



Price Responsive Demand

PJM Staff Whitepaper
March 3, 2011

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Table of Contents

Table of Contents	2
I. Executive Summary	3
II. Overview of Price Responsive Demand	4
A. Purpose of this Whitepaper	4
B. What is Demand Response?.....	4
C. Price Responsive Demand: what it is and why it is important	5
D. Price Responsive Demand will benefit consumers in the PJM region.....	5
E. Price Responsive Demand does not replace the current market rules for Demand Response	7
III. PJM Staff Proposal	8
A. Strong and Unique Eligibility Requirements for PRD	9
B. Rules that Integrate PRD in the PJM Energy Market Operations	11
C. Rules that Integrate PRD in the PJM Capacity Market Clearing Processes	14
D. Wholesale Retail Market Integration	16
E. Penalty Structure for Price Responsive Demand	16
F. PJM Recommendation: Implement PRD As Soon As Feasible	17
IV. Appendix A – Stakeholder Process on PRD	19
V. Appendix B – PJM Staff Proposed Business Rules	25

I. Executive Summary

Investment in Advanced Metering Infrastructure (AMI) is significantly increasing the amount of customer demand in the PJM region with the capability to respond to wholesale electricity prices. State commissions are engaged in examining all facets of the issues surrounding these “smart grid” capabilities. Several states have already enacted dynamic retail electricity rates and AMI pilot programs.

To take advantage of the operational efficiencies that price-responsive retail load will provide, to allow states to clearly understand how their decisions on retail rates will interact with the wholesale market, and to enhance the overall competitiveness of the wholesale market, PJM staff is proposing standard rules for Price Responsive Demand (PRD) participation in the PJM energy and capacity markets.

As consumers gain the ability to respond to dynamic retail electric rates that reflect varying wholesale energy prices, PJM believes consumption patterns will likely change – whether PJM has established PRD rules or not. If the PJM market continues to treat all demand response in the traditional way, system load forecasts will fail to recognize these changes and PJM dispatchers will face increased operational uncertainty that will lead to less efficient market outcomes necessary to offset increased operational reliability risk. The development of business rules that allow PRD, however, will provide PJM with an additional operational resource that enhances reliability in real-time operations and market efficiency: predictable consumption patterns in response to price.

By accounting for and taking advantage of price-responsive retail load at the wholesale level, a vital link will be created that has historically not existed between the retail and wholesale markets. PRD will allow for the evolution of this link without interfering in, and in fact relying on, the relationships between the retail providers, their customers and their regulators.

PRD and various features of proposed rules have been thoroughly vetted with stakeholders in more than three dozen public meetings over a 14-month period. Because PJM Members were unable to reach consensus by the necessary two-thirds majority vote, and in response to letters from the OPSI Board of Directors and four state commissions, PJM staff is requesting the PJM Board to authorize a Section 206 filing to FERC seeking implementation of PRD.

The PJM staff proposal for Price Responsive Demand features these main components:

- requirement for advanced metering capable of automated response to prices and recording consumption by hour;
- requirement for supervisory control with locational knowledge of PRD load;
- requirement for a dynamic retail rate that reflects wholesale prices in some form;
- PRD eligibility to set price in the energy market;
- Penalties for PRD providers that fail to meet commitments during emergencies; and
- PRD eligibility to offset capacity obligations.

Price Responsive Demand will facilitate more active participation by consumers on the demand-side to the benefit of all PJM Members. These proposed rules will enhance grid operations and improve the interaction between wholesale and retail electricity markets.

II. Overview of Price Responsive Demand

A. Purpose of this Whitepaper

The new “PJM Stakeholder Process” Manual¹ includes a section that describes various reports that can enhance information for PJM Members and the Board of Managers. Among the types of documents identified are PJM Staff Whitepapers:

“Occasionally the PJM Board must address issues of significant importance to the stakeholders or independently resolve contentious issues where the stakeholders were not able to come to consensus. In those circumstances, PJM staff shall prepare a whitepaper to inform both the PJM Board and the Membership on the issue. Generally, the whitepaper would discuss the background of the issue, the stakeholder process used to vet the issue, the various proposed solutions including the solution selected by the stakeholders, characterization of stakeholder positions, any other information that PJM staff may rely upon, and any position advocated by the PJM staff....”²

This is the first Whitepaper published to meet this reporting requirement. PJM staff welcomes any comments on the format and content of this document that would be useful for developing future Whitepapers.

B. What is Demand Response?

Demand Response refers to reductions in electricity consumption by end-use customers in response to power grid needs, economic signals from a competitive wholesale market or special retail rates.

Upon the initiation of its electricity markets in 1997, PJM already had a mechanism (a holdover from its old “power pool” days) by which demand response could be compensated for capacity (referred to as Active Load Management). In the summer of 2000, PJM implemented its first rules for demand response participation in the energy market. At that time, demand response was an “emergency only” product that could be compensated for reducing load when PJM declared an emergency condition.

Since then, the PJM demand response rules have expanded to include economic participation right alongside supply resources in the energy market, as well as similar ability in the RPM Capacity construct and ancillary service markets.

Demand Response contributes significantly to PJM’s accomplishment of its two primary missions: reliable operation of the bulk power transmission grid and the operation of robust, transparent, efficient, and non-discriminatory electricity markets. In PJM, the markets for capacity, energy and ancillary services serve to reinforce reliable operations by providing the financial incentives for those that own or control physical resources to follow the instructions of system operators and take actions that therefore promote reliability. Demand Response provides the operators with an additional tool by which to maintain system reliability,

¹ Manual 34: PJM Stakeholder Process, published December 23, 2010: <http://www.pjm.com/committees-and-groups/stakeholder-meetings/stakeholder-groups/~media/documents/manuals/m34.ashx>

² Section 15.5, page 62

and the markets provide the financial incentive for demand response resources to act consistently with reliability needs.

Further, demand response resources increase the efficiency of market operations by adding depth and liquidity to those markets. For example, over the last 5 successive capacity auctions PJM executed under the Reliability Pricing Model, demand response resources offered into those auctions increased from about 4,000 MW to well over 12,000 MW. The significant increase in participation from Demand Response in the PJM capacity market provides additional liquidity and competition, thereby increasing the efficiency with which this market operates.

C. Price Responsive Demand: what it is and why it is important

Price Responsive Demand (PRD)³ is the next market evolution of Demand Response. PRD is the predictable change (a reduction when prices rise, or an increase when prices fall) in electricity consumption (also known as demand) in response to changing wholesale electricity prices.

The development and implementation of dynamic retail electricity rates, together with investment in Advanced Metering Infrastructure (AMI) that accurately documents consumption levels and provides for two-way communication of price, consumption and other information between the end user and the load serving entity provides the opportunity to increase the operational value of the demand response resources. These regulatory, commercial and technological innovations have led to an increasing amount of customer demand in the PJM region with the capability of responding to changing wholesale electricity prices. Through automation technology, consumers can modify their consumption patterns as wholesale prices change without needing to bid demand reductions into the PJM markets and without being centrally dispatched by PJM.

Because these innovations are taking place today, PJM believes that consumer consumption patterns will likely change either in response to price or perhaps other signals -- whether or not the wholesale market establishes price responsive demand procedures. If the PJM market does not establish orderly rules for PRD, and continues to treat all demand in the traditional way, then the aggregate customer response to price will create operational uncertainty for PJM dispatchers. Traditional real-time load forecasting and operational procedures will not recognize the impact of retail customers responding to price. The operational uncertainty will lead to less efficient market outcomes as PJM dispatchers will need to take actions to offset the increased reliability risk from the inability to recognize load response to changing wholesale prices. The development of price responsive demand rules and procedures will not only reduce any potential uncertainty but it will also provide PJM and its stakeholders with an additional operational resource that enhances market efficiency and reliability in real-time operations -- predictable consumption patterns in response to price. PJM believes that wholesale system operations can clearly benefit from consumer predictable flexibility by establishing clear rules and procedures to leverage price responsive demand.

D. Price Responsive Demand will benefit consumers in the PJM region

PJM's wholesale power system was designed and built to meet electric demand under peak conditions while withstanding various contingencies. Within the capacity and energy markets, PJM forecasts and plans for these contingencies on a long-term, near-term and real-time basis. This results in wholesale

³ "The Integration of Price Responsive Demand into PJM Wholesale Power Markets and System Operations", Paul Centolella and Andrew Ott, March 9, 2009.

market costs, which have historically been charged to most retail consumers on the basis of a flat retail rate for every kilowatt hour they consume.

With the introduction of dynamic retail rates and Advanced Metering Infrastructure (AMI), consumers now have the ability to respond to wholesale costs through their energy consumption choices. If customers are provided the ability to “see” and respond to dynamic retail electric rates that reflect and are directly linked to varying wholesale energy prices, then they have the ability to reduce consumption when prices are high and in some cases even shift consumption to times when prices are very low or even negative. With the enabling technology and retail rate innovation, customers can more actively manage their electricity costs, and affect beneficial efficiency and reliability enhancements in the wholesale energy and capacity markets.

PJM recognizes the potential for this mechanism to empower the consumer to exercise control over electricity costs. Through enabling technology and behavioral changes, consumers can achieve predictable response in electric consumption to changing wholesale energy prices. Wholesale markets, in turn, will benefit to the extent that consumers’ choices are incorporated in the market operations.

PJM has proposed and thoroughly discussed with stakeholders the market rules needed to incorporate PRD as dynamic retail electricity rates are implemented in retail jurisdictions in PJM.

PRD will improve reliability and market operations in the following ways:

- PRD will enable end-use customers with load reduction capability to lower electricity bills by making a commitment to reduce consumption in response to retail rates that reflect wholesale market and system conditions. This will enhance reliability by limiting consumption during times of high wholesale prices, thereby assisting operators in managing or even altogether avoiding emergency conditions.
- PRD will reflect the actual cost of consumption during the day, giving customers the power to choose the amount of electricity they are willing to consume at a particular price.
- PRD will improve overall market operations by allowing the PJM energy and capacity market clearing prices to reflect a more accurate level of customer demand to be served.
- PJM will clear the capacity and energy markets recognizing load reductions that will occur as prices rise.
- Additionally, utilities or other entities that serve load who commit demand reductions may decrease their capacity obligations under PJM’s resource adequacy rules thereby lowering their capacity payments, in turn, lowering the overall cost of maintaining resource adequacy
- PRD will provide customers with the ability and incentive to shift consumption to low price periods which could help to balance on-peak verses off-peak consumption patterns.

E. Price Responsive Demand does not replace the current market rules for Demand Response

Market participants will still be able to offer Demand Response (DR) as a supply resource in the PJM capacity and energy markets. PRD simply would be an additional option for demand response participation in PJM's wholesale markets.

Unlike current DR products in PJM, PRD would not be treated as a supply resource in the markets. Instead, PRD will affect the demand in PJM's markets. Current DR products are modeled in the PJM systems and compensated as if they represent supply of additional energy to the grid. In contrast, PRD would be modeled as a predictable change in the quantity of electricity consumed once the wholesale market price reaches an indicated level. That is as wholesale prices rise, consumption would decrease, and conversely as prices fall consumption would increase. The result will be reduced cost to the market participant as a result of either less energy consumed, or shifting consumption to lower priced periods, as opposed to an explicit payment to the participant for energy reductions alone as if energy was supplied to the grid. This distinction is important, as it will result in a more accurate picture of supply and demand conditions by which system operators can manage the grid.

This new PRD option, however, will have unique and distinct eligibility requirements. To be eligible, the price responsive demand must be:

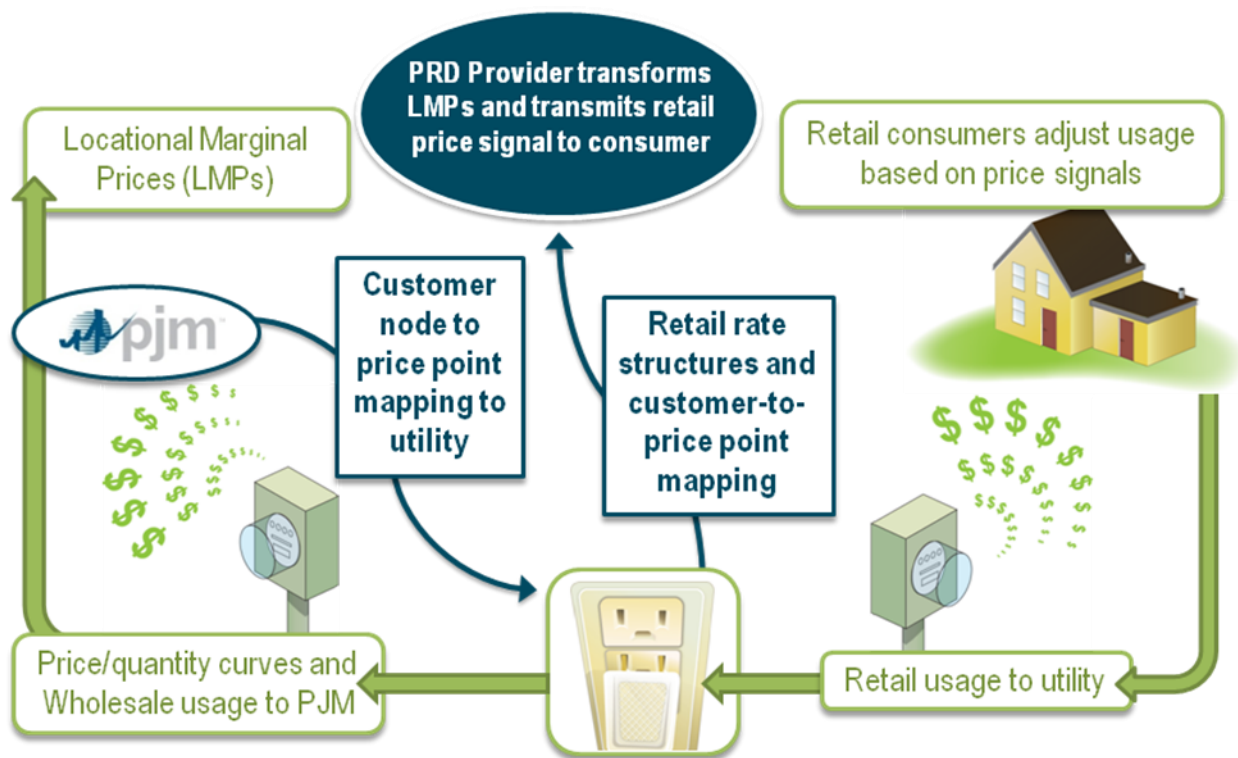
- served under a dynamic retail rate structure with an Load Serving Entity (LSE) or subject to a contractual arrangement with a PRD Provider for which any compensation:
 - changes as frequently as on an hourly basis,
 - is linked to the PJM real-time energy market clearing price at the physical location on the transmission system nearest the customer, and
 - results in a reasonably predictable response to varying wholesale electricity prices.
- subject to supervisory control such that by direct action or other automated trigger the committed demand reduction may be achieved if not already accomplished through response to price should PJM declare an emergency system operations condition and energy prices have risen to the level at which PRD has committed to reduce consumption; and
- subject to advanced metering technology capable of recording electricity consumption at an interval of one hour or less.

Establishing these unique and distinct requirements of PRD is critical to the long-term evolution of the PJM markets. These key design elements will facilitate the development of more direct customer response to any and all high priced hours throughout the year. Ultimately, PRD can bridge the informational and structural gap between wholesale and retail markets, while aligning the market and system conditions to ensure reliable grid operations, transmission planning and capacity adequacy planning.

III. PJM Staff Proposal

PJM staff recommends the implementation of PRD market rules to ensure the long-term evolution of Demand Response in PJM. It is critical that market rules are implemented in the near future that would establish a feedback mechanism that can demonstrate price responsive characteristics of demand accurately and specifically with respect to the load's location.

This new mechanism creates an integrated flow of market information between retail consumers, wholesale market participants, and PJM systems and operations, as shown in the graphic below. PJM produces Locational Marginal Prices (LMPs) that may be used to drive consumer behavior. The key benefit of clear PRD rules at the wholesale level will be feedback to PJM of the consumer response based upon those LMPs. Provision of that feedback will allow for more efficient operation of the bulk power system.



A. Strong and Unique Eligibility Requirements for PRD

PRD can be provided to PJM markets by a PJM Member that represents customers capable of reducing load in response to price and meeting certain eligibility requirements. A PJM Member acting on behalf of such retail customers for the purpose of providing PRD in the PJM markets will generally be referred to as a PRD Provider.

A PRD Provider for a given retail customer may be the customer's retail Load Serving Entity (LSE). However, PRD may also be provided in the PJM markets by an entity such as an Electric Distribution Company (EDC), or a Curtailment Service Provider (CSP) that does not have direct responsibility for serving the retail load but meets all of the eligibility requirements for providing PRD.

In the PRD proposal on which PJM stakeholders voted, registration of PRD was limited only to the entity with direct load serving responsibility for the retail customers involved. This PJM staff proposal would permit the ability to register PRD load to entities such as EDCs and CSPs that may not have such direct load serving responsibility, as long as a contractual arrangement exists that replicates the incentives provided by a dynamic retail rate structure. Whether such incentives may be offered to retail customers by non-load-serving entities is a retail regulatory issue and therefore should not be unnecessarily restrictive at the wholesale level. PJM staff believes that opening the potential to register PRD to alternative types of PRD Providers will maximize the benefit to be achieved from PRD by ensuring that the maximum amount of price-responsive retail load is incorporated in wholesale market operations.

To ensure that a PRD Provider registers PRD that will be effective in meeting PJM reliability needs, the price responsive load must meet specific eligibility requirements that differ from the current demand response products. PJM staff proposes that to be eligible, PRD load must be:

- i) served under a **dynamic retail rate structure** with an LSE or subject to a contractual arrangement with a PRD Provider where such rate or compensation is directly linked to the PJM real-time LMP at the substation location applicable to the load, and that results in predictable response to varying wholesale electricity prices;
- ii) subject to **supervisory control** to curtail any portion of the committed amount of demand that has not responded to price should PJM declare an emergency condition; and
- iii) subject to **advanced metering** capable of recording electricity consumption at hourly intervals or greater frequency.

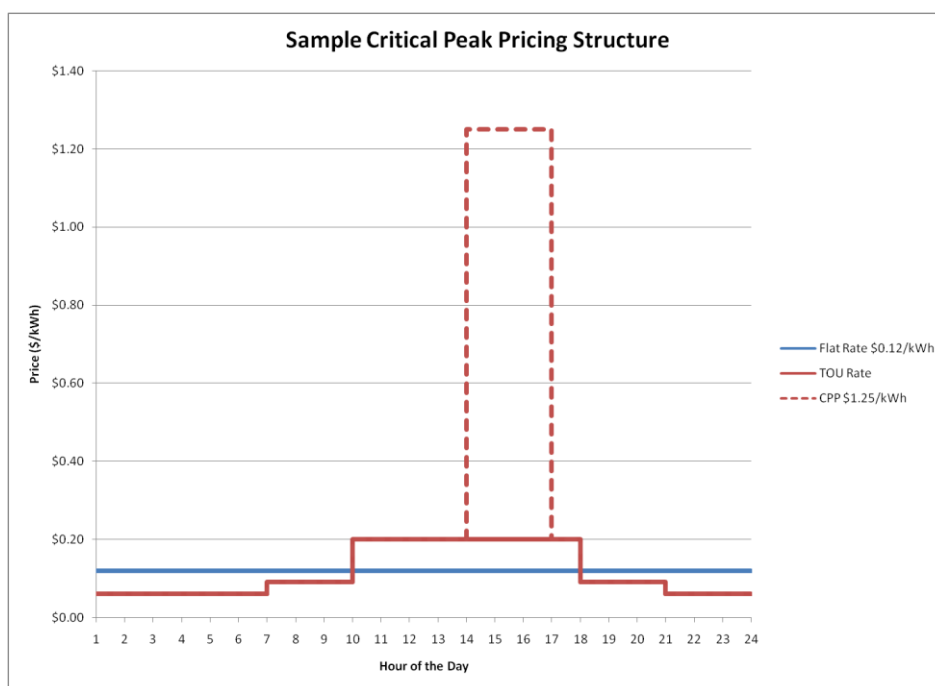
Dynamic Retail Rates with an LSE or contractual arrangements with a PRD Provider are required in order to establish the link between retail consumption and wholesale prices on a locational basis.

To be eligible to be committed as PRD, retail rates or contractual arrangement must be dynamic and have the ability to change as frequently as on an hourly basis, and must be linked directly to wholesale prices (real-time LMPs). The retail rate structure or contractual arrangement must be dependent on the real-time LMP to ensure that PJM can account for price-sensitivity in real-time dispatch. Such real-time rates or contractual arrangements will result in predictable response to varying wholesale electricity prices. This does not mean that to be eligible as PRD, the load must be served solely on an hourly real-time LMP retail

rate. Multiple retail rates or alternative compensation mechanisms could qualify for this requirement, such as a structure where the retail charge changes only when the real-time LMP exceeds a preset threshold.

The goal of PRD is to create financial incentives for the load to respond at real-time LMPs that reflects the location of the load. It is important for PRD load to be able to demonstrate the economic incentive to reduce demand when the wholesale price goes up, due to the impact the LMP has on the retail rate the customer pays or the impact the LMP has on the financial credit the customer receives from the PRD Provider.

For example, the graphic below illustrates an example of one dynamic retail structure known as Critical Peak Pricing (CPP). A CPP retail rate in its simplest form can consist of at least two, pre-defined retail prices; one that customers are charged when real-time LMP is below a threshold or trigger level, and a higher price that applies when the real-time LMP trigger level is exceeded. The graphic below shows a slightly more sophisticated CPP retail rate that has as its base a time-of-use rate, and the CPP rate would be triggered once a real-time LMP threshold is exceeded. In order to be eligible to be PRD, the threshold price trigger level of the CPP rate would be explicitly tied to a PJM real-time LMP at the substation level. Then, when real-time LMP at the applicable location exceeds the trigger, customers in that location would automatically respond by consuming less to avoid paying the higher, critical peak, retail rate.



Supervisory control of customer load committed as PRD is required on the part of the PRD Provider. PJM recognizes that there may be retail regulatory authority rules concerning such control, and has stipulated that any such control must be consistent with any such retail regulatory requirements.

The PRD Provider is required to have the remote capability to decrease the load at each location contained in the PRD registration to the committed level during PJM Maximum Emergency events and when the energy market price hits the price level at which PRD would reduce to its committed level, to the extent load was not already reduced based on price. PRD Providers are required to have automation of PRD that is

needed to respond to Real-time LMPs in accordance to the price-responsive characteristics that are submitted in the energy market. Since capacity has not been procured for PRD load, supervisory control is necessary to ensure reliability during emergency conditions.

Automated response to a real-time LMP trigger is required for PRD participation in the PJM energy market. For PRD that has been committed as capacity, supervisory control is required such that the PRD Provider has the ability to override inconsistent action taken at the end-use site during a PJM Emergency Event. PRD that is implemented by automation technology that cannot be overridden by the end-use customer could also meet the requirement for supervisory control.

It's important to also note that even with supervisory control, PJM will not have authority to "push the button" and reduce the PRD load. PJM's role is grid operator and reliability coordinator and PJM does not have the authority to physically reduce load of the PRD participant no more than PJM performs transmission switching. PJM has included the requirement for supervisory control over the load in order to provide an additional backstop mechanism to ensure reliability.

Advanced Metering Infrastructure (AMI) is required at end-use customer sites for the end-use customer's load to be committed as PRD. To be eligible to be committed as PRD, customer load must be subject to advanced metering capable of recording electricity consumption at an interval of one hour or less. Hourly metering is required because the customer is required to be on a retail rate with an LSE or a contractual arrangement with a PRD Provider that could vary on up to an hourly basis.

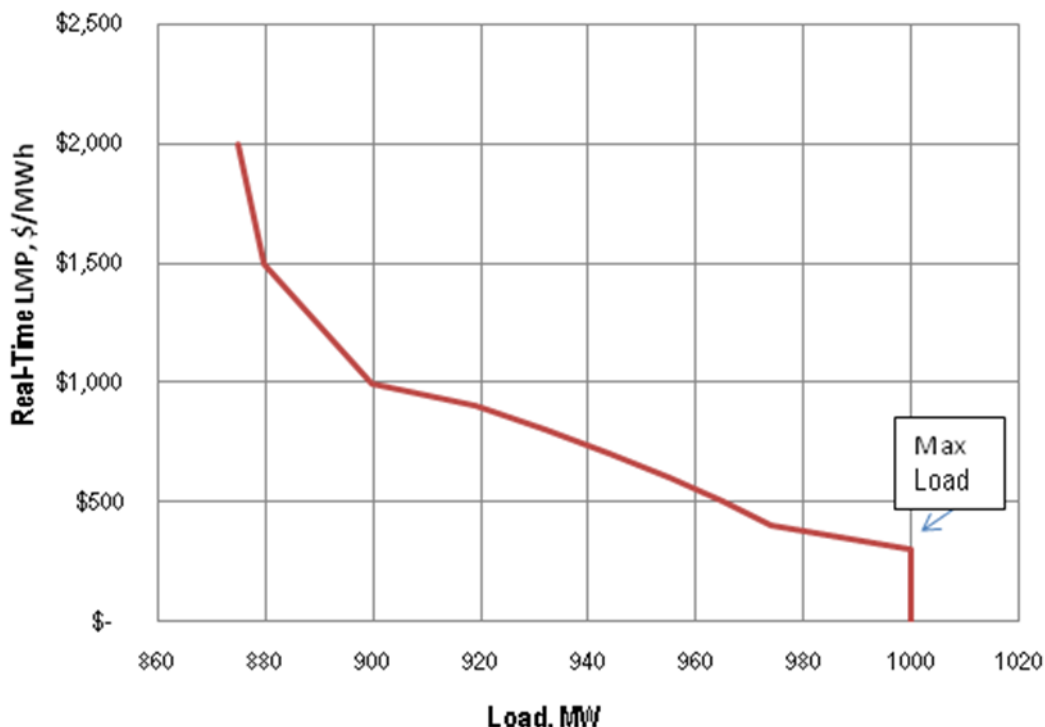
PJM measurement and verification of PRD is also based on the committed load's actual hourly consumption compared to the level to which the customer committed to reduce in emergency conditions. Automated response by the customer to varying real-time LMPs is also required such that changes in real time LMP result automatically in adjustments in the retail customer's consumption.

B. Rules that Integrate PRD in the PJM Energy Market Operations

Through the automated customer response to changing real-time LMPs, responses to spot energy price signals will produce a predictable demand curve as a function of price. Therefore, demand curves for committed price responsive demand can and will be modeled in PJM real-time dispatch solutions. During normal economic conditions, PRD Curves will be included in the PJM Security Constrained Energy Dispatch (SCED) algorithms and will be able to set real-time LMP up to the maximum allowable price that could prevail during reserve shortage conditions.

In real-time operations, it is essential to understand how much energy will be consumed at or above various prices so that PJM can send out the proper price and dispatch signals to market participants to maintain energy balance and reliability. Without this information PJM may be in a position of "over- or under-dispatching" resources, rather than dispatching the amount necessary to maintain energy balance. The PRD curves submitted by the PRD Provider, which include price-quantity pairs, enable short-term load forecasting to account for reactions to dynamic retail rates. The below figure illustrates what such a PRD curve might look like.

PRD vs. Real-time LMP



The ability for PRD to set price in the real-time energy market is a key element of the PJM PRD proposal. With the incorporation of PRD, PJM will have better information about the price responsiveness of load and will be able to more efficiently dispatch resources and set prices that depend on known information about both supply and demand. Permitting PRD to set price in the Real-time Energy Market properly aligns energy market prices with system conditions and dispatch instructions, thereby enhancing operations. If PRD is allowed to set the price of energy at its willingness to pay, the appropriate market signals are sent to all resources providing energy to serve load as well as those providing reserves and avoids the dispatch of either too much or too little supply. These rational market prices will reinforce the dispatch instructions sent by PJM and enhance system stability.

The ability for PRD to set price in the energy market was established as a necessary element during the extensive stakeholder discussions. Business rules⁴ for integrating PRD into the PJM Energy Market were developed for consideration by PJM stakeholders as part of the proposal on which stakeholders voted in November. However, agreement changes reflecting these energy market rules were not proposed, but instead were deferred for later stakeholder consideration. PJM staff feels it is necessary to include energy market integration as a critical element in its proposal at this time for two reasons. First, PJM staff feels it is important to submit a complete proposal to the FERC that includes energy as well as capacity components. Second, including the energy market elements in the proposal at this time will allow for PRD

⁴ Presentation by PJM to PJM MRC on November 17, 2010, "Price Responsive Demand: Integration into PJM Capacity and Energy Markets" (<http://www.pjm.com/~media/committees-groups/committees/mrc/20101117/20101117-item-02-price-responsive-demand.ashx>)

implementation in the energy market sooner rather than later, thereby allowing the benefits of PRD implementation to begin accruing well ahead of the first Delivery Year that PRD capacity commitments could actually be effective.

PJM also proposes the prices at which PRD may designate to reduce consumption to its maximum emergency service level, or stated capacity obligation, be consistent with the shortage pricing rules that FERC approves in docket no ER09-1063. In its Shortage Pricing filing with FERC, PJM proposed to utilize demand curves for reserves that would allow the energy price to rise above the current energy market offer cap, up to a maximum allowable price that could be reached during reserve shortage conditions that is above \$1,000/MWh⁵. To ensure that PRD has the ability to indicate its willingness to curtail demand at any potential level of real-time LMP, PJM proposes that PRD has the ability to submit PRD curves with price-quantity pairs above the current \$1,000/MWh energy market offer cap. Specifically, PJM proposes that PRD curves be allowed to extend up to the maximum price under the transition period established in the PJM Shortage Pricing proposal. Ultimately, if FERC approves a shortage pricing design that varies from what PJM proposed, PJM would want PRD to be able to submit PRD curves consistent with the FERC approved shortage pricing rules.

Additionally, to be consistent with PJM's Shortage Pricing proposal before FERC and in order to provide comparability with respect to generation offers, PJM also proposes to increase the maximum allowable offer price on non-capacity, emergency segments of energy offers to the same levels during and following the Shortage Pricing transition period. If emergency generation offers associated with non-capacity MW were not allowed to exceed the current energy market offer cap up to the maximum shortage price, a discontinuity would exist whereby real-time prices could drop during emergency conditions when such emergency offer segments were loaded. Such a result would be counter-intuitive and damaging to the efficient price signals that need to be sent during times of reserve shortages.

PJM staff notes that the ability for PRD curves to extend up to the maximum Shortage price, as well as the proposed ability for non-capacity emergency generation to offer up to the same level, represents changes from the proposal on which the PJM stakeholders voted in 2010. However, PJM staff feels strongly that the discontinuity in price formation that would result from capping PRD curves below the Shortage Pricing level would create the potential for prices that are inconsistent with operational needs and system conditions during reserve shortage conditions. The nature of the discontinuity in price formation is that the call for non-capacity emergency generation with capped offers and PRD with capped bids would lead to a decrease in energy prices rather than an increase in energy prices that reflect the use of emergency resources were needed to maintain energy balance and some level of reserves. The potential step changes in prices would result in operational uncertainty and market inefficiencies. It follows then that non-capacity, emergency resource offers and PRD curves up to the maximum shortage prices are both required in order to avoid the exact same discontinuity.

Knowledge of the location of PRD is essential when determining how transmission constraints will be affected at various wholesale energy prices. This knowledge will ensure that PJM will send out the proper price and dispatch signals to the right market participants to manage locational transmission constraints in real-time. Lack of locational specificity with respect to PRD submissions could cause retail load to curtail consumption in locations that hurt, rather than help, transmission constraints. PJM then may have to take

⁵See PJM Interconnection L.L.C. Docket No. ER09-1063, dated June 18, 2010, pp 24 - 26. PJM proposed a 4 year transition period where by the end of the transition period the maximum price would be \$2,700/MWh during shortage conditions.

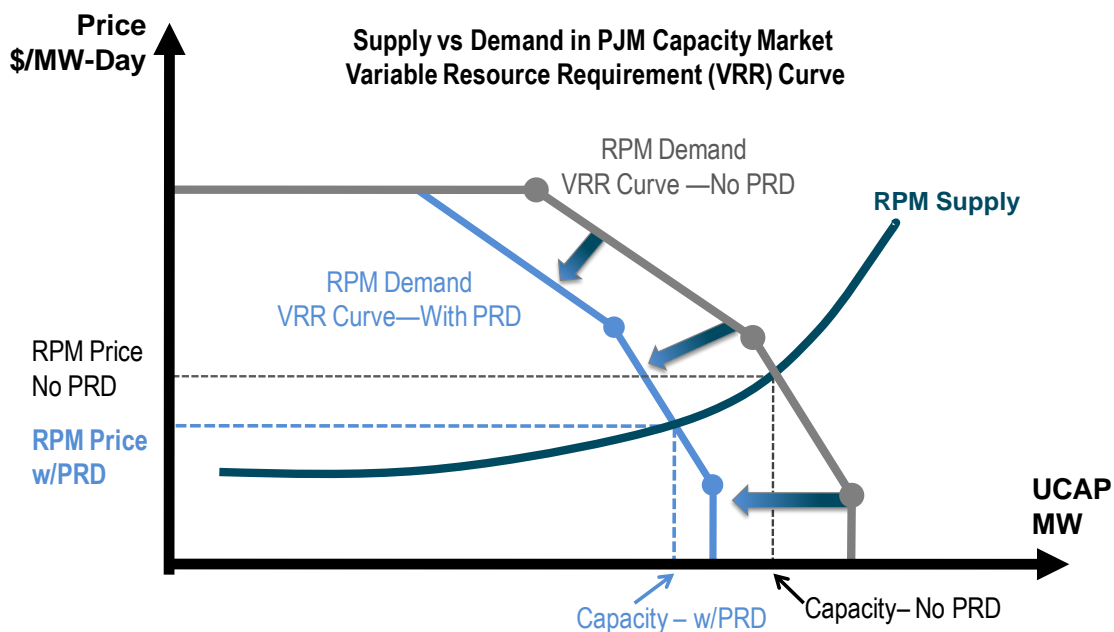
actions that are more costly in order to maintain transmission security than would otherwise be the case. Sending the price signals out to demand on a locational basis ensures that the response occurs at the location where the relief is needed the most by only the demand that can best relieve the constraint.

During emergency conditions, PRD must ensure consumption is no greater than its committed capacity obligation or maximum emergency service level once PJM has: a) declared and loaded max emergency generation; or b) loaded emergency purchases; or c) initiated a voltage reduction and the energy price has reached the price at which PRD has committed to reduce consumption. PJM will issue an emergency procedures notification to clearly indicate when PRD must be reduced to its committed value based on the Maximum Emergency Service Level if it has not already done so in response to real-time LMP. LMPs will be determined based on the interaction of the PRD curves with the Operating Reserve Demand Curve (ORDC) used for Shortage Pricing. Modeling PRD curves in PJM real-time dispatch solutions provides critical information to the market, and is a key element to the success of integrating PRD.

C. Rules that Integrate PRD in the PJM Capacity Market Clearing Processes

PJM staff proposes that PRD participate in the PJM Reliability Pricing Model differently than the existing rules provide for DR resources. PJM staff proposes to allow participants who meet the eligibility requirements as PRD to voluntarily commit the demand reduction as reduction in the LSE's capacity obligation, rather than offer into the auctions as a supply-side resource. This committed quantity will reduce the load forecasts used to determine the RTO and LDA Reliability Requirements to be cleared in the RPM auctions.

The figure below illustrates the impact PRD will have on the construction of the Variable Resource Requirement (VRR) Curve (also known as the "Demand Curve") that is utilized to determine capacity quantities and prices in RPM.⁶

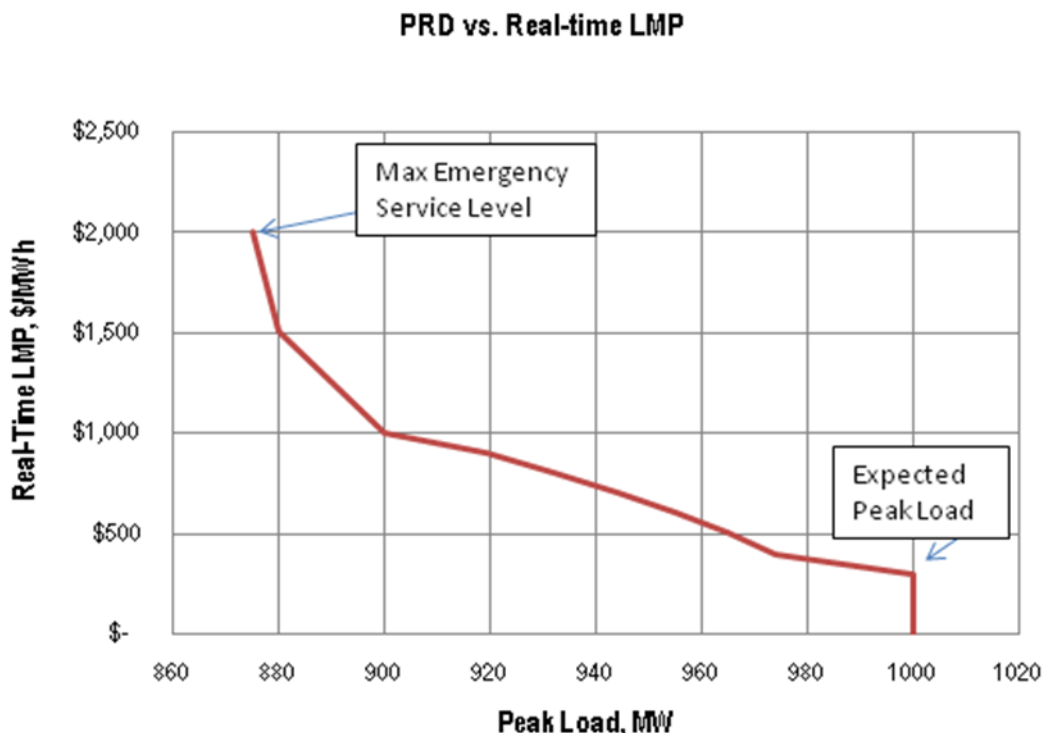


⁶ See PJM Tariff, Attachment DD, section 5.10 (a)

As a result of PRD incorporation into RPM, capacity clearing prices will reflect a reduced amount of demand. This reduction will be possible because the customers who are being registered as PRD are committing to reduce their energy demand in response to real-time energy prices as described above. PRD is therefore able to reduce the installed capacity required to meet PJM reliability standards because there will be less demand to serve during peak times when energy prices are high.

To properly account for PRD in determining the Reliability Requirements, load forecasts and load obligations in RPM, a PRD Provider must submit a PRD Plan that includes the aggregated amount of eligible PRD for PJM use in preparing the load forecast applicable to RPM auctions. In order to commit PRD for a Delivery Year, a PRD Provider must submit the PRD Plan in advance of the Base Residual Auction (the first auction for capacity resources held 3 years in advance of the Delivery Year) or Third Incremental Auction (the final auction before the Delivery Year). The PRD Plan must contain all the required detail, and provide a price-quantity curve that shows the expected relationship the real-time LMP and the aggregate consumption quantity.

The figure below illustrates what such a curve might look like as submitted and utilized during registration in the RPM capacity market. In the figure below, the Maximum Emergency Service Level is the committed capacity obligation of the PRD load and is just below 880 MW. This is the level of consumption that must be reached during PJM Emergencies.



While PRD curves submitted for use in the energy market will indicate expected demand on the day or hour for which they are submitted, in the capacity market such curves will indicate the anticipated peak load for the year. The curve will show how the anticipated peak load for the set of customers being registered will decrease according to increasing levels of real-time LMP. For example, in the above figure, the expected peak load of this set of customers at very low real-time LMPs is 1,000 MW. However, as the real-time LMP increases, the anticipated peak load diminishes so that at a real-time LMP of \$1,000/MWh the anticipated peak load is 900 MW. At a real-time LMP of \$1,500/MWh the anticipated peak load is 880 MW, and so on.

This curve will have a committed level to which the load being registered will be reduced during the Delivery Year at the maximum price level. Known as the Maximum Emergency Service Level (MESL), this value will be used in the measurement & verification process to determine compliance. The MESL will be the value at the highest price point on the price-demand curve. The highest price on the price-demand curve must be less than or equal to the maximum price level that could be reached under shortage conditions (\$2,700/MWh following the transition period under the PJM shortage pricing proposal). The difference between the Expected Peak Load for the Delivery Year and the MESL will be removed by PJM from the load forecast that is then utilized in the RPM auction for that Delivery Year. This reduction in procured capacity will result in a direct financial benefit to the PRD Provider that registered the PRD.

D. Wholesale Retail Market Integration

For PRD implementation to be successful, it's important that the business processes that exist between wholesale and retail entities continue to operate efficiently. In many ways, the business processes for PRD will be similar to the current processes for demand resources. These processes include the registration and tracking of end-use customer specific information such as account number, zone/sub-zone identification, substation identification, Peak Load Contribution (PLC), and MESL values. Even with large numbers of similarly situated customers, customer-specific values could be aggregated to determine values in a zone. PJM has and will continue to work extensively with retail providers and retail regulatory authorities in order to ensure continued close coordination between wholesale markets and retail providers.

E. Penalty Structure for Price Responsive Demand

PJM staff proposes a "belt and suspenders" approach to ensure that load registered as PRD will be reduced during peak conditions. These proposed rules require automated response to price as the first mechanism to support reliability. The second is the requirement that supervisory control exist over the load such that the PRD Provider can reduce the load during an emergency condition should it not have already responded to price. However, PJM staff believes that rules need to be in place to address the circumstance under which the load did not adequately reduce during emergency conditions. Therefore, the proposed rules include a mechanism to penalize market participants that fail to meet their commitments during emergencies.

The purpose of the penalty is to create a strong incentive to ensure performance. Consequently, the market participant that fails to perform to its commitment will be penalized for the value of the yearly cost of foregone capacity that was not procured. PJM staff proposes the following two RPM penalties:

- (1) PRD Max Emergency Event Compliance Penalty**
- (2) PRD Commitment Compliance Penalty**

PRD event compliance will be assessed upon declaration of a PJM Maximum Emergency event. The PRD compliance event hours are the entire hours for which a PJM Maximum Emergency (ME) Event was in effect. The **PRD Max Emergency Event Compliance Penalty** applicable to a PRD Provider for which load committed as PRD does not respond consistent with its commitment and the energy price at the applicable location(s) at the first ME event will be the cost of procuring that amount of capacity for the entire year plus the greater of 20 percent or \$20 / MW-day.

Given that nomination of PRD prior to an RPM auction could occur three years ahead of the actual Delivery Year for which the PRD is being committed, an LSE may not actually have the AMI or supervisory control in place or know the exact customers that will be price responsive at the time of PRD Plan submittal. When the installation of Advanced Metering and Supervisory Controls are delayed beyond the start of the Delivery Year, or when a PRD Provider has not demonstrated that it has subscribed enough load to be PRD throughout the Delivery Year, the LSE will be subject to a **PRD Commitment Compliance Penalty**. A PRD Provider's PRD commitment compliance will be evaluated on a daily basis on a sub-zone/zonal level throughout the Delivery Year. Similar to the Event Compliance Penalty, the Daily PRD Commitment Compliance Penalty will be equal to the cost of the capacity for each day implementation is delayed, plus the greater of 20 percent or \$20 / MW-day.

Because inclusion of PRD in the RPM auction serves to lower the clearing price of capacity for all resource providers, PJM proposes to allocate penalty funds to all RPM Resource Providers with commitments for the Delivery year in proportion to their net RPM Revenues (i.e., RPM Auction Revenue less any RPM performance penalties accrued) for the Delivery Year.

F. PJM Recommendation: Implement PRD As Soon As Feasible

PJM recommends that the implementation of wholesale market PRD rules proceed expeditiously. AMI and dynamic rates are already being implemented at the retail level in states such as Delaware, the District of Columbia, Maryland, Ohio, and Pennsylvania, among others.

As a proactive measure, PJM started stakeholder proceedings in September of 2009 in an effort to ensure a timely implementation. PRD was a topic that has been discussed at over 40 PJM stakeholder meetings during a 14-month period from September, 2009 until November, 2010, and the history of this discussion has been summarized in Appendix A of this document.

Collaboration with stakeholders has proven productive for the development of these proposed market rules. PJM staff and stakeholders shared perspectives on complex issues such as the requirements for locational price signals and dynamic retail rates, the integration of the wholesale and retail markets, potential settlement mechanics, etc. While stakeholders did not achieve a two-thirds majority consensus, PJM staff believes these proposed rules, developed in cooperation with a variety of stakeholder interests, represent an innovative and efficient market design that can and should be implemented in PJM.

It should be noted that during this stakeholder process, PJM staff raised concepts that were intended to promote consensus among competing stakeholder interests. Specifically, in an effort to gain consensus, PJM included elements in the proposal (voted upon November 17, 2010 within the Markets & Reliability Committee) that would have:

- Limited the potential of PRD by capping the amount of allowable PRD for the first several years;
- Limited the pricing threshold at which PRD could indicate respond to the current \$1,000/MWh energy market offer cap; and
- Netted PRD registration against the Short-Term Resource Procurement Target (STRPT, or “holdback”).

These restrictions are not included in this PJM staff proposal. PJM staff recognizes that conservative measures can be prudent when introducing new market instruments, but also notes that conservative measures are already occurring as states are introducing these new dynamic retail rates. In many of the states, introductions of dynamic rates and advanced metering infrastructure are occurring in a phased-in manner, with customer pilots before large scale deployments.

PJM staff believes that limiting the amount PRD or limiting the price at which PRD can be curtailed have the potential of limiting the benefit the overall market can achieve. Staff further believes that netting registered PRD against the STRPT would significantly mute PRD’s effect in the capacity market and would un-necessarily dull the incentive for participation as PRD in the capacity market. This staff proposal therefore would allow the STRPT to continue to operate as currently designed; unless and until it is changed for reasons directly related to its own impact on RPM auctions.

PJM staff also notes that the November PRD proposal on which stakeholders voted included the initiation of further stakeholder process in two areas: development of PRD system requirements and comparability of demand response products.

With respect to PRD system requirements, PJM and its stakeholders worked through much of that issue during the aforementioned stakeholder process. However, to the extent additional stakeholder interaction is necessary to further enhance the integration of the wholesale rules and the retail mechanisms, PJM will continue to support such interactions either individually or through existing stakeholder groups.

With respect to the comparability issue, PJM staff notes FERC accepted (on January 31, 2011) the PJM filing in docket ER11-2288-000 to establish two distinct new DR products. Stakeholders wishing to pursue discussion of this comparability issue should work through their existing procedures to initiate such discussion.

IV. Appendix A – Stakeholder Process on PRD

A. Background

In June, 2009, the PJM Board communicated its long term vision of Demand Response in the PJM Markets, which generally described attributes of Price Responsive Demand. A letter from PJM CEO Terry Boston on behalf of the PJM Board⁷ described PRD as the “ultimate solution to demand participation” and cited the following key drivers:

- Smart grid technologies and advanced metering will “spread transparency to new levels.”
- These technologies, together with innovative retail rate design, will enable end users to implement automated response to price.

PJM staff initiated a stakeholder process in the fall of 2009 to gain input and seek consensus on rules to establish PRD within PJM markets.

B. Overview of Stakeholder Process

PJM staff introduced proposed PRD rules at the September 29, 2009 meeting of Capacity Market Evolution Committee (CMEC.) The proposal laid out the role of PRD in reducing the future reliability requirement of a Load Serving Entity (LSE), targeted implementation for the May 2010 Base Residual Auction (for the 2013/2014 planning year) and referenced the September 16, 2009 adoption by the PJM Planning Committee (PC) of PJM Manual 19 revisions required to implement PRD. When the CMEC became inactive, PJM staff moved this work to the Market Implementation Committee (MIC).

In late 2009, Members deferred voting on a PRD proposal, and PJM therefore extended the expected timeline for PRD implementation by one year.

Throughout 2010, PJM engaged in many stakeholder meetings in which issues were identified and various solutions were discussed.

⁷ Letter from Terry Boston, PJM President and CEO, issued on behalf of the PJM Board of Managers, June 26th, 2009. ([PJM Board Letter](#)).

In June 2010, at the Market Implementation Committee, PJM staff introduced a formal proposal to integrate PRD in the PJM Capacity and Energy Markets for the 2014/2015 Delivery Year. The proposal included a transition plan which PJM staff offered as a way to gain consensus. These elements are summarized below:

1. Limit on the Participation of PRD

During this proposed transition period, the maximum quantity of PRD that can register for a Delivery Year to participate in the PJM Capacity Market is the following:

2014/1015 Delivery Year	2015/1016 Delivery Year	2016/1017 Delivery Year	2017/1018 Delivery Year	2018/1019 Delivery Year
1,500 MW	2,500 MW	3,500 MW	4,000 MW	No Cap

The maximum PRD registered for each Zone would be determined pro-rata based on preliminary zonal peak load forecasts (less load served under FRR). PRD that exceeds the maximum amount during each Delivery Year may participate in the PJM Energy Market.

2. Short-Term Resource Procurement Target

Given the limitation on the amount of PRD that can register during the transition period, after the committed PRD has been adjusted in the RPM Peak Load Forecasts, 100% of the PRD quantity, multiplied by the FPR, is subtracted from the Short Term Resource Procurement Target values.

3. The Maximum Energy Price at which PRD can define its Maximum Energy Service Level

Some stakeholders expressed concern during the discussions that the ability for PRD to set price above the \$1,000/MWh offer cap would hold customers not capable of responding to price hostage to higher prices. As a result, the maximum price at which the MESL could be defined in a PRD registration in the original stakeholder proposal was set at the current \$1,000 offer cap.

C. Additional Proposal Components

In further effort to achieve consensus among competing stakeholder interests during this process, the following concepts were proposed:

1. Stakeholder Process to develop PRD System Requirements

The proposal considered within the Markets and Reliability Committee in November, 2010, included the concept for a stakeholder group to continue discussion on integration of technical systems.

The mission of this stakeholder group was to prepare market participants to modify their existing systems in time for the 2014/2015 Delivery Year. The goal was to develop additional requirements regarding modification or further automation of existing business processes or implementation of new business processes in PJM applications, including registration, bidding, & settlement systems.

This technical group was supposed to produce a work plan to develop recommendations for process and/or rules that can be considered as possible revisions to PJM manuals by June 1, 2011. As mentioned above, however, PJM staff believes the stakeholder discussion that occurred toward the end of the process obviated the need for this ongoing work.

2. Stakeholder Process to discuss comparability of demand response products

The proposal considered within the Markets and Reliability Committee in November, 2010, also included the concept for a stakeholder group to continue discussion of parity among the demand response products in the PJM Market. The goal of this stakeholder group was to review and discuss the existing rules of demand response participation and explore areas of comparability between existing DR products and PRD.

With respect to the comparability issue, PJM staff notes FERC accepted (on January 31, 2011) the PJM filing in docket ER11-2288-000 to establish two distinct new DR products. Stakeholders wishing to pursue discussion of this comparability issue should work through their existing procedures to initiate such discussion.

D. Markets Implementation Committee (MIC) Vote – August 2010

PJM staff explained a package detailing PRD business rules and a transition mechanism that would gradually increase the megawatts of PRD allowed at the capacity auctions, along with further stakeholder development of implementation details. The MIC declined to advance the proposed package to the higher committee, the Markets and Reliability Committee (MRC).

On September 20, 2010, PJM submitted its second informational filing concerning the status of PJM's efforts to work with state regulators to better integrate the impact of price responsive demand in wholesale market operations.⁸

E. MIC – PRD Meetings

At the September 2010 MIC meeting, based on various stakeholder suggestions and input, a revised charge was developed and assigned to the MIC-PRD group, for a complete set of business rules for PRD that focused on the ability of various classes of market participants to implement their roles. The duration of the work was also updated with a target to complete the stakeholder discussions by December 2010, in order for the revised language to be filed and reviewed by FERC in time for the 2014/2015 RPM Base Residual Auction to be held in May 2011.

The first of the four MIC-PRD meetings began on September 21, 2010, with the goal to discuss any issues that must be resolved or processes documented in order for stakeholders to be able to endorse filing of PRD rules in November. The Committee brainstormed and identified the areas of continued discussion and action items to be discussed at the upcoming meetings.

Highlights and outcome of the four special MIC-PRD meetings are provided below.

⁸ See PJM Interconnection L.L.C. Docket No. ER09-1063, dated September 20, 2010. ([ER09-1063](#))

September 21, 2010 MIC-PRD Meeting:

The first of the four MIC-PRD meetings began on September 21, 2010, with the goal to discuss any issues that stakeholders believed must be resolved or processes documented to be able to endorse filing of PRD rules in November. The Committee brainstormed and identified the areas of continued discussion. The group identified action items and issues to be discussed at the upcoming meetings which included the following:

- Define issues that must be resolved or processes documented in order for stakeholders to be able to endorse filing of business rules in November, 2010.
- Potentially explore scenarios that will assist in defining such issues so they may be resolved within the tight timeline.
- Review proposed business rules at the beginning of each of discussion focusing on changes since last meeting.

October 4, 2010 MIC-PRD Meeting:

At the October 4, 2010 meeting, PJM staff provided an overview of revisions to the draft PRD business rules and presented examples of PRD participation in the Day-ahead Energy Market. PJM staff also reviewed examples of Real-time Energy Market participation, and re-presented examples of PRD participation in the Real-time Energy Market. PJM staff also facilitated a brainstorming session to discuss the process for selecting aggregate load settlement.

October 15, 2010 MIC-PRD Meeting:

At the October 15, 2010 meeting, PJM continued to provide an overview of revisions to the draft PRD business rules. PJM provided an overview of the following PRD administrative processes: PRD Plan submittal, Unforced Capacity (UCAP) Obligation, Peak Load Contribution (PLC), PRD registrations, & PRD commitment compliance. PJM re-presented examples of PRD participation in the Day-ahead Energy Market and discussed Balancing Operating Reserve deviation calculations for PRD.

PJM facilitated a brainstorming session to discuss the criteria for retail rate eligibility, and brainstormed any revisions that may be suggested. Discussion and comment was provided by PJM stakeholders, as well as representatives from Monitoring Analytics and Commissioner Centonella, from the Public Utility Commission of Ohio.

November 4, 2010 MIC-PRD Meeting:

The final MIC-PRD meeting was scheduled prior to the voting at the MRC & MC in November, 2010

The goal of this meeting was to finalize all previous discussions and fulfill the groups charge to develop detailed wholesale-retail market integration rules for implementation of PRD. The group developed additional rules to be incorporated in the PRD proposal that result in a complete set of business rules for

PRD focusing on the ability of various classes of market participants to implement their roles, for consideration at the MRC in November.

Outcome of MIC-PRD Meetings

As a result of the MIC-PRD meetings, PJM made significant progress on the following wholesale-retail market integration issues related to PRD:

- PJM addressed the concerns of the EDCs regarding workload to support tracking of PRD vs. non-PRD load. Specifically, PJM demonstrated a design of the PLC ticketing process that would work very much like the business process that exists today for Demand Resources. The design would also require that no additional data information to be tracked by the EDCs. During this discussion, PJM also addressed EDC concerns with respect to infrastructure investment at the retail level.
- As a result of the discussions at the MIC-PRD meetings, a separate stakeholder process was initiated to address EDC concerns regard the process by which loads may switch from zonal to nodal wholesale settlement.
- As a result of the discussions at the MIC-PRD meetings, PJM added proposed business rules by which Balancing Operating Reserve deviation calculations will be accomplished for PRD load. PJM committed to finalizing Operating Agreement revisions and market rules required for the PRD integration into the energy market in early 2011. Those agreement changes are included in the current PJM staff proposal.

F. Final Stakeholder Consideration

Upon completion of the MIC-PRD discussions, PJM staff presented a PRD package that included proposed business rules, revised agreement language, a transition mechanism that would gradually increase the megawatts of PRD allowed at the capacity auctions, and further stakeholder processes where the implementation details would be developed. PJM staff explained this proposal at the November 17th, 2010 Markets & Reliability Committee. The proposal failed to achieve the necessary super majority (majority support of Members across all sectors), by a vote of 1.52 in favor⁹ of the proposal.

The PJM Independent Market Monitor (IMM) participated in many stakeholder discussions, offering redlined comments to the draft PRD business rules at the November 4, 2010 MIC-PRD meeting. The stakeholders did not agree to incorporate all of the IMM's comments into the draft rules that were brought forward to the MRC. Therefore, at the MRC's meeting of November 17, 2010, the IMM offered an alternative proposal¹⁰. This IMM proposal also failed to receive the required two-thirds Members support for approval.

⁹ Meeting Minutes, PJM Markets & Reliability Committee, November 17, 2010.

(<http://pjm.com/~media/committees-groups/committees/mrc/20101215/20101215-item-01-draft-minutes-mrc-20101117.ashx>)

¹⁰ IMM Proposal posted at: <http://www.pjm.com/~media/committees-groups/committees/mrc/20101117/20101117-item-02-monitoring-analytics-prd-proposal.ashx>

G. State Commissions

Four individual state commissions sent letters to the Chair of the PJM Members Committee expressing support for implementation of PRD¹¹. In addition, the Board of Directors of the Organization of PJM States, Inc. urged the PJM Board to “take independent action” to implement PRD.¹²

H. Issue Tracking

The minutes and detailed materials covered in these various stakeholder discussions can be found on the PJM Issue Tracking System¹³. This material includes a draft Manual with the specific business rules that would be implemented should this PJM staff proposal for PRD gain FERC approval.

¹¹ Ohio Public Utilities Commission Letter Regarding Price Responsive Demand ([PUCO Letter](#));
DC Public Service Commission Letter Regarding Price Responsive Demand ([DCPSC Letter](#));
Michigan Public Service Commission Letter Regarding Price Responsive Demand ([MI PSC Letter](#));
PA Public Utility Commission Letter Regarding Price Responsive Demand ([PAPUC Letter](#))

¹² Letter from Organization of PJM States, Inc. (OPSI), re: Support for Price Responsive Demand, dated December 17, 2010.
([OPSI Letter](#))

¹³ <http://www.pjm.com/committees-and-groups/issue-tracking/issue-tracking-details.aspx?Issue={CD79A76A-E9E4-4F58-ADF9-88A65F2B61EB}>

V. Appendix B – PJM Staff Proposed Business Rules

This Appendix contains the proposed business rules to integrate PRD into the PJM Capacity and Energy Markets. If the PJM Board approves staff's proposal, appropriate revisions to Attachment K of the PJM Open Access Transmission Tariff and Schedule 1 of the PJM Operating Agreement will be submitted for filing with the FERC. If approved by FERC, revision is required **to PJM Capacity Market Manual (M-18), and PJM Energy & Ancillary Service Market Operations Manual (M-11)** to incorporate the final business rules.

Integration of Price Responsive Demand

1. 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 led 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 (PRD). 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 enables dynamic and time-differentiated retail rate structures linked to wholesale prices. AMI supports dynamic retail rate structures and these types of retail rates provide the exposure to market prices necessary to provide the incentive for retail customers to reduce or shift consumption in response to price.

Although Price Responsive Demand is not directly dispatchable by PJM, automated retail customer response to real time energy prices signals can produce a predictable demand curve as a function of price. Prices typically increase during capacity emergencies and as a consequence demand drops. Price Responsive Demand will therefore be able to reduce the installed capacity required to meet Loss of Load Expectation (LOLE) based reliability standards.

PRD is provided by a PJM Member that represents retail customers that have the capability to reduce load in response to price. PJM Member acting on behalf of such retail customers for the purpose of providing PRD is referred to as the PRD Provider. A PRD Provider for a given retail customer may be the customer's retail Load Serving Entity (LSE). However, PRD may also be provided in the PJM markets by an entity such as an Electric Distribution Company (EDC), or Curtailment Service Provider (CSP) that does not have direct responsibility for serving the retail load but meets all of the eligibility requirements for providing PRD.

In RPM, a PRD Provider may voluntarily make a firm commitment of the quantity of Price Responsive Demand that will reduce its consumption in response to price during a Delivery Year. This committed quantity of PRD (i.e., the Nominal PRD Value) reduces the load forecasts used to determine the RTO and

LDA Reliability Requirements and impact the development of the RTO and LDA Variable Resource Requirement curves used in the RPM Auctions for such Delivery Year.

In order to commit PRD for a Delivery Year, a PRD Provider must submit a PRD Plan in advance of the Base Residual Auction or Third Incremental Auction, as specified below, for such Delivery Year that demonstrates to PJM's satisfaction that the nominated amount of price responsive demand will be available by the start of the Delivery Year. A PRD Provider with a PJM approved PRD Plan will be required to register price responsive load prior to the start of the Delivery Year to satisfy their PRD commitment. Failure to register enough price responsive loads to meet their PRD commitment prior to the start of the Delivery Year or failure to maintain enough price responsive loads to meet their PRD commitment throughout the Delivery Year will result in a PRD Commitment Compliance Penalty.

A PRD Provider will also be subject to performance compliance during Maximum Emergency Events during the Delivery Year. Failure to comply during Maximum Emergency Events will result in a PRD Maximum Emergency Event Compliance Penalty.

The PRD Provider will receive a Daily PRD Credit (\$/MW-day) during the Delivery Year. If the PRD Provider is a LSE, the Daily PRD Credit may offset the Daily Locational Reliability Charges (\$/day) that are assessed to the LSE serving such price responsive load during the Delivery Year. If the PRD Provider is an EDC or CSP, the Daily PRD Credit may offset the costs of aggregating the retail customers and installing the supervisory controls and advanced metering infrastructure. In both cases, a portion of the credit may be shared with retail customers.

2. Effective Delivery Year

Effective with the 2015/2016 Delivery Year, a LSE may nominate a quantity of Price Responsive Demand prior to the Base Residual Auction or Third Incremental Auction.

3. Eligibility of Price Responsive Demand

In order for load to be eligible to be considered as Price Responsive Demand, the price responsive load must be:

- served under a dynamic retail rate structure with an LSE or subject to a contractual arrangement with a PRD Provider where such rate or compensation arrangement can change on an hourly basis, is linked to or based upon a PJM real-time LMP trigger at a substation location within a transmission zone as electrically close as practical to the applicable load, and 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 registered as Price Responsive Demand is required on the part of the PRD Provider consistent with any retail regulatory authority requirements. The PRD Provider is required to have the remote capability to decrease the load at each location contained in the PRD Registration to the required service level during PJM Maximum Emergency events, to the extent load was not already reduced

based on price, and the LMP at the applicable location has exceeded the level at which the load has committed to reduce. PRD Providers with committed PRD are required to have automation of PRD that is needed to respond to Real Time LMPs for the PRD Curves that are submitted.

The customer load must be on a dynamic retail rate structure with an LSE or subject to a contractual arrangement with a PRD Provider that results in retail charges or credits to the end use customer that are linked to or based on the Real Time LMP. Multiple retail rates or contractual arrangements could qualify for this requirement, such as a structure where the retail charge or credit to the end-use customer is greater than or equal to the Real-time LMP, or applies only when the Real Time LMP exceeds a preset threshold. Dynamic retail rate structures, based on PJM Real-time LMP, that qualify as Price Responsive Demand may include:

- 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.

4. Submittal of Price Responsive Demand Plan

To properly account for Price Responsive Demand in the Reliability Requirements, Load Forecasts and Load Obligations in RPM, a PRD Provider must submit in a PRD Plan the aggregated amount of eligible Price Responsive Demand (i.e., the Nominal PRD Value) by zone and sub-zone (if committing price responsive demand in PSEG-North or DPL-South) for PJM's use in preparing the load forecast applicable to RPM auctions. The aggregated amount of the Price Responsive Demand by Zone/LDA is determined based on the PRD Provider's Zonal Expected Peak Load and Maximum Emergency Service Level values documented for such Zone/LDA in the PRD Plan.

The PRD Plan must detail the price responsive characteristic of the customer load at a zonal or sub-zonal (if load is in PSEG-North or DPL-South) level. If known, the PRD Plan should detail the price responsive characteristics 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.

The Zonal Expected Peak Load Value of PRD is the expected contribution of such PRD Provider's price responsive load to the Delivery Year's Zonal Peak Load Forecast if such load were not to be reduced in response to price. The substation/sub-zonal/zonal Zonal Expected Peak Load Value of PRD will be aggregated to determine the Zonal/LDA Zonal Expected Peak Load Value of PRD quantity for the PRD Provider in such Zone/LDA.

The Maximum Emergency Service Level (MESL) is the level to which the price-responsive load will be reduced during the Delivery Year when a Maximum Emergency Event is declared. The quantity of load that will be consumed at a price equal to the highest price achievable during shortage conditions applicable to the relevant delivery year represents the MESL. The locational MESL quantities (at substation/sub-zonal/zonal) will be aggregated to determine the Zone/LDA MESL quantity for the PRD Provider in such Zone/LDA.

The PRD Provider's Nominal PRD Value for a Zone/LDA is the difference between the PRD Provider's Zonal Expected Peak Load Value of PRD and MESL for such Zone/LDA.

A PRD Provider must submit a PRD Plan to PJM by email via the RPM Hotline at rpm_hotline@pjm.com no later than January 15, prior to the Base Residual Auction or Third Incremental Auction in order to commit PRD for the Base Residual Auction or Third Incremental Auction. Once received by PJM, the PRD Provider will receive a confirmation that the plan has been received and will be reviewed. PJM will review the content of a PRD Plan to ensure the PRD Plan contains all the necessary detail and information. Once PRD Plan reviews and approvals are completed by PJM, PJM adjusts the Zonal Peak Load Forecasts considering all approved PRD Plans and will post the resulting load forecasts with the planning parameters prior to conducting the relevant Base Residual Auction or relevant Third Incremental Auction. An approved PRD Plan represents a firm commitment by the PRD Provider to provide Price Responsive Demand for the relevant Delivery Year.

Additional PRD may participate in the Third Incremental Auction only if the LDA final peak load forecast for the Delivery Year (as known prior to the approval of PRD Plans submitted in advance of Third Incremental Auction) increases relative to the LDA preliminary peak load forecast used for BRA. If the total additional Nominal PRD Value submitted by PRD Providers in the LDA exceeds the increase in peak load forecast in such LDA, the nominations from PRD Providers will be accepted in order of the lowest to highest price level set to implement PRD, up to a Nominal PRD Value in an LDA that equals to the increase in peak load forecast in such LDA.

5. PRD Plan Timeline

Nomination of PRD load for a Base Residual Auction must be made by January 15, 3 years prior to the Delivery Year for relevant Base Residual Auction. Nomination of additional PRD load for a Third Incremental Auction when LDA peak load forecast increases may be made by January 15, 4 months prior to the Delivery Year. Approved PRD will be used to adjust the planning parameters to be posted by February 1 prior to relevant Base Residual Auction and by Third Week of January prior to relevant Third Incremental Auction.

To help a PRD Provider plan for PRD and submit a PRD Plan by January 15, the following information will be made available:

- Prior year summer weather normalized Zonal peak loads by October 31. The summer weather normalized Zonal peak loads include any add backs due to PRD for hours that load is reduced in response to price.
- Customer PLCs developed by EDCs based on prior year summer weather normalized Zonal peak loads by December 31.
- Zonal Scaling Factors (Ratio of Delivery Year Zonal Peak Load Forecast to prior year summer weather normalized Zonal peak load) by January first week.

A PRD Provider with a PJM approved PRD Plan will be required to register price responsive load in a PJM software application prior to the start of the Delivery Year and maintain the registration of enough price responsive load throughout the Delivery Year to satisfy their PRD commitment.

6. Price Responsive Demand (PRD) Plan

The PRD Plan is a document submitted by the PRD Provider that defines and provides data to support a PRD Provider's Nominal PRD Value in a Zone/LDA. 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 Zone/LDA locations, provided that the price-demand curves are submitted on a Zone/LDA level. All of 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 PRD Provider's Nominal PRD Value in a Zone/LDA.

6.1 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 applicable electrical location within a transmission zone (i.e., PNODE), if available at the time of submittal of PRD Plan, or by Zone/LDA. At the time of the submittal of PRD Plan, the PRD Provider may provide a point at the smallest LDA level, but the PRD Provider is required to provide final locational detail (i.e., PNODE) prior to Delivery Year
- (5) Zonal Expected Peak Load Value of PRD by applicable electrical location, if available, or by Zone/LDA
- (6) Maximum Emergency Service Level (MESL) of Price Responsive Demand by applicable electrical location, if available, or by Zone/LDA
- (7) Nominal PRD Value by applicable electrical location, if available, or by Zone/LDA
- (8) Price-Demand curves at the applicable electrical location, (PNODE)/zone/LDA level that detail the base consumption level as well as the decreasing consumption levels at increasing prices.
- (9) A description of the methodologies, analysis, or pilot programs used to determine the Zonal Expected Peak Load Value of PRD, Maximum Emergency Service Level (MESL) value, and Price-Demand Curves
- (10) 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.
- (11) If the PRD Provider is an LSE, verification that the LSE has Relevant Electric Retail Regulatory Authority ("RERRA") approval:

- (a) Where LSE is under the jurisdiction of a RERRA, verification that the RERRA has approved the LSE's PRD Program including the time varying rate required to implement the program.
 - (b) Whether or not the LSE is under the jurisdiction of a RERRA, such rate shall conform to implementation standards documented in either the PJM Operating Agreement, PJM OATT or PJM Manuals which pertain to PRD (such standards appear in sections 3 and 6.3 of these proposed rules).
- (12) If the PRD Provider is not a LSE, verification that the contractual arrangement with end-use customers conforms to implementation standards documented in either the PJM Operating Agreement, PJM OATT or PJM Manuals which pertain to PRD (such standards appear in sections 3 and 6.4 of these proposed rules)
- (13) Automated Metering Infrastructure (AMI) is required in support of the PRD installation:
- (a) In jurisdictions where the PRD program is under the jurisdiction of a RERRA, the PRD Provider shall use the AMI infrastructure in conformance with RERRA requirements. Furthermore, the AMI system shall be designed to allow for full implementation of PRD including metering reading requirements, supervisory control requirements, and all other requirements developed under PJM Operating Agreements, OATT and PJM Manuals as they pertain to PRD.
 - (b) In jurisdictions where PRD Provider is not required to obtain RERRA approval for the PRD program, the PRD Provider shall use an automated metering infrastructure that effects the needed operational requirements for PRD. Furthermore, the metering infrastructure shall be designed to allow for full implementation of PRD including metering reading requirements, supervisory control requirements, and all other requirements developed under PJM Operating Agreements, OATT and PJM Manuals as they pertain to PRD.
 - (c) The meter utilized to measure consumption for the purpose of retail billing shall also be the meter utilized to measure consumption for the purpose of PRD participation.

A PRD Provider must submit a PRD Plan to PJM by email via the RPM Hotline at rpm_hotline@pjm.com no later than January 15, prior to the Base Residual Auction or Third Incremental Auction in order to commit PRD for the Base Residual Auction or Third Incremental Auction. Once received by PJM, the PRD Provider will receive an email confirmation that their plan has been received and will be reviewed by PJM. PJM will review the content of the PRD Plan and will notify the PRD Provider within 10 days of receipt of the PRD Plan and indicate whether or not the PRD Plan is approved or rejected. PJM may reject a PRD Plan if the submitted PRD Plan is incomplete or falls short of the meeting the requirements.

A PRD Provider must submit a PRD Plan no later than January 1, prior to a Base Residual Auction or Third Incremental Auction if the PRD Provider wants PJM to conduct an advance review of their PRD Plan. PJM will review the content of the PRD Plan and will notify the PRD Provider within 10 days of receipt of the PRD Plan if the submitted PRD Plan is approved or rejected. If the PRD Plan is rejected, PJM will provide to the PRD Provider a list of the areas in the PRD Plan that were not adequate. PRD Plans that are denied

by PJM in an advance review may be corrected and resubmitted no later than January 15, prior to the Base Residual Auction or Third Incremental Action.

Alternately, PJM may approve a lower Nominal PRD Value supported by the PRD Plan.

6.2 Determination of the Nominal PRD Value

The following steps may be followed by a PRD Provider to estimate the Nominal PRD Value in their PRD Plan:

Step A: PRD Provider may analyze the PLC data available for existing and potential customers and the Zonal Scaling Factors provided by PJM for the Delivery Year to determine the anticipated load growth to the Delivery Year. The growth may also be based on discussions with specific end-use customers. The LSE should aggregate the end-use customer forecasted demands to determine the Zonal Expected Peak Load Value of PRD for the Delivery Year. The Zonal Expected Peak Load Value of PRD is the expected contribution of such PRD Provider's price responsive load to the Delivery Year's Zonal Peak Load Forecast if such load were not to be reduced in response to price.

The Zonal Expected Peak Load Value for PRD should be determined consistent with the 50/50 load forecast that is the input to the RPM auctions and weather-sensitive loads should consider the Zonal Weighted Temperature Humidity Index Standard for each Zone as posted by PJM on its web site.

The substation/sub-zonal/zonal Zonal Expected Peak Load Value of PRD will be aggregated to determine the Zonal/LDA Zonal Expected Peak Load Value of PRD quantity for the PRD Provider in such Zone/LDA.

Step B: The PRD Provider estimates the demand reduction as a function of price based on a pilot study conducted by the PRD Provider or based on data from other pilot studies for classes of customers. Demand reduction as a function of price for specific large customers may be based on discussions and agreements with those customers. The PRD Provider must include the Zonal Expected Peak Load Value and the MESL Value in a Price-Demand curve at the locational level (sub-station/sub-zonal/zonal/LDA). The Price-Demand curve must detail the base consumption level (Zonal Expected Peak Load Value) as well as the decreasing consumption levels at increasing prices. A Price-Demand Curve must be monotonically decreasing.

The MESL will be the MW value at the highest priced point on the Price-Demand Curve. The highest price on the price-consumption curve must be less than or equal the energy offer cap applicable to the relevant delivery year.

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 PRD Provider submits its PRD Plan to PJM for review and approval, the PRD Provider 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.

The Price-Demand curves for all PRD customers are aggregated to determine the PRD Provider's aggregate Price-Demand curve at a locational level (at substation/sub-zonal/zonal). The locational Price-Demand curves (at substation/sub-zonal/zonal) are aggregated to determine the Zonal/LDA Price-Demand

curves in such Zone/LDA. The aggregated quantity of demand that will consume at a price equal to the energy offer cap represents the MESL in such Zone/LDA.

Step C: A PRD Provider's Nominal PRD Value in Zone/LDA is calculated as

Nominal PRD Value in Zone/LDA = Zonal Expected Peak Load Value in Zone/LDA – MESL in Zone/LDA

6.3 Verification of Retail Rate Structure with LSE

Before PJM will approve a LSE's PRD Plan, PJM will require that the LSE verify that it has received Relevant Electric Retail Regulatory Authority ("RERRA") approval of its time-varying retail rate structure for the referenced load. An LSE that seeks to assert that the RERRA approves or conditionally approves (which condition the LSE asserts has been met) its time varying retail rate structure for the referenced load, shall provide to PJM, within ten (10) business days of PJM's request, either: (a) an order, resolution or ordinance of the RERRA, approving or conditionally approving (which condition the LSE asserts has been met) the LSE's time varying retail rate structure for the referenced load, or (b) an opinion of the Relevant Electric Retail Regulatory Authority's legal counsel attesting to existence of a RERRA order, resolution or ordinance approving or conditionally approving (which condition the RERRA legal counsel or the LSE asserts has been met) the LSE's time varying retail rate structure for the referenced load. In the absence of a response by the LSE within the referenced ten business days, PJM shall reject the LSE's PRD Plan.

In RERRA jurisdictions where a LSE is not required by the RERRA to seek approval from the RERRA for its time varying retail rate structure for the referenced load, the LSE shall provide to PJM, within ten (10) business days of PJM's request, an opinion of either the LSE's legal counsel or the RERRA's legal counsel attesting that the LSE does not need to obtain approval from the RERRA for the LSE's time varying retail rate structure for the referenced load, and that the LSE's time-varying retail rate structure for the referenced load adheres to any guidelines established by the RERRA. In the absence of a response by the LSE within the referenced ten business days, PJM shall reject the LSE's PRD Plan.

6.4 Verification of Contractual Arrangement with PRD Provider

In the case where the PRD Provider is not a LSE, PJM will require the PRD Provider attest that their contractual arrangement with end-use customers conforms to implementation standards documented in the PJM Operating Agreement, PJM OATT or PJM Manuals which pertain to PRD. The PRD Provider shall provide to PJM, within ten (10) business days of PJM request, a copy of their standard contract with end-use customers capable of reducing load in response to price. In the absence of a response by the PRD Provider within the referenced ten business days, PJM shall reject the PRD Provider's PRD Plan.

7. Registration of Price Responsive Demand

A PRD Provider will be required to register price responsive load in a PJM software application prior to the start of the Delivery Year and maintain the registration of enough price responsive load throughout the Delivery Year to satisfy their PRD commitment.

Only load that meets all the eligibility requirements of PRD can be registered as PRD. The PRD Provider must specify the smaller of the zone or sub-zone in which the PRD is located at the time of the initial submittal of the PRD Plan. The final registration of price responsive load must be identified on a locational basis at the substation location within a transmission zone as electrically close as practical to the applicable load (i.e. PNODE). This level of 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 electrical 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 maintain power balance while correctly solving for transmission constraints.

If during the Delivery Year, the load no longer meets all the eligibility requirements of PRD, the PRD Provider must terminate the initial registration on the date the load no longer meets the eligibility requirements. The PRD Provider may also register new customers throughout the Delivery Year to cover loss of PRD load when customers drop out of the PRD Provider's program.

The portion of any customer load that is registered and committed as Price Responsive Demand cannot also be offered as Energy Efficiency or DR in RPM Auctions, or registered as Economic Load Response applicable to the Delivery Year for which it is committed as PRD.

The PJM software applications will be used to verify registrations in order to monitor and track the level of Price Responsive Demand registered at the zonal level to allow adjustments to the zonal unrestricted load forecasts. The application will also be used to verify registrations in order to monitor and verify the level of eligible Price Responsive Demand at the end-use customer level to ensure that the PLC calculation to the end-use customer will be based on adjustment for Price Responsive Demand.

PJM will receive data to validate the PLC calculation of any EDC who is also an LSE that has registered PRD for a given year.

Any PRD that is registered at the time of PRD Plan submittal may be considered as Existing PRD and not be subject RPM Credit Requirement.

8. 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 and LDA Reliability Requirements.

PJM determines the Zonal Peak Load Forecasts considering Price Responsive Demand that is committed by PRD Providers 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 in accordance with the **Load Data Systems Manual (M-19)** and are adjusted for Price Responsive Demand that is nominated and approved in advance of the Base Residual Auction. The Preliminary RTO Peak Load Forecast and the Preliminary Zonal Peak Load Forecasts for the Delivery that are determined by PJM are reduced by the total amount of Nominal PRD Values in the RTO and the applicable zone, respectively, approved in advance of the Base Residual Auction.

The Final RTO Peak Load Forecast and the Final Zonal Forecasts for the Delivery Year are determined by PJM in accordance with the **Load Data Systems Manual (M-19)** and are adjusted for Price Responsive Demand that is nominated and approved in advance of the Base Residual Auction and any additional Price Responsive Demand that is nominated and approved in advance of the Third Incremental Auction. The Final RTO Peak Load Forecast and the Final Zonal Peak Load Forecasts for the Delivery that are determined by PJM are reduced by the total amount of Nominal PRD Values in the RTO and the applicable zone, respectively, approved in advance of the Base Residual Auction and Third Incremental Auction..

In order to allow PJM to determine an unrestricted load forecast, PRD load that is reduced in response to price is added back similar to adding back load reduced due to load management (DR) as defined in PJM Manuals. As a result, the load charges to LSEs will be based on PLCs adjusted for Price Responsive Demand.

9. Performance Requirements of Price Responsive Demand

Once a PRD Provider commits PRD for the Delivery Year, the LSE will be subject to both commitment compliance and performance compliance during Maximum Emergency Events during the Delivery Year.

A PRD Provider must register enough PRD prior to the start of the Delivery Year and maintain enough Price Responsive Demand registrations throughout the Delivery Year to satisfy their PRD commitment. PJM will determine the actual Daily Nominal PRD Value based on the information provided in the registration system. If the actual Daily Nominal PRD Value is less than their committed Nominal PRD Value, the PRD Provider will be subject to a Daily PRD Commitment Compliance Penalty.

Committed PRD is required to reduce to a level based on the MESL in the registration system upon PJM declaration of a Maximum Emergency Event during that Delivery Year. During the Delivery Year, PRD Providers for which committed Price Responsive Demand does not respond consistent with the commitment during emergency conditions will be subject to a PRD Maximum Emergency Event Compliance Penalty.

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 available capacity resources or Excess Commitment Credits.

9.1 PRD Bilaterals

A PRD Provider may transfer the obligation to provide PRD bilaterally to another PRD Provider during the Delivery Year. The bilateral transfer must specify the amount to be transferred, the zone or sub-zone in which the PRD is registered, and the auction for which the PRD was committed. As a result of the transfer, the transferee PRD Provider that is assuming the transferor PRD Provider's obligation will receive the Daily PRD Credit and be subject to performance requirements and any penalties (PRD Commitment Compliance and PRD Maximum Emergency Event Compliance Penalty) during the term of the transfer.

10. 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. PRD Providers are responsible for the submittal to PJM of all information required to complete this verification for each PJM Maximum Emergency Event 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 and when the real-time LMP has reached the applicable point on their submitted PRD curve 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. PRD Providers 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.

11. Penalties for Non-Performance of Price Responsive Demand

11.1 PRD Commitment Compliance Penalty

Given that nomination of PRD prior to an RPM auction could occur three years ahead of the actual Delivery Year for which the PRD is being committed, a PRD Provider may not actually have the AMI or supervisory control in place or have customer agreements fully executed to know the exact customers that will be price responsive at the time of PRD Plan submittal. When the installation of Advanced Metering and Supervisory Controls are delayed beyond the start of the Delivery Year, or when a PRD Provider has not demonstrated that it has subscribed enough load to be Price Responsive Demand throughout the Delivery Year, the PRD Provider will be subject to a PRD Commitment Compliance Penalty.

PRD commitment compliance will be evaluated on a daily basis throughout the Delivery Year. PJM will determine the actual Daily Nominal PRD Value of the PRD Provider in a Sub-Zone/Zone based on the information provided in the registration system. If a PRD Provider's actual Daily Nominal PRD Value in a Sub-Zone/Zone is less than their committed Nominal PRD Value in Sub-Zone/Zone, the PRD Provider will be subject to a Daily PRD Commitment Compliance Penalty in the Sub-zone/Zone.

The Daily PRD Commitment Compliance Penalty is equal to the MW shortfall in the Sub-zone/Zone * [Forecast Pool Requirement] * [Weighted Final Zonal Capacity Price in \$/MW-Day + Higher of 0.2 * Weighted Final Zonal Capacity Price or \$20/MW-day].

A PRD Provider's Weighted Final Zonal Capacity Price is the average of the Final Zonal Capacity Price and the price component of the Final Zonal Capacity Price due to the Third Incremental Auction, weighted by the Nominal PRD Values committed by such PRD Provider in Base Residual Auction and Third Incremental Auction.

The MW Shortfall in Sub-zone/Zone is the Daily Nominal PRD Value committed in BRA and/or Third IA minus the Daily Nominal PRD Value determined as a result of registration process.

11.2 PRD Maximum Emergency Event Compliance Penalty

PRD event compliance is assessed upon declaration of a PJM Maximum Emergency event. The PRD compliance event hours are those hours for which a PJM Maximum Emergency Event was in place.

The penalty applicable to a PRD Provider for which load committed as Price Responsive Demand and the load does not respond consistent with its daily commitment at the first ME event is

MW shortfall * [Forecast Pool Requirement] * [Weighted Final Zonal Capacity Price in \$/MW-Day + Higher of 0.2 * Final Zonal Capacity Price or \$20/MW-day] * 365 days.

A PRD Provider's Weighted Final Zonal Capacity Price is the average of the Final Zonal Capacity Price and the price component of the Final Zonal Capacity Price due to the Third Incremental Auction, weighted by the Nominal PRD Values committed by such PRD Provider in BRA and Third IA.

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

The MW shortfall will be based on MESL identified at the time of the PRD registration, except that the MESL will be increased by the ratio of actual Zonal peak load at the time of the Maximum Emergency Event to the Final Zonal Peak Load Forecast. That is:

MW shortfall = [highest hourly integrated aggregate metered load for the PRD Provider's PRD load in the Sub-zone/Zone] – {(aggregate MESL for Sub-zone/Zone)*Higher of 1.0 or [(actual Zonal load – actual total PRD load in Zone) / (Final Zonal Peak Load Forecast – final Zonal Expected Peak Load Value of PRD in total for all PRD load in Zone)]}

To avoid double-counting of penalties, the MW shortfall for PRD event compliance may be adjusted downward if the PRD Provider is also assessed a Daily PRD Commitment Compliance Penalty.

A PRD Provider cannot use Replacement Capacity to reduce a PRD MW shortfall for commitment compliance or for failure to perform during a Maximum Emergency Event. However, a PRD Provider can use Replacement Demand by registering additional PRD throughout the Delivery Year to cure a daily commitment compliance shortfall or avoid additional event compliance shortfalls.

Penalty funds are allocated to all RPM Resource Providers with commitments for the Delivery Year in proportion to their net RPM Revenues (i.e., RPM Auction revenue net of any RPM resource performance penalties accrued) for the delivery year.

PRD Providers 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 Nominal PRD Value or revise the Nominal PRD Value estimate for the purposes of the next Delivery Year for which an RPM auction has not yet occurred.

12. Credit Requirements

PRD Providers that nominate Price Responsive Demand that has satisfied the eligibility requirements (i.e., already installed the required AMI and supervisory control and have customers that are being served under a retail rate structure or contractual arrangement that changes on an hourly basis in response to PJM real-time LMP at the substation location applicable to the load) as demonstrated by approved registrations in the PJM software application at the time of the PRD Plan submittal, are not required to establish credit for the RPM Auctions.

PRD Providers that nominate Price responsive Demand that are in the process of installing the required equipment and subscribing customers 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**.

13. Testing of Advanced Metering and Supervisory Controls

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

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

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

Tests must be executed simultaneously for all Price Responsive Demand in a given transmission zone/sub-zone.

During testing PRD is required to demonstrate compliance for a one hour period.

14. 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 this case, the Preliminary Daily Unforced Capacity Obligation of an FRR Entity is calculated based on the FRR Entity's preliminary zonal peak load forecast reduced by the approved Nominal PRD Value submitted in advance of a Base Residual Auction. The Final Daily Unforced Capacity Obligation of an FRR Entity is calculated based on the FRR Entity's final zonal peak load forecast reduced by the approved Nominal PRD Values submitted in advance of a Base Residual Auction and Third Incremental Auction.

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

15. RPM Settlement/PRD Credit

Use of Nominal PRD Value to modify the VRR Curve used in RPM auctions reduces the resources to be procured and as a result reduces the clearing price in RPM Auctions. All LSEs may benefit from this reduction in RPM Auction clearing prices.

The settlement steps are summarized below:

- Determine the Final RTO Unforced Capacity Obligation for the Delivery Year as net of the unforced capacity obligations satisfied through BRA and all Incremental Auctions. Unforced capacity satisfied in an Incremental Auction may be negative if capacity is de-committed in an Incremental Auction.

- Allocate the Final RTO Unforced Capacity Obligation for the Delivery Year to zones based on Final Zonal Peak Load Forecasts made one month prior to Third Incremental Auction to determine Final Zonal Unforced Capacity Obligations. The Final Zonal Peak Load Forecasts used in the allocation are not adjusted for the approved Nominal PRD in the zone.
- Final Zonal Unforced Capacity Obligations are allocated to LSEs daily based on the LSE daily Obligation Peak Loads. The same method is used for LSE that is serving price responsive demand (either committed by the same LSE or an alternate PRD Provider) and the LSE's daily unforced capacity obligation is based on PLCs that are not reduced by Nominal PRD Values.
- $\text{PRD Provider's PRD Credit} = [(\text{Nominal PRD Value in BRA} * (\text{FZWNSP}/\text{FZPLDY}) * \text{Final Zonal RPM Scaling Factor} * \text{FPR} * \text{Final Zonal Capacity Price}) + (\text{Nominal PRD Value in Third IA} * (\text{FZWNSP}/\text{FZPLDY}) * \text{Final Zonal RPM Scaling Factor} * \text{FPR} * \text{Final Zonal Capacity Price} * \text{Third Incremental Auction Component of Final Zonal Capacity Price stated as a Percentage})]$.
- Where, FZPLDY = Final Zonal Peak Load Forecast for Delivery Year; and
- FZWNSP = Zonal Weather-Normalized Peak Load for the summer concluding prior to the commencement of such Delivery Year.

The PRD Credit provided to the PRD Provider may help towards covering the costs of installing the Advanced Metering and Supervisory Control infrastructure and aggregating customers. A portion of the PRD Credit may also be shared with end-use customers. If the PRD Provider is a LSE, the Daily PRD Credit may offset the Daily Locational Reliability Charges that are assessed to the LSE serving such price responsive load during the Delivery Year. If PRD is committed and registered in an FRR Service Area, the FRR Service Area's load obligation will be reduced instead of providing a PRD Credit to the PRD Provider. The reduction in load obligation is a direct benefit if the PRD Provider is also the FRR Entity that serves the load. PRD may be committed and registered by an alternate PRD Provider, such as a CSP, under an agreement for financial compensation from the FRR Entity serving the load in the FRR Service Area. In either case, the PRD performance penalties are applicable to the PRD Provider.

16. Price-Demand Curves in the Energy Market

Price Responsive Demand that is committed in RPM for a Delivery Year will bid in the PJM Energy Market per the business rules below. Price Responsive Demand that is not committed in RPM for a Delivery Year has the option to bid in the Energy Market as an "Energy Only" bid.

If PRD is bid into the market as "Energy Only", the Maximum Emergency segments that are not committed MW of capacity may submit a bid price above \$1,000, and up to the maximum shortage price for the respective delivery year.

16.1 Characteristics of Price-Demand Curves in PJM Energy Market

The Price-Demand Curves (PRD Curves) for Price Responsive Demand Committed in RPM for a Delivery Year will have the following characteristics and can be submitted in the PJM Energy Market on a daily basis:

- PRD Curves accepted at the time of PRD registration, will be used as default Price Responsive Demand bids in the Day Ahead Market clearing process. Updates to the default curves may be submitted into the DA market on a daily basis by 1200 at the closing of the Day-ahead bid period
- PRD Curves in the Energy Market will be modeled in the real-time dispatch algorithms and can set Real-Time LMP. Price Responsive Demand will set Real-Time LMP based on offer price on the PRD curve, as described in next section.
- PRD Curves in the Energy Market must be submitted locationally; identified at the substation location within a transmission zone as electrically close as practical to the applicable load (ie PNODE)
- PRD Curves in the Energy Market must be non-increasing and can have up to 10 price-quantity segments for each hour.
- PRD Providers with committed PRD are required to have automation of PRD that is needed to respond to Real Time LMPs for the PRD Curves that are submitted.
- PRD curves may be submitted with price-quantity pairs above the \$1,000/MWh energy market offer cap. PRD curves may be extended up to the maximum price under the transition period established in the PJM Shortage Pricing proposal. At the end of the transition period these curves could extend up to the maximum price of \$2,700/MWh.

16.1.1 Business Rule Changes to Generation Market Seller Offers

- The maximum allowable offer price that may be submitted for non-capacity, emergency segments of energy offers is the maximum price under the transition period established in the PJM Shortage Pricing proposal. At the end of the transition period these offers may extend up to the maximum price of \$2,700/MWh.

16.2 Price-Demand Curves in Real-time Energy Market Operations

During normal Economic conditions:

- PRD Curves will be included in Security Constrained Energy Dispatch (SCED)
- Price Responsive Demand can set Real-time LMP up to the energy market offer cap

During Emergency conditions:

- Price Responsive Demand must be curtailed once PJM has;
 - a) declared and loaded Max Emergency Generation; or
 - b) loaded emergency purchases; or
 - c) initiated a voltage reduction;and the real-time LMP at the applicable location meets or exceeds the price on the submitted PRD curve at which the load has committed to curtail.

- PJM will issue an emergency procedures notification to clearly indicate when PRD must be reduced to its committed value based on the MESL.
- Price will be determined based on the interaction of the PRD Curves with the Operating Reserve Demand Curve (ORDC) used for Shortage Pricing (SP)

16.3 Balancing Operating Reserves Deviations

In general, while PJM will not send dispatch signals to PRD load, PRD load that reduces consumption in real time in response to price will be viewed as having “followed dispatch instructions” and therefore not accrue Balancing Operating Reserve (BOR) deviations for the reduced demand.

- PJM will sum an LSE’s total fixed and price sensitive demand cleared in the Day-Ahead market in each zone.
- PJM will sum the LSE’s total real time load in each zone.
- If the LSE has PRD load in a given zone, the Real- Time LMP at the PNODEs where such PRD was modeled for a given hour is higher than the Day-ahead LMP at those PNODEs for that hour and the LSEs real time load minus its Day-Ahead fixed demand was less than the LSE’s Day-Ahead cleared price sensitive demand in that zone, then the LSE will not accrue BOR deviations for the amount by which the Day-Ahead cleared price sensitive demand exceeded the real time load minus the Day-Ahead fixed demand.

16.4 PRD Curves Submitted by Curtailment Service Providers (CSPs)

- PRD Curves may be submitted by PRD Providers without direct load responsibility in the PJM energy market by 1200 at the closing of the Day-ahead bid period.
- PRD Curves submitted by PRD Providers without direct load responsibility will be identified as CSP-PRD bids in the Day-ahead Market software and user interface.
- CSP-PRD bids will be modeled in the Real-time Energy market only, and will be modeled in the real-time dispatch algorithms. CSP-PRD bids will not be modeled in the Day-ahead Market Clearing process.
- CSP-PRD bids will be not result in any energy market charges or credits to the CSP. Any energy market settlements associated with the load represented by CSP-PRD bids will accrue to the LSE responsible for serving the load.