the solid dark blue line in Figure 5. The CSP begins as pay-for-performance at low shortfall levels (<5%), simply adjusting the payment to correspond to the demonstrated capacity. At higher levels (>10%), the penalty is equal to twice the shortfall. In between, the marginal penalty on the shortfall above 5 percent increases to allow the pay-for-performance segment to meet the full penalty segment. Once the shortfall exceeds 50 percent, the penalty equals 100 percent of the contract value and no incremental penalty is imposed.

Figure 5: Capacity Shortfall Penalty



The CSP is intended to apply to the entire contract value across months and hours. However, IOU-implemented programs do not have an explicit capacity contract price and third-party DR providers are not obligated to share capacity prices or contract values. In these cases, the RA capacity deficiency penalty values adopted by the CPUC will be used as proxies for monthly capacity price. Currently, this penalty value is $8.88/kW-month from May through October, and $4.44/kW-month from January through April and November through December.[6] These default values are not intended to be static and will change as new penalty values are adopted by the CPUC.

Penalty Enforcement Mechanism

Under this proposal, the CPUC will require DR capacity contracts to include the CSP as a prerequisite to qualify for RA. Third party DR providers will repay each LSE a pro rata share of any penalty assessed based on the proportion of capacity committed by each LSE. IOU DR providers will repay any penalty to the CPUC. Deliberation on specifics regarding the enforcement of this penalty will continue and be finalized before staff's ultimate recommendation in December 2024.

[6] CPUC. 2021. Decision 21-06-029. DECISION ADOPTING LOCAL CAPACITY OBLIGATIONS FOR 2022-2024, FLEXIBLE CAPACITY OBLIGATIONS FOR 2022, AND REFINEMENTS TO THE RESOURCE ADEQUACY PROGRAM. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M389/K603/389603561.PDF.