Flexible Resource Adequacy Criteria and Must Offer Obligation – Phase 2

Revised Draft Framework Proposal

Karl Meeusen, Ph.D.
Stakeholder Meeting
February 7, 2018
<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 – 10:10</td>
<td>Introduction</td>
<td>James Bishara</td>
</tr>
<tr>
<td>10:10 – 10:25</td>
<td>Summary of Stakeholder Comments</td>
<td>Lauren Carr</td>
</tr>
<tr>
<td>10:25 – 10:30</td>
<td>Flexible Resource Adequacy Framework</td>
<td>Karl Meeusen</td>
</tr>
<tr>
<td>10:30 – 11:15</td>
<td>Identifying Ramping Needs</td>
<td>Karl Meeusen</td>
</tr>
<tr>
<td>11:15 – 12:00</td>
<td>Defining required products</td>
<td></td>
</tr>
<tr>
<td>12:00 – 1:00</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>1:00 – 1:45</td>
<td>Quantifying capacity requirements</td>
<td>Karl Meeusen</td>
</tr>
<tr>
<td>1:45 – 3:15</td>
<td>Establish resource qualification criteria</td>
<td>Karl Meeusen</td>
</tr>
<tr>
<td>3:15 – 3:50</td>
<td>Allocation of flexible capacity requirements</td>
<td></td>
</tr>
<tr>
<td>3:50 – 4:00</td>
<td>Next Steps</td>
<td>James Bishara</td>
</tr>
</tbody>
</table>
CAISO policy initiative stakeholder process
## Stakeholder Engagement Plan

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised Flexible Capacity Framework posted</td>
<td>January 31, 2018</td>
</tr>
<tr>
<td>Revised Flexible Capacity Framework stakeholder Meeting</td>
<td>February 7, 2018</td>
</tr>
<tr>
<td>Submit Revised Flexible Capacity Framework into CPUC RA proceeding</td>
<td>February 16, 2018</td>
</tr>
<tr>
<td>Stakeholder Written Comments Due</td>
<td>February 21, 2018</td>
</tr>
<tr>
<td>Second Revised Flexible Capacity Framework posted</td>
<td>Early April, 2018</td>
</tr>
<tr>
<td>Second Revised Flexible Capacity Framework stakeholder Meeting</td>
<td>Mid-April, 2018</td>
</tr>
<tr>
<td>Stakeholder Written Comments Due</td>
<td>Early May, 2018</td>
</tr>
<tr>
<td>Draft Final Flexible Capacity Framework posted and submitted to the CPUC RA proceeding</td>
<td>June 6, 2018</td>
</tr>
<tr>
<td>Draft Final Flexible Capacity Framework stakeholder Meeting</td>
<td>June 13, 2018</td>
</tr>
<tr>
<td>Stakeholder Written Comments Due</td>
<td>June 27, 2018</td>
</tr>
<tr>
<td>Complete coordination with CPUC’s RA proceeding prior to Board Approval of final flexible RA Framework</td>
<td>Q4 2018</td>
</tr>
</tbody>
</table>
SUMMARY OF STAKEHOLDER COMMENTS
Identification of Need

- Many stakeholders generally support the ISO’s identification of predictable ramping needs and uncertainty as the two main drivers of flexible capacity needs.

- IOUs believe the ISO should pause the initiative until the appropriate market enhancements are developed.
  - Both stakeholder processes are necessary and interdependent.
  - The ISO plans to conduct these processes on parallel tracks.

- Stakeholders are divided on the three proposed products (i.e. Day-Ahead Load Shaping, fifteen-minute, and five-minute).
  - The ISO believes these products are necessary and will best meet operational needs by aligning with our market timeline.
Quantification of Flexible RA Needs

• Many stakeholders question the need for additional flexible capacity above the three-hour net load ramp
  – The ISO finds these comments persuasive and has modified its proposal by removing the additional upward uncertainty requirement

• Powerex suggests including regulation need in the five-minute product due to overlap in resources that can provide these products
  – The ISO agrees with this suggestion and has modified its proposal to include regulation in the five-minute flexible capacity need

• Several stakeholders recommend using forecast data to determine flexibility needs
  – The ISO proposes to use this approach to estimate needs and allocate requirements
Eligibility Criteria

• Most stakeholders are supportive of intertie, EIM, and VER participation in flexible RA
  – LSEs must have a MIC for any imports or EIM resources that provide flexible RA

• Calpine suggests keeping eligibility requirements minimal, as only a ramping capability requirement is necessary
  – LS Power, Cogentrix, and Powerex support start-up time requirements in addition to ramping capability requirements
  – Ramping capability and start-up time requirements are required for each product in order to ensure sufficient flexibility

• ECE suggests eliminating the deliverability study requirement for flexible RA
  – It is important to ensure flexible capacity is deliverable
  – The proposal includes a new flexible capacity deliverability study requirement separate from the generic RA study
  – This allows reliable NQC and EFC unbundling
Must Offer Obligation

- CEDMC, First Solar, and Six Cities support a more granular MOO

- Powerex, Seattle City Light, and LS Power support a 24x7 MOO
  - The ISO has considered both options and is proposing MOOs be consistent across all resources
  - This requires a 24x7 MOO capped at a resource’s EFC
Flexible RA Counting Rules

• Calpine supports the ISO’s “nested requirements”, while Energy Innovation suggests separating the requirements
  – To maintain simplicity, the proposal continues to use “nesting requirements”

• Calpine recommends eliminating the 90 minute start-up time requirement for the day-ahead product
  – In order to manage the Pmin burden of long start resources, the ISO declines to remove the start-up time requirement at this time

• CEDMC, Nextera, and ECE request the decoupling of EFC values from NQC values
  – Due to the separate flexible RA study process, the ISO can reliably decouple EFC from NQC

• For VER EFC calculations, several stakeholders suggest variations of a forward looking calculation using a forecast of VER output
  – The ISO is currently weighing two options and is requesting stakeholder feedback on 1) PG&E’s “simple” methodology and 2) a variant of an exceedance methodology
Equitable Allocation of Flexible Capacity Needs

- Many stakeholders recommend relying on the current flexible capacity allocation process

- CLECA proposes an allocation methodology based on resource portfolios of LSEs
  - The ISO will allocate flexible capacity needs similar to current practice, based on LSEs’ contributions from load, wind, and solar to predictable and unpredictable ramping needs
  - The ISO will apply this allocation methodology to each flexible RA product
Other

• PGP and Powerex believe the MIC process is inefficient and should be reviewed
  – MIC allocation is beyond the scope of this initiative

• Several stakeholders are concerned that the proposal does not adequately address the ability for self-schedules to adjust for flexibility needs
  – The ISO is not considering changes to the treatment of self-schedules under the current methodology with limited exceptions

• WPTF and PCWA suggest the ISO explore alternative definitions of net load
  – The ISO will maintain its current definition of net load to be in alignment with NERC accepted definition

• Congentrix is concerned with an overly lengthy timeline and suggests a two track approach to facilitate timelier implementation
  – The proposed timeline is consistent with schedule in CPUC scoping memo in R.17-09-020
Changes to flexible RA should closely align with ISO operational needs and align with ISO market runs

- The current flexible RA product results in fundamental gaps between the ISO’s markets and operational needs:
  - Integrated Forward Market
  - Fifteen-minute market
  - Five-minute market

- Need to meet both:
  - Anticipated ramping needs and
  - Uncertainty within the time scales of the real-time market

The ISO seeks to close gap by developing a flexible RA framework that captures the ISO’s operational needs and the (un)predictability of ramping needs
The ISO will develop critical linkages between RA and forward energy markets

• Ensures the ISO is able to meet grid reliability needs through its markets, accounting for uncertainty
  – including load forecast error, VER forecast error, and outages and other resource deviations
• Provide a framework for intertie and VER resources to be part of the flexible capacity solution
• Provide LSEs and LRAs flexibility to meet system, local, and flexible capacity needs in ways that best align with their business and policy objectives
Basis of a new flexible RA framework in five steps

1) Identify the ramping needs that flexible RA should be procured to address
2) Define the product to be procured
3) Quantify the capacity needed to address all identified needs
4) Establish criteria regarding how resources qualify for meeting these needs
5) Allocation of flexible capacity requirements based on a sound causal principles
IDENTIFYING RAMPING NEEDS
Flexible capacity needs break down into two categories

1) Predictable: known and/or reasonably forecastable ramping needs, and

2) Unpredictable: ramping needs caused by load following and forecast error

These two types of flexible capacity needs drive different forms of flexible capacity procurement needs
A new flexible RA framework is needed to address load and supply variability and uncertainty

• **General ramping needs**
  – IFM schedules shape and conform to forecasted loads and ramping needs
    • Sustained ramping periods and ramping speed (up and down) are increasing
    • Forecasted net load continues to drop, indicating additional trade-off between ramping vs. curtailment

• **Uncertainty**
  – Majority of ramping needs can be addressed through IFM schedules, however uncertainty after IFM can only be met with resources available in real-time
Net load ramp growth and minimum net load decrease over time may require additional exceptional dispatches if not addressed through forward planning.

The ISO proposes to maintain a flexible capacity product and assessment to ensure sufficient bid range to cover maximum three-hour net load ramps:

- Provides the resources needed to shape IFM awards and commitments based on market solutions and
- Mitigates the need for exceptional dispatches and CPM designations
- Improves ISO market efficiency and sends signal to the market about how well procurement profiles are able to facilitate increased VER penetration
Both load and generation are creating uncertainty between the day-ahead and real-time markets

• Variable energy resources and behind the meter solar photovoltaic systems continue to expand

• ISO cannot commit additional long-start units after day-ahead/RUC closes

• Uncertainty between day-ahead and real-time markets caused by both load following needs and forecast error
  – Must be addressed by resources committed in the IFM or resources that are committable during the real-time market runs
Propose to establish new requirements to address uncertainty between market runs
Regulation is distinct from the other types of uncertainty in three ways

1) Regulation is explicitly procured through the day-ahead market
2) A resource’s ability to provide regulation is based on it having Automatic Generation Control (AGC)
3) There is sufficient regulation capacity available in the system

The same type of resources needed to address five-minute uncertainty could be procured by the ISO for regulation
– The ISO is currently exploring the options for how much overlap to account for, focused on options that reflect the quantities of market procurement of regulation
DEFINING REQUIRED PRODUCTS
Changes to flexible RA should closely align with ISO operational needs and align with ISO market runs

ISO will develop three flexible RA products:

• Day-ahead load shaping:
  – Ensure the ISO is able to meet its three-hour net load ramps

• Real-time products (five and fifteen minute flexible RA capacity):
  – Designed to address real-time uncertainty, including both forecast error and load following needs that occur between IFM and RTD
Non-coincident errors provide a basis for determining how much flexible capacity might be needed and the timeframe within which that uncertainty occurs.

The ISO is not seeking to address each source of error independently.
It is not possible to know which direction uncertainty will occur until it happens.

- Flexible RA needs should be procured to cover both upward and downward forecast error ranges
  — Uncertainty will be due to under or over-forecast error

*Upward and downward ranges do not occur on the same days*
Flexible RA needs should be procured to cover both upward and downward uncertainty ranges

- ISO does not know if the uncertainty will be due to under or over-forecast error
- Therefore, while real-time flexible RA may not need to be greater than the maximum coincidental errors, flexible RA requirements should account for the both the upward and downward uncertainty between the FMM to RTD and IFM to FMM.
The ISO must be prepared to address the largest uncertainties that occur with the shortest notice

- Flexible RA needs should first plan for the uncertainty that occurs between FMM and RTD
  - Then extending that planning to longer notice intervals, i.e. IFM to FMM
- Resources capable of addressing FMM to RTD needs should also be capable of addressing the uncertainty between IFM and FMM
  - Additional capacity should be procured to address the uncertainty that occurs between IFM and FMM
- Flexible RA needs should be procured to cover both upward and downward uncertainty ranges
  - Uncertainty will be due to under or over-forecast error
Uncertainty occurs most often during daylight hours, including during maximum net load ramps.
Approximately 75 percent of the flexible capacity needs to be available 24 hours a day

• The ISO conducted additional analysis regarding the relative ranges of the largest MW needs between day-time and night-time hours.

• Wide range of proportions
  – 50 percent and 80 percent for the IFM to FMM
  – 50 percent to 95 percent for FMM to RTD

• No clear delineation month-by-month

• General assessment is that roughly 75 percent of uncertainty presents a reasonable starting point for considering how much flexible capacity needs to be available 24 hours a day.
QUANTIFYING CAPACITY REQUIREMENTS
The maximum forecasted three hour net load ramp plus contingency reserves should continue being the starting point for establishing Flexible RA needs

- The interplay between contingency reserves and flexible capacity identified in FRACMOO process still exists
  - ISO will modify this to be consistent with modifications to WECC Standard BAL-002-WECC-2a

- The ISO will reconstruct overall available wind and solar output into formulation of the three hour net load ramp
Overall flexible capacity needs should be defined as a function of the maximum three-hour net load ramp

**Overall flexible capacity need**

- Maximum Forecasted Three-Hour ramp (including reconstituted renewable curtailments) + \( \frac{1}{2} \) Max(MSSC, 6% of the monthly expected peak load) + \( \varepsilon \)

- Modifications to previous proposal
  - Based on stakeholder feedback, the ISO has removed the proposal to add a portion of the upward uncertainty measure to the overall flexible capacity need
  - The \( \varepsilon \) term was included from the original FRACMOO needs assessment
    - Its omission from the previous iteration was as an oversight and it has been reinserted
Percentile rankings for observed errors between IFM and FMM and the need for a fifteen-minute product

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100.0%</td>
<td>3,781</td>
<td>2,673</td>
<td>4,210</td>
<td>3,877</td>
<td>4,276</td>
<td>3,950</td>
<td>4,331</td>
<td>3,033</td>
<td>2,996</td>
</tr>
<tr>
<td>99.5%</td>
<td>2,617</td>
<td>1,933</td>
<td>3,324</td>
<td>2,821</td>
<td>3,154</td>
<td>2,392</td>
<td>3,254</td>
<td>2,411</td>
<td>2,346</td>
</tr>
<tr>
<td>97.5%</td>
<td>1,597</td>
<td>1,311</td>
<td>2,244</td>
<td>2,006</td>
<td>2,281</td>
<td>1,761</td>
<td>2,332</td>
<td>1,885</td>
<td>1,671</td>
</tr>
<tr>
<td>95.0%</td>
<td>1,200</td>
<td>1,041</td>
<td>1,798</td>
<td>1,590</td>
<td>1,575</td>
<td>1,260</td>
<td>1,865</td>
<td>1,479</td>
<td>1,426</td>
</tr>
<tr>
<td>87.5%</td>
<td>706</td>
<td>634</td>
<td>971</td>
<td>906</td>
<td>863</td>
<td>666</td>
<td>1,164</td>
<td>886</td>
<td>901</td>
</tr>
<tr>
<td>75.0%</td>
<td>303</td>
<td>299</td>
<td>454</td>
<td>446</td>
<td>356</td>
<td>189</td>
<td>621</td>
<td>419</td>
<td>465</td>
</tr>
<tr>
<td>50.0%</td>
<td>-147</td>
<td>-149</td>
<td>-72</td>
<td>-49</td>
<td>-130</td>
<td>-278</td>
<td>-5</td>
<td>-79</td>
<td>-77</td>
</tr>
<tr>
<td>25.0%</td>
<td>-579</td>
<td>-541</td>
<td>-555</td>
<td>-636</td>
<td>-632</td>
<td>-780</td>
<td>-493</td>
<td>-591</td>
<td>-597</td>
</tr>
<tr>
<td>12.5%</td>
<td>-968</td>
<td>-845</td>
<td>-950</td>
<td>-1,098</td>
<td>-1,179</td>
<td>-1,222</td>
<td>-868</td>
<td>-999</td>
<td>-1,006</td>
</tr>
<tr>
<td>5.0%</td>
<td>-1,367</td>
<td>-1,207</td>
<td>-1,435</td>
<td>-1,728</td>
<td>-1,811</td>
<td>-1,708</td>
<td>-1,254</td>
<td>-1,467</td>
<td>-1,497</td>
</tr>
<tr>
<td>2.5%</td>
<td>-1,698</td>
<td>-1,449</td>
<td>-1,966</td>
<td>-2,185</td>
<td>-2,198</td>
<td>-1,980</td>
<td>-1,544</td>
<td>-1,820</td>
<td>-2,063</td>
</tr>
<tr>
<td>0.5%</td>
<td>-2,286</td>
<td>-1,902</td>
<td>-2,765</td>
<td>-3,046</td>
<td>-3,049</td>
<td>-2,587</td>
<td>-1,981</td>
<td>-2,789</td>
<td>-2,958</td>
</tr>
<tr>
<td>0.0%</td>
<td>-3,826</td>
<td>-2,591</td>
<td>-3,428</td>
<td>-3,912</td>
<td>-4,421</td>
<td>-3,813</td>
<td>-2,610</td>
<td>-3,938</td>
<td>-3,753</td>
</tr>
</tbody>
</table>
Percentile rankings for observed errors between FMM and RTD and the need for a five-minute product

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100.0%</td>
<td>1,537</td>
<td>1,542</td>
<td>1,715</td>
<td>1,842</td>
<td>1,933</td>
<td>1,761</td>
<td>1,615</td>
<td>1,178</td>
<td>1,164</td>
</tr>
<tr>
<td>99.5%</td>
<td>1,041</td>
<td>1,104</td>
<td>1,027</td>
<td>974</td>
<td>1,255</td>
<td>991</td>
<td>1,016</td>
<td>723</td>
<td>780</td>
</tr>
<tr>
<td>97.5%</td>
<td>734</td>
<td>718</td>
<td>668</td>
<td>669</td>
<td>760</td>
<td>626</td>
<td>646</td>
<td>516</td>
<td>511</td>
</tr>
<tr>
<td>95.0%</td>
<td>566</td>
<td>534</td>
<td>504</td>
<td>536</td>
<td>572</td>
<td>464</td>
<td>497</td>
<td>404</td>
<td>405</td>
</tr>
<tr>
<td>87.5%</td>
<td>347</td>
<td>290</td>
<td>280</td>
<td>321</td>
<td>310</td>
<td>263</td>
<td>294</td>
<td>258</td>
<td>246</td>
</tr>
<tr>
<td>75.0%</td>
<td>183</td>
<td>145</td>
<td>147</td>
<td>167</td>
<td>160</td>
<td>115</td>
<td>155</td>
<td>129</td>
<td>113</td>
</tr>
<tr>
<td>50.0%</td>
<td>10</td>
<td>0</td>
<td>-2</td>
<td>13</td>
<td>-2</td>
<td>-33</td>
<td>-9</td>
<td>-37</td>
<td>-51</td>
</tr>
<tr>
<td>25.0%</td>
<td>-133</td>
<td>-137</td>
<td>-161</td>
<td>-134</td>
<td>-183</td>
<td>-217</td>
<td>-220</td>
<td>-223</td>
<td>-232</td>
</tr>
<tr>
<td>12.5%</td>
<td>-256</td>
<td>-275</td>
<td>-317</td>
<td>-283</td>
<td>-366</td>
<td>-391</td>
<td>-401</td>
<td>-376</td>
<td>-384</td>
</tr>
<tr>
<td>5.0%</td>
<td>-420</td>
<td>-447</td>
<td>-509</td>
<td>-471</td>
<td>-610</td>
<td>-611</td>
<td>-609</td>
<td>-575</td>
<td>-558</td>
</tr>
<tr>
<td>2.5%</td>
<td>-565</td>
<td>-583</td>
<td>-650</td>
<td>-632</td>
<td>-760</td>
<td>-770</td>
<td>-783</td>
<td>-704</td>
<td>-699</td>
</tr>
<tr>
<td>0.5%</td>
<td>-871</td>
<td>-871</td>
<td>-1,019</td>
<td>-996</td>
<td>-1,025</td>
<td>-1,093</td>
<td>-1,096</td>
<td>-1,017</td>
<td>-1,165</td>
</tr>
<tr>
<td>0.0%</td>
<td>-1,297</td>
<td>-1,557</td>
<td>-1,921</td>
<td>-1,559</td>
<td>-1,565</td>
<td>-1,779</td>
<td>-1,765</td>
<td>-1,548</td>
<td>-1,693</td>
</tr>
</tbody>
</table>
Real-time flexible RA capacity needs for fifteen-minute product

Distribution of IFM to RTPD Forecast Errors and Load Following Needs
Real-time flexible RA capacity needs for five-minute product

Distribution of RTPD to RTD Forecast Errors and Load Following Needs
Daily uncertainty ranges over 6,000 MW occur almost every month

Maximum single day adjustments

- October
- November
- December
- January
- February
- March
- April
- May
- June

MW

Months

 Up  Down  Largest Range  Second Largest Range
The ISO proposes to set flexible capacity requirements to encompass the widest range of uncertainty for all real-time flexible capacity products.

<table>
<thead>
<tr>
<th>Month</th>
<th>Max Positive error DA-FMM</th>
<th>Max Negative error DA-FMM</th>
<th>Max Error Range DA-FMM</th>
<th>Max Positive error FMM-RTD</th>
<th>Max Negative error FMM-RTD</th>
<th>Max Error Range FMM-RTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>3781</td>
<td>-3826</td>
<td>7606</td>
<td>1537</td>
<td>-1297</td>
<td>2834</td>
</tr>
<tr>
<td>November</td>
<td>2673</td>
<td>-2591</td>
<td>5264</td>
<td>1542</td>
<td>-1557</td>
<td>3099</td>
</tr>
<tr>
<td>December</td>
<td>4210</td>
<td>-3428</td>
<td>7638</td>
<td>1715</td>
<td>-1921</td>
<td>3636</td>
</tr>
<tr>
<td>January</td>
<td>3877</td>
<td>-3912</td>
<td>7789</td>
<td>1842</td>
<td>-1559</td>
<td>3401</td>
</tr>
<tr>
<td>February</td>
<td>4276</td>
<td>-4421</td>
<td>8697</td>
<td>1933</td>
<td>-1565</td>
<td>3498</td>
</tr>
<tr>
<td>March</td>
<td>3950</td>
<td>-3813</td>
<td>7763</td>
<td>1761</td>
<td>-1779</td>
<td>3540</td>
</tr>
<tr>
<td>April</td>
<td>4331</td>
<td>-2610</td>
<td>6941</td>
<td>1615</td>
<td>-1765</td>
<td>3380</td>
</tr>
<tr>
<td>May</td>
<td>3033</td>
<td>-3938</td>
<td>6971</td>
<td>1178</td>
<td>-1548</td>
<td>2726</td>
</tr>
<tr>
<td>June</td>
<td>2996</td>
<td>-3753</td>
<td>6750</td>
<td>1164</td>
<td>-1693</td>
<td>2857</td>
</tr>
</tbody>
</table>

The ISO proposes that 100% of the monthly needs be procured for year-ahead showings.
The ISO will propose using the maximum identified needs for both predictable and unpredictable ramps

**Overall flexible capacity need**

Maximum Forecasted Three-Hour ramp (including reconstituted renewable curtailments) + \( \frac{1}{2} \) Max(MSSC, 6% expected monthly peak load) + \( \varepsilon \)

**Five-Minute product**

Max forecasted uncertainty between FMM and RTD + fixed MW quantity to account for overlap with regulation

**Fifteen-Minute product** (Five-Minute product count towards requirement)

Max forecasted uncertainty between IFM and FMM

**Day Ahead Load Shaping** (Five and Fifteen-Minute products count towards requirement)

**Overall flexible capacity need**
Requirements should cover the widest range of uncertainty for real-time flexible capacity products
ESTABLISH RESOURCE QUALIFICATION CRITERIA
Eligibility criteria should be simple, based on operational attributes, and reasonably inclusive

- Establish criteria regarding how resources qualify for meeting these needs including:
  - Basic eligibility criteria
  - Must-offer obligations
  - Counting rules
  - Rules necessary to determine if sufficient capacity has been procured
    - Includes any necessary backstop procurement rules
Eligibility criteria should be simple, based on operational attributes, and reasonably inclusive (cont.)

- Eligibility criteria for the three basic Flexible RA products must be provided for each product
  - The Five-minute Flexible RA product
  - Fifteen-minute Flexible RA Product
  - Day-ahead load shaping product
- Must be done separately for
  - Internal resources
  - EIM resources
  - Purely external resources (i.e. resources external to both the ISO BAA and any EIM)
Requirements for Internal Resources
The five-minute and fifteen-minute flexible RA products must be available to the ISO real-time markets

• The ISO considered numerous operational attributes to determine resource eligibility to provide this product

• The only necessary eligibility criteria are
  – Capacity comes from a specific resource
    • Defined as a single resource ID, not a single physical facility
  – Resource must have a start-up time of less than 60 minutes to be eligible to provide this product
    • Allows the ISO to commit resource in the shortest interval of the RTUC process

• Must be studied for EFC deliverability
Longer-start resources might not be available to address real-time uncertainty

- Resources with longer start times could address real-time uncertainty only if committed in the IFM.

- Removing the start-time eligibility criteria may result over inclusion of inflexible capacity.

- This could defeat one of the primary overall objectives of flexible RA capacity:
  - Creating a deep pool of economic bids in the real-time market to address uncertainty.
There is no need to impose a start-time requirement to provide the Day-ahead Load Shaping product

- ISO can make commitments of long-start resources in the IFM
- Resources providing Day-ahead Load Shaping product must be studied for EFC deliverability
- Eliminate the three categories of flexible capacity currently being used for three-hour net load ramps in favor of a single product
  - Should help simplify flexible RA procurement and understanding of obligations
EFC eligibility will include a flexible capacity deliverability study for the times of greatest flexibility needs

• Current deliverability assessments do not test deliverability of capacity during times of greatest flexible capacity need

• Deliverable flexible capacity means the output of a flexible resource can be ramped simultaneously with other flexible resources in the same generator pocket to match the net load ramping without being constrained by the transmission capability
  – The specific conditions that will be studied (i.e. the most stressed conditions) must be determined through a separate stakeholder process
There are at least two main benefits a separate EFC deliverability study

1. Confirms that the EFC is deliverable under stressed grid conditions
   – Similar to the ISO’s deliverability studies for NQC

2. ISO will no longer have to rely on the use of the “dispatchable” flag in Masterfile as a primary qualifying attribute to provide flexible capacity
Flexible RA deliverability can be more stressed than the peak load in SCE’s North of Lugo area

The net export is the highest at the starting point of the ramping curve when flexible resources are dispatched at $P_{\text{min}}$, combined output from all solar, wind and energy efficiency is the highest and the load is mild.
With two separate deliverability studies, NQC and EFC can be reasonably and reliably unbundled

• This allows a resource to have:
  – An NQC with no EFC
  – An EFC with no NQC
  – Both an NQC and EFC equal to one another
  – Different NQC and EFC

• The EFC deliverability study will study all flexible resources
Flexible RA resources for real-time products must submit economic bids for the shown EFC value for all 24 hours in the day-ahead and real-time markets.

- The ISO has elected to not define multiple must offer obligations (i.e. 24 by seven vs. daytime only)
  - Minimizes the number of flexible RA products procured
- VERs may not be capable of providing the full shown EFC value during all hours
  - Must offer the lower of the shown EFC value or the resource’s forecasted output
  - For example, a solar resource would have to bid up to its shown EFC during daylight hours and 0 MW overnight
All resources that provide the Day-ahead load shaping product must submit an economic bid into the day-ahead market for all capacity shown

- Resources must make all capacity committed or awarded in the IFM available in the real-time market
- Committed or awarded capacity may be either economically bid or self-scheduled into real-time markets
- Resources that can be committed in the real-time market must make flexible RA capacity available in the real-time market
- Resources committed in the IFM to less than shown EFC, must economically bid the uncommitted shown EFC capacity but may self-schedule day-ahead awards
Flexible capacity products will be “nested”

• Capacity procured to meet a higher quality product will automatically be counted towards meeting the lower quality requirements
  – Fifteen-minute requirement = 7,500 MW and the five-minute requirement = 3,500 MW, then 7,500 – 3,500 or 4,000 MW of additional fifteen-minute flexible capacity must be procured
ISO proposes to limit solar capacity to providing 25 percent of any single flexible RA product

- Uncertainty can occur at any time
  - Must have most resources available at all hours
- Somewhat conservative but still provides opportunities for allow solar resources to provide flexible RA
- Proxy demand resources typically have similar production profiles as solar resources
  - The ISO is not including proxy demand resources in this cap because this may not be universally true
- Wind resources are explicitly not included in this limit
  - May have 24 hour fuel availability
Resource counting for real-time products will be based on the MWs the resource can ramp in five or fifteen minutes

- For example, a 100 MW resource with a 10 MW/minute ramp rate would be eligible to provide
  - 50 MW of five-minute RA flexible capacity
  - 100 MW of the fifteen-minute product
- Determining VER EFC is more challenging because uncertainty caused by daily weather patterns
The ISO believes PG&E’s “simple” approach offers a potential option for VER EFC calculation

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nameplate Capacity of Solar Resource 1</td>
<td>200 MW</td>
</tr>
<tr>
<td>Aggregate Nameplate Capacity of all solar resources</td>
<td>10,000 MW</td>
</tr>
<tr>
<td>3-hour net load ramp + 3.5 Percent of Forecast Peak Load in December 2018</td>
<td>15,000 MW</td>
</tr>
<tr>
<td>Total solar resources’ contribution to 3-hour net load ramp in December 2018 (%)</td>
<td>48%</td>
</tr>
<tr>
<td>Total solar resources’ contribution to 3-hour net load ramp in December 2018 (MW)</td>
<td>15,000 MW * 48% = 7,200 MW</td>
</tr>
<tr>
<td>Solar Resource 1 contribution to 3-hour net load ramp in December 2018 (MW)</td>
<td>7,200 MW * 200 MW/10,000 MW = 7,200 * 0.02 = 144 MW</td>
</tr>
</tbody>
</table>
ISO considered two additional options for calculating the EFC for VERs

1. An ELCC-like assessment of only ramping hours
   – Developing an ELCC for only a subset of hours and conditions would make for a complex and time consuming process

2. An exceedance methodology for only ramping hours
   – Inconsistent with NQC counting rules but easier and can be implemented on a much quicker timeframe
   – Is another viable option for determining VERs’ monthly EFC values

Seeking stakeholder feedback regarding whether PG&E’s simple option or a simplified exceedance methodology would be the best option for calculating an EFC for VERs
Counting rules for the day-ahead shaping product will remain the same as those used today for the EFC value for most resources

- The ISO declines to remove the start-time as a means to determine if the PMin is flexible
Requirements for EIM resources
EIM resources must be registered as an EIM Participating Resource

• The eligibility criteria apply to all real-time and day-ahead load shaping products
• ISO will enhance Masterfile registration to support System Resource association with the EIM Resources
  – System Resource will be auto-mirrored with a Mirror System Resource (ETIE) registered from the relevant EIM Entity at the same ISO Scheduling Point.
• Allows ISO to see resource’s participation in both the day-ahead and real-time markets
Any LSE using an EIM resource for flexible capacity must demonstrate that it has sufficient Maximum Import Capability (MIC) capacity

- MIC capacity is how LSEs demonstrate that the resource’s output, and therefore flexibility, is deliverable to the ISO
- ISO will still need to ensure the flexible capacity is credited to the ISO BAA for purposes of the EIM sufficiency tests
  - All EIM sufficiency tests will credit the ISO with any capacity from resources based in an EIM BAA shown as flexible RA capacity and remove the resources from any EIM entity’s sufficiency tests
EIM resources have similar offer obligations to internal resources providing real-time flexible RA capacity

- Must submit economic bids into day-ahead and real-time markets with an energy bid range the shown EFC value
- For the five-minute product, the TG must be used instead of a System Resource.
  - The TG must submit an energy bid range shown EFC for the five-minute product in to the real-time markets
- Transmission capacity must be secured prior to the DAM
  - Shown in the e-tag from the EIM Participating Resource ISO Scheduling Point
  - Specified in the DAM/RTM bid for System Resource
- The OASIS field on the e-tag must specify the System Resource name and with an association to the EIM participating resource ID shown for flexible RA capacity
EIM resources providing Day-ahead load shaping product must submit economic bids day ahead, but can self-schedule day-ahead awards into real-time

- Economic bids must be for range at least as large as the shown EFC
- If scheduled in the DAM/RUC, it must also bid in the real-time markets
  - A self-schedule or economic bid with an Upper Economic Limit (UEL) at the RUC Schedule will satisfy the obligation
The ISO will use the same counting rules for EIM resources as are used for internal resources

• Applies to all real-time and day-ahead load shaping products

• One primary difference: EIM resources will be deemed deliverable for purposes of EFC calculations

• All resources must have an associated MIC allocation for an LSE to count the resources towards its flexible RA requirements
Requirements for purely external resources
External resources may provide the fifteen-minute, but not the five-minute flexible RA product

- Purely external resources are not dispatchable on a five-minute basis
  - The exception to this limitation is for dynamic and pseudo-tied resources
    - dynamic and pseudo-tied resources are five-minute dispatchable
- Any LSE using an import resource for flexible capacity must demonstrate that it has sufficient MIC capacity
- Must submit fifteen-minute bids
ISO will require that the Resource SC provide to the ISO the physical resources used to support the resource ID

- Resource SC must also provide any information necessary to determine if the resources are capable of providing the flexible capacity for which it has been procured

- Resource combinations must be submitted prior to issuance of final EFC list to be eligible to provide flexible RA capacity
ISO proposes to change real-time bidding obligations for purely external resources providing real-time flexible RA products

• Currently, external RA resources are only required to provide real-time bids unless they receive a day-ahead award

• Purely external resources providing real-time flexible RA products will be required to submit economic bids into both the day-ahead and real-time markets.
  – Must be submitted in fifteen-minute intervals and cannot be submitted as hourly block schedules

• System Resource or Intertie Generating Resource (TG) is needed with the required e-tag
The ISO expects to have sufficient information to count external resources comparable to internal resources

- Because the ISO proposes to require details regarding the purely external resources, the ISO can calculate the EFC for external resources
- Applies to all real-time and day-ahead load shaping products
The ISO will maintain backstop procurement authority for flexible RA capacity deficiencies

- First assess if sufficient system-wide flexible RA capacity has been shown for each product
  - If sufficient, the ISO will not assess individual showings
  - If deficient, then the ISO will look to determine which LRA(s) is deficient and then which of its jurisdictional LSEs are deficient
The ISO may conduct backstop procurement if deficiencies are not cured

- Costs allocated to deficient LSE’s
- If there are deficiencies in multiple products, the ISO will procure capacity that meets that highest quality deficient product first
  - Will allocate costs first to the LSE(s) that was deficient in the highest quality product
  - Any remaining deficiencies of lower quality products will be allocated to the entities deficient in that product
The ISO has conducted an assessment of historic flexible RA showings

- Objective: To determine if existing flexible RA procurement practices would fulfill the new flexible RA framework defined above

- Assessment relies on
  - 2017 and 2018 Flexible Capacity Technical Needs Assessment
  - 2018 EFC list
  - Proposed new counting and eligibility rules with the exception of the EFC deliverability study requirement

- It is not possible to determine the overall willingness and availability of resources external to the ISO at this time
Assessment of historic Flex RA showings using new counting rules vs estimated needs

<table>
<thead>
<tr>
<th></th>
<th>MW Available</th>
<th>Showings</th>
<th>Need</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 minute 15 minute</td>
<td>DALS 5 minute 15 minute</td>
<td>Day-Ahead LS 5 minute* 15 minute DALS</td>
<td></td>
</tr>
<tr>
<td>Jan-17</td>
<td>10,133</td>
<td>14,458</td>
<td>33,099</td>
<td>4,397</td>
</tr>
<tr>
<td>Feb-17</td>
<td>10,033</td>
<td>14,347</td>
<td>32,959</td>
<td>4,231</td>
</tr>
<tr>
<td>Mar-17</td>
<td>10,104</td>
<td>14,494</td>
<td>33,073</td>
<td>3,977</td>
</tr>
<tr>
<td>Apr-17</td>
<td>10,321</td>
<td>14,934</td>
<td>33,469</td>
<td>4,194</td>
</tr>
<tr>
<td>May-17</td>
<td>10,338</td>
<td>14,862</td>
<td>33,353</td>
<td>3,863</td>
</tr>
<tr>
<td>Jun-17</td>
<td>10,404</td>
<td>15,068</td>
<td>33,027</td>
<td>3,417</td>
</tr>
<tr>
<td>Jul-17</td>
<td>10,385</td>
<td>15,015</td>
<td>32,935</td>
<td>3,386</td>
</tr>
<tr>
<td>Aug-17</td>
<td>10,358</td>
<td>14,962</td>
<td>32,855</td>
<td>3,677</td>
</tr>
<tr>
<td>Sep-17</td>
<td>10,211</td>
<td>14,626</td>
<td>32,525</td>
<td>3,672</td>
</tr>
<tr>
<td>Oct-17</td>
<td>10,224</td>
<td>14,580</td>
<td>32,603</td>
<td>3,997</td>
</tr>
<tr>
<td>Nov-17</td>
<td>10,229</td>
<td>14,621</td>
<td>32,780</td>
<td>4,996</td>
</tr>
<tr>
<td>Dec-17</td>
<td>10,253</td>
<td>14,670</td>
<td>32,907</td>
<td>5,201</td>
</tr>
<tr>
<td>Jan-18</td>
<td>10,133</td>
<td>14,458</td>
<td>33,099</td>
<td>4,433</td>
</tr>
<tr>
<td>Feb-18</td>
<td>10,033</td>
<td>14,347</td>
<td>32,959</td>
<td>4,481</td>
</tr>
</tbody>
</table>

*includes a flat 600 MW adder in all months to account for ISO procured regulation
ALLOCATION OF FLEXIBLE CAPACITY REQUIREMENTS
Proper allocation of flexible capacity requirements must be based on reasonable causation principles

• Requirements will be allocated based on an LRA’s jurisdictional LSEs’ contribution
  – The primary driver operational needs identified here continue to be driven by LSE procurement to meet state policy objectives

• Many stakeholders recommended that the ISO simply rely on the existing allocation methodology
  – May be a reasonable reflection of the need for three-hour net load ramps
  – May not reflect the drivers of uncertainty
Allocation of requirements will be based on similar causation rules as are used today

- Each product would be allocated based on proportion of need caused by load and VER uncertainty and proportion of each LSE or LRA share
- Allocation proportions would apply requirements for a given product
  - Only need to procure lower quality product to fill residual need once higher quality product is accounted for
The ISO will apply this allocation methodology to each flexible RA product

• The ISO will determine the relative contributions to load, wind, and solar to each of the proposed products
  – Contributions can be different for each product
• Each factor’s contribution based on contributions to the most significant observations
  – Five largest forecasted three-hour net load ramps for the day ahead load shaping product
  – Top five percent of upward and downward uncertainty observations for the real-time flexible RA product
    • i.e. a total of 10 percent of observations
It is not necessary to try to attribute the cause of uncertainty to a specific resource

- ISO will allocate the requirements caused by wind and solar based on relative proportions of resources contracted
  - i.e. 10 percent of total solar fleet contracted would result in an allocation of 10 percent of the overall contribution caused by solar for a given product

- ISO will allocate contributions caused by load for the real-time products based on load-ratio share

However, the ISO seeks stakeholder input regarding other means for determining allocation
Example of allocations

<table>
<thead>
<tr>
<th>5 min</th>
<th>Total Cause</th>
<th>Percent to LSE</th>
<th>MW to LSE</th>
<th>LSE Product Obligation</th>
<th>Residual Need</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>load</td>
<td>wind</td>
<td>solar</td>
<td>load</td>
<td>wind</td>
</tr>
<tr>
<td>LSE1</td>
<td>1500</td>
<td>750</td>
<td>250</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>LSE2</td>
<td>1500</td>
<td>750</td>
<td>250</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>LSE3</td>
<td>1500</td>
<td>750</td>
<td>250</td>
<td>35%</td>
<td>30%</td>
</tr>
<tr>
<td>LSE4</td>
<td>1500</td>
<td>750</td>
<td>250</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>LSE5</td>
<td>1500</td>
<td>750</td>
<td>250</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15 min</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LSE1</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>25%</td>
<td>30%</td>
<td>25%</td>
<td>687.5</td>
<td>360</td>
<td>137.5</td>
<td>1185</td>
<td>522.5</td>
</tr>
<tr>
<td>LSE2</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>20%</td>
<td>25%</td>
<td>20%</td>
<td>550</td>
<td>300</td>
<td>110</td>
<td>960</td>
<td>422.5</td>
</tr>
<tr>
<td>LSE3</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>35%</td>
<td>30%</td>
<td>30%</td>
<td>962.5</td>
<td>360</td>
<td>165</td>
<td>1487.5</td>
<td>662.5</td>
</tr>
<tr>
<td>LSE4</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>15%</td>
<td>5%</td>
<td>5%</td>
<td>412.5</td>
<td>60</td>
<td>27.5</td>
<td>500</td>
<td>225</td>
</tr>
<tr>
<td>LSE5</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>137.5</td>
<td>120</td>
<td>110</td>
<td>367.5</td>
<td>167.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>2750</td>
<td>1200</td>
<td>550</td>
<td>4500</td>
<td>2000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DALS</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th>load</th>
<th>wind</th>
<th>solar</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LSE1</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>25%</td>
<td>30%</td>
<td>25%</td>
<td>1000</td>
<td>450</td>
<td>625</td>
<td>2075</td>
<td>890</td>
</tr>
<tr>
<td>LSE2</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>20%</td>
<td>25%</td>
<td>20%</td>
<td>800</td>
<td>375</td>
<td>500</td>
<td>1675</td>
<td>715</td>
</tr>
<tr>
<td>LSE3</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>35%</td>
<td>30%</td>
<td>30%</td>
<td>1400</td>
<td>450</td>
<td>750</td>
<td>2600</td>
<td>1112.5</td>
</tr>
<tr>
<td>LSE4</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>15%</td>
<td>5%</td>
<td>5%</td>
<td>600</td>
<td>75</td>
<td>125</td>
<td>800</td>
<td>300</td>
</tr>
<tr>
<td>LSE5</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>200</td>
<td>150</td>
<td>500</td>
<td>850</td>
<td>482.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>4000</td>
<td>1500</td>
<td>2500</td>
<td>8000</td>
<td>3500</td>
</tr>
</tbody>
</table>
Next steps

- Submit Revised Flexible Capacity Framework into CPUC RA proceeding February 16, 2018

- Stakeholder comments due February 21, 2018
  - Comments template posted by COB February 8, 2018

- Second Revised Flexible Capacity Framework posted early April, 2018
THANK YOU

Stay connected

@California_ISO

Download ISO Today mobile app

Sign up for the Daily Briefing at www.caiso.com