Ramp Product Design

Ramp Product Focus Group
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INTEGRATED MARKETPLACE
What is a Ramp Product

- What is the problem we are trying to solve?
- What are the benefits of a ramp product?
Benefits of a Ramp Product

- More available near term ramp capability
  - Hold units back when required for future ramp needs
  - Reduce real-time price volatility caused by ramp shortage
  - Less frequent relaxation of Operating Reserve requirement

- Production cost savings
  - Ability to use economical ramping units during sudden change in system requirements
  - Avoided cost of uneconomic commitments to provide ramp
  - Avoided cost of reserve shortage
Benefits of a Ramp Product, Cont.

• Transparent pricing for the supply of ramp capability
  – Resources are paid opportunity cost
• Long term benefits of ramp product
  – Provide market incentives for participants to offer and develop improved resource flexibility
Ramp Capability Needs

Up Ramp Capability = \((t_5 - t_3 \text{ demand change}) + (\text{uncertainty factor})\)

Down Ramp Capability = \((-1)((t_5 - t_3 \text{ demand change}) - (\text{uncertainty factor}))\)

Diagram from “Ramp Capability Product Design for MISO Markets,”
Dec 22, 2013, white paper available at misoenergy.org
Ramp Product Design

• New ramp requirement per interval
• DAMKT and RTBM product
• All dispatchable Resources are eligible to clear ramp
  – No ramp offer price
  – MCE decides which Resources to clear ramp
  – All cleared Resources are paid the marginal opportunity cost
• New ramp demand curves
  – MISO has done studies using $5 and $10 demand curves with similar results
  – Deploy ramp through current RTBM dispatch when requirement is not met within demand curve
• Ramp Product design similar to Op Reserve model design
Ramp Product Cost Allocation

• The costs of ramp capability are expected to be allocated like the costs of the existing Operating Reserves since ramp capability is similarly needed for reliable system operations

• Cost allocated to causers vs benefiters
  – Allocating to causers would require complex rate structures
  – MISO proposes to allocate costs to primary benefiters (i.e. load and exports)
    ▪ Same way contingency reserves are allocated
### Ramp Clearing Example #1

<table>
<thead>
<tr>
<th>Resource</th>
<th>Online Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offer cost</td>
<td>$50/MWh</td>
</tr>
<tr>
<td>Energy LMP</td>
<td>$52/MWh</td>
</tr>
<tr>
<td>Cleared Energy</td>
<td>50 MW (eco min)</td>
</tr>
<tr>
<td>Cleared Up Ramp</td>
<td>50 MW</td>
</tr>
<tr>
<td>Opportunity Cost</td>
<td>$2/MWh</td>
</tr>
<tr>
<td>Ramp Clearing Price</td>
<td>$3/MWh</td>
</tr>
</tbody>
</table>

#### RESULTS

<table>
<thead>
<tr>
<th></th>
<th>w/o Ramp Product</th>
<th>w/Ramp Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Payment</td>
<td>$5200/h ($52/MWh*100MW)</td>
<td>$2600/h ($52/MWh*50MW)</td>
</tr>
<tr>
<td>Ramp Payment</td>
<td>$0</td>
<td>$150/h ($3/MWh*50MW)</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>-$5000/h ($50/MWh*100MW)</td>
<td>-$2500/h ($50/MWh*50MW)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$200/h</td>
<td>$250/h</td>
</tr>
</tbody>
</table>
### Ramp Clearing Example #2

<table>
<thead>
<tr>
<th>Resource</th>
<th>QSR available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offer cost</td>
<td>$50/MWh</td>
</tr>
<tr>
<td>Energy LMP</td>
<td>$45/MWh</td>
</tr>
<tr>
<td>Cleared Energy</td>
<td>0 MW</td>
</tr>
<tr>
<td>Cleared Up Ramp</td>
<td>100 MW</td>
</tr>
<tr>
<td>Opportunity Cost</td>
<td>$0/MWh</td>
</tr>
<tr>
<td>Ramp Clearing Price</td>
<td>$3/MWh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESULTS</th>
<th>w/o Ramp Product</th>
<th>w/Ramp Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Payment</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Ramp Payment</td>
<td>$0</td>
<td>$300/h</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$0</td>
<td>$300/h</td>
</tr>
</tbody>
</table>
Ramp Product Ideas From Other ISOs

- Ramp products have been designed by MISO and CAISO to help deal with future load uncertainty
- MISO filed with FERC (Docket ER14-2156-000) in June 2014
- FERC conditionally accepted MISO’s Tariff revisions in October 2014
- There is no firm implementation date
  - CAISO has not filed with FERC (still in stakeholder process)
- The MISO and CAISO methods are similar in purpose
MISO Study

• MISO is currently working on a Ramp Capability Product design
  – MISO cost-benefit studies show potential annual savings of $3.8M-5.4M
    ▪ SPP and MISO designs differ when it comes to Operating Reserve scarcity due to ramp. SPP relaxes the constraint and resolves, while MISO violates which force penalized prices into the LMP.
    ▪ Part of the MISO potential savings is related to the reduction of these high prices, which SPP will not see due to the difference in current design.

• MISO studies demonstrate that through the use of the ramp capability products the system can be:
  – In a better position to address short term ramp needs, and
  – Prepared to addresses increases in the ramp capability requirements while realizing a tangible cost savings.
CAISO – Flexible Ramping Products

• Traditionally: Look-ahead commitment and dispatch solutions satisfy the forecasted load over the time horizon

• However, there is no “margin for error” with this approach
  – The dispatch solution exactly satisfies forecasted load
  – Unforeseen but ordinary changes in renewable energy output, intertie flows, and generation deviations from dispatch instructions can be problematic
  – Even a good look-ahead dispatch system might not meet actual load and system requirements without the presence of spare ramping capability in addition to required contingency reserves
CAISO – Purpose of Flexible Ramping Products

- CAISO’s flexible ramping (“flexiramp”) products are meant to address short-term load uncertainty
- Flexiramp products are NOT meant to solve multi-hour pre-ramping problems such as those faced by ISO New England
- Pre-ramping concerns of ISO New England
  - Would exist even if system load forecasts were perfect
  - Would not be resolved by a flexiramp implementation
CAISO – Key ideas for flexible ramping products

• Flexiramp product constraints impose confidence intervals around the forecasted load level
• Purpose is to provide a “safety margin” in case actual load differs unexpectedly from the forecast
• There are flexiramp up and flexiramp down products
• Flexiramp capability is NOT the same as contingency reserves: a contingency is not required for flexiramp deployment
CAISO – Flexible ramping products

- There is no bidding for flexiramp products (assumes generators have no variable cost for providing unloaded ramp capability)
- Flexiramp products are co-optimized with energy and reserves
- Conceptually, prices for flexiramp products are based on opportunity costs (similar concept to RT reserve prices)
  - CAISO’s actual pricing and settlement rules are complex
CAISO – Flexible ramping products

CAISO’s Look-ahead dispatch is based on forecasted loads (represented by dots)

CAISO is currently evaluating whether it should consider ramp capabilities over longer time frames

The flexiramp constraint forces the binding dispatch for Time 5 to be such that this 95% confidence interval is feasible

Current time

Load

Time
CAISO – Flexible ramping product demands

• The minimum flexiramp up and down requirements are determined by the expected net load change
• The maximum flexiramp up and down requirements are defined as the 2.5%ile and the 97.5%ile of net load change
• A demand curve connects the minimum and maximum flexiramp requirements for each direction
  – Demand curve quantities and prices are determined by historical data
  – Price for minimum up and down quantities was originally proposed to be $247/MWh
CAISO – Flexible ramping product payments

Settlement rules are complex

1. Because flexiramp capacity can be deployed as energy or reserves, CAISO has settlement rules to modify payments depending on how/if the flexiramp capacity is deployed during actual operations
   – Avoid double-payment for the same capacity

2. Non-performance rules are designed to avoid paying for undispachable/undeliverable flexiramp capability
   – Unit might not be able to deliver its flexiramp designation due to not following dispatch, not complying with synchronization standards, etc.
MISO – Ramp capability

- Very similar to CAISO flexiramp products in purpose and function
- Settlement rules are different
Conclusions – Other ISO ramp products

• Flexiramp constraints deal with future load uncertainties, not multi-hour ahead load forecasts (NEISO’s “pre-ramping” issue)

• Conditions specific to the CAISO system make managing very-short-term load forecast uncertainty important

• ISO New England does not face the same conditions, so a flexiramp-type product is not an operational priority for the New England system at this time
Ramp Product Stakeholder Schedule

Target Dates

- MWG – 10/20/2015, Initial Discussion Item
- ORWG – 11/5/2015, Initial Discussion Item
- MWG – 11/17/2015, Approval Item
- RTWG – 11/19/2015, Initial Discussion Item
- ORWG – 12/3/2015, Approval Item
- RTWG – 12/17/2015, Approval Item
- MOPC – 1/12/2016, Approval Item
- BOD – 1/26/2016, Approval Item