



Flexible Ramping Sufficiency Test Overview

Kyle Westendorf
Market Monitoring Analyst
Department of Market Monitoring
California ISO

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Flexible ramping sufficiency test

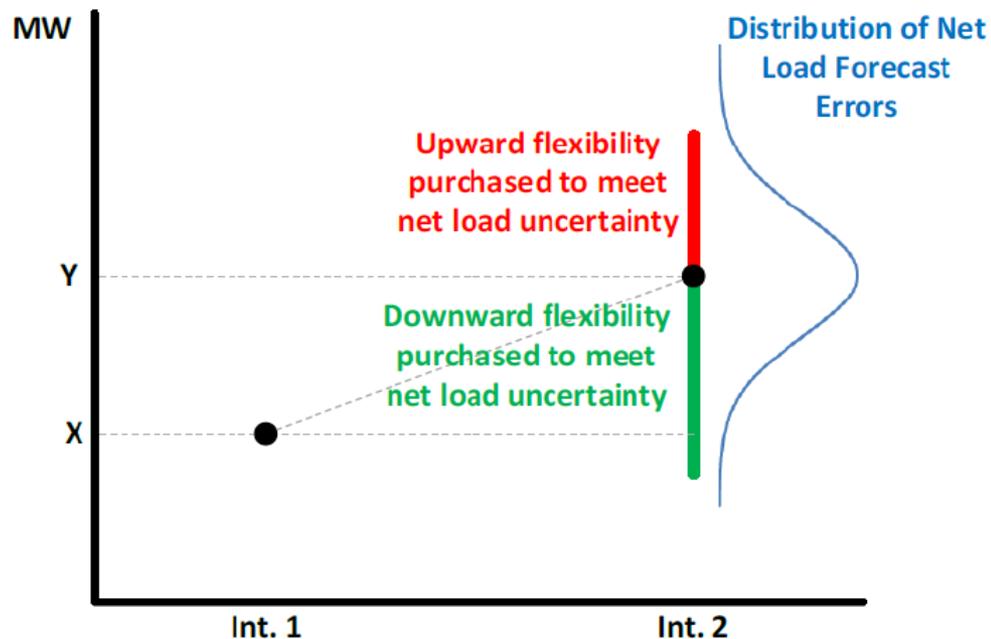
- In order to pass the hourly flexible ramping sufficiency test in a given direction (upward or downward), an EIM entity needs to show sufficient ramping capability from the start of the hour to each of the four 15-minute intervals in the hour.
- An EIM entity must pass all four 15-minute interval tests in order to pass the hourly flexible ramping sufficiency test for the given ramping type

Flex Ramp Up Requirement

$$= \underbrace{\Delta Load}_{\text{Forecasted component}} + \underbrace{\text{Flex Up Uncertainty}}_{\substack{\text{Uncertainty component} \\ \text{(Same used in FRP)}}} - \min \left[\underbrace{\text{Net import capability,} \\ \text{Diversity benefit + Flex ramp up credit}}_{\substack{\text{Diversity benefit and credit reduction} \\ \text{capped at net import capability}}} \right]$$

Uncertainty component

- Reflects the upper and lower ends of net load errors from the historical distribution, specific to the balancing area and hour.
 - Net Load = Load – Wind – Solar
- Same component as 15-minute market uncertainty requirement used with the flexible ramping product.



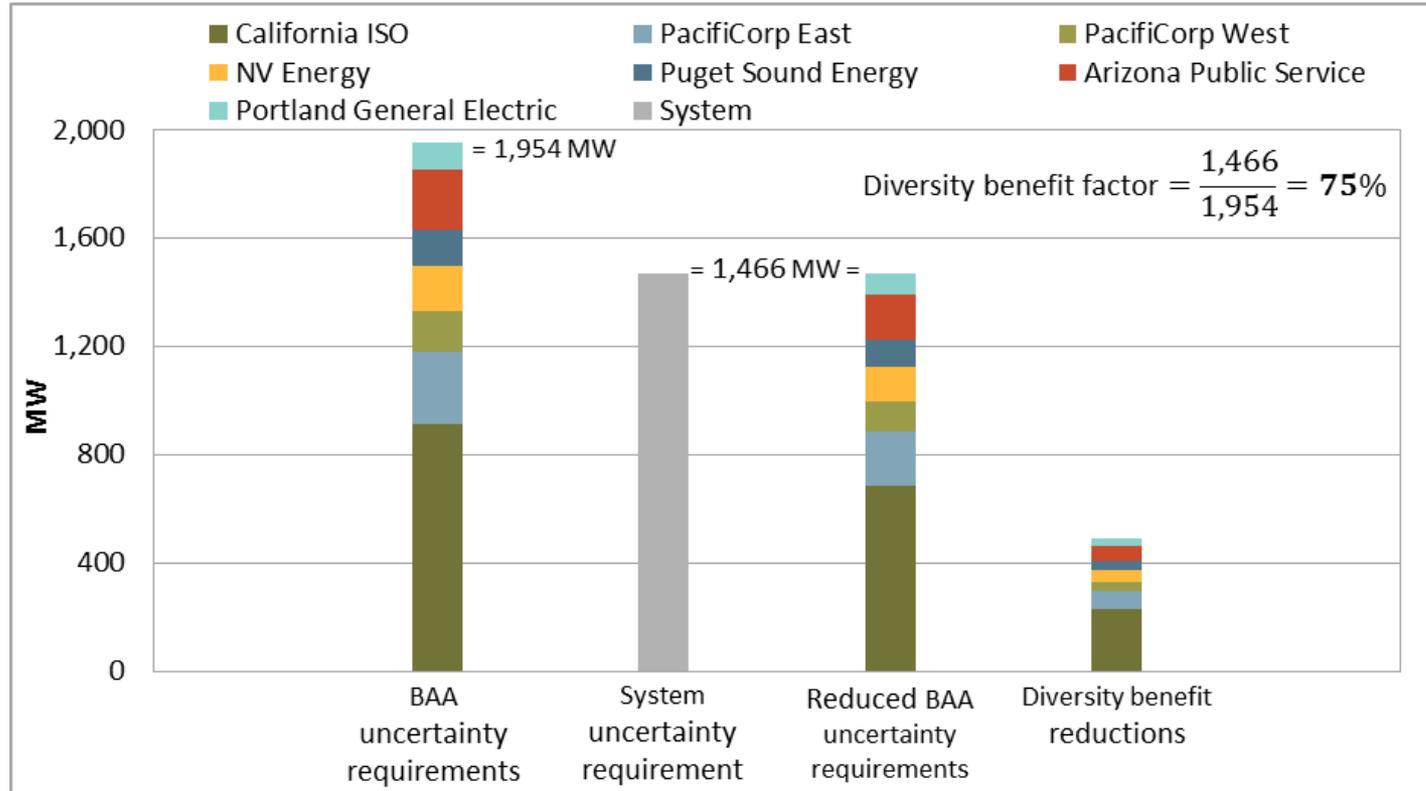
Uncertainty calculation and implementation issues

- In February 2018, DMM identified several implementation errors with this uncertainty calculation.
- Special report on the issue includes the impact of the calculation error on the flexible ramping sufficiency test results:
<http://www.caiso.com/Documents/FlexibleRampingProductUncertaintyCalculationImplementationIssues.pdf>
- Upward and downward sufficiency test requirements were impacted by the incorrect uncertainty calculation.
- Generally for the individual balancing areas, issue impacted 5-minute market uncertainty requirements more so than 15-minute market requirements, so impact on sufficiency test results was estimated to be small.

Flex ramp sufficiency test modifiers

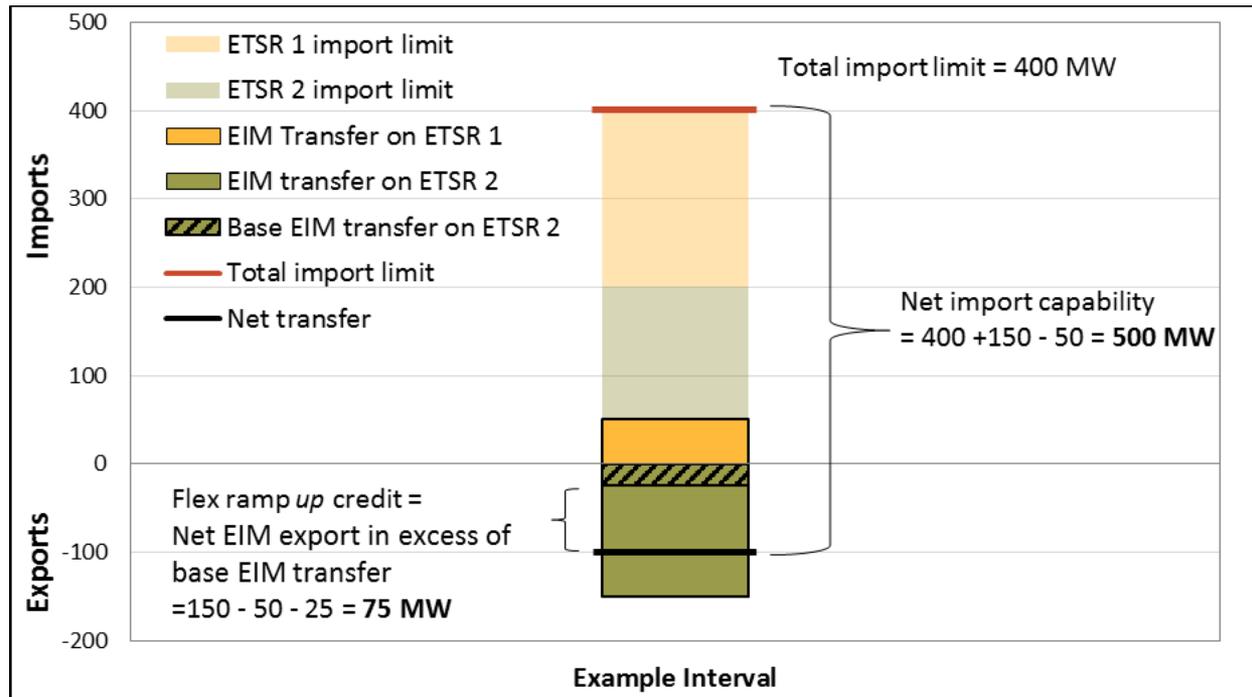
- **Diversity benefit factor** – A fraction that represents a BAA's share of the forecast error for the EIM area. It is equal to the EIM area uncertainty requirement divided by the sum of the individual BAA uncertainty requirements. It represents the smoothing effect, that happens across a larger footprint.
- **Flex ramp credit** – The ability to reduce exports to increase upward ramping capability or reduce imports to increase downward ramping capability.
- **Net import capability** – The amount of import capacity a BAA has in each 15-minute interval. The reduction in the upward sufficiency test requirement because of any diversity benefit or flex ramp up credit may not be greater than the available net import capability.
- **Net export capability** – The amount of export capacity a BAA has in each 15-minute interval. The reduction in the downward sufficiency test requirement because of any diversity benefit or flex ramp down credit may not be greater than the available net export capability.

Diversity benefit example (upward ramping)



- Diversity benefit factor = $\frac{1,466}{1,954} = 75\%$
- *Reduction* to each area's upward uncertainty requirement equals 25% of the area's uncertainty requirement

Net import capability and credits example (upward ramping)

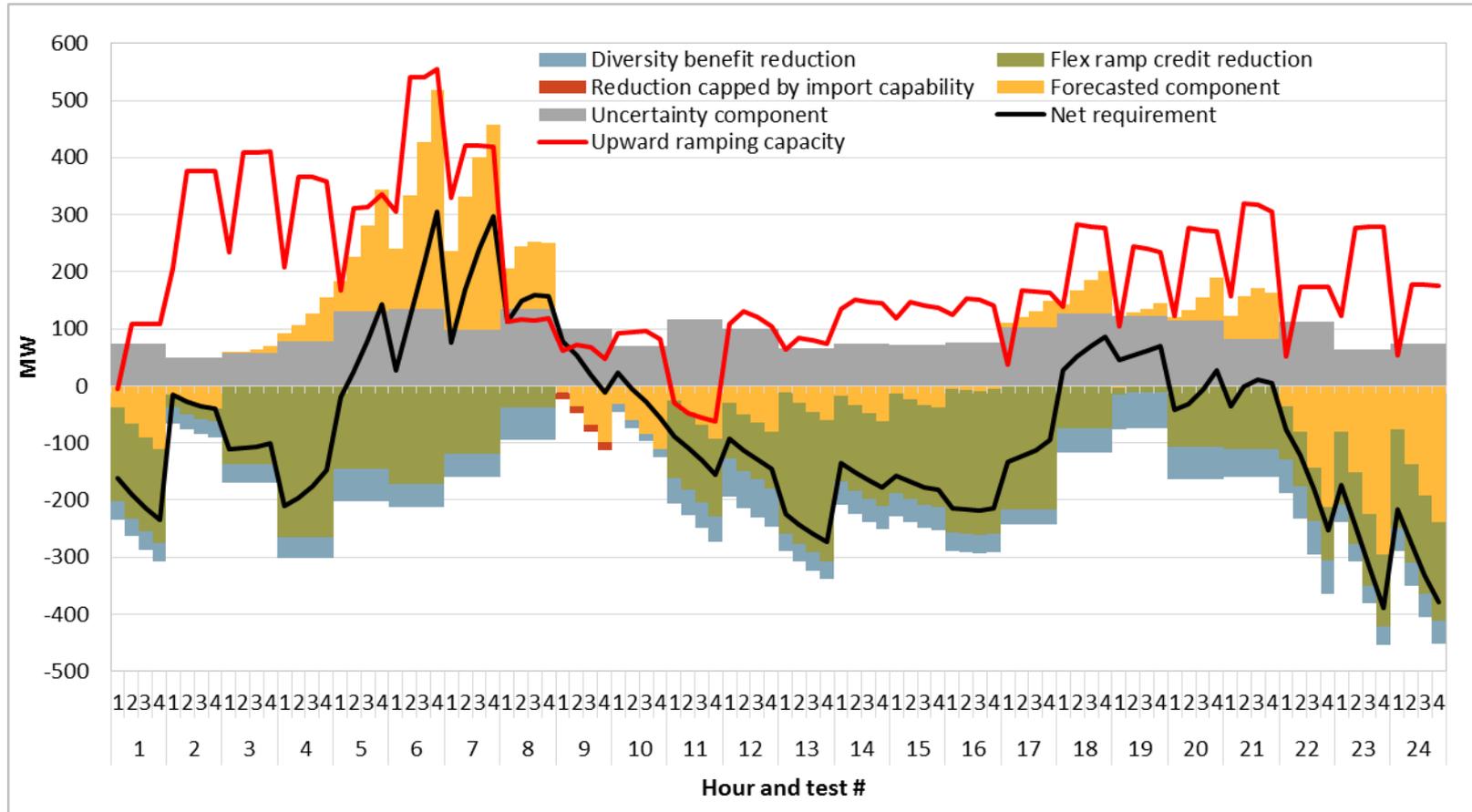


- **Net export** = export transfer schedules minus import transfer schedules
 $= 150 \text{ MW} - 50 \text{ MW} = 100 \text{ MW}$
- **Net import capability** = sum of import limits in excess of the net import
 $= 400 \text{ MW} - (-100) \text{ MW} = 500 \text{ MW}$
- **Upward ramping credit** = net export in excess of the base transfer
 $= 150 \text{ MW} - 50 \text{ MW} - 25 \text{ MW} = 75 \text{ MW}$

Flexible ramping sufficiency test example (April, 2018)

Flex Ramp Up Requirement

$$= \Delta\text{Load} + \text{Flex Up Uncertainty} - \min \left[\begin{array}{l} \text{Net import capability,} \\ \text{Diversity benefit} + \text{Flex ramp up credit} \end{array} \right]$$



- Area failed sufficiency test in hour ending 8 & 9.

Recommendation

- Credits, net import capability, and net export capability are calculated from the EIM transfers and limits in the last binding 15-minute interval prior to the hour.
- If the balancing area failed the sufficiency test in the previous hour, net import or export capability – pulled from the last binding 15-minute interval – will be based on the limited transfer quantity as a result of failing the test rather than total energy imbalance market import or export scheduling limits.
- DMM has recommended that the ISO reevaluate this interaction in a manner that does not impact the independence of consecutive hourly sufficiency tests.