



Market Monitoring Unit

# **Analysis of the Three Pivotal Supplier Test: March 1, 2006 through June 30, 2007**

PJM Market Monitoring Unit  
November 19, 2007

## Summary

The Market Monitoring Unit (MMU) submits this report in compliance with its obligation to evaluate on a quarterly basis whether any changes in status are appropriate for the exempt and non-exempt interfaces in PJM.

The PJM Operating Agreement (OA) (Schedule 1, Section 6.4.1(d)(i)) states that “offer price caps shall not be applicable to generation resources used to relieve the Western, Central and Eastern reactive limits in the MAAC Control Zone and APS South Interface,” subject to the additional OA provision (Schedule 1, Section 6.4.1(d)(ii)) that “on a quarterly basis, using an analysis no less stringent than the test for suspending offer capping set forth in sections 6.4.1(e) and (f) below, the PJM Market Monitoring Unit will evaluate whether additional interfaces also should be exempt and whether any existing exemptions should be terminated.”

These four identified interfaces, the Western, Central, Eastern and AP South Interfaces are thus currently exempt from offer capping and are referred to in this report as the exempt interfaces. These four interfaces are the only exempt interfaces. Interfaces are one type of potential transmission constraints and these four interfaces are the only exempt constraints.

The test for suspending offer capping set forth in the OA Schedule 1, Sections 6.4.1(e) and (f) is the three pivotal supplier test. The three pivotal supplier test is applied by PJM on an ongoing basis in both the day-ahead and real-time energy markets in order to determine whether offer capping is required for any constraints not exempt from offer capping and for any units not exempt from offer capping.<sup>1</sup> The three pivotal supplier test is applied in real time in both the day-ahead and real-time markets. In the day-ahead market, PJM market operators apply the test as they clear the market. In the real-time market, PJM market operators also apply the test as they clear the market.

The MMU analyzed the results of the three pivotal supplier tests conducted by PJM for the real-time energy market during the period March 1, 2006, through June 30, 2007. In this report, for a comprehensive view of the results, the MMU presents the results for the first sixteen months during which the three pivotal supplier test was applied.<sup>2</sup> A summary of the results of PJM’s application of the three pivotal supplier test is presented for all constraints, including interfaces currently exempt from the application of the offer mitigation rules and interfaces currently subject to the application of the offer mitigation rules.

The MMU could not analyze the results of the three pivotal supplier test for exempt interfaces in the day-ahead market because, in contrast to PJM’s approach in the real-time market, PJM does not consistently apply the three pivotal supplier test to these constraints in the day-ahead market and the results are not reliably documented. As a

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<sup>1</sup> For additional information on the three pivotal supplier test, see *2006 State of the Market Report*, Volume II, pp. 40 – 55 and Appendix J, “Three Pivotal Supplier Test.”

<sup>2</sup> The three pivotal supplier test was implemented effective March 1, 2006. This report covers the sixteen month period through June 30, 2007.

result, it is not possible for the MMU to analyze the market structure associated with exempt interfaces in the day-ahead market in the same way as the MMU analyzes the market structure associated with exempt interfaces in the real-time market. In response to the MMU's recommendation in its quarterly report on three pivotal supplier testing for the period ending December 31, 2006, PJM has begun a dialogue with the MMU on a process to capture and retain three pivotal supplier test results from the day-ahead market. There remains the need to continue to improve the process to explicitly identify, validate and retain an historical record of the final three pivotal supplier testing results conducted and applied within the context of executing the day-ahead market. PJM and the MMU are working together to accumulate a reliable history of three pivotal supplier testing inputs and results to allow for future examination and process improvement. When this identification and retention process permits, the MMU will include in quarterly reports an analysis of three pivotal supplier testing in the day-ahead market.

As an illustration of the importance of extending the analysis to the day-ahead market, the currently exempt interfaces accounted for \$160 million in day-ahead congestion costs in 2006 and \$6 million in balancing congestion costs. In addition, the exempt interfaces were constrained for more hours in the day-ahead market than in the real-time market. During 2006, the exempt interfaces were constrained 2,643 hours in the day-ahead market and 591 hours in the real-time market.<sup>3</sup>

As a result of PJM's implementation of the three pivotal supplier test, decisions about offer capping are based on real-time analysis of the actual competitive conditions associated with each binding constraint as they occur in both the day-ahead and real-time energy markets. The three pivotal supplier test replaced the prior approach which was to offer cap all units required to resolve a binding constraint.

## Recommendations

As a result of the fact that the three pivotal supplier test ensures that offer capping will be applied only when required by market conditions, the MMU recommends that no interfaces or constraints be granted a blanket exemption. The MMU recommends that offer capping be based on the application of the three pivotal supplier test to actual market structures for all constraints in both the day-ahead and real-time energy markets, including those interfaces now exempt from offer capping.

The MMU recommends that three pivotal supplier testing be immediately and consistently applied to all constraints in the clearing of the day-ahead energy market and the results reliably documented, so that the results of the day-ahead market can be replicated and analysis of the day-ahead market results can be performed.

The MMU recommends that PJM modify its existing practice in the day-ahead market to ensure that watch list facilities are fully and completely subject to application of the three pivotal supplier test. The MMU also recommends that as part of PJM's cooperation with the MMU's review of the implementation of the three pivotal supplier test, PJM provide the MMU with a detailed explanation of the process used to determine which schedule a

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<sup>3</sup> See *2006 State of the Market Report*, Volume II, p. 43.

unit is placed on when brought on out of economic merit order for a watch list constraint in the initial dispatch solution.

The MMU recommends that PJM create an auditable method for identifying the specific test result used in making a decision about whether to impose or not impose mitigation in the day-ahead market on specific units.

The MMU recommends that PJM create an automated and auditable method for identifying the specific real-time test result used in making a decision about whether to impose or not impose mitigation when starting an offline unit to resolve a transmission constraint.

The MMU has clearly indicated that the PJM scarcity pricing rules should be clarified and extended to ensure that economic scarcity conditions are actually reflected in prices.<sup>4</sup> Scarcity pricing, in every case, would mean that offer capping would not be imposed.

The MMU recommends that PJM cooperate with the MMU to facilitate a complete and thorough review by the MMU of the actual implementation of the three pivotal supplier test in both the day-ahead and real-time markets including a detailed review and testing of the relevant software and operating procedures. Such a review has not been done and such a review is critical to ensure that the test is being properly applied.

## Background

By order issued April 18, 2005, the United States Federal Energy Regulatory Commission (the Commission or the FERC) set for hearing, in Docket No. EL04-121-000, PJM's proposal (a) to exempt the AP South Interface from PJM's offer-capping rules and (b) to conduct annual competitive analyses to determine whether additional exemptions from offer capping are warranted.

By order issued July 5, 2005, the Commission also set for hearing, in Docket No. EL03-236-006, PJM's three pivotal supplier test used to determine whether suppliers have market power when units must be called out of merit order in order to resolve transmission constraints. The Commission further set for hearing issues related to the appropriateness of implementing scarcity pricing in PJM. In the July order, the Commission consolidated Docket No. EL04-121-000 and Docket No. EL03-236-006.

On November 16, 2005, PJM filed a settlement agreement resolving all issues set for hearing in these two proceedings. On December 20, 2005, the presiding administrative law judge certified the settlement agreement to the Commission as uncontested. On January 27, 2006, in Docket Nos. EL03-236-006, EL04-121-000, 001 and 002 the Commission ordered that the settlement agreement, including the amendments to the PJM Tariff and Operating Agreement, was in the public interest and was thereby

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<sup>4</sup> See *2006 State of the Market Report*, Volume II, Section 1, "Introduction," at "Recommendations."

approved and accepted for filing and made effective as set forth in the settlement agreement.<sup>5</sup>

## **Prior Analyses**

The Commission conferred blanket exemptions from offer capping for local market power on four of the largest interfaces in PJM, prior to the development and implementation of the three pivotal supplier test. The current exemption of the Western, Central and Eastern Interfaces (reactive limits) in the MAAC Control Zone is based on a study completed in 1997 and submitted as part of PJM's initial application to the Commission.<sup>6</sup> That study examined Herfindahl-Hirschman Index (HHI) statistics for a then recent historical period and determined that concentration was generally not high enough to be a concern for these interfaces. The study did not examine the markets defined by the demand for effective MW to resolve the identified interface constraints and associated incremental MW of effective supply available to meet that demand, but analyzed the total capacity in the areas created by the interfaces, taking account of estimated costs as well as a market definition for total capacity consistent with the delivered price test approach. As a result of data limitations, that study did not account for distribution factor impacts on effective supply or the effective cost of that supply. That study also concluded that local market power was a concern for the local markets created by other transmission constraints.

The current exemption of the AP South Interface is based on an October 2004 report of the PJM market monitor. On October 26, 2004, PJM submitted a "Report of the PJM Market Monitor Regarding Offer Capping of Major Transmission Constraints" in which the PJM market monitor concludes that the continued exemption of the Western, Central and Eastern Interfaces was supported by competitive analysis as was exemption of the AP South Interface.<sup>7</sup> In the October 2004 report, a delivered price test was performed based on supply curves simulated using GE MAPS and representative loads for each constraint analyzed. The supply curve was divided into four quartiles, representing relatively competitive resources within each quartile of the supply curve, for each system load condition. Load duration analysis was used to divide load levels into four quartiles for each constraint where the difference among the four quartiles was the system load and the corresponding system price. The demand for MW levels of control actions was determined by reviewing a range of actual system conditions and selecting a representative high requirement for control actions taken by PJM where these data were available from PJM and using estimates where the data were not available. Within the markets defined in this manner, a pivotal supplier analysis was performed to determine the extent to which one or more suppliers were individually or jointly pivotal in the market to provide required control for the identified major transmission constraints.<sup>8</sup>

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<sup>5</sup> 114 FERC ¶ 61,076.

<sup>6</sup> *PJM Supporting Companies*, Transmittal Letter, Docket No. ER97-3729-000 (July 14, 1997).

<sup>7</sup> See "Report of the PJM Market Monitor" filed October 26, 2004, in Docket Nos. ER04-539-001, 002, EL04-121-000 at P 27.

<sup>8</sup> *Id* at P 16.

The conclusions of the October report differ from the recommendations in this report for a number of reasons, primarily that offer capping is now applied in real time based on the results of the three pivotal supplier test that takes account of actual, real-time system conditions including generator availability and transmission system conditions. Given this real-time application of a test for competition, there is no longer a need to make a general determination about the competitiveness of any constraint, including the currently exempt interfaces.

The 1997 decision to exempt the Western, Central and Eastern Interfaces and the 2004 recommendation to exempt the AP South Interface made sense at the time based on analytical limitations and based on the associated broad brush application of offer capping to all units required to operate to control a constraint. These decisions made sense at the time given that the local markets created by the interfaces were generally structurally competitive based on the analysis at the time, and given that offer capping could not be limited to periods when the local markets were not structurally competitive or to the specific owners who had structural market power and who would otherwise exercise market power.

The three pivotal supplier test defined in the OA represents a significant evolution in accuracy over both the 1997 analysis and the 2004 analysis because the three pivotal supplier test uses real-time data and tests constraints as they actually arise with all the actual system features that exist at the time including transmission constraints, load and generator availability.

## **Three Pivotal Supplier Results for All Constraints: Real-Time Energy Market**

The analysis here relies on the output from the application of the three pivotal supplier test in the real-time energy market by PJM. The MMU does not apply the three pivotal supplier test in the execution of either the day-ahead or real-time energy markets. The three pivotal supplier test utilizes software systems developed, operated and maintained solely by PJM. The MMU does not determine any components of the three pivotal supplier test calculation, but relies entirely on the test inputs and results as determined by PJM's market software. The analysis here reflects the actual test outcomes as determined by PJM and utilized in the conduct of the real-time energy market. PJM may apply the three pivotal supplier test for a constraint as frequently as every five minutes or less frequently, depending on actual system conditions. The results reported here reflect the actual frequency with which the test is applied by PJM.

### ***Peak Hours***

There were a total of 74,539 three pivotal supplier tests applied across 517 constraints during peak hours for the period March 1, 2006, through June 30, 2007.<sup>9</sup> Of the 517 constraints tested during peak hours, all but two demonstrated market structures which resulted in one or more owners failing the three pivotal supplier test for at least one tested interval. Of the 74,539 tests conducted during peak hours, 72,598 were applied to

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<sup>9</sup> Peak hours are defined as weekdays between hours ending 0800 and 2300, excluding NERC holidays.

non-exempt constraints.<sup>10</sup> Of these 72,598 peak hour tests, 11,505, or 16 percent, resulted in one or more suppliers passing the three pivotal supplier test. Under PJM's prior offer mitigation rules, all suppliers would have been subject to offer capping. A summary of these results is presented in Table 1.

### **Off-Peak Hours**

There were a total of 60,410 tests applied across 331 different constraints during off-peak hours for the period March 1, 2006, through June 30, 2007. Of the 331 constraints tested during off-peak hours, all but four demonstrated market structures which resulted in one or more owners failing the three pivotal supplier test for at least one tested interval. Of the 60,410 tests conducted during off-peak hours, 59,303 were applied to non-exempt constraints. Of these 59,303 off-peak hour tests, 19,427, or 33 percent, resulted in one or more suppliers passing the three pivotal supplier test. Under PJM's prior offer mitigation rules, all suppliers would have been subject to offer capping. A summary of these results is presented in Table 1.

**Table 1 PJM Application of Three Pivotal Supplier Test to All Constraints**

	Peak hours	Off-peak hours
<b>Total tests applied</b>		
All constraints	74,539	60,410
Non-exempt constraints	72,598	59,303
Exempt Constraints	1,941	1,107
<b>Tests resulting in one or more passing owners</b>		
All constraints	13,195	20,366
Non-exempt constraints	11,505	19,427
Exempt Constraints	1,690	939
<b>Percent of tests resulting in one or more passing owners</b>		
All constraints	18%	34%
Non-exempt constraints	16%	33%
Exempt Constraints	87%	85%

### **Three Pivotal Supplier Results for Interfaces**

Offer caps currently do not apply to generation resources used to relieve the Western, Central and Eastern reactive limits in the MAAC Control Zone or the AP South Interface. Nonetheless, during the period March 1, 2006, through June 30, 2007, three pivotal supplier test results for the real-time energy market were calculated by PJM for all four currently exempt interfaces. This section compares the results of the application of the

<sup>10</sup> Offer price caps currently are not applicable to generation resources used to relieve the Western, Central and Eastern reactive limits in the MAAC Control Zone and AP South Interface.



three pivotal supplier test to exempt and non-exempt interfaces in the real-time energy market.

## ***Interface Testing Results: Peak Hours***

### **Exempt Interfaces**

There were a total of 1,941 three pivotal supplier tests applied in the real-time energy market to the exempt interfaces during peak hours for the period March 1, 2006, through June 30, 2007. Of the 1,941 three pivotal supplier tests applied to exempt interfaces during peak hours, 371, or 19 percent of those, resulted in one or more suppliers failing the three pivotal supplier test. Under PJM's current offer mitigation rules, these suppliers were not subject to offer capping. A summary of the exempt interface results is presented in Table 2. A breakdown of the results for exempt interfaces is presented in Table 3. Table 3 shows that 613, or 32 percent, of the tests applied to exempt interfaces during on-peak periods were applied to the AP South Interface with the remainder applied to the other three exempt interfaces. Table 3 also shows that 301, or 81 percent, of the three pivotal supplier tests during on-peak periods with one or more failing owners were for the AP South Interface, again with the remainder for the other three exempt interfaces.

### **Non-Exempt Interfaces**

There were a total of 5,396 tests applied in the real-time energy market to non-exempt interfaces during peak hours for the period March 1, 2006, through June 30, 2007.<sup>11</sup> Of the 5,396 three pivotal supplier tests applied to non-exempt interfaces during peak hours, 2,217, or 41 percent of those, resulted in one or more suppliers failing the three pivotal supplier test. Under PJM's current offer mitigation rules, these suppliers were subject to offer capping. A summary of these results is presented in Table 2.

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<sup>11</sup> Non-exempt transfer interfaces are those constraints defined as transfer interfaces and not subject to exemption from offer mitigation per section 6.4.1(d)(i) of the PJM Operating Agreement. Non-exempt transfer interfaces for which the three pivotal supplier test was applied during the study period and included in this analysis are the 5004/5005, Bedington-Black Oak, Kanawha-Matt Funk and PL North transfer interfaces. A list of interfaces used by PJM in real-time operations and in the day-ahead energy market may be found at [www.pjm.com/markets/energy-market/downloads/20031017-interface-definitions.xls](http://www.pjm.com/markets/energy-market/downloads/20031017-interface-definitions.xls) (35 KB).



**Table 2 PJM Application of Three Pivotal Supplier Test to Non-Exempt and Exempt Interfaces**

	Peak hours	Off-peak hours
Total tests applied		
Non-exempt interfaces	5,396	8,411
Exempt interfaces	1,941	1,107
Tests resulting in one or more failed owners		
Non-exempt interfaces	2,217	3,671
Exempt interfaces	371	250
Percent of tests resulting in one or more failed owners		
Non-exempt interfaces	41%	44%
Exempt interfaces	19%	23%

## ***Interface Testing Results: Off-Peak Hours***

### **Exempt Interfaces**

There were a total of 1,107 tests applied in the real-time energy market to exempt interfaces during off-peak hours for the period March 1, 2006, through June 30, 2007. Of the 1,107 three pivotal supplier tests applied to exempt interfaces during off-peak hours, 250, or 23 percent of those, resulted in one or more suppliers failing the three pivotal supplier test. Under PJM's current offer mitigation rules, these suppliers were not subject to offer capping. A summary of the exempt interface results is presented in Table 2. A breakdown of the results for exempt interfaces is presented in Table 3. Table 3 shows that 288, or 26 percent, of the tests applied to exempt interfaces during off-peak periods were applied to the AP South Interface with the remainder applied to the other three exempt interfaces. Table 3 also shows that 160, or 64 percent, of the three pivotal supplier tests during off-peak periods with one or more failing owners were for the AP South Interface, again with the remainder for the other three exempt interfaces.

### **Non-Exempt Interfaces**

There were a total of 8,411 tests applied in the real-time energy market to non-exempt interfaces during off-peak hours for the period March 1, 2006, through June 30, 2007. Of the 8,411 three pivotal supplier tests applied to non-exempt interfaces during off-peak hours, 3,671, or 44 percent of those, resulted in one or more suppliers failing the three pivotal supplier test. Under PJM's current offer mitigation rules, these suppliers were subject to offer capping.

## ***Results for Regional Constraints***

Regional constraints are constraints that occur on the 500 kV system. The exempt and non-exempt interfaces are a subset of regional constraints. For comparison, three pivotal supplier test results are presented for non-exempt regional constraints which occurred during the period March 1, 2006, through June 30, 2007.

Several regional transmission constraints occurred during the period March 1, 2006 through June 30, 2007 in the real-time energy market. The 5004/5005, AP South, Bedington-Black Oak, Western, Central and Eastern Interfaces all occurred during the study period.<sup>12</sup> The three pivotal supplier test was applied to all of these constraints. The AP South, Western, Central and Eastern Interfaces are those constraints for which generation owners are exempt from offer capping.

Table 3 includes information on the three pivotal supplier test results for the regional constraints in the real-time energy market during the study period.<sup>13</sup> For the listed regional constraints that are not exempt, the percentage of tested intervals resulting in one or more owners passing ranged from 80 percent to 83 percent during peak hours and from 85 percent to 86 percent during off-peak hours. For the listed regional constraints that are not exempt, the percentage of tested intervals resulting in one or more owners failing ranged from 28 percent to 33 percent during peak hours and 28 percent during off-peak hours. For the listed regional constraints that are exempt, the percentage of tested intervals resulting in one or more owners passing ranged from 62 percent to 98 percent during peak hours and from 0 percent to 94 percent during off-peak hours. For the listed regional constraints that are exempt, the percentage of tested intervals resulting in one or more owners failing ranged from 4 percent to 49 percent during peak hours and from 7 percent to 100 percent during off-peak hours.

**Table 3 PJM Application of Three Pivotal Supplier Test to Regional Constraints**

Constraint	Period	Total Tests Applied	Tests with One or More Passing Owners	Percent Tests with One or More Passing Owners	Tests with One or More Failing Owners	Percent Tests with One or More Failing Owners
5004/5005 Interface	Peak	1,060	878	83%	296	28%
	Off Peak	310	266	86%	86	28%
Bedington - Black Oak	Peak	3,557	2,835	80%	1,188	33%
	Off Peak	5,899	5,017	85%	1,656	28%
AP South	Peak	613	398	65%	301	49%
	Off Peak	288	174	60%	160	56%
Western	Peak	1,280	1,256	98%	56	4%
	Off Peak	803	751	94%	88	11%
Central	Peak	27	23	85%	6	22%
	Off Peak	15	14	93%	1	7%
Eastern	Peak	21	13	62%	8	38%
	Off Peak	1	0	0%	1	100%

<sup>12</sup> The 5004/5005 Interface is comprised of two 500 kV lines, which include the Keystone-Juniata 5004 and the Conemaugh-Juniata 5005. These two lines are located between central and western Pennsylvania.

<sup>13</sup> The number of tests with one or more failing owners plus the number of tests with one or more passing owners can exceed the total number of tests applied. A single test can result in one or more owners passing and one or more owners failing. In such a case, the interval would be counted as including one or more passing owners and one or more failing owners.

## Results for Regional Constraints: Additional Details

Additional information is provided for the listed regional constraints, including the average MW required to relieve a constraint, the average supply available, the average number of owners included in each test and the average number of owners that passed or failed each test.

Table 4 shows that, on average, during peak periods, the local market created by the 5004/5005 Interface had an average of 18 owners with available supply during the peak period, of which an average of 15 passed the three pivotal supplier test.<sup>14</sup> During off-peak periods, the local market created by the 5004/5005 Interface had an average of 16 owners with available supply during the peak period, of which an average of 14 passed the three pivotal supplier test. The local market created by Bedington-Black Oak had an average of 12 owners with available supply during on-peak hours of which an average of nine owners passed the three pivotal supplier test. During off-peak hours, the local market created by Bedington-Black Oak had an average of 11 owners with available supply of which an average of nine owners passed the three pivotal supplier test. The local market created by AP South had an average of 17 owners with available supply during on-peak hours and an average of 16 during off-peak hours, of which 10 owners passed during on-peak periods and 9 owners passed during off-peak periods. The local market created by the Western Interface had an average of 18 owners with available supply during on-peak hours and an average of 17 during off-peak hours, of which 18 owners passed during on-peak periods and 16 owners passed during off-peak periods.

**Table 4 Three Pivotal Supplier Test Results for Regional Constraints – Additional Details**

Constraint	Period	Average Constraint Relief (MW)	Average Effective Supply (MW)	Average Number Owners	Average Number Owners Passing	Average Number Owners Failing
5004/5005 Interface	Peak	109	399	18	15	3
	Off Peak	97	356	16	14	3
Bedington - Black Oak	Peak	57	224	12	9	3
	Off Peak	62	237	11	9	2
AP South	Peak	98	267	17	10	7
	Off Peak	89	292	16	9	7
Western	Peak	151	837	18	18	0
	Off Peak	168	772	17	16	1
Central	Peak	145	611	18	15	3
	Off Peak	159	876	19	18	1
Eastern	Peak	205	703	14	11	3
	Off Peak	187	695	12	0	12

<sup>14</sup> The average number of owners passing and the average number of owners failing are rounded to the nearest whole number and may not sum to the average number of owners, also rounded to the nearest whole number.

The local market created by the Central Interface had an average of 18 owners with available supply during on-peak hours and an average of 19 during off-peak hours, of which 15 owners passed during on-peak periods and 18 owners passed during off-peak periods. Table 4 shows that, on average, the local market created by the Eastern Interface had 14 owners during peak periods of which 11 passed the test. The local market created by the Eastern Interface had 12 owners during off-peak periods of which none passed the test.

## **Process and MMU Recommendations**

Section 6.4.1(d)(ii) of Schedule 1 of the PJM Operating Agreement states:

On a quarterly basis, using an analysis no less stringent than the test for suspending offer capping set forth in sections 6.4.1(e) and (f) below, the PJM Market Monitoring Unit will evaluate whether additional interfaces also should be exempt and whether any existing exemptions should be terminated. Considering the recommendations of the PJM Market Monitoring Unit, the Office of the Interconnection shall determine whether to make a filing with the FERC proposing that an additional interface should be exempt or an existing exemption should be terminated. Any change in the exempt status of the interface shall become effective upon FERC acceptance. The Office of the Interconnection shall post a summary of the results of the PJM Market Monitoring Unit's quarterly analyses and the Office of the Interconnection's determination whether to make a filing with the FERC.

Section 6.4.1(e) of the PJM Operating Agreement states in part:

Notwithstanding the number of jointly pivotal suppliers in any hour, if the Market Monitoring Unit determines that a reasonable level of competition will not exist based on an evaluation of all facts and circumstances, it may propose to the Commission the removal of offer-capping suspensions otherwise authorized by this section. Such proposals shall take effect only upon Commission acceptance or approval.

### ***Terminate Current Interface Exemptions***

The MMU recommends that the Commission terminate the exemption from offer capping currently applicable to generation resources used to relieve the Western, Central and Eastern reactive limits in the MAAC Control Zone and the AP South Interface. The PJM market monitor recommends that all constraints, including these interfaces, be subject to three pivotal supplier testing as specified in the PJM Operating Agreement.

The current exemption of the Western, Eastern and Central Interfaces is based on an analysis performed in 1997 and supported by the October 2004 report cited above. The current exemption of the AP South Interface is based on the October 2004 report. Neither analysis was as accurate as the current application of the three pivotal supplier test by PJM. The 1997 analysis was based on HHI and market share results for broad areas of the system and did not incorporate distribution factor impacts or analysis of incremental supply and demand associated with constraints. The October 2004 report was described above.

The primary reason to remove the exemptions for the identified interfaces is that they are no longer necessary given PJM's dynamic implementation of the three pivotal supplier test based on actual market conditions in real time. It is not necessary to make an *ex ante* decision about the market structure associated with individual interface constraints that applies for an extended period. Prior to the implementation of the three pivotal supplier test, all units required to resolve a constraint were offer capped whenever the constraint was binding. For the identified exempt interfaces, this could have resulted in the offer capping of a large number of units even when the relevant market was structurally competitive. That is no longer the case. Under the current PJM dynamic approach, offer capping will be applied only as necessary and will be applied on a non-discriminatory basis for all units operating for all constraints.

The fact that some non-exempt constraints had no generation resources that failed the three pivotal supplier test during the period analyzed does not lead to the conclusion that such constraints should always be exempt from offer capping for local market power. The same logic applies to currently exempt interface constraints. Even if no generation resources associated with any of the exempt interface constraints failed the three pivotal supplier test during the study period, that does not mean that such interfaces should always be exempt from offer capping for local market power. The fact that one or more generation resources required to resolve these interfaces did fail the three pivotal supplier test at times simply reinforces the point. If the generation resources associated with these interfaces always pass the three pivotal supplier test, there will be no offer capping and conversely if such resources at times fail the three pivotal supplier test, appropriate offer capping will be applied.

Local market power is clearly defined in the PJM Tariff and the appropriate local market power mitigation is also clearly defined in the PJM Tariff. The definition of local market power should apply to all constraints and the appropriate market power mitigation should also apply to all constraints.

### ***Additional Recommendations***

In addition to recommending the termination of the current interface exemptions, the MMU also recommends that PJM take certain actions to improve the application of the three pivotal supplier test. A more detailed discussion of these additional recommendations follows.

It is not currently possible to comprehensively analyze PJM's application of the three pivotal supplier test in the day-ahead market. The MMU recommends that three pivotal supplier testing be immediately and consistently applied to all constraints in the clearing of the day-ahead energy market and the results reliably documented, so that analysis of the day-ahead market results can be performed. The MMU recommends that PJM continue to improve its efforts to explicitly identify, validate and retain an historical record of the final three pivotal supplier test results conducted and applied within the context of executing the day-ahead market.

The MMU recommends that PJM create an auditable method for identifying the specific test result used in making a decision about whether to impose or not impose mitigation in the day-ahead market on specific units.

The MMU recommends that PJM modify its existing practice in the day-ahead market to ensure that watch list facilities are fully and completely subject to application of the three pivotal supplier test. The MMU also recommends that as part of PJM's cooperation with the MMU's review of the implementation of the three pivotal supplier test, that PJM provide the MMU with a detailed explanation of the process used to determine which schedule a unit is placed on when brought on out of economic merit order for a watch list constraint in the initial dispatch solution.

The MMU recommends that PJM create an automated and auditable method for identifying the specific real-time three pivotal supplier test result used in making a decision about whether to impose or not impose mitigation when starting an offline unit to resolve a transmission constraint. At present, PJM cannot identify the real-time test result that is used to decide whether or not to offer cap a unit.

## **Analytical Issues**

The MMU has identified a number of analytical issues with respect to the application of the three pivotal supplier test. In addition, PJM has responded to issues raised in several of the quarterly reports. This section identifies analytical issues, responds to PJM points where relevant and suggests resolutions. PJM makes the general claim that the MMU's recommendation to terminate the exemption from offer capping of certain interfaces is not supported by sufficient analysis. PJM neither defines what would constitute sufficient analysis nor offers any analysis to support maintaining the exemption.

### ***Application of Three Pivotal Supplier Test in the Day-Ahead Market***

The MMU recommends that three pivotal supplier testing be immediately and consistently applied to all constraints in the clearing of the day-ahead energy market and the results reliably documented, so that analysis of the day-ahead market results can be performed.

### **Day-Ahead TPS Test Data**

The MMU has identified the need to test PJM's implementation of the three pivotal supplier test to ensure that it is being applied as intended. In addition, the MMU has identified the need to save data which will permit a reproducible, detailed analysis of the application of the three pivotal supplier test in the day ahead market and the identification of the link between test inputs, test results and market operator decisions with respect to offer capping in the day ahead market as well as in the real time market.

In response to the MMU's recommendation in its quarterly report on three pivotal supplier testing for the period ending December 31, 2006, PJM has begun a dialogue with the MMU on a process to capture and retain three pivotal supplier test results from the day-ahead market. There remains the need to continue to improve the process to explicitly identify, validate and retain an historical record of the final three pivotal supplier test results conducted and applied within the context of executing the day-ahead market. PJM and the MMU are working together to accumulate a reliable history of three pivotal supplier test inputs and results to allow for future examination and process improvement. As this identification and retention process provides reliable data, the MMU will include



in upcoming quarterly reports an analysis of three pivotal supplier testing in the day-ahead market.

The MMU recommends that PJM cooperate with the MMU to facilitate a complete and thorough review by the MMU of the actual implementation of the three pivotal supplier test in both the day-ahead and real-time markets including a detailed review of the relevant software and operating procedures. Such a review has not been done, and it is critical to ensure that the test is being properly applied.

## **Watch List**

In the clearing of the day-ahead market, PJM currently controls for certain constraints without subjecting those constraints to three pivotal supplier testing. In developing an initial day-ahead dispatch case, PJM assigns these constraints to what PJM terms a “watch list.” It is the MMU’s understanding that the ratings of these watch list facilities are respected, but units brought on out of economic merit order to control for these facilities are not subject to application of the local market power mitigation rules. It is not clear how PJM assigns an offer schedule for these out of merit resources without applying the market power mitigation rule. This initial dispatch case becomes the basis for the clearing of the day-ahead market, with those generator offer schedule selections carried into the real-time energy market. After this initial dispatch case is developed, PJM tests all constraints in clearing the day-ahead market, including those on the watch list. At that point, it is the MMU’s understanding that the watch list constraints have already been largely resolved, so only incremental requirements for out of merit dispatch are subject to the local market power mitigation rule.

The MMU recommends that PJM modify its existing practice to ensure that watch list facilities are fully and completely subject to application of the three pivotal supplier test. The MMU also recommends that as part of PJM’s cooperation with the MMU’s review of the implementation of the three pivotal supplier test, that PJM provide the MMU with a detailed explanation of the process used to determine which schedule a unit is placed on when brought on out of economic merit order for a watch list constraint in the initial dispatch solution.

## ***Linking Test Results to Offer Capping Decisions***

The MMU recommends that PJM create an automated and auditable method for identifying the specific real-time test result used in making a decision about whether to impose or not impose mitigation when starting an offline unit to resolve a transmission constraint. At present, PJM cannot identify the real-time test result that is used to decide whether or not to offer cap a unit.

## **Application of TPS Test**

The MMU in its quarterly report on PJM’s application of the three pivotal supplier test provides the results of all three pivotal supplier tests in the real-time energy market, whether resulting in mitigation or not and whether resulting in a decision or not. The existence of a test does not mean that a decision was made based on the test result. The existence of a failed test result does not mean that mitigation was imposed. A test is triggered whenever PJM’s Unit Dispatch System (UDS) software detects the need to provide incremental relief for a transmission constraint. The universe of three pivotal



supplier tests is all intervals in which PJM’s UDS software identifies the need to provide incremental relief for a transmission constraint.

When incremental relief is required for a transmission constraint, the three pivotal supplier test is executed. The test is an analysis of the ownership structure of units which are available to the operators to relieve the constraint. The relevant supply curve for providing incremental constraint relief includes increases in output from units already operating, reductions in output from units already operating and output from offline units that can provide the required relief in the time defined by the operators. Only offline units are subject to offer capping. In the majority of cases, the relevant supply curve consists of units which are already operating. Units which are already operating and selected to provide relief for a constraint are not subject to offer capping, regardless of the three pivotal supplier test result. Once a unit is started on its price schedule, it may not be offer capped due to a subsequent failure of a three pivotal supplier test. Mitigation is only applied to units started out of economic merit order for the purpose of relieving a constraint and which fail the test. An offline unit is brought on only if that unit provides a more cost effective solution than modifying the output of units which are already operating. Table 5 shows the proportion of units included in the three pivotal supplier tests which would have been eligible for mitigation for the currently exempt interfaces and which were eligible for mitigation for two frequently occurring non-exempt interfaces. That proportion is quite small for each of these interface constraints. Eligible for mitigation does not mean that these units were or would have been offer-capped. The results simply indicate the existence of an offline unit capable of providing relief to the constraint which failed the three pivotal supplier test. These units would have been subject to offer capping only in the event that the least cost solution to the constraint dictated starting one of these units rather than altering the output of a unit which was already online.

**Table 5 Units Eligible for Mitigation**

Constraint	Period	Average Number Units	Average Number of Units Eligible for Mitigation	Average Percent of Units Eligible for Mitigation
5004/5005 Interface	Peak	412.5	2.6	1.1%
	Off Peak	354.2	1.5	0.4%
Bedington - Black Oak	Peak	253.6	1.8	0.8%
	Off Peak	227.3	1.2	0.5%
AP South	Peak	372.0	5.5	1.8%
	Off Peak	330.6	3.9	1.1%
Western	Peak	426.7	0.3	0.1%
	Off Peak	392.4	0.7	0.1%
Central	Peak	448.7	0.7	0.3%
	Off Peak	434.1	0.0	0.0%
Eastern	Peak	257.8	10.6	6.5%
	Off Peak	292.0	42.0	14.4%

PJM responded to this MMU analysis of the average number of units eligible for mitigation and suggested that this average alone may not appropriately convey the range of possible outcomes.<sup>15</sup> The MMU's analysis of real-time offer capping experience shows similar results.<sup>16</sup> In addition, PJM failed to suggest an alternative approach.

## **Linking Test Results to Offer Capping Decisions**

The universe of three pivotal supplier test results shows the structural conditions for all transmission constraints when PJM's UDS software determined that additional relief was required to resolve the constraint. Only a subset of those test results formed the basis for a decision to impose or not impose mitigation on a newly started unit.

PJM does not currently log which specific occurrence of the three pivotal supplier test forms the basis for a decision to impose mitigation or not to impose mitigation for a specific unit for a specific constraint at a specific time. PJM logs a "called-on" and a "start time" for the unit, but does not flag the test result relied upon in making the decision whether or not to impose mitigation. There is a time lag between when the mitigation decision is made, contact is initiated with the unit's owner and the request is logged by PJM. During this time, multiple three pivotal supplier tests may be applied by the PJM system software.

Given the actual application of the test, the fact that a small proportion of failed three pivotal supplier tests result in offer capping does not mean that the test has inconsistent results. Only when PJM creates a clear link between test inputs, test results and dispatcher action will it be possible to more completely understand this relationship. There is no evidence that the results of the three pivotal supplier test are inconsistent, are not based on the underlying market dynamics or result in excessive mitigation. PJM also refers to "false positive" test results without defining this term.<sup>17</sup> There is no evidence that the three pivotal supplier test ever results in a failed test that is not appropriate. PJM has provided no data or examples to support this assertion.

In response to the MMU recommendation that PJM automate a process for identifying which three pivotal supplier test result supported a decision to impose mitigation, PJM states that it is not possible to define such a linkage due to the simultaneity of constraints.<sup>18</sup> The MMU does not agree that this is a legitimate reason for not creating a verifiable audit trail of decision support materials to explain why a unit was mitigated. While constraints do occur simultaneously, there exists a manual process by which the dispatcher reviews and approves recommended generation resource configurations (UDS cases) to resolve constraints. Each of these UDS cases has an associated set of three pivotal supplier test results which drive the selection of a unit's price or cost schedule. The three pivotal supplier test results are themselves stored with an index key referencing their associated approved UDS case. If the UDS solution recommended

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<sup>15</sup> <http://www.pjm.com/committees/mic/postings/20070828-pjm-response-to-mmu-quarterly-report-04.pdf>.

<sup>16</sup> See *2006 State of the Market Report*, Volume II, Table 2-5.

<sup>17</sup> <http://www.pjm.com/committees/mic/postings/pjm-response-to-the-quarterly-mmu-interface-report.pdf>.

<sup>18</sup> <http://www.pjm.com/committees/mic/postings/20070828-pjm-response-to-mmu-quarterly-report-04.pdf>.

starting an offline unit and mitigated its offer, the associated three pivotal supplier test results should provide the justification for such action. Even if a unit were providing relief to several constraints simultaneously, that unit's effect on each of these constraints is examined separately by the three pivotal supplier test and the results of those tests stored. Ultimately, the decision to offer cap a unit must be based on an identifiable three pivotal supplier test. PJM should save a record of that identifiable test.

### ***Short-term Changes in Test Results***

The three pivotal supplier test measures actual, real-time system market structure based on actual system conditions and the test results reflect the dynamic nature of actual supply and demand. The time lag between running a test and actual unit response and the dynamic nature of the actual system conditions can result in changed pass/fail results for the owner of a given unit within a short period of time. (PJM refers to this result as oscillation.)<sup>19</sup> Such changes in pass/fail results for the owner of a given unit are only relevant to offer capping if the specific unit is offline and is selected to be started for the constraint. In addition, such changes are only of interest if they occur within a relatively short period of time.<sup>20</sup> It is therefore critical to be able to link specific test results to the decision to offer cap or not offer cap a particular unit. While the overwhelming majority of three pivotal supplier test results do not change over short periods, short term changes in test results cannot be analyzed without a link between test result and dispatcher action. PJM has not defined oscillation and cannot measure it in a meaningful way without this link.

In the presence of dynamic supply/demand conditions for a constraint, there should be no opportunity for the exercise of discretion in deciding whether to impose mitigation. Under such conditions, it is critical that PJM and the MMU be able to link the specific test and the test inputs relied upon in making a decision with respect to offer capping. Once a decision is made to start a unit on its price or cost schedule, the dispatcher may not make a subsequent change to that schedule due to a change in three pivotal supplier test result. As an example, if the dispatcher elects to bring on a combustion turbine for a constraint and the current three pivotal supplier test result shows that the unit should run on its price schedule, the dispatcher should not be able to require the unit to run on its cost schedule based on the next test result. Similarly, if the test result shows that the unit should run on its cost schedule, the dispatcher should not be able to require the unit to run on its price schedule based on the next test result. To allow such discretion would be analogous to a motorist challenging a ticket for running a red light because the light turns green while the police officer is writing the ticket.

For these reasons, the MMU recommends that PJM create an automated and auditable method for identifying the specific test result used in making a decision about whether to

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<sup>19</sup> The term oscillation refers to changes occurring in a regular cycle. To the extent that the underlying conditions result in changed test results, it does not appear to be happening in a regular cycle.

<sup>20</sup> The potential for such short term changes in test results exists in the real-time energy market and not in the day-ahead market. In the real-time energy market, dispatch decisions are made in real time and reflect the changing characteristics of the underlying system while in the day-ahead energy market, dispatch decisions reflect market operators' more comprehensive knowledge of system conditions throughout the day.

impose or not impose mitigation when starting an offline unit to resolve a transmission constraint.

Once PJM incorporates the ability to link offer capping decisions with the supporting three pivotal supplier test result and saves the related data, the MMU will include an analysis of this subset of tests in its quarterly reports. As part of its analysis, the MMU will evaluate the offer behavior of those offline resources selected to run for a constraint, along with the frequency of any associated offer capping. The MMU will also analyze the system conditions underlying specific cases where test results change for specific units within a short period of time.

Rather than explain a technical obstacle to implementing the MMU's recommendation in this regard, PJM suggests that the MMU report appears to agree that observed oscillation in the three pivotal supplier test results over short periods of time can create uncertainty for the PJM dispatcher which needs to be eliminated. This description of the MMU's recommendation is inaccurate. The MMU in fact recommended the linkage between test result and mitigation be automated and auditable not because of uncertainty for the dispatcher, but because of an inability by PJM to justify why specific units are mitigated. PJM further suggests that the MMU has failed to explain the "oscillation" of test results. PJM has to date failed to explain a single instance in which a change in test result was indicative of anything other than a structural change in the market interval being examined. PJM's contention that this suggests an inaccuracy in the test results remains without explanation or support.

Ultimately, changes in test results reflect changes in the underlying UDS solutions. When those solutions change frequently, the resultant test results may also change. That is an expected and a desired result. The test is intended to reflect the actual market situation faced by the market operators. It is the understanding of the MMU that PJM is currently engaged in modifications to the UDS application that may result in fewer changes to the UDS solutions.

## **Impact**

A documented link among test inputs, test results and offer capping decisions is also required in order to analyze the impact of not offer capping for exempt constraints. This is true for the day-ahead and the real-time markets. When that data is available, the MMU will analyze the data.

As a general matter, any analysis of the impact of offer capping or not offer capping must be comprehensive. The LMP impact in a single hour of not offer capping a unit does not capture the full impact of that decision. A comprehensive analysis must begin with the day-ahead market, the potential impacts of offer capping in the day-ahead market and the effects of such offer capping on the selection of units which ultimately run in real time. The analysis in real time must begin with these units committed day-ahead and analyze the impacts of offer capping subsequently imposed throughout the operating day. An impact analysis also needs to consider operating reserve payments to units running for constraints. Take for example a CT with a minimum run time of 6 hours which is needed for a constraint for two hours. After the second hour of operation, the unit may no longer be needed for the constraint but must continue to operate to satisfy

its minimum run time requirement. If LMP falls below the unit's offer price, operating reserve charges would be incurred. This is part of the impact of not offer capping.

The mark up of units that are part of the supply curve for resolving specific constraints is a measure of the potential impact of not offer capping. The mark up measures the difference between the price offers and the cost offers of units in the relevant supply curve and thus is a measure of the potential increase in price when offer capping is not implemented and market power is exercised as a result.

## Scarcity

In its response to the MMU's quarterly report, PJM stated that "The offer exemption is necessary because it reduces the potential for excessive mitigation during times of regional scarcity."<sup>21</sup> This statement is not supported in the PJM document and the statement is not correct.

PJM has well defined FERC approved scarcity pricing rules.<sup>22</sup> The three pivotal supplier test has no impact on offer capping during times of regional scarcity. The scarcity rules explicitly state that all offer caps are relaxed during scarcity conditions for the scarcity region and that offer caps may not be reinstated until the scarcity event has been formally concluded, regardless of three pivotal supplier testing results.

The MMU has clearly indicated that the PJM scarcity pricing rules should be clarified and extended to ensure that economic scarcity conditions are actually reflected in prices.<sup>23</sup> Scarcity pricing, in every case, would mean that offer capping for local market power would not be imposed.

## Incentives

PJM suggests that the use of a single price-based offer curve by generators each day makes it unlikely that a generation owner could exercise market power when a constraint has a non-competitive test result for only a few intervals.<sup>24</sup> The fact that the test fails for a small number of intervals is not a measure of the incentives to market participants to attempt the exercise of market power, which can have a substantial impact on portfolio revenues and which can persist for long periods of time once established. There are a number of strategies for exercising market power in such a case, absent offer capping, for a single unit or for a portfolio of units.

## Relevant Market

The Appendix to PJM's May 31, 2007 document addresses the definition of the relevant market for purposes of defining competition. The document states that to "measure the overall competitiveness of the sub-region" one must analyze the times when

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<sup>21</sup> <http://www.pjm.com/committees/mic/postings/pjm-response-to-the-quarterly-mmu-interface-report.pdf>

<sup>22</sup> 114 FERC ¶ 61,076 (2006).

<sup>23</sup> See *2006 State of the Market Report*, Volume II, Section 1, "Introduction," at "Recommendations."

<sup>24</sup> <http://www.pjm.com/committees/mic/postings/pjm-response-to-the-quarterly-mmu-interface-report.pdf>.

transmission constraints create a smaller market and the times when there is no constraint.<sup>25</sup>

When there are no binding transmission constraints, the relevant market is the entire PJM footprint. When the entire PJM footprint is the relevant market, there is a presumption of competitiveness in PJM and there is no offer capping. When there is a binding transmission constraint, the relevant market is defined by the constraint and includes both the incremental demand for MW to relieve that constraint and the incremental supply available to solve the constraint. When evaluating the competitiveness of that market, this is the only relevant supply and demand. The overall competitiveness of the subregion does not refer to an identifiable market. Rather it refers to two or more specific markets which must be analyzed separately.

PJM's suggestion that the two markets be analyzed as if they were one market is not consistent with economic logic. Each is a separate market and each must be analyzed as a separate market. Nonetheless, PJM combines the markets and calculates that when the number of tests with at least one failing owner is compared to the total number of intervals, the number is a small percent. On this basis PJM concludes, incorrectly, that market power concerns are virtually eliminated. If applied previously, PJM's logic would have resulted in not including the actual local market power mitigation in the initial 1996 PJM FERC filing and in the absence of all local market power mitigation now.<sup>26</sup>

## Market Certainty

PJM suggests that there should be no offer capping for the exempt interfaces because these interfaces are used as reference points for bilateral trading and providing market certainty is an important objective. It is not clear why retaining the interface exemption from offer capping would provide certainty. It is not clear what PJM considers to be certainty in this context. While market outcomes are never certain, it is a reasonable objective to have certainty about the definition and application of market rules. It would be preferable for the markets to have the certainty that the interface prices are not and cannot be subject to market power but are the outcome of competitive forces. It is not reasonable to pursue "certainty" by permitting the potential exercise of market power. PJM's goal is to ensure robust, competitive markets.

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<sup>25</sup> <http://www.pjm.com/committees/mic/postings/pjm-response-to-the-quarterly-mmu-interface-report.pdf>.

<sup>26</sup> As a factual matter, it is not true that PJM runs the three pivotal supplier test for every five minute interval as stated in the Appendix and reflected in Table 1. The three pivotal supplier test is run when there is incremental relief required for a constraint.