



**Analysis of the
Combined Regulation Market:
August 1, 2005 through July 31, 2006**

PJM Market Monitoring Unit
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Introduction

1. PJM Interconnection, L.L.C. (“PJM”) integrated American Electric Power (“AEP”)¹ and the Dayton Power and Light Company (“Dayton”), effective October 1, 2004, Duquesne Light Company (“Duquesne”) effective January 1, 2005, and Virginia Electric Power Company (“Virginia Power” or “Dominion”), effective May 1, 2005.
2. PJM temporarily modified the regulation market on August 1, 2005 to combine the separately settled PJM Mid-Atlantic Regulation Market and Western Region Regulation Market into a single market hereinafter called the PJM RTO Regulation Market or the Combined PJM RTO Regulation Market. The final combination of the regulation markets is contingent upon the recommendation of the PJM Market Monitoring Unit (“MMU”) and a decision by PJM members.
3. This report presents the results of the MMU’s structural analysis of the Combined PJM RTO Regulation Market. The analysis is based upon twelve months of combined regulation market data, August 1, 2005 through July 31, 2006.
4. On September 1, 2004 PJM filed revisions to the PJM Open Access Transmission Tariff (“PJM Tariff”) and Amended and Restated Operating Agreement of PJM Interconnection, L.L.C. (“Operating Agreement”), among other things, to establish separate zones for the provision and pricing of regulation and spinning reserves. The filing also indicated that PJM would invoke the requested authority to designate the combination of the ComEd, AEP, Dayton, Duquesne and Allegheny Power zones as one Regulation Zone while the Mid-Atlantic Regulation Market would remain a separate Regulation Zone.²
5. In the September 1 Filing PJM also stated that “PJM does not propose any changes at this time to the tariff provisions that require cost-based offers for regulation in the portions of the PJM region in MAIN and ECAR. However, the larger regulation market enabled by these changes may facilitate a subsequent request to the Commission for market-based rate authority for this service. PJM’s market monitoring unit is considering this question, and PJM will report the results of that analysis when it is complete.”³ By letter order dated September 28,

¹ The American Electric Power Company operating companies are: Appalachian Power Company, Columbus Southern Power Company, Indiana Michigan Power Company, Kentucky Power Company, Kingsport Power Company, Ohio Power Company, and Wheeling Power Company.

² PJM Interconnection, L.L.C., Transmittal Letter, Docket No. ER04-1175-000, at 7 (Sept. 1, 2004) (“September 1 Filing”).

³ Id. at 8 (footnote omitted).

2004, the Commission accepted the revisions to the PJM Tariff and Operating Agreement submitted in the September 1 Filing.⁴

6. The PJM Mid-Atlantic Regulation Market has been market-based since June 2000, with an offer cap of \$100.⁵ The PJM Market Monitor filed an affidavit on February 15, 2000 supporting a market-based PJM Mid-Atlantic Regulation Market.⁶ The PJM MMU recognized in the 2005 State of the Market Report that the PJM Mid-Atlantic Region Regulation Market structure can no longer be considered to be consistent with a competitive outcome, based on market share and pivotal supplier results.⁷
7. On October 1, 2004 the PJM Market Monitor filed with FERC a declaration presenting the results of an analysis of the expected competitiveness of regulation markets in the newly redefined regulation markets within PJM.⁸ In the October 1 Declaration, the PJM Market Monitor recommended that the regulation market in the PJM Western Region Regulation Market continue to be cost based until the integration of Virginia Power. In the October 1 Declaration the MMU also committed to the submission of an updated analysis and recommendation to the Commission prior to the integration of Virginia Power indicating if the cumulative experience with the PJM Western Region Regulation Market “demonstrates that the combined market following the integration of Virginia Power may not pass the Commission’s market power tests, including any additional, relevant mitigating factors.”
8. The Commission did not issue an order in the referenced proceeding but rather issued a Notice of Acceptance of Filing by Operation of Law dated November 30, 2004 stating, “Pursuant to section 205 of the Federal Power Act, PJM’s filing will take effect by operation of law.”⁹
9. On April 25, 2005 the PJM Market Monitor filed with FERC a declaration presenting the results of an updated analysis of the expected competitiveness of regulation markets in the PJM Western Region Regulation Market.¹⁰ In the April

⁴ PJM Interconnection, L.L.C., Letter Order, Docket No. ER04-1175-000 (Sept. 28, 2004).

⁵ Market-based means that the market is cleared on the basis of price offers with an overall offer cap while cost-based means that the market is cleared on the basis of cost plus a margin offers.

⁶ PJM Interconnection, L.L.C., Docket No. ER00-1630-000, Affidavit of Joseph E. Bowring (Feb. 15, 2000).

⁷ 2005 State of the Market Report, page 262.

⁸ PJM Interconnection, L.L.C., Docket No. ER05-10-000, Market Based Regulation Offers in the PJM West/South Region, Exhibit. A (October 1, 2004) (“October 1 Declaration”).

⁹ PJM Interconnection, L.L.C., Docket No. ER05-10-000, Notice of Acceptance of Filing by Operation of Law, at P 3 (Nov. 30, 2004).

¹⁰ PJM Interconnection, L.L.C., Transmittal Letter, Docket No. ER05-10-000(April 25, 2005) (“April 25 Filing”).

25th Declaration, the PJM Market Monitor concluded, based on the information available prior to the integration, that the data did not support a finding that the market in the PJM Western Region would be competitive following the integration of Dominion.

10. On April 29, 2005 FERC issued an order accepting for filing PJM’s tariff revisions (October 1, 2004 filing) to permit market-based rate offers for suppliers of regulation service in the PJM Western Region Regulation Market, subject to the condition that the offers by AEP and Dominion must be cost-based, to become effective on the date on which Dominion integrates with PJM.¹¹
11. In the April 29 Order, the Commission stated that their decision with respect to AEP and Dominion “is without prejudice to future filings to permit market-based rate offers by these companies for regulation service that are based upon actual operating experience in the PJM West/South Regulation Zone for a period (e.g., six months) after the integration of Virginia Power. This assessment should also include an independent confirmation, under actual operating conditions, of the amount of excess regulation supply in these regions.”¹²
12. The provision of the regulation ancillary service, defined by FERC in Order No. 888,¹³ is coordinated by PJM. NERC requires that PJM maintain regulating capability in order to match short-term deviations in system load. Regulation refers to the PJM control action that is performed to correct for load changes that may cause the power system to operate above or below 60 Hz.¹⁴ The Capacity Resources assigned to meet the PJM Regulation Requirement must be capable of responding to the Area Regulation (“AR”) signal within five minutes and must increase or decrease their outputs at the Ramping Capability rates that are specified in the Offer Data that is submitted to PJM.¹⁵ The regulation service supplied by individual generating units is: “[t]he capability of a specific resource with appropriate telecommunications, control and response capability to increase or decrease its output in response to a regulating control signal.”¹⁶

¹¹ 111 FERC ¶ 61,134 at P 21.

¹² 111 FERC ¶ 61,134 at P 26.

¹³ Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, Order No. 888, 1991-1996 FERC Stats. & Regs., Regs. Preambles ¶ 31,036 (1996), order on reh’g, Order No. 888-A, 1996-2000 FERC Stats. & Regs., Regs. Preambles ¶ 31,048, order on reh’g, Order No. 888-B, 81 FERC ¶ 61,248 (1997), reh’g denied, Order No. 888-C, 82 FERC 61,046 (1998), aff’d in part and remanded in part sub nom. Transmission Access Policy Study Group v. FERC, 225 F.3d 667 (D.C. Cir. 2000), aff’d sub nom. New York v. FERC, 535 U.S. 1 (2002).

¹⁴ “PJM Manual 10: Pre-Scheduling Operations” (June 15, 2006), p. 26.

¹⁵ “PJM Manual 10: Pre-Scheduling Operations” (June 15, 2006), p. 27.

¹⁶ “PJM Manual 35: Definitions and Acronyms” (August 25, 2006), p. 64.

13. A Regulation Zone is defined as “any of those one or more geographic areas, each consisting of a combination of one or more Control Zone(s) as designated by the Office of the Interconnection in the PJM Manuals, relevant to the provision of and requirements for, regulation service.”¹⁷ Regulation for “each Regulation Zone shall be supplied from generation resources and/or Demand Resources located within the metered electrical boundaries of such Regulation Zone.”¹⁸ Thus, prior to August 1, 2005, the largest relevant geographic market for regulation service in the PJM Western Region Regulation Market is that entire regulation zone. After August 1, 2005 the largest geographic market for regulation service was the entire PJM RTO. Imports of regulation are not possible. Potential suppliers in the relevant geographic market include all entities which own generating capacity in the market that have the required capability to provide regulation and pass PJM tests for regulation. To date, the regulation capability in the newly integrated areas has generally not yet been tested by PJM.¹⁹
14. The provision of regulation constitutes a separate market as there are no good substitutes for the regulation product in the PJM market.
15. The supply of regulation can be measured as regulation capability, regulation offered, regulation offered and eligible, or regulation assigned. Regulation offered and eligible or regulation assigned are the appropriate measures of regulation supply for purposes of applying the market structure tests. As explained in more detail below, regulation capability is the theoretical maximum level of regulation that could be provided but the entire capability amount is not actually available to participate in regulation markets. Similarly, regulation offered is the theoretical maximum level of regulation that could be provided in any hour on a particular day but the entire amount offered is not actually available to participate in the hourly regulation markets during that day. Regulation offered and eligible, sometimes referred to as eligible, is actually available to provide regulation in the hourly regulation markets during the day. Regulation assigned is the regulation actually selected to provide regulation in the hourly regulation markets during the day.
16. Regulation capability per unit for a given period of time represents the highest amount of regulation MW offered daily by the resource owner for that unit during that period of time without regard to the actual availability of the resource. Regulation capability represents the theoretical maximum level of regulation and exceeds both the expected and actual level of hourly regulation offers for a variety of reasons discussed below.
17. Regulation offered represents the level of regulation capability offered to the PJM Regulation Market on a particular day. Resource owners may offer units with

¹⁷ Operating Agreement, Section 1.38A.

¹⁸ Operating Agreement, Section 1.7.18(a).

¹⁹ PJM tests units’ regulation capability when they are providing regulation service.

- approved regulation capability into the PJM Regulation Market. PJM does not require a resource capable of providing regulation service to offer its capability to the market. Regulation offers may be submitted on a daily basis by 1800 on the day prior to the operating day. Critical elements of these daily offers may be modified on an hourly basis including unit availability status. For example, it is possible to offer regulation for a day but subsequently to make that capability unavailable for any number of hours, including all hours of the day.
18. Regulation offered and eligible (also referred to as eligible regulation) represents the level of regulation capability actually offered to the PJM Regulation Market and actually eligible to provide regulation in an hour. Some regulation offered to the market is not eligible to participate in the regulation market as a result of identifiable offer parameters specified by the supplier. As an example, the regulation capability of a unit will be included in regulation offered based on the daily offer and availability status, but that regulation capability will not be eligible in one or more hours because the supplier sets the availability status to unavailable for one or more hours of that same day. (The availability status of a unit may be set in both a daily offer and an hourly update table in the PJM markets software.) As another example, the regulation capability of a unit will be included in regulation offered if the owner of a unit offers regulation, but that regulation capability will not be eligible if the owner sets the unit's economic maximum generation level equal to its economic minimum generation level. In that case, the unit cannot provide regulation and is not eligible to provide regulation. As another example, the regulation capability of a unit will be included in regulation offered but that regulation capability will not be eligible if the unit is not operating, unless the unit is a combustion turbine that meets specific operating parameter requirements, including start time. As another example, the regulation capability of a unit will be included in regulation offered but that regulation capability will not be eligible because PJM has selected the unit to provide another product, e.g. energy or spinning reserves.²⁰
 19. Regulation assigned represents those regulation resources actually selected through the regulation market-clearing mechanism to provide regulation service for a given hour.
 20. Only those offers which are eligible to provide regulation in an hour are part of supply for that hour and only those eligible offers are considered by PJM for purposes of clearing the market. Such offered and eligible regulation offers constitute the maximum extent of the market in an hour and are the maximum appropriate universe of market offers for the application of market structure tests.
 21. The available market data across all PJM regulation markets, both market-based and cost-based, indicate that approximately 61 percent of submitted capability is actually offered into the regulation market on a daily basis while 33 percent of

²⁰ Operating Agreement, Section 1.11.4(b).

submitted capability is offered and eligible on an hourly basis.²¹ This is neither good nor bad; it is simply an observed fact about the regulation markets. This result does not have any necessary implications for whether withholding is occurring. There are many legitimate reasons why regulation capability is not offered into the regulation markets on an hourly basis including whether a unit is on line, how a unit's operating parameters are set, whether a unit is providing spinning reserves, whether a combustion turbine ("CT") has a start time permitting it to participate in the next hour and a variety of other factors. A unit may be offered but not eligible to provide regulation because it is selected to provide another product, like energy or spinning reserves. The level of actual MW offers also does not have any necessary implications for reliability. With some exceptions, PJM has had adequate regulation resources available to meet the regulation requirements.

22. The MMU's market power analysis follows the Commission logic specified in the AEP Order.²² The analysis follows the logic of the delivered price test by calculating market share, HHI and pivotal supplier metrics for each market configuration.²³ The delivered price test starts with the universe of regulation offered and eligible and then limits the analysis to those offered and eligible units that are relevant competitors. The analysis includes one pivotal supplier results when the market definition includes all eligible offers made at less than or equal to 1.05 times the market clearing price and three pivotal supplier results when the market definition includes all eligible offers made at less than or equal to 1.50 times the market clearing price.²⁴ For purposes of an automated, real-time test for structural market power, the MMU uses the market definition that includes all eligible offers less than or equal to 1.50 times the clearing price and the three pivotal supplier test. For each market definition, the analysis includes all eligible regulation provided by each supplier. This is termed economic capacity under the delivered price test. The delivered price test may also be applied using available economic capacity, or total supply by participant net of their load obligation. The fact that suppliers have load obligations may affect their incentives to exercise market power, although not unambiguously. If a generation owner has more regulation capacity than obligation, the owner may have an incentive to increase the market price as this may increase returns to the owner. If a generation owner has less regulation capacity than obligation, the owner may have an incentive to increase price to disadvantage competitors. If a regulation owner has expensive regulation capacity, it will be more economic for that owner to rely on the market

²¹ The regulation capability is the maximum daily offer of each unit during the period from August 1, 2005 through July 31, 2006.

²² AEP Power Mktg. Inc., 107 FERC ¶ 61,018 ("AEP Order"), order on reh'g, 108 FERC ¶ 61,026 (2004).

²³ AEP Order at 105 et seq.

²⁴ In the 2005 State of the Market Report, the MMU analyzed the Combined PJM RTO Regulation Market using regulation provided from steam and combustion turbine units as a proxy for the market definition based on 1.05 times the clearing price.

- to purchase regulation rather than to self supply. In such a case, the net regulation position would not correctly reflect the market position of that owner whether the owner had a long, short or balanced position. In addition, as the amount of load that will be served by integrated utilities in the future is unknown given the unknown extent of retail competition, a reasonable approach is to evaluate the entire regulation supply, as is done here.
23. The Commission's AEP Order indicates that failure of any one of the specified tests is adequate for a showing of market power including delivered price test results based on market concentration, market share and pivotal supplier analyses. The analysis presented here goes further in order to analyze the significance of excess supply. The MMU applies the pivotal supplier test using one, two and three pivotal suppliers for each market definition. In addition, when there are hours with one, two or three pivotal suppliers, the analysis also examines the frequency with which generation owners are in the pivotal group.
 24. The pivotal supplier tests represent an analytical approach to the issue of excess supply. Excess supply, by itself, is not necessarily adequate to ensure a competitive outcome. A monopolist could have substantial excess supply but the monopolist would not be expected to change its market behavior as a result. The same logic applies to a small group of dominant suppliers. However, if there is adequate competitive supply, without the three dominant suppliers, to meet the demand, then the market can reasonably be deemed competitive.

The Competitiveness of the PJM RTO Combined Regulation Market: August 1, 2005 through July 31, 2006

25. An analysis of the competitiveness of the PJM RTO Combined Regulation Market during the period August 1, 2005 through July 31, 2006 was performed.
26. Excess supply, defined as the ratio of the hourly regulation offered to the hourly regulation requirement, averaged 3.92 for the period August 1, 2005 through July 31, 2006. Excess supply, defined as the ratio of the hourly regulation offered and eligible to the hourly regulation requirement, averaged 2.10. The average regulation requirement for the PJM RTO Combined Regulation Market was 949 MW during this twelve-month period.
27. Hourly HHIs were calculated based upon total regulation offered and eligible using three definitions of the relevant market. The "Eligible" category includes all eligible offers without respect to offer price while the other two definitions include all eligible regulation offers with a price less than or equal to a defined multiple of the clearing price. Table 1 summarizes the August 1, 2005 through July 31, 2006 PJM RTO Regulation Market HHIs by market definition. Based upon all regulation offered and eligible, HHIs ranged from a maximum of 1563 to a minimum of 799, with an average of 1067. Based upon regulation offered and eligible at an offer price less than or equal to 1.50 times the clearing price, HHIs

ranged from a maximum of 2221 to a minimum of 793, with an average of 1119. Based upon regulation offered and eligible at an offer price less than or equal to 1.05 times the clearing price, HHIs ranged from a maximum of 3106 to a minimum of 830, with an average of 1199. The average HHIs fall in FERC’s moderately concentrated range and there are very few hours with an HHI in excess of 1800.

Table 1 PJM RTO Combined Regulation Market HHIs, August 1, 2005 through July 31, 2006

	Minimum	Average	Maximum	Percent of Hours > 1800	Percent of Hours > 2500
Eligible	799	1067	1563	0	0
Eligible with Price $\leq 1.5 \times$ RMCP	793	1119	2221	0	0
Eligible with Price $\leq 1.05 \times$ RMCP	830	1199	3106	0.2	0

28. The largest hourly market share for regulation offered and eligible was 30 percent. The second largest hourly market share for regulation offered and eligible was 29 percent.
29. Table 2 summarizes eligible regulation market pivotal supplier statistics. In the PJM RTO Combined Regulation Market, for eligible regulation offers, including all offers without regard to a competitiveness screen, total demand could not be met in the absence of the largest single supplier during 1 percent of the hours. Under the competitiveness screen that includes all offers with a price less than or equal to 1.05 times the clearing price, total demand could not be met in the absence of the largest single supplier in the market during 64 percent of the hours.²⁵ Under the competitiveness screen that includes all offers with a price less than or equal to 1.50 times the clearing price, total demand could not be met in the absence of the largest single supplier in the market during 13 percent of the hours. For eligible regulation offers, including all offers without regard to a competitiveness screen, total demand could not be met in the absence of the two largest suppliers in the market during 3 percent of the hours. Under the competitiveness screen that includes all offers with a price less than or equal to 1.05 times the clearing price, total demand could not be met in the absence of the two largest suppliers in the market during 95 percent of the hours. Under the competitiveness screen that includes all offers with a price less than or equal to 1.50 times the clearing price, total demand could not be met in the absence of the two largest suppliers in the market during 56 percent of the hours. For eligible regulation offers, including all offers without regard to a competitiveness screen, total demand could not be met in the absence of the three largest suppliers in the market during 20 percent of the hours. Under the competitiveness screen that

²⁵ The clearing price is also referred to as the RMCP, or regulation market clearing price.

includes all offers with a price less than or equal to 1.05 times the clearing price, total demand could not be met in the absence of the three largest suppliers in the market during 99 percent of the hours. Under the competitiveness screen that includes all offers with a price less than or equal to 1.50 times the clearing price, total demand could not be met in the absence of the three largest suppliers in the market during 87 percent of the hours.

Table 2 PJM RTO Combined Regulation Market eligible regulation pivotal supplier statistics, August 1, 2005 through July 31, 2006

	Percent of 1-Pivotal Hours	Percent of 2-Pivotal Hours	Percent of 3-Pivotal Hours
All Offers	1%	3%	20%
Eligible Price $\leq 1.5 \times$ RMCP	13%	56%	87%
Eligible Price $\leq 1.05 \times$ RMCP	64%	95%	99%

30. In summary, the regulation market fails the relevant pivotal supplier tests in a significant number of hours. Specifically, the regulation market fails the three pivotal supplier test in 87 percent of the hours, using the 1.50 times clearing price market definition. The regulation market fails the one pivotal supplier test in 64 percent of the hours, using the 1.05 times clearing price market definition.
31. In order to determine the persistence of pivotal status by owner, the MMU also analyzed the frequency with which individual companies were in the pivotal group for each hour during which there were one, two or three pivotal suppliers, by market definition. During hours in which there were three pivotal suppliers, one owner was in the pivotal group for 86 percent of the hours (market definition based on 1.5 times RMCP), a second owner was in the pivotal group for 80 percent of the hours and a third owner was in the pivotal group for 78 percent of the hours. During hours in which there was one pivotal supplier, one owner was the single pivotal supplier for 69 percent of the hours (market definition based on 1.05 times RMCP), a second owner was also singly pivotal for 60 percent of the hours and a third owner was also singly pivotal for 56 percent of the hours.
32. In summary, in addition to failing the relevant pivotal supplier tests in a significant number of hours, the pivotal suppliers in the regulation market are the same suppliers in the majority of hours where the test is failed. This is a further indication that the structural market power issue in the regulation market is persistent and repeated.
33. The MMU concludes from these results that the PJM RTO Combined Regulation Market between August 1, 2005 and July 31, 2006 was characterized by persistent structural market power. This conclusion is based on the pivotal supplier results. The MMU relied, in particular, on the results of the three pivotal supplier test with

a market definition that includes all offers with a price less than or equal to 1.50 times the market clearing price.

34. Although the PJM RTO Combined Regulation Market is characterized by structural market power, the MMU also concludes that the market structure of the PJM RTO Combined Regulation Market implemented by PJM on August 1, 2005 is generally more competitive than either the PJM Mid-Atlantic Regulation Market or the Western Region Regulation Market on a standalone basis. This conclusion is based on improved HHI results and generally fewer hours during which there were one, two, and three pivotal suppliers.²⁶ As a result, the MMU concludes that it would be preferable to retain the existing, experimental Combined PJM RTO Regulation Market as the long-term market, if appropriate mitigation can be implemented.
35. With respect to mitigation, the MMU recommends that real time, hourly market structure tests be implemented in the regulation market, that market power mitigation be imposed only for hours in which the market structure is non-competitive and that market power mitigation be imposed only on the companies failing the market structure tests. More specifically, the MMU recommends that the three-pivotal supplier test be applied hourly in the regulation market using a market definition of all eligible offers less than or equal to 1.50 times the clearing price and that mitigation be applied to only those regulation owning companies that fail the test in that hour. Mitigation would consist of requiring a cost-based regulation offer including the currently defined margin of \$7.50 per MW, plus opportunity costs. This more flexible and real-time approach to mitigation represents an improvement over the current approach to mitigation which designates specific companies as dominant and requires cost-based offers from the dominant companies at all times. The proposed approach to mitigation also represents an improvement over prior methods of simply defining the market to be non-competitive and limiting all offers to cost-based offers. The real-time approach reduces emphasis on making a single, permanent determination as to whether a specific market is competitive or as to whether specific companies are dominant. The real-time approach recognizes that at times the market is structurally competitive and therefore no mitigation is required, that at times the market is not structurally competitive and mitigation is required and that at times generation owners other than the designated dominant suppliers may have structural market power that requires mitigation. This approach is identical to that currently implemented in the PJM energy markets.
36. The MMU also recommends that the overall \$100 regulation offer cap remain in effect. The retention of an overall offer cap together with a real-time three pivotal supplier test for market structure reflect PJM's current practice in the energy markets.

²⁶ 2005 *State of the Market Report* (March 8, 2006), pp. 260-263.