At the April 9, 2015 PC meeting, a RRS Assumptions Letter was made available with the meeting material. Contained within the Letter, specifically Attachment II, is the following:

> 5. Planned outages of generating units will be represented throughout the summer period. This is done to reflect operating experience related to a reduction of generating capability due to extreme ambient temperatures that would not be captured otherwise.

Question 1: Please tell us how much capacity (MWs) is modeled out in the summer.

Response 1: We currently remove 2,500 MW RTO-wide to account for reductions of generating capability due to extreme ambient temperatures.

Posted with the meeting material for the October 8, 2015 PC meeting is a file titled 2015 IRM Study Results. Contained within this file is the following (page 3):

- Implementation of Capacity Performance rules alone should not result in a lower IRM
  - IRM Studies have always assumed that generators will perform at CP standards

Question 2: Please tell us how note 5 from the RRS Assumption Letter (see above) comports with the comment made in the 2015 IRM Study Results? Specifically, it is our understanding that in CP resources are required to be available at all times which would include any hours of "extreme ambient temperatures". Therefore, we are seeking an explanation for why there is a continued adjustment to "[p]lanned outages of generating units…throughout the summer period" if the generators are assumed to "perform at CP standards."

Response 2:

Under CP, ambient deratings will continue to not be captured as an outage in GADS or to be reflected in a unit's EFORd. PJM believes, therefore, it is important to continue to recognize this risk through the ambient derating assumption in the IRM Study. The threat of steeper penalties under CP may not induce generators to mitigate the performance impact of ambient deratings. The CP penalties are incurred only if a unit fails to output its UCAP rating (not its ICAP rating) under emergency conditions. For the vast majority of PJM units, the unit EFORd is much greater than the 2-3% ambient derating it may experience under extreme summer conditions. Therefore, assuming a unit is not on an outage of any kind, it will be extremely likely for the unit to be able to produce its UCAP (even if it is experiencing an ambient derating) and to avoid a performance penalty.

Posted with the meeting material for the October 8, 2015 PC meeting is a file titled 2015 IRM Study Results. Contained within this file is the following (page 2):

- GADS data based on 2010-2014 time period.
- PJM and World load models based on 2003-2012 time period and 2015 PJM Load Forecast.

Question 3: Please explain the rationale for relying on the most recent 5 years of GADS data (2010-2014) but a different time frame and number of years (2003-2012, 10 years) for load models?

Response 3: In the capacity model case, we use the most recent 5 years of GADS data because we believe that such a period allows us to estimate individual UCAP values for the units in the IRM case that are more representative of the current UCAP valuation of the same units in RPM (which is based on only

one year of data). On the other hand, the load model time period is chosen based on how well the resulting load model matches the uncertainty modeled in the PJM Load Forecast's CP1 distribution. PJM has not detected a correlation between generator EFORd's and the load profile over a full Delivery Year so we do not believe it is critical that the load and capacity models be coincident. Use of different time periods to build capacity and load models seems to be a common practice in the industry. Most areas that run the GEMARS model, for example, use a load model based on 2002 but the most recent GADS data.

Question 4: Has PJM performed an IRM and a CBOT study if the GADS data and load models used the same set of data under the following scenarios, and if so, what were the resulting IRMs?:

- 2010-2014 (5 most recent years in line with the GADS data)
- 2003-2012 (10 years of data in line with load model data)
- 2005-2014 (10 years, most recent data for both GADS and load model data)

Response 4: Unfortunately, we cannot make the first and third suggested runs since we currently do not have hourly load data for the World areas for delivery year 2014 (delivery year 2014 includes the January-May period in 2015 and 2015 World load data is not yet available).
The second suggested run produces an average EFORd of 6.2% (compared to 6.6%) and an IRM of 16% (compared to 16.5%). However, the FPR remains at 1.0881.

Question 5: Please explain why years 2013 and 2014 were not used in the load model data as described above?

Response 5: PRISM, the tool that PJM uses to compute the IRM/FPR, allows us to model load uncertainty via a collection of 52 normal distributions (one for each week of the year under study). The PJM Load Forecast, on the other hand, produces 260 discrete daily distributions (one for each weekday of the year under study). Since the distributions in the PJM Load Forecast are discrete (not normal) and daily (not weekly), we cannot input them directly into PRISM. In 2009, the PC approved a PRISM Load Selection methodology that evaluates several PRISM load model candidates to check how well each one matches the daily annual peak distribution from the PJM Load Forecast and then selects the one that is the best match (more details on the methodology can be found on the slides presented at the April 2015 PC Meeting here: http://www.pjm.com/~/media/committees-groups/committees/pc/20150709/20150709-item-06-load-model-selection-for-2015-irm-study.ashx).

The above methodology does not specifically take into account the vintage of the selected Load Model (only in the case of a tie between several load model candidates, PJM would select the most recent one).

It must be noted though that the reason 2013 and 2014 were not included in the load model selected this year was that we did not have World hourly load data for those two full delivery years. Thus, there were no load model candidates that included these years in the load model selection process described in the April 2015 PC Meeting slides above.

Question 6: Has PJM conducted a study to determine how much the over forecasting of PJM's models has affected the need to increase the percentage of reserve margin?

Response 6: The impact of the PJM Load Forecast on the IRM is limited to the load model selection step mentioned in the previous answer. Therefore, from an IRM perspective, the only relevant aspect from

the PJM Load Forecast is the distribution around the 50/50 load (on per-unitized terms) but not the actual 50/50 MW load.

We performed a sensitivity analysis this year by using the preliminary daily peak distribution under the new, proposed load forecast specification to select a PRISM load model. The resulting selected PRISM load model was built with data from 2004-2011, instead of 2003-2012, yet the computed IRM (16.6%) was about the same as the one we are recommending this year (16.5%).

It must be noted though that, despite the load model selection process mentioned above, PRISM Load Models tend to underestimate the uncertainty modeled in the PJM Load Forecast.

Question 7: Has PJM determined how much PJM model forecast error has contributed to the reserve margin requirements over the last 5 years?

Response 7: The reserve margin requirement is computed as (1+IRM) * 50/50 Forecast (while the amount of capacity procured in RPM is FPR*50/50 Forecast). Therefore, if the PJM Load Forecast error is X% then the PJM reserve requirement error can be estimated as (1+IRM)*X%.

Question 8: Has PJM estimated how much Demand Response/Reduction and Energy Efficiency/Expanded Solar production will reduce the need for expanded reserve margins in future years?

Response 8: PJM is currently developing a new load forecast specification that will account for energy efficiency improvements and expanded solar production. This new specification produces a 2.5%-3% reduction (assuming no EE offers into RPM) with respect to the current forecast specification and will result in a reserve requirement reduction of about (1+IRM)*(2.5%-3%) (if no EE offers into RPM).

Question 9: Can PJM provide sensitivity studies and confidence intervals surrounding the last 5 years of reserve margin requirements?

Response 9: Please see the Sensitivity section in each of the following RRS Reports:
http://www.pjm.com/~/media/planning/res-adeq/2014-pjm-reserve-requirement-study.ashx (Page72)
http://www.pjm.com/~/media/planning/res-adeq/2013-pjm-reserve-requirement-study.ashx (Page 64)
http://www.pjm.com/~/media/planning/res-adeq/2012-pjm-reserve-requirement-study.ashx (Page 67)
http://www.pjm.com/~/media/planning/res-adeq/2011-rrs-study.ashx (Page 71)
http://www.pjm.com/~/media/documents/reports/2010-pjm-reserve-requirement-study.ashx (Page 70)

We have not computed IRM confidence intervals but the above sensitivities provide a good sense of the magnitude and direction of changes in the IRM in response to a variety of factors.

Question 10: Has PJM quantified how Capacity Performance penalties strictly enforced would impact on the need to increase the PJM percentage of reserve margin?

Response 10: We have not quantified that impact. However, our IRM model has always assumed that forced outages are random; our model has not and does not account for common-mode outages or outages that are weather-driven. In general, CP penalties have the potential to reduce the forced

outage rates of units and consequently, reduce the IRM. Nevertheless, such a reduction in forced outages will not impact the FPR, which is the key input to compute the reliability requirement in RPM.

Question 11: Has PJM performed any back testing using this year's model to see if it would have solved the problem of persistent peak over-forecasting?

Response 11: PJM is in the final stages in the development of a new load model forecast specification that addresses the over-forecasting in previous years.