

**UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION**

PJM Interconnection, L.L.C.)
) Docket No. ER18-87-000
)

**ANSWER AND MOTION FOR LEAVE TO ANSWER
OF THE INDEPENDENT MARKET MONITOR FOR PJM**

Pursuant to Rules 212 and 213 of the Commission’s Rules and Regulations,¹ Monitoring Analytics, LLC, acting in its capacity as the Independent Market Monitor for PJM Interconnection, L.L.C. (“PJM”)² (“Market Monitor”), submits this answer to the answers submitted on December 13, 2017 by the Energy Storage Association (“ESA”), on December 11, 2017 by NextEra Energy Resources, LLC (“NextEra”) and on December 15, 2017 by EDF Renewable Energy, Inc. (“EDF Renewable”).

I. ANSWER

A. Diminishing Returns in the RRTS Curve Are Due to Signal Design and Expected Response to the Signal Design.

ESA claims (at 5) “PJM’s ‘conditional neutrality’ scheme eliminates the old issue of diminishing value from increased amounts of RegD.” ESA then asserts (*id.*) that “the new RegD signal never moves in opposition to system control and only accommodates energy limited resources when it can do so with no compromise to system control... [t]his largely eliminates the ‘diminishing returns’ problem that the RRTS was designed to solve.”

¹ 18 CFR §§ 385.212 & 385.213 (2017).

² Capitalized terms used herein and not otherwise defined have the meaning used in the PJM Open Access Transmission Tariff (“OATT”) or the PJM Operating Agreement (“OA”).

There is no basis for this assertion. ESA is arguing that the Regulation Rate of Technical Substitution (RRTS) should be based on the signal alone, and not the characteristics of the resources following that signal. ESA is also arguing that the proportion of RegA and RegD that clear in the market should not determine the relative value of RegA and RegD, given the signal design and given the characteristics of the resources following the signals. This is nonsensical.

Within any signal design set up for substitutable resources, the RRTS functions must be determined by the signal design and the ability of RegA and RegD resources to follow that signal under different system conditions. The set of RRTS curves are designed to reflect the expected rate of substitution between RegA and RegD resources, following specified signal design and with expected ability to follow the signal, under different expected system conditions, holding expected ACE control constant.

Given the current supply stack for RegD there are diminishing returns from the use of RegD resources as a replacement for RegA resources. Under the current market design, RegA is explicitly used to support the conditional energy neutrality of RegD. Conditional neutrality provides increased viability for RegD resources when there is sufficient RegA capability to support RegD and this should be reflected in the RRTS curves. The RegD signal is now the difference between ACE and RegA. ESA protest aside, the current limited neutral signal design can and will result in RegD moving in the wrong direction for system control, so long as there is sufficient RegA MW to compensate and maintain system control. RegA is used to offset RegD when RegD moves in the opposite direction of that required by ACE control in order to permit RegD to recharge. These changes in the signal design allow

PJM to accommodate more RegD in its market solutions, but the ability to support RegD requires sufficient RegA to support RegD energy limitations.³

In system conditions where RegD MW are expected to be energy limited, based on actual resources that are physically (not hypothetically) available and cannot follow the regulation signal in one direction for as long as required, the RRTS should show a rapid decrease in the RRTS value for every MW of RegD added. As the value of energy limited RegD is, in part, supported by RegA MW, each additional MW of RegD is less and less valuable as a substitute for a MW of RegA.

B. ESA Confuses Performance Scores and Rate of Substitution.

ESA argues (at 7) that PJM's proposal double counts the drop out of RegD resources. ESA states "the value of a RegD resource is reduced twice: once for the assumed drop out reflected in the RRTS curve, and then again by a lower performance score for the very same drop out."

There is no basis for the ESA assertion. The ESA assertion confuses the role of the RRTS and the role of the performance score in the PJM proposal.

The RRTS describes the rate of substitution between performance adjusted RegA MW and performance adjusted RegD MW on a marginal effective MW basis, holding expected ACE control constant. The RRTS therefore provides a means of comparing the relative value of RegA MW and RegD MW at every viable combination of RegA and RegD in terms of a common metric: effective MW. This allows, within the optimization, a ranking of resources on the basis of \$/effective MW, which is essential for finding the optimal, least cost market solution.

³ The appropriate regulation market design would not incorporate the requirement that RegA resources support RegD resources when RegD resources cannot move in the correct direction for system control.

The performance score, on the other hand, does not describe the rate of substitution between performance adjusted RegA MW and performance adjusted RegD MW on a marginal effective MW basis. That is why the performance score is not used in the optimization as the rate of substitution between RegA MW and RegD MW. Instead, resource specific performance scores provide a basis for comparing the relative value and costs of resources of the same signal type in providing the service required by that specific signal. In other words, the performance score provides a means of comparing offers from one RegD resource to offers from other RegD resources on the basis of a common metric: performance adjusted RegD MW. For example, a 1 MW RegD resource with a \$10/MW offer and a 50 percent performance score can be directly compared to a 1 MW RegD resource with a \$10/MW offer and a 100 percent performance score. The resource with a 50 percent performance score is offering 0.5 performance adjusted RegD MW at a performance adjusted offer of \$20/MW, while the resource with the 100 percent performance score is providing 1 MW performance adjusted RegD MW at a performance adjusted offer of \$10/MW.

Resource specific performance scores allow the ordering of RegD MW within the supply stack for RegD MW on the basis of performance adjusted \$/RegD MW and ordering of RegA MW within the supply stack for RegA MW on the basis of performance adjusted \$/RegA MW. However, resource specific performance scores provide no information about the relative value of a performance adjusted RegD MW and a performance adjusted RegA MW in the optimization. That information is provided by the marginal RRTS for every possible combination of performance adjusted RegA MW and performance adjusted RegD MW, as described in PJM's proposal.

C. The PJM Proposal Includes Actual Mileage in Settlement Calculations.

NextEra argues (at 3) "that Elimination of Mileage in the Regulation Settlement Calculation Would Violate Order No. 755."

NextEra appears to confuse the elimination of the mileage ratio in settlement with the elimination of actual mileage in settlement. The PJM proposal does not eliminate actual mileage from the settlement calculation. The PJM proposal specifically includes actual mileage in the determination of realized within hour offers, the realized within hour marginal offer, the realized within hour price of regulation and the realized within hour settlement.

All performance offers are provided on a \$/mile basis. The historic, expected mileage of a signal (rolling average mileage for the signal) is used to determine the ex-ante offer on a \$/MW basis for purposes of clearing the market. However, once a resource clears, the actual within hour mileage of followed signal is used to convert every \$/mile offer into the actual \$/MW performance hour based on the actual mileage of the followed signal within the hour among all cleared resources. Actual mileage is therefore used in the determination of the clearing price and in the settlement of resources.

D. The Primary Issue with the Current Market Design is the Incorrect and Inconsistent Implementation of MBF/RRTS Curves Not the Signal Design

EDF Renewable argues that the IMM errs in identifying the issue with the current market design being the incorrectly defined and implemented technical rate of substitution assumed between RegA and RegD, rather than the signal controller. EDF Renewable states (at 4): “The IMM Assumes that the Issues in PJMs Regulation Market Are Primarily Due to an Incorrect Formula for the Substitution Between RegA and RegD Resources, Ignoring a Core Issue Relating to the Design of PJM’s Regulation Signal Controller.” EDF argues (at 2) “there is no justification for concluding, as the IMM does, that simply changing the rate of substitution between RegA and RegD resources is adequate or necessary to resolve the issues in PJM’s regulation market.” EDF Renewable asserts (at 7) that “[t]he primary flaw in this design is that the split signals are not guaranteed to be dynamically complimentary [sic]—that is, their sum is not guaranteed to be a scaled version of the original signal simply because under PJM’s implementation the low-pass and derived high-pass filters are not mathematically matched.”

EDF Renewable's assertions are based on a misunderstanding of the fundamental economic theory behind the market design. More specifically, EDF Renewable's assertions are based on a misunderstanding of the basis and purpose of defining an isoquant that provides combinations of RegA MW and RegD MW that provide an expected level of ACE control and the basis and purpose of Marginal Benefit Function (MBF)/marginal RRTS⁴ resulting from that isoquant. As explained in PJM's proposal and the Market Monitor's answer and comments, the purpose of the MBF/RRTS function is to define the marginal rate of substitution between RegA MW and RegD MW for every combination of RegA MW and RegD MW that provide an expected, acceptable level of ACE correction.

An isoquant is a mathematical function that describes the combinations of two or more input variables that provide the same output.⁵ More specifically, the isoquant describes the amount of one input that is needed given a specified amount of another input to produce a fixed amount of output. In PJM's case, the isoquant function describes the amount of RegA MW (vertical axis) needed for a given amount of RegD MW (horizontal axis) to produce the target level of ACE control.⁶ The amount of ACE control provided by different combinations of RegA MW and RegD MW is a function of the signal design and the ability of resources to follow that signal design. Properly defined and implemented, any combination of RegA MW and RegD MW on a defined isoquant will provide the same level of ACE control, given the signal design and the ability of resources to follow that signal

⁴ The Marginal Benefit Function (MBF) is the current regulation market's incorrectly defined and implemented version of the Marginal Rate of Technical Substitution between RegA MW and RegD MW. The PJM Proposal replaces the MBF with the marginal RRTS.

⁵ An isoquant in economics refers to a curve that defines all of the input combinations that yield a fixed level of output. *See* Katz/Rosen at 253–254.

⁶ The isoquant could also be expressed in terms of RegD MW needed for any given amount of RegA. This would change the MRTS (point specific slope) to describe a change in RegD MW for a change in RegA MW. This would not change the outcome of the market solution or pricing, so long as the functional form was consistently applied through the regulation market design.

design. Properly defined and implemented, the resulting MBF/marginal RRTS derived from the isoquant will define the marginal rate of substitution between RegA MW and RegD MW at every point on the isoquant.

If there is a bad signal design that makes RegD resources useless, or harmful, beyond some level, this should be reflected in the isoquant and the resulting MBF/RRTS. A properly defined and implemented MBF/marginal RRTS will limit market clearing combinations of RegA MW and RegD MW to those that are consistent with desired levels of ACE control, despite any flaws in signal design and/or despite inabilities of resources to follow the signal. If the current MBF were properly defined and implemented relative to the original signals, PJM would not have had run into the actually observed operational issues caused by the amount of RegD clearing in the market.

The MBF was not, and is not, correctly defined in the current PJM market rules and is not correctly or consistently implemented in the optimization, clearing and settlement of the regulation market. The MBF function, as implemented in the current PJM Regulation Market, even after the signal overhaul, is not equal to the MRTS between RegA and RegD. The calculation of total regulation cleared using the MBF is therefore incorrect.⁷ The result has been perverse economic incentives and PJM operational problems.

II. MOTION FOR LEAVE TO ANSWER

The Commission's Rules of Practice and Procedure, 18 CFR § 385.213(a)(2), do not permit answers to answers or protests unless otherwise ordered by the decisional authority. The Commission has made exceptions, however, where an answer clarifies the issues or assists in creating a complete record.⁸ In this answer, the Market Monitor provides the

⁷ The MBF, as used here, refers to PJM's incorrectly calculated MBF and not an MBF correctly defined as the marginal RRTS.

⁸ See, e.g., *PJM Interconnection, L.L.C.*, 119 FERC ¶61,318 at P 36 (2007) (accepted answer to answer that "provided information that assisted ... decision-making process"); *California Independent*

Commission with information useful to the Commission's decision-making process and which provides a more complete record. Accordingly, the Market Monitor respectfully requests that this answer be permitted.

System Operator Corporation, 110 FERC ¶ 61,007 (2005) (answer to answer permitted to assist Commission in decision-making process); *New Power Company v. PJM Interconnection, L.L.C.*, 98 FERC ¶ 61,208 (2002) (answer accepted to provide new factual and legal material to assist the Commission in decision-making process); *N.Y. Independent System Operator, Inc.*, 121 FERC ¶61,112 at P 4 (2007) (answer to protest accepted because it provided information that assisted the Commission in its decision-making process).

III. CONCLUSION

The Market Monitor respectfully requests that the Commission afford due consideration to this answer as the Commission resolves the issues raised in this proceeding.

Respectfully submitted,



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Dated: December 20, 2017

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in this proceeding.

Dated at Eagleville, Pennsylvania,
this 20th day of December, 2017.



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