Price Responsive Demand Overview and DR Hub Implementation

Demand Response Operations
May 18, 2020
DR Hub May Release

• Training: 5/19/2020
• Production 5/28/2020

• Complete PRD Enhancements
  – Interface to Capacity Exchange
  – Interface to Markets Gateway
  – DR Hub PRD Events and Compliance Records
Load that will automatically respond to energy prices and be off the grid during a PJM emergency will receive a lower capacity requirement.
PRD must be managed by pricing point/substation ("pnode")
Eligibility Requirement - Retail Rates

- Customer response if based on a dynamic retail rate.
  - “….. and a retail rate structure, or equivalent contractual arrangement, capable of changing retail rates as frequently as an hourly basis, that is linked to or based upon changes in real-time Locational Marginal Prices at a PRD Substation level and that results in a predictable automated response to varying wholesale electricity prices”.

- Examples:
  - **Critical Peak** that allows retail rates to rise when the wholesale market price exceeds a threshold level;
  - **Critical Peak Rebate** which provides bill credits to consumers who reduce their usage below a baseline quantity during periods when the wholesale market price exceeds a threshold level; or
  - **Index based on Real-Time LMP**.
Eligibility Requirement - Supervisory Control (automated load reduction)

- Customer load at each substation automatically reduced based on PRD price curve
  - “load shall be reduced automatically in response to control signals sent by the PRD Provider directly to the control equipment where the load is located without the requirement for any action by the end-use customer.”
  - Exception: individual site with supervisory control
- PRD provider can reduce customer’s load remotely

Load must be reduced – capacity was not procured for the customer
PRD changes filed at FERC (22/23 DY)

<table>
<thead>
<tr>
<th>Design Components</th>
<th>Status Quo</th>
<th>Original Filing (FERC rejected)</th>
<th>New Filing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auction/FRR Plan credit requirement</td>
<td>Credit based on Base Capacity Rate</td>
<td>Credit based on new CP rates (which are higher than base rates)</td>
<td>same</td>
</tr>
<tr>
<td>Auction/FRR Plan Nominated capacity amount (PRD plan)</td>
<td>Existing based on prior registered capacity nomination, Planned based on estimated nominated capacity amount</td>
<td>Existing based on prior registered capacity nomination, Planned based on estimated nominated capacity amount</td>
<td>same</td>
</tr>
<tr>
<td>Nominated capacity amount (PRD registration)</td>
<td>Expected Peak Load (PLC times Zonal Forecast Peak / Zonal W/N Peak) minus MESL</td>
<td>Lesser of: PLC - Summer FSL (adjusted for losses), WPL - Winter FSL (adjusted for WWAF and losses)</td>
<td>same</td>
</tr>
<tr>
<td>Event Compliance Penalty Rate</td>
<td>Provider's Weighted Final Zonal Capacity Price + Higher of [0.2 Provider's Weighted Final Zonal Capacity Price, $20/MW-day] * number of days in DY. The penalty is applied on event basis</td>
<td>Subject to CP non-performance assessment. Higher of (Net Cone * 365/30 and Daily Commitment Penalty), up to the stop loss provision. Penalty applied on hourly basis</td>
<td>same</td>
</tr>
<tr>
<td>load reduction measurement add back (PJM unrestricted load for forecast and customer PLC input)</td>
<td>Expected Peak Load minus load plus MESL adjustment amount</td>
<td>Summer = PLC minus Summer load, Winter = adjusted WPL minus Winter load. Performance measured for each hour</td>
<td>PLC - load. Performance measured for each hour.</td>
</tr>
<tr>
<td>Trigger to assess CP Penalty</td>
<td>LMP at or above PRD curve and max emergency generation action</td>
<td>PAH and LMP greater than PRD curve triggers penalty</td>
<td>same</td>
</tr>
<tr>
<td>Overperformance/bonus payments</td>
<td>not applicable</td>
<td>overperformance will be eligible for bonus payment (similar to Load Management event), update balancing ratio calculation to include PRD bonus performance (similar to DR bonus performance).</td>
<td>same</td>
</tr>
</tbody>
</table>

Slides are based on the PRD changes which will become effective for X if approved by FERC
Overview of PRD roles

• PRD provider
  – PJM member
  – Typically the Load Serving Entity (LSE) for the retail customer
  – Responsible for all PRD obligations and associated penalties

• LSE
  – receives reduced capacity charges (PJM bill credit)
  – Registration review – ensure it is there customer if they are not the PRD Provider

• EDC
  – Registration review - data validation for account number, PLC, line losses, etc.

PRD customer may not participate as Economic or Emergency (Load Management) DR
Submit PRD plan
~3.5 years in advance (Jan 15 prior to BRA)

Register locations by pnode
Jan – May prior to DY

PRD may participate in 3rd IA if Load Forecast goes up

Update Registrations, Performance compliance

Submit PRD curves by pnode
Key PRD processes when there is a PRD commitment

Registration  PRD curves  Test  Bill Credits  Compliance & Penalties
• LSE PRD Credit = \([\text{PRD Icap commitment} \times \text{Final Zonal RPM Scaling Factor} \times \text{FPR} \times \text{Final Zonal Capacity Price}]\)
  – Very similar to DR BRA credit.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Nominated PRD Value [MW]</th>
<th>PRD Credit [$/day]</th>
<th>PRD credit effective price</th>
<th>BRA prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGE</td>
<td>330.0</td>
<td>$34,223.35</td>
<td>$103.71</td>
<td>$86.04</td>
</tr>
<tr>
<td>PEPCO</td>
<td>170.0</td>
<td>$17,630.21</td>
<td>$103.71</td>
<td>$86.04</td>
</tr>
</tbody>
</table>
PRD Penalties

Commitment Penalty (do not have enough customers to cover commitment)

Max Emergency Event Penalty (don’t reduce enough load when required)

Test Penalty (don’t reduce enough load when required)
### PRD vs DR/CP comparison in capacity market

<table>
<thead>
<tr>
<th>Process</th>
<th>PRD</th>
<th>DR/CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM</td>
<td>BRA or 3rd IA if forecast goes increases, No replacement, Submit PRD plan, PRD provider only. Credit based on the CP rates</td>
<td>BRA and IAs, replacement allowed, Submit DR plan, CSPs provide. Credit based on new CP rates</td>
</tr>
<tr>
<td>Revenue</td>
<td>No revenue – bill credit to LSE based on FZCP if cleared in BRA. No energy market revenue. If PRD provider different from LSE then they must work out arrangements for any transfer for money</td>
<td>Revenue to CSP based on auction clearing price. Energy market revenue based on full LMP</td>
</tr>
<tr>
<td>Registration</td>
<td>LSE required and pnode required (and limits aggregation), Dynamic retail rates (linked to nodal LMP). Not allowed to participate as economic DR</td>
<td>No LSE required. Registration not permitted after start of DYs.</td>
</tr>
<tr>
<td>Reporting</td>
<td>PRD hourly curve (load and LMP) by pnode</td>
<td>Expected reductions by dispatch group</td>
</tr>
<tr>
<td>Dispatch &amp; Notification</td>
<td>PRD provider dispatches from price curve and supervisory control during Max Emergency. Eligible to set LMP. May have price curve of 1 point at energy offer cap</td>
<td>PJM dispatch/release by zone/subzone by type by lead time. Eligible to set LMP. PJM dispatches based on system needs when short on reserves</td>
</tr>
<tr>
<td>Verification</td>
<td>FSL (compared to PLC, hourly basis)</td>
<td>Summer FSL (compared to PLC) and Winter FSL (compared to WPL). Hourly basis</td>
</tr>
<tr>
<td>Penalty</td>
<td>Daily deficiency charge (FZCP * &gt; of 1.2 or $20/mwday Event – same as DR</td>
<td>Daily deficiency charge (RPM price * &gt; of 1.2 or $20/mwday Event – Net Cone * 365/30</td>
</tr>
<tr>
<td>Testing</td>
<td>Same</td>
<td>same</td>
</tr>
<tr>
<td>Add Back</td>
<td>Based on emergency event and 5 CPs</td>
<td>Based on emergency and economic events</td>
</tr>
</tbody>
</table>
• PRD Registrations
• PRD Events
  – Compliance and Non-Compliance Events
• PRD Test and Re-Test Events and Compliance
Location and Registrations must be by Pnode

- One location per registration
  - Same CSP/EDC/LSE/Zone/Pricing Point (Pnode)
- Locations < 10 kW that are part of a utility program may be on one location with a pseudo-EDC Account Number
  - Must maintain accurate list of same information throughout the DY and provide to PJM upon request
- Locations > 10 kW must have their own location
- EDC and LSE reviews registrations
PRD Events

- **Non-compliance event:** Pnode load must reduce load within 15 minutes whenever a 5-minute LMP is above or equal to the Offer Price for that pnode.
  - There may be multiple times during a day that the 5-minute LMP is above or equal to the Offer Price for a pnode

- **Compliance event:** If Maximum Generation Emergency event is declared by PJM **AND** 5 min LMP is above or equal to offer Price then PRD provider must do same as non-compliance event, but ALSO get down to MESL (Maximum Emergency Service Level)
  - A PRD compliance event is created if LMP=>offer price for at least 4 contiguous intervals. Compliance will be measured starting with the 4th interval until the last interval.
Test and Re-Test Events

• Same as Load Management Tests for Capacity Performance (Annual):
  – Must test if no PRD Compliance Event during the delivery year
  – PRD Providers acknowledge start and end of test by registration using Electronic Notification
  – Compliance records are created when PRD Provider confirms test
Markets Gateway Real-Time Offers

- PRD Offers are the expected load if LMP is higher than the offer price of the DR Hub registrations assigned to a Pricing Point.

- PRD Response Curve and PRD Hourly Offers must be entered for each day and each hour in Markets Gateway for every Pricing Point with an effective registration in DR Hub.
  - **Response Curves** are hourly offers (MW and Price) by Pricing Point and can be up to 10 segments per hour. MW represents expected load when LMP=Price.
  - **Hourly Offers** represent the hourly MinMW (LMP>Price) and MaxMW (LMP<Price) and up and down response or ramp rates (measured in MW per hour).
More information about the DR Hub Implementation can be found on pjm.com => Training => Training Material => Demand Response => Price Responsive Demand, or directly here: https://www.pjm.com/-/media/training/core-curriculum/ip-dsr/in-dr-hub-and-markets-gateway.ashx?la=en