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April 18, 2014

The Honorable Fred Upton, Chairman
U.S. House of Representatives
Committee on Energy and Commerce
2125 Rayburn House Office Building
Washington, DC 20515-6115

Dear Chairman Upton, Chairman Whitfield and Committee Members:

PJM appreciates the Committee's focus on performance of the electric grid during the recent January 2014 "Polar Vortex" event as well as the Committee's interest in obtaining information on affordability and reliability issues going forward as explained in your letter of March 26. PJM is the Regional Transmission Organization serving all or portions of Illinois, Indiana, Michigan, Ohio, Kentucky, Tennessee, West Virginia, North Carolina, Virginia, Maryland, Delaware, Pennsylvania, New Jersey and the District of Columbia (the "PJM region"). PJM stands ready to assist the Committee in its inquiry and below has provided responses based on the information we have available to date to the questions in your letter of March 26.

Although specific responses are set forth below, we believe it would be helpful, at the outset, to set forth in broad terms the conditions that have come to be known as the Polar Vortex. The Polar Vortex occurred between January 6 and January 10, 2014. Starting Tuesday, December 31, PJM's in-house meteorologist tracked the potential for extremely cold weather throughout the region beginning January 6, 2014. In the advance preparation for the cold weather, PJM utilized forecasts of demand on the system as well as forecasts of available generation in order to prepare for the cold weather and ensure adequate reserves to meet potential unprecedented winter demand. Specifically, PJM's models forecasted approximately 134,000 megawatts of load for the January 6 to 8 cold weather events. To proactively prepare, and to provide an appropriate cushion given the potential for weather conditions more severe than forecast, PJM utilized a conservative, but realistic, load forecast of 140,000 megawatts for purposes of PJM's operational planning for this period.¹

Following the Polar Vortex, a second series of winter storms hit the PJM region during the period January 20 through January 29, 2014. Although the conditions were different than the Polar Vortex, PJM used its experience from the Polar Vortex in preparing for operations during this second cold spell. We utilized conservative load forecasts and adjusted expected generator performance downward based on the conditions experienced during the Polar Vortex. Moreover, during both cold weather events, we undertook extensive advance communications to PJM stakeholders, state officials and messages to the public in order to ensure full information and awareness of the need for conservative operation and public conservation during these periods of unprecedented high demand.

¹ Kormos, Michael. Statement to the Federal Energy Regulatory Commission. Winter 2013-2014 *Operations and Market Performance in Regional Transmission Organizations and Independent Service Operators*. 4/01/2014. Available at <http://www.pjm.com/~media/documents/reports/20140331-testimony-of-michael-kormos-regarding-polar-vortex-ferc-20140401.ashx>; accessed 4/17/2014.

In order to discuss the specific events of January 2014, it is important to put these events in the context of other changes occurring in the industry as noted in your March 26 letter. The PJM region is experiencing a major shift in the type of fuel used by generators as the generation fleet becomes more dependent on natural gas as a fuel source. For the period 2011 to 2019, PJM is projecting about 25,000 megawatts of generation capacity to retire with 77 percent of the retirements being coal fired generators. To date, we have seen over 20,000 megawatts of new generation (mostly gas-fired) developed in the region and committed to meet our future capacity needs as well as over 15,000 megawatts of demand response and energy efficiency resources. Thus, the PJM region is embarking upon a major change in the age and types of generation providing electricity over a relatively short time period.

There is a current and projected paradigm shift in changing from coal to natural gas due to environmental restrictions and changing market dynamics. PJM would like to stress that the PJM market ensures that PJM procures and commits sufficient generation and demand response resources three years ahead of time. As a result, PJM has adequate reserves committed to meet the projected peak over the next three years. Nevertheless, PJM is experiencing a very high level of retirements of coal fired units and their replacement with natural gas. Notably, coal is projected to remain a significant fuel source within PJM counting for 33 percent of total resources in the PJM region through 2017. Nevertheless, the addition of more gas-fired resources as well as greater reliance on customer-driven demand response could well mean greater price volatility than has been seen previously. Moreover, due to this retirement of older units and reliance on demand response, PJM has lost much of the “cushion” that existed in the operation of the system and could well be calling on demand response more than in the past as we increasingly trigger “pre-emergency” and “emergency” conditions. Once again, although PJM can never guarantee that service interruptions will not occur in the PJM footprint, PJM will maintain adequate reserves to meet the projected load requirements past 2017. In short, PJM is meeting reliability objectives by deploying the resource portfolio mix that results from government policy directives at the state and federal level as well as the economics of competing resource options.

Figure 1: Map showing over 20 gigawatts of actual and announced deactivations 2011-2016 in the PJM region

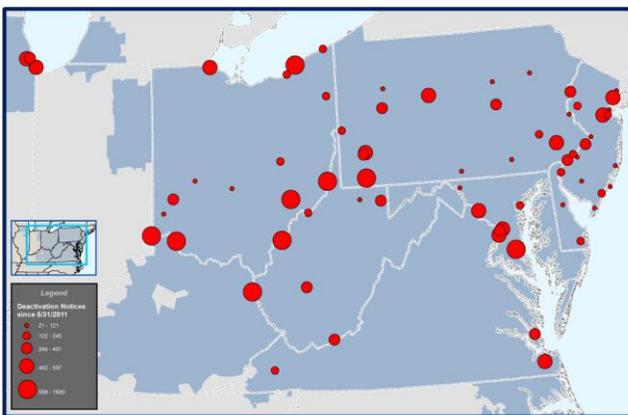




Figure 1 shows the actual and announced generator deactivations from 2011-2016. These resources are retiring largely due to existing and proposed environmental regulations and the changing market dynamics brought about by shale natural gas. PJM has provided in the attached document our responses to the Committee's specific questions. We remain committed to serving as a resource to the Committee and the Congress as a whole and are grateful for your continued interest in these important subjects.

Please feel free to contact me at 202-423-4743 or by e-mail at Craig.Glazer@PJM.COM should you have any questions or wish to discuss this issue further.

A handwritten signature in black ink, appearing to read 'Craig A. Glazer', written in a cursive style.

Craig A. Glazer

Vice President – Federal Government Policy
PJM Interconnection

Cc: Patrick Currier, Majority Staff
Greg Dotson, Minority Staff

PJM Response to Committee Questions of March 26 re: Polar Vortex

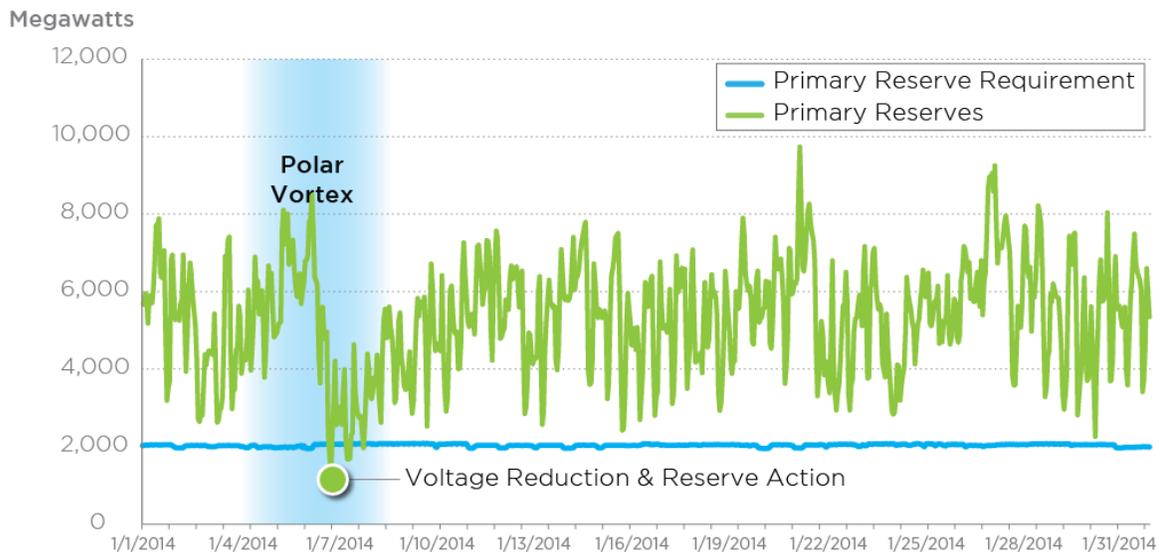
For this past winter season, please address the following relating to the PJM system:

a: Did PJM have sufficient operating reserves during the recent cold weather conditions?

PJM Response: Overall during this past winter heating season, PJM had sufficient Operating Reserves. During real-time operations, Primary Reserves (which are operating reserves available in real time) are the main focus. Primary Reserves are comprised of online generation with available capacity to convert to energy, interruptible Demand resources, and off line generation that can come on line and generate within ten minutes in response to a call from PJM dispatchers. PJM carries enough Primary Reserves to cover 150 percent of the largest generator on the PJM system. Maintaining these reserves provides access to energy supplies for the grid for unexpected events that requires additional power on short notice. Primary Reserves allow PJM to restore the generation/load balance after an unexpected generation loss. This is accomplished by directing online units with available capacity to increase output, directing interruptible Demand to disconnect from the grid, and, if necessary, to direct off line resources online.

During the Polar Vortex, there were three periods when PJM fell below the Primary Reserve requirement during real-time operations. This occurred due to the unusual number of generation units that were out of service and unavailable. PJM has established emergency procedures to address these temporary shortfalls. At no time was the PJM region near to an interruption of service to customers. Consistent with our emergency procedures, PJM issued a voltage reduction of 5 percent on January 6 and a Voltage Reduction Warning in response to the deficiency on January 7 and was prepared to implement another Voltage Reduction if necessary. (In fact, PJM did not need to issue a Voltage Reduction on January 7). In terms of customer impact, the five percent voltage reduction taken on January 6 was not noticeable by the average residential or business customer. However, this modest action from a customer viewpoint provides immediate relief to PJM to help re-establish system reserves in the form of a reduction in system load. This allows generators to reduce output providing additional capacity and thereby restoring the Primary Reserve total.

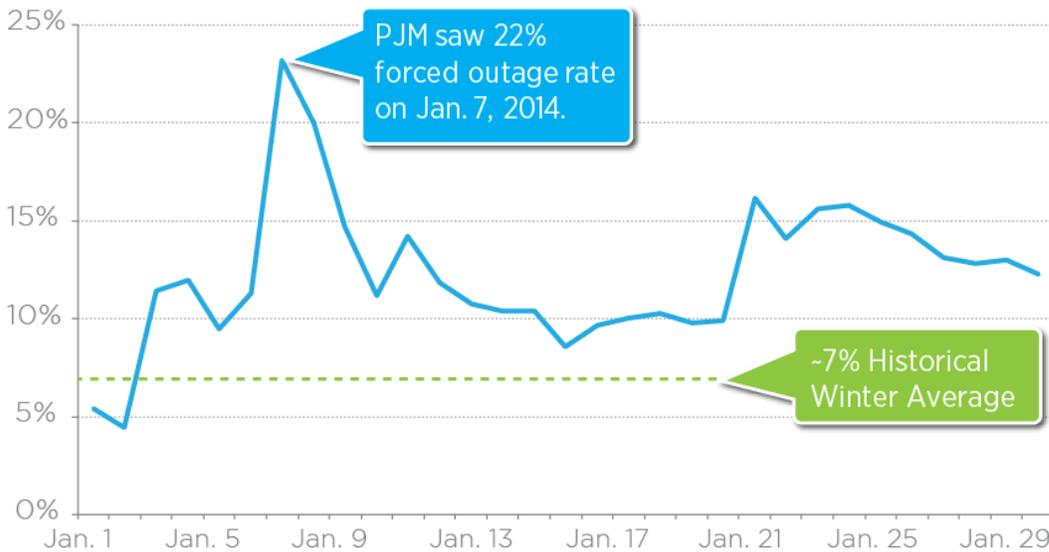
Figure 2: PJM Primary Reserve and Requirement in January 2014



b: Were there generating units contracted for capacity that failed to produce power when called upon during the recent cold weather events? If yes, please describe the type of generation source for each contracted unit that failed to produce power.

PJM Response: The amount of unavailable generation was unprecedented at the peak of January 7. The PJM region has not experienced temperatures this cold since the 1970s and 80s. Forced outage rates have not reached the levels experienced in January 2014 since January 1994 during the “Deep Freeze” event in which rotating blackouts were implemented for several hours.

Figure 3: January 2014 Unplanned Generation Unavailable in PJM



PJM operators witnessed a significant increase in the number of generation units that failed to produce power when called upon (known as a “forced outage”). All conventional forms of generation, including natural gas, coal and nuclear plants were challenged by the extreme conditions.

Figure 4: January 2014 Unplanned Generation Unavailable in PJM by Fuel Type

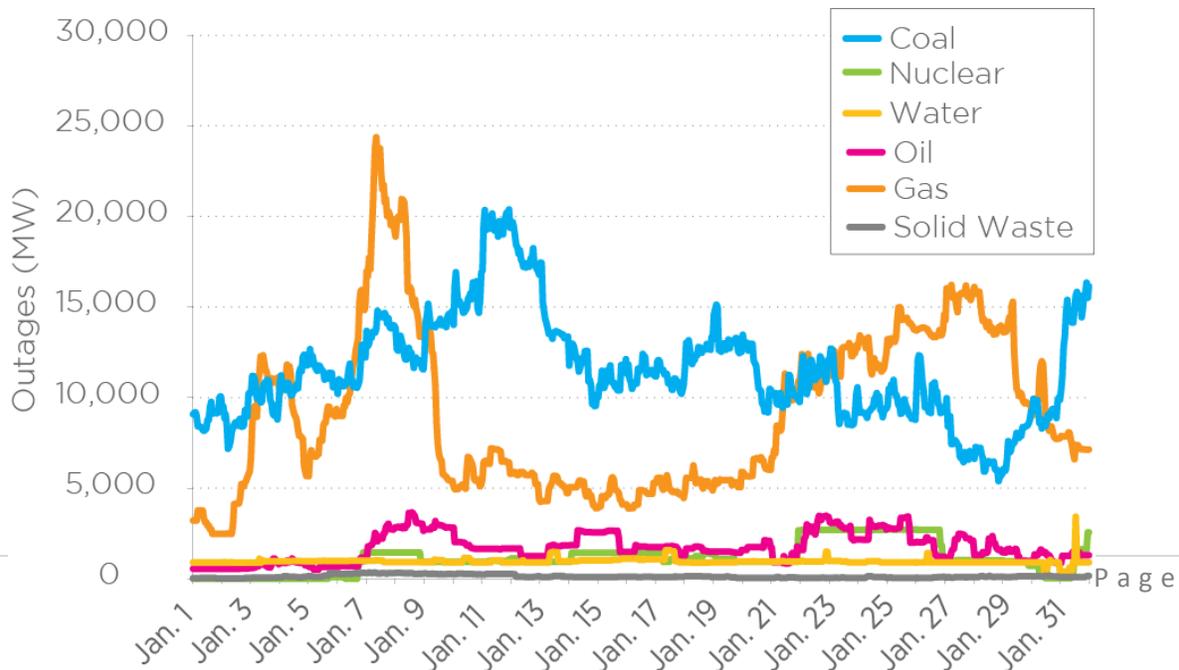


Figure 5: January 7, 7 p.m. Outage by Primary Fuel

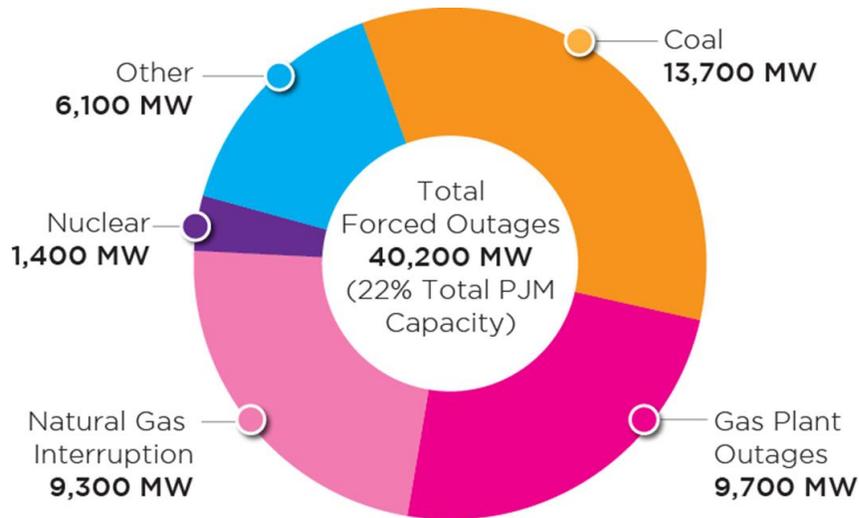


Figure 5 shows unavailable megawatt capacity by fuel type for 19:00 on January 7, 2014.

c. At any time did PJM rely on electricity imports from other systems in order to meet its own system energy needs, outside of normal operating conditions? If yes, please describe the magnitude and duration of such reliance, and any remedial actions.

PJM Response: PJM routinely imports and exports power to adjoining regions. These imports and exports occur throughout any given day and are largely driven by price differentials in market prices in the PJM region versus our neighboring regions.

PJM does have the ability to obtain emergency purchases from our neighbors. During the Polar Vortex, PJM did obtain emergency power from our neighboring regions on Tuesday January 7, 2014. Specifically, we made emergency purchases as follows:

- 600 Megawatts: 6:00 a.m. – 11:00 a.m., 5 hours duration, sourced from the New York Independent System Operator.
- 500 Megawatts: 6:00 a.m. – 9:00 a.m., 3 hours duration, sourced from Midcontinent Independent System Operator

PJM also relied on shared reserves as described in question 6 below.

d: Were there any periods of unplanned loss of load during this time? If yes, please describe the reason, scope, and duration of any unplanned loss of load.

PJM Response: No unplanned loss of load occurred. In the PJM region, no customers lost service as a result of any conditions on the Bulk Electric System.



e. Did PJM experience any generation outages or curtailments due to lack of fuel? If yes, please describe the reason, scope, and duration of any lack of fuel.

PJM Response: At the time of the peak demand hour on January 7, approximately 22 percent of total installed generation capacity in PJM (of all fuel types) was unavailable because of forced outages associated with routine equipment breakdowns, problems related to operating in extreme cold temperatures and, fuel-supply issues. Although there has been much focus on gas issues associated with interruptible transportation, overall the gas interruptions were not the major driver (figure 5 above) of the high forced outage rates experienced in the PJM region. Natural gas interruptions, although significant, removed less than five percent of the total capacity required to meet demand on January 7, while equipment issues associated with both coal and natural gas units made up the far greater proportion of forced outages.

f. Was PJM required to adjust generation commitment and/or dispatch due to the conditions on the natural gas system?

PJM Response: Yes, in some cases the generator commitments were required to be made by 9:30 a.m. EST before the natural gas day and therefore before the PJM Day-Ahead Market commitment. In some cases, PJM had to decide whether generators were needed without forward-looking information available on the price of natural gas or whether the generator would ultimately be able to procure natural gas with delivery to the plant. The opaque nature of the gas markets, particularly on weekends, forced many PJM generators to procure gas under terms and conditions which were inconsistent with PJM's requirement to dispatch based on economics and reliability.

During this period, we received authority from the Federal Energy Regulatory Commission to engage in confidential discussions with the natural gas pipelines serving PJM. Nevertheless, the opaque nature of the markets governing the purchase of natural gas commodity, particularly on weekends lead to significant price increases which will ultimately be passed through to customers depending on the particular regulatory regime in a given state.

Figure 6: Example of how PJM was required to adjust commitment due to the conditions on the natural gas system

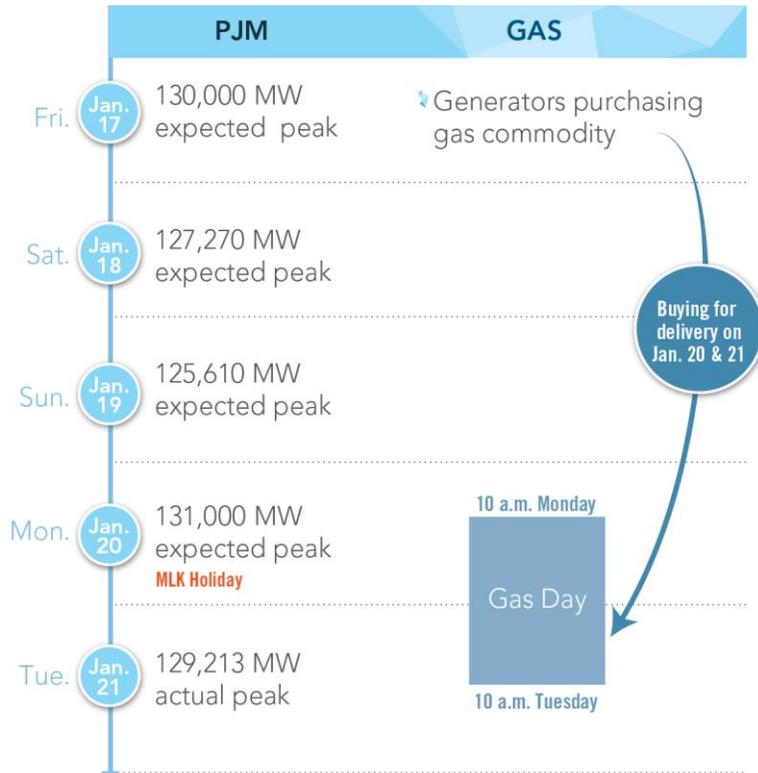


Figure 6 shows specifically the issues faced by PJM during the weekend of Jan. 17-20. Martin Luther King Jr. Day was a Monday and there was a concern on how much demand for electricity there would be for the Tuesday morning ramp up time. Generation owners told PJM that in order to ensure that they had natural gas on Tuesday, they needed to know on Friday if they would be needed for the Tuesday morning ramp-up.

2. For the PJM region this past winter season, what would have occurred in terms of reliability and affordability of electricity if coal-fired units, other fossil fuel-fired units, or nuclear power plants that have announced retirement had not been available?

PJM Response: Of the generators that are expected to retire before winter 2014/2015 less than half of the units were able to run and only half of their capacity was available at the peak on January 7. Although this is about 7000 megawatts that will not be available next winter, all of this capacity will be replaced by other resources.

Through the Reliability Pricing Model capacity auctions we have maintained not only required reserve margins but additional reserves. The committed resource mix including new generation, demand response, and additional imports are sufficient to preserve reliability. As we go through the transition, PJM will maintain reliability. Nevertheless, because less expensive coal generation is retiring and in part is being replaced by demand response or other potential high energy cost resources, excess generation will narrow and energy prices could become more volatile due to the increasing reliance on natural gas for electricity generation. As the generation fuel mix changes, the resources available to meet peak demands in extreme winter weather will be different.



PJM has procured adequate reserves for the next three years (and will continue to procure such supplies on a rolling year-by-year basis three years forward) and, in fact, has procured into 2017 approximately 5,000-8,000 megawatts more than our target reserve margin to address contingencies. As a result, the PJM region has adequate reserves to meet our forecasted needs through the next three years including 2016 when the US EPA MATS (United States Environmental Protection Agency Mercury & Air Toxics Standard) rule is scheduled to take effect. Although overall, we have procured adequate reserves to meet the projected demand, the mix of resources will change dramatically during this period. We are seeing a rapid “change out” of the generation fleet with a record number of coal plant retirements: approximately 12,000 megawatts in 2015/2016 alone and a total of more than 19,000 megawatts of coal retirements from 2011 to 2019. This kind of turnover of the generation fleet usually takes over a decade – yet we are seeing this turnover occurring over the next two to three years.

The PJM generation fleet profile will markedly change in this short time period. Coal will still play a large role in our overall resource fleet representing over 32 percent of the total generation mix in PJM. But our future reserves will be made-up of a great deal more demand response resources, natural gas generation, renewables and imports from other regions.

a. How many of these retiring units ran during the recent cold weather incidents? How many megawatts did these retiring units provide?

PJM Response: Despite being scheduled to retire sometime after this winter, 134 generators continued to operate at an output of about 7,000 megawatts (MW) during this peak time period. This represents roughly half of their installed capacity (“ICAP”) of 14,036 megawatts.

Figure 6: Retiring unit performance on January 7, 7 p.m.

Retiring Unit Performance for 1/7/2014	Unit Count	Units Online	% Units Online	ICAP MW	MW Output	% MW Output
RTO Units	134	58	43.30%	14,036	7,273	51.80%

b. Does PJM plan to replace capacity provided by the retiring units? If the replacement is expected to be natural gas units, is deliverability of natural gas an issue of concern in the PJM footprint?

PJM Response: PJM administers a forward capacity market called the Reliability Pricing Model (RPM). With RPM, PJM procures capacity on behalf of the load located in the PJM Region on a rolling three-year forward basis. The primary RPM procurements occur each May for a three-year forward delivery year - the most recent three-year forward RPM procurement occurred in May of 2013 for the 2016/2017 Delivery Year which begins on June 1, 2016 and ends on May 31, 2017. RPM utilizes a sloped demand curve that permits cost-effective procurement of capacity resources beyond the target Installed Reserve Margin (IRM) of approximately 116 percent of the forecasted PJM Peak load. Eligible capacity resources include Generation Capacity Resources, Demand Resources and Energy Efficiency Resources and can include both existing resources and planned resources. Capacity Resources offer their capacity into each RPM Auction at their cost to provide the capacity. The intersection of the capacity supply curve with the sloped demand curve determines the clearing price; the capacity resources that clear the RPM Auction have a commitment to provide the physical capacity that cleared during the auction delivery year with substantial penalties for failure to deliver.



While RPM has procured adequate reserves to meet the projected peak demand, the mix of resources has changed dramatically. There is a continuing trend of increasing capacity commitments by natural gas-fired generation resources and decreasing commitments by coal-fired generation resources. Nearly 10,000 megawatts of coal that offered into the 2016/2017 RPM Auction did not clear the auction and cleared capacity from gas-fired generation resources exceeded cleared capacity from coal-fired generation resources by over 15,000 megawatts.

Regarding the future natural gas transportation capability to meet the needs of the anticipated new natural gas units, PJM considers the natural gas transportation capability adequate to meet the needs of anticipated new generation; however, there are concerns with localized natural gas availability for generation during peak demand periods.

In order to further examine the adequacy of the natural gas infrastructure to meet the needs of the electric system, PJM is currently participating in an Eastern Interconnection Planning Collaborative (EIPC). The EIPC Gas-Electric System Interface Study will examine the future adequacy of gas pipeline infrastructure in PJM and other, neighboring control areas (Tennessee Valley Authority, New York Independent System Operator, ISO-New England, Midcontinent Independent System Operator and the Ontario Independent Electricity System Operator) over five and ten year time horizons. Preliminary results from that study, which deals with natural gas infrastructure capability, will be available this summer.

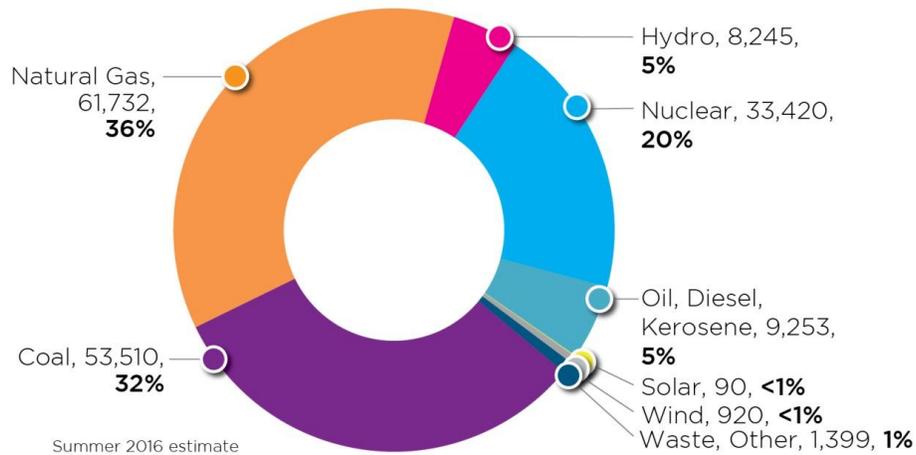
c. Has PJM performed any economic modeling to determine how many natural gas units are likely to be built to replace retiring capacity?

PJM Response: PJM does not specifically perform any economic modeling to determine how many natural gas units are likely to be built to replace retiring capacity. Capacity resources that clear in the RPM market and thus are committed to PJM face heavy penalties should they not be available to run when called upon. For this reason, many of these units supplement their natural gas supplies with on-site oil or kerosene as an alternative fuel. As a result, PJM is not depending solely on the natural gas pipeline system to ensure the availability of capacity resources. Those that do not have such alternative supplies either must procure alternative generation to meet their commitment or face significant penalties and continued future discounting of their resource in the capacity market to reflect failures to deliver during peak periods when called upon by PJM to be available to run.

d. Does PJM expect or have any firm commitments that new natural gas units will be constructed within the PJM footprint?

PJM Response: Yes, PJM forward capacity market has procured ever increasing amounts of gas (refer to response to 2B) and the majority of new generation in the queue is gas (see response to 2C). The PJM “queue” is the process by which PJM plans and tracks the building of resources, such as generation units. Historically, approximately 60 percent of projects entered into the queue are actually executed. Over 64 percent of new resources in our queue are proposed gas-fired generation. Improvements in the efficiency of combined-cycle generating plants, the availability of Marcellus and Utica shale right in our region as well as the impact of the EPA rules on coal generators clearly have driven the industry to invest in new gas-fired rather than coal-fired generation. (See response to question 2B for a discussion of “RPM,” PJM’s forward capacity market).

Figure 7: Fuel mix of future PJM installed capacity



e. Is there sufficient natural gas transportation capability available in the PJM footprint for anticipated new natural gas units?

PJM Response: In the short run, it is worth noting that the PJM region has always peaked in the summer time while gas pipelines universally experience peak loads in the winter. Although gas-fired generation and the need to replenish storage reserves have put greater strains on pipeline capacity in the summer months, the fundamentals of when peaks occur in the PJM region are not expected to change. Moreover, capacity resources in PJM have procured on-site back-up fuel to address any location-specific pipeline capacity issues. In the longer term regarding the future natural gas transportation capability to meet the needs of the anticipated new natural gas units: PJM is currently participating in an Eastern Interconnection Planning Collaborative (EIPC) study to determine just that. The EIPC Gas-Electric System Interface Study will determine the future adequacy of gas pipeline infrastructure in PJM and other, neighboring control areas (TVA, NYISO, ISO-NE, MISO and IESO) over 5 and 10 year time horizons. Preliminary results from that study, which deals with natural gas infrastructure capability, will be available this summer.

3. Please describe in detail how renewable energy resources performed when dispatched the cold weather conditions.

PJM Response: The following chart shows the performance of renewables during the Polar Vortex (at the 1/7/2014 19:00 peak). Normal performance of renewable energy resources was experienced during the recent cold weather operations, and the total amount of installed capacity (ICAP) is approximately eight percent of the installed PJM fleet.

Figure 8: Performance of Renewables on January 7, 7 p.m.

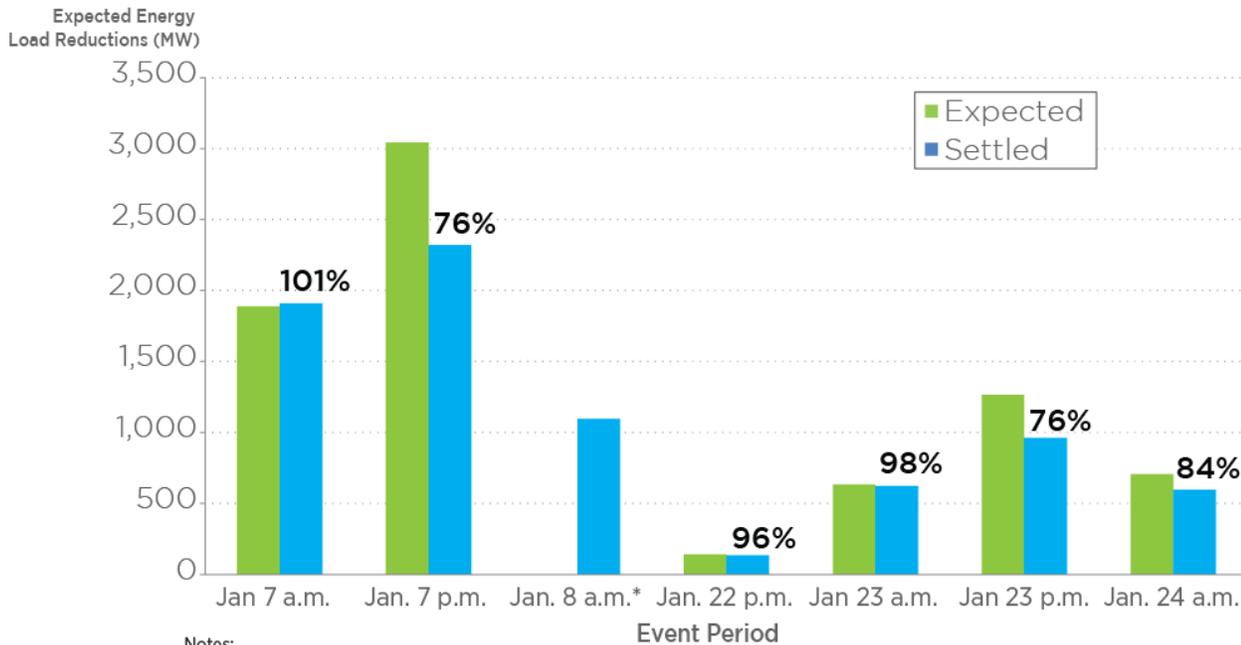
RENEWABLES	ICAP (MW)	Generation (MW)	Performance (Based on Installed Capacity)
Wind	6,633	1,516	22.90%
Hydro	8,304	4,000	48.20%
Other (Solar, Landfill, etc.)	288	120	41.80%



4. Please describe in detail how demand response performed during the cold weather conditions. Was demand response subject to compliance penalties?

PJM Response: PJM called for emergency DR resources on five days in January. Performance by Demand Response providers is, under current PJM rules, non-mandatory in January thus no compliance penalties are calculated. Performance was very good, varying from approximately 75 percent to a 100 percent of the expected values.

Figure 9: Cold Weather Voluntary Demand Response



- Notes:
1. DR events dispatched during non-compliance period.
 2. Expected Energy Load Reductions (MW) - CSP reported estimate based on current market rule.
 3. MW value is average hourly load reduction for non-ramp in hours.
 4. Event on Jan. 8 was cancelled prior to official start time. PJM allowed CSPs to settle if their load reduction had already started (or needed run for 2 hours).

5. Please describe in detail how distributed generation performed during the cold weather conditions.

PJM Response: Distributed generation is, by definition, generation behind the customer’s meter and thus not visible or dispatchable by PJM. As a result, PJM does not have information to determine the exact level of distributed generation performance during the January events and whether the start-up difficulties that PJM saw with the generation fleet connected to the bulk electric system also were experienced among distributed generation resources.

As a result, PJM’s information is more anecdotal on this point. One example of the use of distributed generation during this period, of which PJM is aware, is the performance of the distributed generation resources serving Princeton University for the period January 6 - January 8, 2014. Princeton University’s bid in the PJM day ahead and real-time energy markets in order that the University could participate in PJM’s Economic Load Response Program on those days. For these three days, Princeton has reported that its distributed generation facility was available around the clock, providing approximately 135 megawatts of energy reduction to PJM System via distributed generation serving campus load.

6. Please describe in detail how system conditions in neighboring Balancing Authorities affected PJM's operations during recent cold weather conditions.

PJM Response: Neighboring entities were impacted by the same extreme cold temperatures and generator forced outage rates in a similar manner to that experienced by PJM. This was particularly true during the evening of Monday January 6, 2014 and the morning of Tuesday January 7, 2014. During these periods, interchange imports to PJM were low. This caused PJM to rely on internal resources and during particular days to use emergency procedures such as Emergency Load Management (demand response) in order to meet PJM load.

PJM participates in two Shared Reserves groups but is not a member of either group. Reserve Sharing Groups allow entities to share reserves on a routine basis and deploy those reserves to recover from a system event such as loss of generation. The two Reserve Sharing groups are Northeast Power Coordinating Council (NPCC) and the Virginia-Carolinas (VACAR). PJM supplied Shared Reserves when declared by those groups and also requested Shared Reserves to help recover from the loss of internal PJM generation during the winter season. Below are the times when PJM proved Shared Reserves to neighbors.

- Monday January 6, 2014: 9:15 p.m. – 9:56 p.m., 163 megawatts with Northeast Power Coordinating Council
- Tuesday January 7, 2014: 6:27 a.m. – 7:30 a.m., 200 megawatts with Virginia Carolinas (VACAR)
- Tuesday January 7, 2014: 08:45 a.m. – 9:28 p.m., 200 megawatts with Virginia Carolinas (VACAR)
- Monday, January 6, 8:49 a.m. – 10:35 a.m., PJM also delivered 200 megawatts of emergency energy to Duke Energy Progress.

PJM had to recall the 200 megawatts Shared Reserve obligations to VACAR on Tuesday January 7, 2014 due to internal reserve shortages. Once reserves were restored, PJM offered and reactivated the 200 megawatts Shared Reserve flow to VACAR.

PJM requested and were provided Shared Reserves on the following occasions:

- Monday January 6, 2014: 5:01 p.m. – 5:15 p.m., 775 megawatts from Northeast Power Coordinating Council to PJM
- Monday January 6, 2014: 11:20 p.m. – 11:34 p.m., 800 megawatts from Northeast Power Coordinating Council to PJM

These occasions represent where PJM relied on electricity imports from other systems to meet its own energy needs, outside of normal operations. Once PJM requested Shared Reserves as noted in the last two bullets above, we implemented Emergency Procedures and committed internal generation to meet internal load obligations. Shared Reserves were cancelled once PJM was able to restore the generation/load balance with internal resources and market priced imports.