



Integration of Price Responsive Demand in RPM

Overview of Price Responsive Demand

The development and implementation of dynamic and time-differentiated retail rates, together with utility investment in Advanced Metering Infrastructure (AMI) has lead an increasing quantity of load in PJM to be responsive to changing wholesale prices. Through enabling technology and behavioral changes, consumers modify their demand as prices change without being centrally dispatched by PJM or bidding demand reductions into the PJM markets. Given the linkage between dynamic retail rate structures and wholesale prices, this price responsiveness is predictable and needs to be accounted for in the wholesale market design and operations. This predictable reduction in consumption in response to changing wholesale prices is known as Price Responsive Demand. The continued development of Price Responsive Demand requires coordination between the wholesale market and the retail rate design to maximize its benefit to consumers. The deployment of AMI for small commercial and residential customers will enable dynamic and time-differentiated retail rate structures linked to wholesale prices. AMI supports dynamic retail rate structures, such as:

- Critical Peak Pricing that allows retail rates to rise when the wholesale market price exceeds a threshold level;
- Critical Peak Rebate pricing 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
- Real-Time Pricing based on LMP.

These types of retail rates provide the necessary exposure to market prices to reduce consumption during high demand periods.

Although Price Responsive Demand is not directly dispatchable by PJM, responses to spot energy prices signals produce a predictable demand curve as a function of price. Price Responsive Demand is therefore able to reduce the installed capacity required to meet Loss of Load Expectation (LOLE) based reliability standards.

In RPM, LSEs may make a firm commitment of the quantity of Price Responsive Demand that reduces its consumption in response to price. This committed quantity reduces the load forecasts used to determine the RTO and LDA Reliability Requirements to be cleared in the RPM auctions.



Eligibility of Price Responsive Demand

In order for an LSE to reduce its capacity obligation through the commitment of Price Responsive Demand, the price responsive load must be:

- served under a dynamic retail rate structure that changes on a daily or hourly basis, that is linked to or based upon the PJM real-time LMP at the location applicable to the load, and that results in predictable response to varying wholesale electricity prices;
- subject to advanced metering capable of recording electricity consumption at an interval of one hour or less; and
- subject to supervisory control to curtail the demand should PJM declare an emergency condition.

Supervisory control of customer load committed as Price Responsive Demand is required on the part of the EDC, LSE or CSP consistent with any retail regulatory authority requirements. The EDC, LSE, or CSP is required to have the remote capability to decrease the load at each location contained in the PRD Plan to the required service level during PJM Maximum Emergency events when the Real-Time LMP is greater than \$1,000, to the extent load was not already reduced based on price.

Registration of Price Responsive Demand

To properly account for Price Responsive Demand in the Reliability Requirements, Load Forecasts and Load Obligations in RPM, Load Serving Entities must submit in a PRD Plan the aggregated amount of eligible Price Responsive Demand for PJM use in preparing the load forecast applicable to RPM auctions. The aggregated amount of the Price Responsive Demand is determined based on values documented in the PRD Plan. The portion of any customer load that is registered and committed as Price Responsive Demand cannot also be registered as Interruptible Load for Reliability (ILR) for the same Delivery Year or offered as Energy Efficiency or DR in RPM Auctions applicable to the Delivery Year for which it is committed as PRD.

Registration of PRD is accomplished through the LSE's submission of its PRD Plan to PJM. The PRD plan must detail the price responsive characteristic of the customer load at a substation level. The price responsive characteristic of such customer loads must be provided in terms of the quantity of load that will continue to consume at various levels of price. At a minimum, the characteristic must indicate the quantity of customer load that will continue to consume when the wholesale price reaches \$1,000/MWh. This quantity will establish the Maximum Emergency Service Level (MESL) of PRD at each substation. The substation MESL quantities will then be aggregated to determine the Zone/LDA MESL quantity for the LSE in that Zone/LDA. The MESL is utilized to determine the contribution of the PRD to the LSEs capacity obligation.

The PRD plan must be submitted to PJM no later than December 1st prior to the auction for which it will be included. PJM reviews the PRD Plan to ensure the Plan contains all the necessary detail and information. Once PRD Plan reviews are completed, PJM adjusts the Preliminary Zonal Peak Load



Forecasts considering all accepted PRD Plans and post the resulting load forecasts with the planning parameters prior to the conduct of the RPM Auction.

If the PJM Zonal Load Forecast for a given Delivery Year increases after the Base Residual Auction, an LSE may submit a PRD Plan for participation in the RPM Incremental Auctions for that Delivery Year. PRD Plans that are submitted for registration in an Incremental Auction may only include PRD values for:

- a) New price-responsive load that meets the eligibility requirements, that has not been previously committed in an earlier RPM auction; or
- b) An increase in Nominal PRD Value (i.e. – a decrease in MESL) for a previously committed PRD load.

If the total increase in the Nominal PRD Values of all LSEs in a Zone exceeds the increase in the Zonal Load Forecast the Nominal PRD Values will be reduced proportionately.

Price Responsive Demand (PRD) Plan

The PRD Plan is a document that defines the Maximum Emergency Service Level (MESL) of PRD. The MESL is determined based on the price-consumption characteristic of the PRD at each substation location. The PRD plan must identify any methods and techniques that will be used to determine and verify the quantity of load consumed at varying wholesale price levels. A single PRD Plan may be submitted to cover multiple locations within a transmission zone, provided that the price-consumption curves are submitted on a substation level. The single PRD Plan must clearly document the MESL that aggregates all the values for each sub-station covered in the PRD Plan.

All the assumptions, procedures, and data for the PRD Plan should be clearly documented. The data included should be sufficient for a third party to audit the procedures and verify the MESL of Price Responsive Demand.

Requirements of Price Responsive Demand (PRD) Plan

A Price Responsive Demand (PRD) Plan submitted to PJM must include:

- (1) Company name
- (2) Submission date
- (3) Company address and contact information
- (4) Location of Price Responsive Demand by substation
- (5) Maximum Emergency Service Level (MESL) of Price Responsive Demand by substation
- (6) A description of the methodologies used to determine the Maximum Emergency Service Level (MESL) including the additional items listed below.



Determination of the Maximum Emergency Service Level (MESL) of Price Responsive Demand (PRD)

The **Maximum Emergency Service Level (MESL)** of Price Responsive Demand is the level to which price-responsive load will be reduced during the Delivery Year when a Maximum Emergency Event is declared and the real-time LMP is greater than or equal to \$1,000/ MWh. This level is to be determined consistent with the 50/50 load forecast that is the input to the RPM auctions, specifically the Zonal Weighted Temperature Humidity Index Standard for each Zone as posted by PJM on its web site.

In the PRD Plan, the LSE determines and provides the MESL for its price-responsive load at a substation level in each Zone and/or LDA, whichever is smaller. Substation level detail is necessary for Day-Ahead & Real-Time Market operation processes to ensure that the PJM dispatch software recognizes the price-consumption characteristic of the PRD on a locational basis. This recognition by location is necessary such that the dispatch algorithms recognize that at pre-defined price levels the demand required to be served at specific locations on the system will decrease. Failure to recognize this characteristic on a locational basis would result in the software's inability to either maintain power balance or correctly solve for transmission constraints.

In order to determine the Nominal PRD Value for specific loads for a given Delivery Year, the PRD Plan must include the Expected Peak Load value that would normally apply to the price-responsive loads and the MESL value given the load's price responsive characteristics. In RPM clearing and load forecasting processes, Nominal PRD Values are calculated and aggregated for each Zone and/or LDA.

The MESL in the PRD Plan must be based on its end-use customers served by the Load Serving Entity that continue through the applicable Delivery Year. If price responsive load switches to another LSE, the MESL, Nominal PRD Value and PRD commitment would shift with it.

In support of the Maximum Emergency Service Level (MESL) of PRD, an LSE must provide in the PRD Plan:

- (1) Price-consumption curves at the sub-station level that detail the base consumption level as well as the decreasing consumption levels at increasing prices.
- (2) Expected Peak Load of the PRD for the given Delivery Year.
- (3) Nominal PRD Value. Weather sensitive load must use the Zonal Weighted Temperature Humidity Index Standard for each Zone as posted by PJM on its web site.
- (4) Specifications of the equipment used to meet the advanced metering and supervisory control requirements, including a project plan and timeline with the milestones that demonstrates that the AMI and supervisory control will be available and operational for the start of the Delivery Year.
- (5) Documentation that supports the eligibility of load that will be served under a dynamic retail rate structure during the relevant delivery year, as specified in the Eligibility Section.



(6) Any and all updates to required key elements listed above that were submitted in previously accepted PRD Plans.

If one or more of the variables that will be measured or monitored and/or assumptions that will be used in the determination of the MESL are not known at the time the Load Serving Entity submits its PRD Plan to PJM for review and approval, the Load Serving Entity may provide alternative information and/or forecasts and indicate the portion of the MESL associated with such measurement and monitoring variables and/or assumptions and explain the basis for such forecasts.

Adjustments to RPM Peak Load Forecasts

PJM produces **annual peak load forecasts** for the RTO and individual transmission zones for use in the RPM auction clearing processes and for planning purposes. In RPM, the load forecasts are used to determine the RTO Reliability Requirement.

PJM determines the Zonal Peak Load Forecasts considering Price Responsive Demand that is committed by Load Serving Entities in each Zone prior to conduct of RPM Auctions.

The Preliminary RTO Peak Load Forecast and the Preliminary Zonal Peak Load Forecasts for the Delivery Year are determined by PJM and adjusted for Price Responsive Demand in accordance with ***the Load Data Systems Manual (M-19)***.

Performance Requirements of Price Responsive Demand

Once registered and included in the load forecast and thereby committed in RPM for a given Delivery Year, Price Responsive Demand is required to reduce to a level based on the MESL upon PJM declaration of a Maximum Emergency Event when the Real-time LMP \geq \$1,000/MWh during that Delivery Year. Once committed by virtue of being included in the load forecast for an RPM auction, Price Responsive Demand may not be uncommitted or replaced by supply resources. During the Delivery Year, Load Serving Entities for which committed Price Responsive Demand does not respond consistent with the commitment during emergency conditions will be subject to financial penalty as specified below.

Measurement & Verification of Performance of Price Responsive Demand

Measurement and Verification of PRD is based on the committed load's actual consumption under specific conditions during the Delivery Year. Verification of Price Responsive Demand is conducted whenever PJM declares a Maximum Emergency Event and the real time LMP in the locations subject to the event is equal to or greater than \$1,000/MWh. Load Serving Entities are responsible for the submittal to PJM of all information required to complete this verification for each PJM Maximum Emergency Event when LMP is at least \$1,000/MWh during the Delivery Year. PJM will establish and communicate reasonable deadlines for the timely submittal of data to expedite reviews. Reviews are completed as soon after a Maximum Emergency Event as possible, with the expectation that reviews of each event will be completed within two months of the end of the month in which the event took place.



For Price Responsive Demand, compliance is assessed upon declaration of a PJM Maximum Emergency Event when the Real-time LMP \geq \$1,000/MWh, by comparing actual load to an adjusted MESL value. In order to account for the fact that actual load can be greater than the PJM 50/50 load forecast during emergency events, the MESL is adjusted by a ratio equal to the amount by which the actual zonal load during the event exceeded the PJM load forecast for the Delivery Year. Load Serving Entities must submit actual customer load levels for all hours during the PJM Emergency Event. No additional credit is provided for any load reduction below the MESL.

Penalties for Non-Performance of Price Responsive Demand

Given that registration of PRD prior to an RPM auction could occur years ahead of the actual Delivery Year for which the PRD is being committed, LSEs may not actually have the AMI or supervisory control in place at the time of registration. In such cases, LSEs will be required to provide PJM with documentation indicating that such AMI and supervisory control is in place prior to the start of the actual Delivery Year. Registered PRD for which the required AMI and supervisory control is not in place as of the start of the Delivery Year will be penalized on a daily basis for the full amount of non-performance until such time as the AMI and supervisory control capability is installed and documentation of such installation is provided to PJM.

PRD compliance is assessed upon declaration of a PJM Maximum Emergency event when the Real-time LMP \geq \$1,000/MWh. The PRD compliance event hours are those hours for which a PJM Maximum Emergency Event was in place, and for which the Zonal load-weighted average hourly-integrated Real-time LMP \geq \$1,000/MWh for the entire clock hour.

The penalty applicable to an LSE for which load committed as Price Responsive Demand does not respond consistent with its commitment at the first ME event is

$$\text{MW shortfall} * [\text{Final Zonal RPM Scaling Factor} * \text{Forecast Pool Requirement}] * [1.2 * \text{Final Zonal Capacity Price in } \$/\text{MW-Day} * 365].$$

The same penalty rate will be applied to the subsequent Maximum Emergency Events based on MW shortfall exceeding the total shortfalls in the prior Maximum Emergency Events.

The MW shortfall will be based on MESL identified at the time of the PRD nomination, except that the MESL will be increased by the ratio of actual PJM peak load at the time of the Maximum Emergency Event to the final PJM load forecast for the Zone. That is:

$$\text{MW shortfall} = [\text{highest hourly integrated aggregate metered load for LSE's PRD load in the Zone/LDA}] - [(\text{aggregate MESL for Zone/LDA}) * (\text{actual zonal load}/\text{Final Zonal Load Forecast})]$$

An LSE cannot use Replacement Capacity to reduce a PRD MW shortfall in the case of either failure to install the required AMI by the start of the Delivery Year or failure to perform during a Maximum Emergency Event.

Penalty funds are allocated to RPM Load Serving Entities in proportion to their RPM Locational Reliability Charges for the delivery year.



Load Serving Entities that do not meet their PRD commitments in a given year with the amount of load reduction for which they are committed as PRD, need to justify their MESL amount or revise the estimate for the purposes of the next Delivery Year for which an RPM auction has not yet occurred. PJM monitors and tracks the level of Price Responsive Demand at the zonal level to allow adjustments to zonal unrestricted load forecasts. PJM also tracks and monitors the level of Price Responsive Demand at the LSE level to ensure that the load charges to LSE will be based on PLCs adjusted for Price Responsive Demand.

Credit Requirements

Load Serving Entities that register Price Responsive Demand that has already installed the required AMI and supervisory control, are not required to establish credit for the RPM Auctions.

Load Serving Entities that register Price responsive Demand that are in the process of installing the required equipment to become eligible, must establish an RPM Credit Limit prior to an RPM Auction on the same basis as Planned Demand Resources as defined in **Section 4 of PJM Manual M18: PJM Capacity Market**.

Testing of Advanced Metering and Supervisory Controls

Testing requirements for PRD will be comparable to testing requirements for Load Management resources as defined in **Section 8 of PJM Manual 18: PJM Capacity Markets**

Testing is required to ensure that the committed load LSE has the ability to achieve the committed Maximum Emergency Service Level (MESL) via either:

- Respond to the Real-time LMP signal; or
- Reducing load in response to a supervisory control signal

Tests may be executed for all resources in a given transmission zone.

Testing is required to demonstrate compliance for a one hour period.

Fixed Resource Requirement (FRR) Alternative

The above rules for Price Responsive Demand are also applicable to participants in the FRR alternative of PJM Capacity Markets.

In the case of FRR Entities, penalties for non-performance will be based on the Capacity Resource Price for the LDA encompassing the FRR Entities Zone in place of the Final Zonal Capacity Price.