Qualifying Capacity and Effective Flexible Capacity Calculation Methodologies for Energy Storage and Supply-Side Demand Response Resources

Staff Proposal Outline
Resource Adequacy Proceeding R.11-10-023
California Public Utilities Commission – Energy Division

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Introduction

This Energy Division Staff Proposal Outline (Proposal Outline) recommends basic features for the California Public Utilities Commission's Qualifying Capacity (QC) and Effective Flexible Capacity (EFC) methodologies for energy storage (ES) and supply-side demand response (DR) resources. A resource's Qualifying Capacity (QC) is the number of megawatts eligible to be counted towards meeting a load serving entity's (LSE's) System and Local Resource Adequacy (RA) requirements, subject to deliverability constraints.[1] A resource's Effective Flexible Capacity (EFC) is the number of megawatts eligible to be counted towards meeting an LSE's Flexible Resource Adequacy (RA) requirements.

In accordance with the RA proceeding Scoping Memo (R.11-10-023), Energy Division (ED) staff issues this Proposal Outline and will later seek formal comments, following an associated workshop. Party comments will inform the development of a more detailed Staff Proposal and ultimately a Proposed Decision, and will become part of the rulemaking's record. In addition, the comments submitted in response to this Proposal Outline may inform staff efforts in the ES and DR as well as other related proceedings, for example in the development of performance testing protocols.

The only ES and DR resources that are included in the scope of this Proposal are those that bid into California Independent System Operator (CAISO) markets and are subject to a Must-Offer Obligation (MOO). These resources are: transmission-level energy storage, some distribution-level and behind-the-meter storage (depending on whether it is operated in accordance with the above requirements), and supply-side demand response.[2]

[1] The revised QC that incorporates deliverability constraints is called the Net Qualifying Capacity (NQC).

[2] Information on the energy storage and demand response proceedings, including additional details on what types of resources are considered to be energy storage and supply-side demand response, can be found at http://www.cpuc.ca.gov/PUC/energy/electric/storage.htm and http://www.cpuc.ca.gov/PUC/energy/Demand+Response/DemandResponseWorkshops.htm, respectively.

Supply-side demand response, which is eligible for RA credit, is distinguished here from customer-focused programs and rates. Customer-focused programs and rates count towards reliability needs as load modifiers rather than as supply-side resources, and are included in load forecasting rather than receiving a QC or EFC. The Commission is considering bifurcating current DR programs into supply-side and demand-side (customer-focused programs and rates) in the DR Rulemaking (R.)13-09-011, and ED staff will coordinate across both that rulemaking and the RA rulemaking to ensure consistency.

ED staff has considered a variety of approaches to capacity calculations. While this Proposal Outline recommends one particular approach, the primary purpose of this Proposal is not only to solicit stakeholder feedback regarding the validity and desirability of this approach, but also to prompt alternative suggestions from stakeholders for further consideration. Parties will be able to submit formal comments according to the dates in the ALJ Scoping Memo from August 2, 2013.[3]

The following sections outline the key recommendations proposed by ED staff. These recommendations may be expanded upon in the future, in light of the aforementioned collaboration and input from parties.

RA eligibility requirements for ES and DR

1. Energy storage resources located within a single Sub-LAP may be aggregated to form a single, RA-eligible resource. DR resources may also be similarly aggregated. ES and DR may further be jointly aggregated to create a combined ES-DR resource. Staff requests parties' input as to the desirability of coordinating with the CAISO to enable larger aggregation granularity (e.g., by IOU service territory) for System and Flexible RA in future years. To be eligible for Local RA, ES and DR assets must be located within a single Sub-LAP or Custom LAP and within a single local capacity area. Aggregated resources must reflect the use limitations of their individual elements. However, elements of aggregated resources need not individually meet RA eligibility requirements; rather, the resource as a whole must demonstrate eligibility. An example of resource aggregation is shown in Figure 1, below.
    - Operators may request to qualify an aggregate resource for an RA capacity that is less than its maximum output, in order to account for anticipated non-performance in a percentage of the portfolio. For example, operators may wish to reduce their RA value in order to account for some storage not being in the desired state when dispatched, or to account for a portion of DR participants overriding dispatches.

[3] The ALJ Scoping Memo for R.11-10-023 can be viewed at http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=75391604.

2. To the extent possible, RA eligibility requirements should remain consistent across all resource types, including ES and DR. These requirements include the ability to operate for at least four consecutive hours at maximum energy output (P_{max}), and to do so over three consecutive days. Resources wishing to qualify for RA must also have the capability to offer into the CAISO markets, either via economic bids or via self-scheduling, under the RA Must Offer Obligation (MOO). Resources that wish to be qualified as Flexible RA must comply with the CAISO's Flexible RA Criteria and Must Offer Obligations (FRAC-MOO).[4]

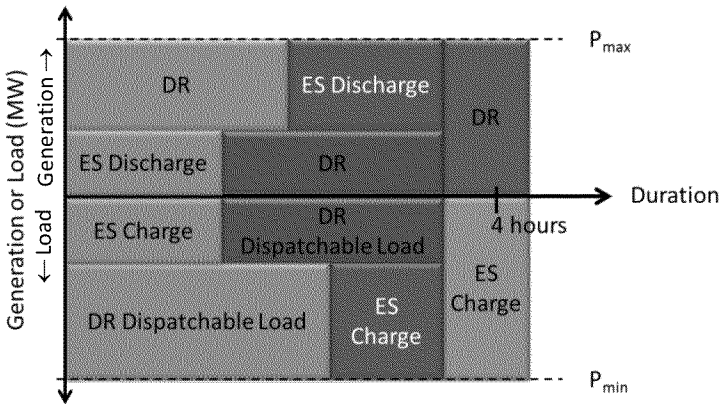

Figure 1. Resource aggregation example

3. Co-located ES operating in conjunction with another, larger RA-eligible resource need not meet the RA eligibility requirement of being able to operate for four consecutive hours on three consecutive days; the RA qualification of the primary generating facility is sufficient.

4. Future modeling of reliability may indicate ways in which some of the above requirements could be altered; future RA proceedings will be informed by that analysis. For example, the ED's ongoing reliability modeling study may suggest that resources that are currently RA-ineligible can nevertheless contribute to reliability. Once this study is complete, the Commission may revisit the RA eligibility rules for all resources.

[4] A must-offer obligation, or MOO, is a commitment to be available for economic dispatch by the CAISO during standard hours that are set by the CAISO. The MOO, which sets a window of availability for dispatch, is distinct from the four hour capability requirement for continuous operation upon dispatch. System and Local RA resources, whether DR or ES, may either bid into the CAISO markets or self-schedule. The MOO for Flexible RA resources (FRAC-MOO) is still under development at the CAISO. According to the most recent straw proposal, demand response resources wishing to qualify for Flexible RA must submit economic bids in the day ahead and real time markets during a set time window on non-holiday weekdays in either the morning (07:00-12:00) or the evening (15:00-20:00), in order to ensure that they will be available to contribute to the times of greatest system ramping. In the case of storage, resources wishing to qualify for Flexible RA must either submit economic bids into the CAISO day ahead and real time markets from 05:00-22:00, or bid into the regulation energy market during that time. However, these rules are subject to change.

CPUC testing and verification requirements

1. QC and EFC determinations shall incorporate historical performance data where possible. To the extent that historical performance data is not available or appropriate, program design and/or test data may be used.

2. DR must be tested and/or dispatched at least once annually, to demonstrate initial and continued performance. Testing should simulate expected dispatch conditions, and two-hour testing is required to ensure performance does not degrade over the course of operation; operators should be paid for the test event exactly as if it were a regular dispatch event. This testing will be designed in coordination with the CAISO, to avoid duplicative testing. In particular, DR wishing to qualify as Flexible RA must submit to testing that occurs within its must-offer obligation window. This testing should occur within a month chosen by the demand response provider, with the day and time randomly selected by the CAISO. This testing must only be repeated if the DR program is not dispatched at all over any given twelve-month period. If the DR is dispatched at least once during a given twelve-month period, additional testing is not required.

    - Successful testing to qualify as Flexible RA will be deemed sufficient for qualification as System and Local RA, provided that the program design complies with those product types. Namely, the program must be available during at least four of the standard availability assessment hours each day to qualify as System RA, and the program must be locally dispatchable to qualify as Local RA.

    - If a resource does not wish to qualify for Flexible RA, it must submit to similar testing for qualification as System RA, but conducted at a time of its own choosing rather than at a time selected by the CAISO.

3. DR performance should be measured based on ex-post (after-the-fact) analysis of testing and dispatches using the load impact protocols (LIPs), as is already the case for the utilities' current DR programs (Retail DR).[5]

    - In determining the resource's QC and EFC, test results may be adjusted by the CPUC to reflect anticipated changes in weather, enrollment, or program design.

    - Resources may elect to request a QC or EFC that is lower than that calculated based on testing, if they wish to reduce the amount of capacity that is subject to a MOO.

4. Staff seeks parties' feedback on its proposal that aggregated resources may provide performance data from a single aggregation point and need not report individual element performance in real time or on a regular basis. Regardless of aggregation, individual element performance data must be

[5] LIPs were specified by Decision 08-04-050, and modified by Decision 10-04-006.

made available to the CPUC and the CAISO for auditing and verification purposes upon request and as part of initial testing for RA qualification. In the future, more detailed testing and performance reporting protocols will be explored jointly with the CAISO and other parties in order to balance the needs for verifiable performance, practical feasibility, and reasonable cost.

5. In the energy storage and demand response proceedings, the Commission may consider testing and assessment protocols that can measure the performance of those resources.

Approach recommended for QC and EFC calculations for the 2015 RA Compliance Year

Qualifying Capacity (QC)

1. Staff recommends that dispatchable ES receive QC in the same manner as other dispatchable resources, based on a four-hour P_{max}, including testing and verification in CAISO operations. Specifically, the ES operator must submit to the CAISO an output level (in MW) at which it is capable of discharging for four or more uninterrupted hours; this is its P_{max}. The facility must then submit to physical testing by the CAISO to verify that it can be dispatched at this capacity. The QC will be equal to this P_{max} value. The facility will also be subject to the standard CAISO NQC process, whereby the Net Qualifying Capacity of a resource is limited to an output level that is deliverable to the aggregate of CAISO load; this process is also undertaken for conventional resources.

2. Facilities may also submit a short-term maximum rated output to the CAISO, for dispatch purposes. However, if this output duration is below the four hour requirement for RA eligibility, it cannot be used as the P_{max} value in RA credit determinations.

3. DR resources should receive QC values based on their LIPs, in the same manner as existing Retail DR.

Effective Flexible Capacity (EFC)

1. Facilities wishing to qualify for Flexible RA must still be qualified for System RA, and receive QC values as described previously. P_{max} values for Flexible RA shall be identical to those utilized in determining the resource's System RA credit, and set according to the rules previously described.

2. EFC should incorporate dispatchable load/ES charging because these operational modes can address ramping needs. Qualifying capacity, because it solely aims to address capacity shortfalls, should not incorporate these operational modes. This difference will frequently result in EFC > QC. While EFC is currently limited to be less than or equal to NQC, Staff recommends that the Commission modify that rule to allow EFC to be limited by the greater of NQC and (NQC – P_{min}), where P_{min} is the minimum sustainable operating level of the facility. If the facility is capable of dispatchable charging (ES) or load increase (DR), its P_{min} will be negative.

3. For ES and DR facilities with *only positive output ranges*, the operator shall submit to the CAISO the facility's minimum sustainable operating level in MW; this is the facility's P_{min}. P_{min} may be zero. For

facilities with *both positive and negative operating ranges*, the facility operator shall submit to the CAISO an operating level in MW at which the facility is capable of charging (or increasing demand) for 1.5 or more uninterrupted hours; that will be the facility's P_{min} value. Such facilities can thus meet the three-hour ramping requirement for flexibility by charging (or increasing demand) at P_{min} for the first half of the three-hour ramp and then discharging at or above P_{max} for the remainder of the ramp. For facilities with a *negative operating range only* (i.e., a P_{max} of zero), the facility must submit a P_{min} value that is sustainable for the full three hours required for Flexible RA eligibility.

4. All facilities are subject to CAISO testing to verify the submitted P_{min}. Negative P_{min} will also be subject to limits on how much charging is possible given transmission constraints, if and when the CAISO develops deliverability assessments for that condition.

5. Energy storage and DR facility operators must also submit their ramp rates to the CAISO. A ramp rate is defined as the maximum MW/minute by which a facility can increase its output. An increase in output is defined as a change in output that is in the direction from P_{min} to P_{max} (i.e., more positive generation or more load reduction); for DR, for example, increased output means an increase in the magnitude of load that is reduced. The ramp rate may change over different segments of operation; for example, a facility's ramp rate may be lower between 10 and 20 MW than it is between 20 and 50 MW. A facility's average ramp rate is generally defined as the number of MW by which it can increase its generation over 180 minutes, if it begins at P_{min}; P_{min} may be positive or negative. However, for facilities with a start-up time of less than ninety minutes *and* a P_{min} greater than zero (positive operating range only), the average ramp rate is defined as the number of MW by which the facility can increase its generation over a time period of 180 minutes *minus the facility's start up time*, assuming the facility begins at its P_{min}.

6. Both ES and DR EFC calculations should be based on the conventional EFC formulas, with modifications to allow for negative P_{min} (indicating dispatchable load or charging):

    - EFC = Minimum of (NQC – P_{min}) and (180 minutes * Average Ramp Rate), for ES and DR facilities with start-up time (SUT) > 90 minutes *or* $P_{min} \leq 0$

    - EFC = Minimum of (NQC) and (P_{min} + (180 minutes – SUT) * Average Ramp Rate), for all other ES and DR resources (those with SUT < 90 minutes *and* $P_{min} > 0$)

7. Aggregated ES-DR resources should be granted a composite QC and EFC, based on both the duration over which the individual facilities can operate and the magnitude of their output. An example of this is shown in Figure 1, above.

8. Energy Division should continue ongoing efforts to develop probabilistic modeling and calculation methodologies for energy storage and demand response, with additional staff white papers and one or more workshops in spring 2014. Energy Division should also consider publishing provisional QC and EFC values calculated through probabilistic methods, in parallel to the official QC and EFC values calculated according to the methodology for 2015 recommended above. However, these probabilistically-derived values should be non-binding and for informational purposes only.

Co-Located Storage

Energy storage that is co-located and operated in conjunction with an RA-eligible conventional facility or variable energy resource (such as wind or solar) should not receive a separate QC or EFC, and should instead modify the QC and EFC of the primary facility.[6] In the event that a storage facility is larger than the co-located energy generator, the ES device will be viewed as an independently operating resource and be separately evaluated for QC and EFC.

Parallel QC and EFC methodology development recommended for consideration beyond the 2015 RA Compliance Year

1. The proposed rules for the 2015 RA compliance year may be re-evaluated in future years as CAISO and CPUC analyses of system needs and resource benefits evolve.

2. The recent CAISO FRAC-MOO Straw Proposal would allow ES resources to bid into a regulation energy management market without bidding the energy market, but FERC has not weighed in on this proposal yet. Energy Division staff proposes to explore the implications of this proposal when and if this proposal is adopted by the Federal Energy Regulatory Commission (FERC).

3. The QC and EFC for ES and DR should ultimately be based on probabilistic modeling, which assesses likely system needs, rather than on deterministic modeling, which is based on a single assumed case (e.g., a 1-in-2 weather condition for DR ex-ante forecasting). The probabilistic modeling should yield:

    - an Effective Load Carrying Capability (ELCC)[7], which expresses how well the resource is able to meet reliability conditions and reduce expected reliability problems or outage events (considering availability and use limitations) as compared to a "perfect" generator,[8] and

    - an Effective Ramping Capability (ERC), which expresses how well the resource is able to meet three-hour upward ramping and intra-hour operational needs (considering availability and use limitations) as compared to a perfect generator.

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[6] The calculation methodologies for wind and solar facilities will be addressedin a separate staff proposal. Any calculation methodology adjustments required for wind and solar facilities with co-located storage will be addressed in that proposal.

[7] For additional reading on ELCC methodologies, see http://www.nerc.com/docs/pc/ivgtf/ieee-capacity-value-task-force-confidential%20(2).pdf.

[8] A perfect generator has ideal operating characteristics: immediate start-up, infinite ramping capability, no use limitations, and no outages. This generator has positive output only (no charging or dispatchable load).

4. QC and EFC should reflect the greatest magnitude of capacity available from a resource, derated by its ELCC and ERC respectively, in order to capture resource availability, use limitations, and the usefulness of the resource's operating characteristics towards meeting system needs. For example, if modeling indicates that reliability needs are greatest in the afternoon, then a resource that only operates in the morning would be derated more than an otherwise-identical resource that only operates during the afternoon.

5. QC and EFC should ultimately be calculated according to the following equations:

    - $QC = ELCC * P_{max}$
    - $EFC = ERC * (P_{max} - P_{min})$, for $P_{min} < 0$
    - $EFC = ERC * P_{max}$ for all other resources