Flexible ramping constraint discussion

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Flexible Ramping Constraint

- The constraint is designed to procure capacity in the 15-minute market to meet changes in forecasted net load in the 5-minute market
- Affects two market processes:
  - Flexible Ramping Constraint
    - Capacity reserved in the 15-minute market to be used in the 5-minute market
  - Flexible Ramp Sufficiency Test
    - Test that occurs at T-40 before each hour to ensure an EIM entity has sufficient ramping capacity to meet both the expected change in net load and the flexible ramping constraint
    - Applied for each RTPD interval for a given hour

Determining Flex Ramp Constraint Requirement

- From the ISO Tariff:
  - *The flexible ramping constraint is determined by: CAISO operators using tools that estimate the: 1) expected level of imbalance variability; 2) uncertainty due to forecast error; and 3) differences between the hourly, fifteen (15) minute average and historical five (5) minute Demand levels. The Flexible Ramping Constraint relaxation parameter is $60.*

Evolution of Determining Flexible Ramping Constraint Requirements

- From implementation to March 2015, Flexible Ramping Constraint Requirements were static for each hour and determined manually
- From March 2015 to August 2015, the Requirements were dynamic for each 15-minute interval and estimated via the Balancing Area Ramp Requirement (BARR) tool
- From August 2015 to current, the calculation to estimate the Requirements was enhanced by simplifying the calculation and making it a more direct estimate of differences between FMM and RTD

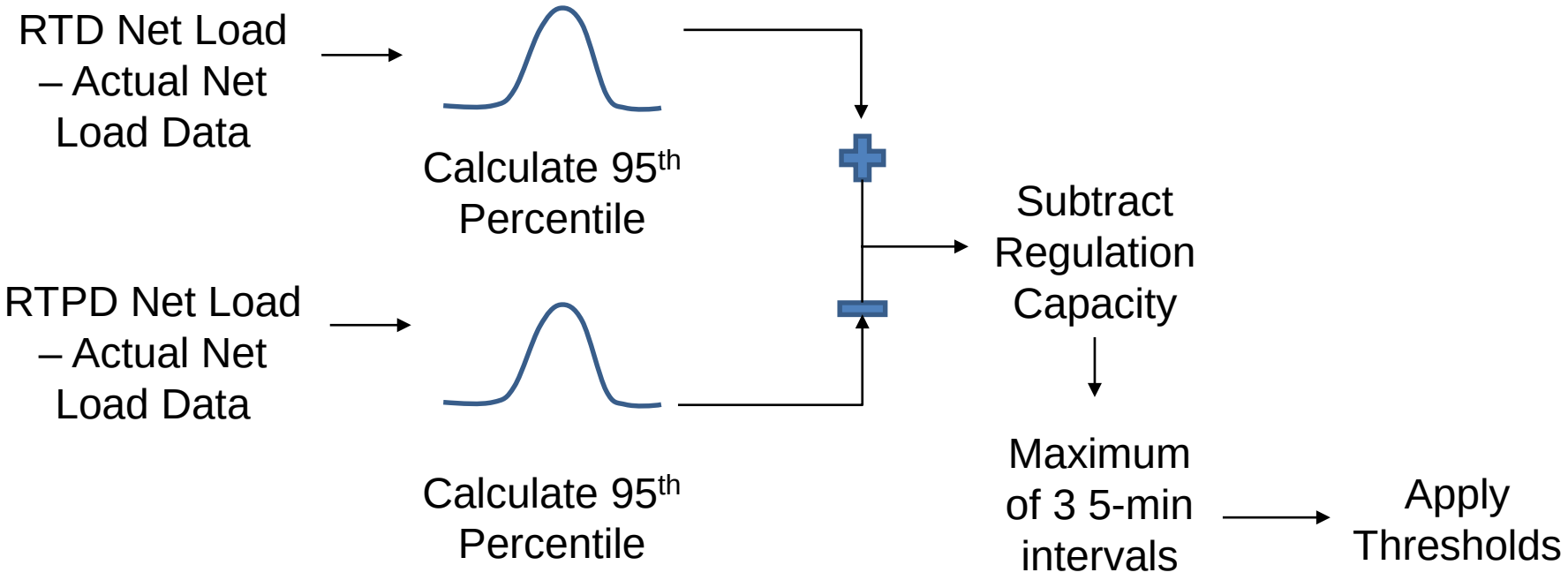
Details of Determining Static Flexible Ramping Constraint Requirements

- Prior to March 2015, Flexible Ramping Constraint requirements were static values for each hour
  - Hourly requirements were determined manually by analyzing historical data
  - Requirements were re-evaluated on an seasonal basis or as system conditions changed

Details of Determining Dynamic Flexible Ramping Constraint Requirements

- From March 2015 to August 2015, the Flexible Ramping Constraint requirements were dynamically estimated using the BARR tool
  - Introduced the concept of using recent historical bounds (95th percentile) on variability and uncertainty to determine requirements
  - Used indirect method to estimate historical distribution of net load differences between FMM and RTD
  - Requirements are determined for each 5-min interval and the maximum 5-min requirement in a 15-min interval is used as the final requirement

Graphical Overview of Prior BARR Method to Calculate Flexible Ramping Constraint Requirement

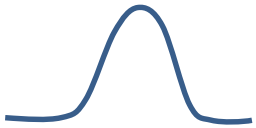


Used from March 2015 to August 2015

Details of Determining Dynamic Flexible Ramping Constraint Requirements

- From August 2015 to present, the Flexible Ramping Constraint requirements are dynamically estimated using the BARR tool
  - Only change from prior method is the requirement uses a direct method to estimate historical distribution of net load differences
  - 95th percentile is still used to set the requirement
  - Requirements are also still determined on a 5-minute basis and the maximum estimated 5-min requirement sets the 15-min requirement

Graphical Overview of Current Flexible Ramping Constraint Requirement Calculation

RTD Net Load – RTPD Net Load Data →  Calculate 95th Percentile → Maximum of 3 5-min intervals → Apply Thresholds

Currently in use

Increased Transparency of Requirements through OASIS

- During the last week of Christmas, the ISO began publishing to OASIS the Flexible Ramping Constraint Requirement for the three upcoming hours
- In addition, estimates of net demand movement (relevant to flexible ramp sufficiency test) are published to OASIS for the three upcoming hours

Additional Processes for Implementing the Flexible Ramping Product

- Use statistical tests to determine appropriate grouping of interval data
- Develop automated tests to aid with implementation and monitoring
- Test implementation design using historical data
  - Aides in refinement of detailed implementation of flexible ramp product
  - Net system demand calculation in particular
- Develop process to regularly determine appropriate threshold levels