



Update on Winter Season Resource Adequacy Analysis

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Winter Season Resource Adequacy and Capacity Requirements

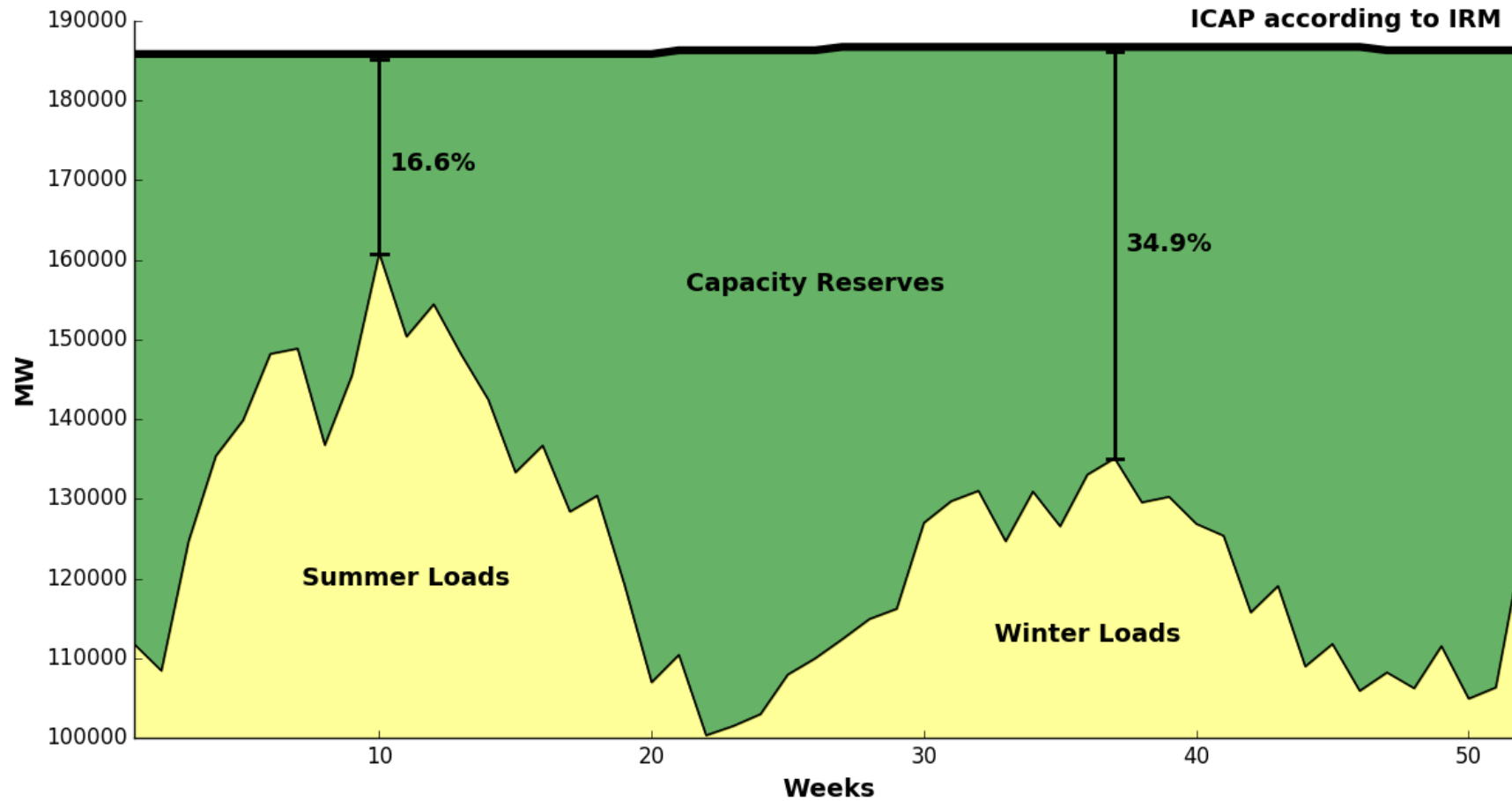
Issue Charge is posted at:

<http://www.pjm.com/~media/committees-groups/committees/mrc/20161117/20161117-item-09-winter-reliability-requirement-ps-ic-clean.ashx>

The Issue Charge has three Key Work Activities

- Winter peak load forecasting (work in progress)
- Winter season resource adequacy (reviewed at July PC meeting)
- **Winter season reliability requirements (under various seasonal risk allocations)**

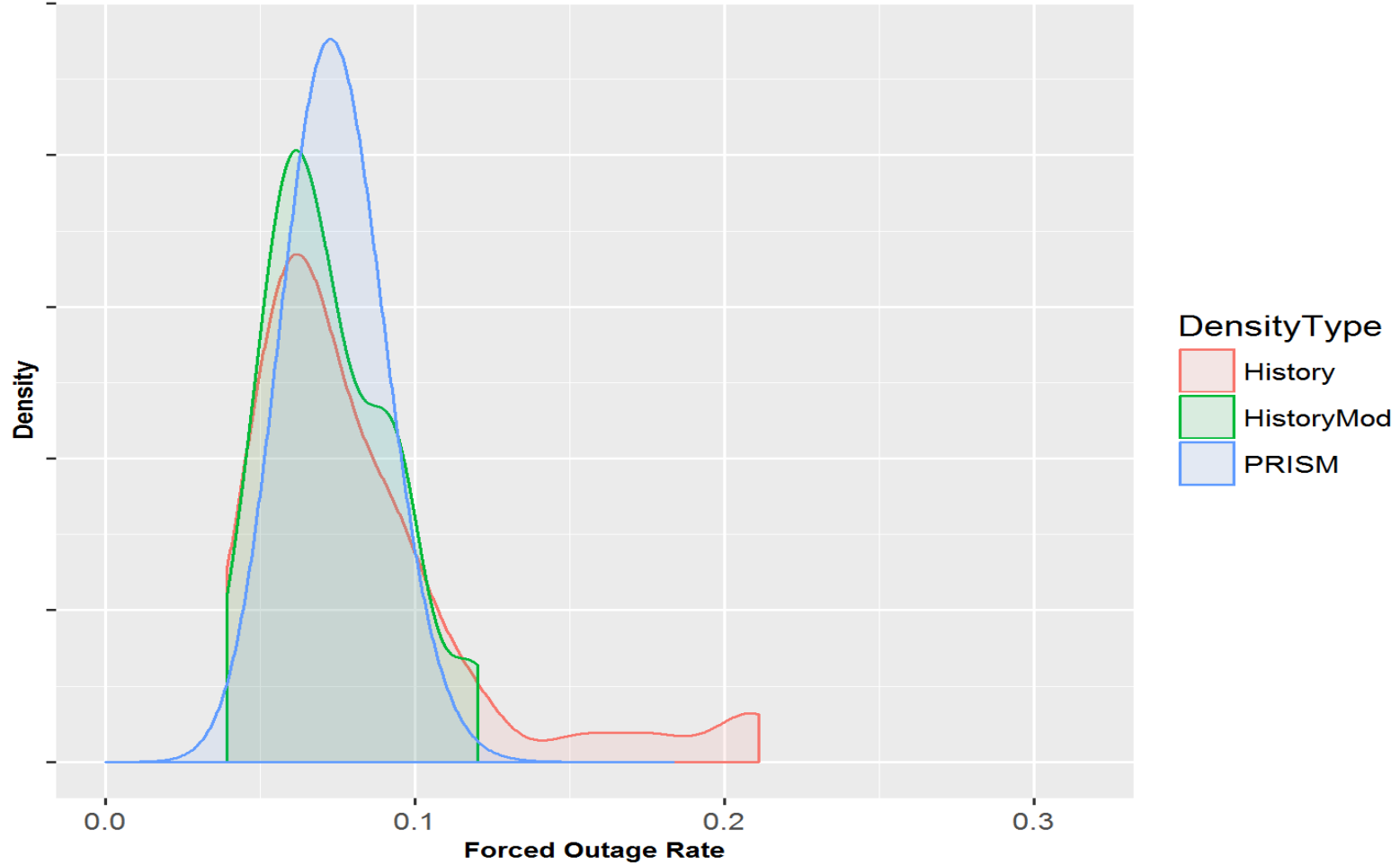
PJM Weekly Installed Capacity (ICAP) Reserves

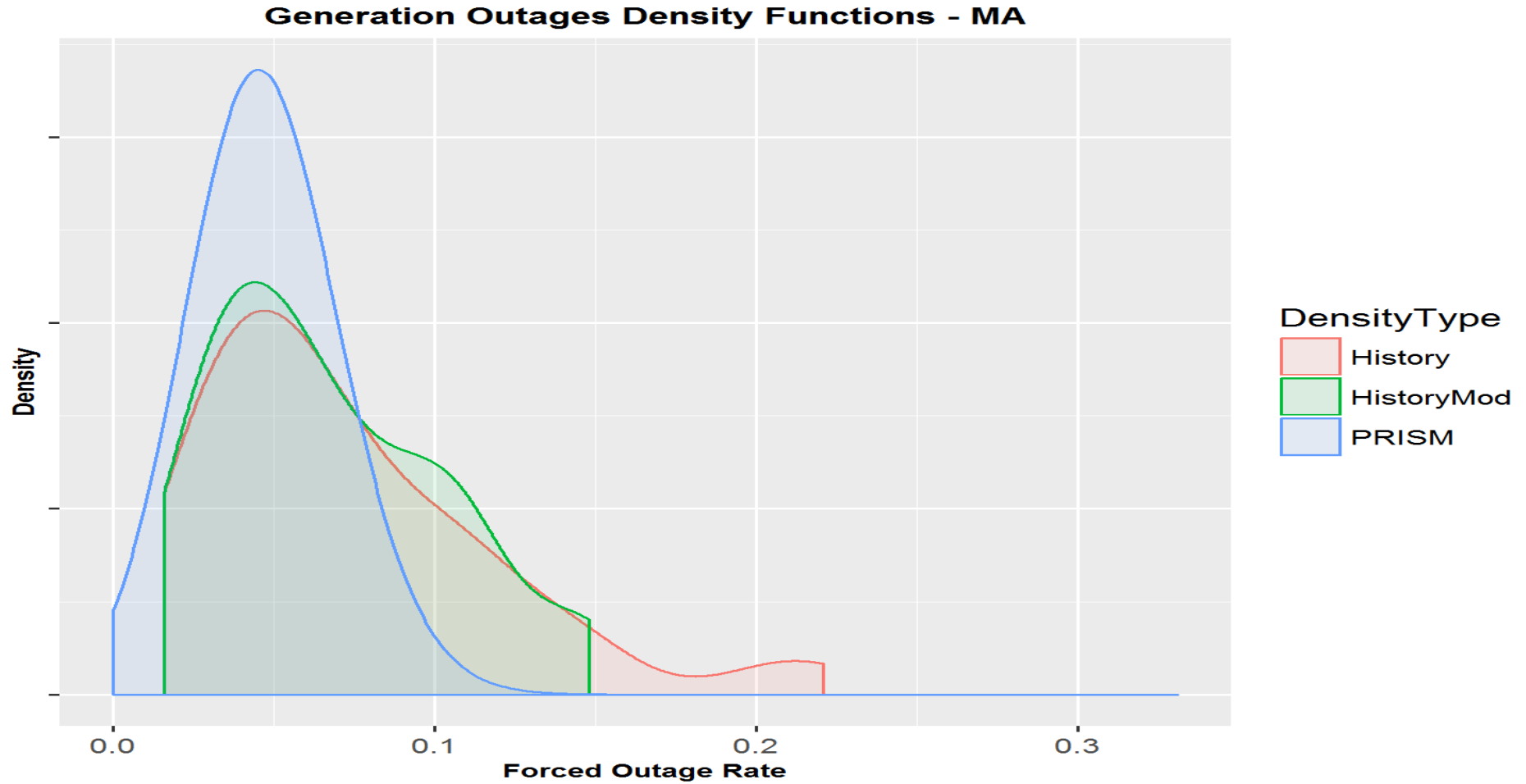


Description of Curves Plotted on Slides 5 and 6

- **PRISM Curve** - Based on individual unit EFORd's that are assumed to be mutually independent.
- **History Curve** – Based on system-wide forced outages from the five weekdays of the peak load week of each of the winters over the 9-yr period (DY2007/08-DY2015/16). (45 data points.)
- **History Mod Curve** – Same as History Curve but removes Winter 2014/15 peak week data (first polar vortex) and replaces it with Winter 2015/16 peak week data (second polar vortex).

Generation Outages Density Functions - PJM

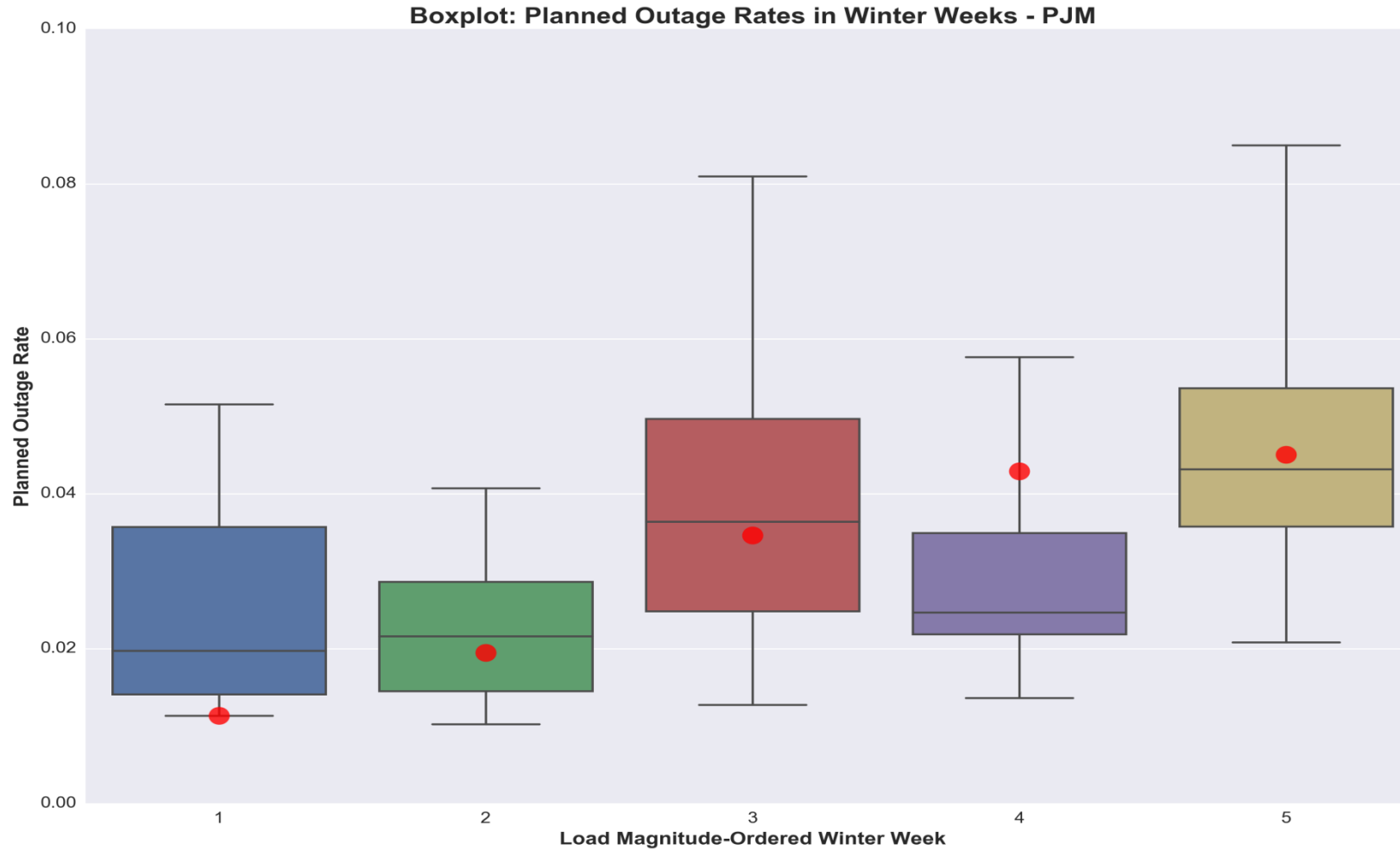




Description of Data Plotted on Slide 8

- Planned Outages are observed values from the five weekdays of each week in each winter over the 9-yr period (DY2007/08-DY2015/16). The winter weeks are combined based on load magnitude, not calendar order.
- The box plot shows the range of historical planned outage rates on each of the top five load weeks of the winter.
- The red dots are the planned outage rates modeled by PRISM in each of the top five load weeks of the winter.

PJM - Planned Outages (Top Five Winter Weeks)



- Historical Forced Outages & Mean Historical Planned Outages
 - Winter peak forced and maintenance outages are based on observed values from the five weekdays of the peak load week of each of the winters over the 9-yr period (DY2007/08 – DY2015/16). (45 data points.)
 - Winter peak planned outages are the observed values from the five weekdays of each winter peak week over the 9-yr period (DY2007/08 – DY2015/16).
 - Specifically, the mean of the historical values is calculated and assumed to be the amount of planned outages in the peak winter week. Planned outages in all other weeks are based on PRISM.

The table below shows the summer and winter reliability requirements for the RTO and for three LDAs. The requirements are shown under four different allocations of LOLE risk between the summer and winter seasons.

The analysis includes generator performance data from both the 2014 and 2015 Polar Vortex events.

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq
		RTO	167393	0	0	433	-2	913	-1203
MAAC	66385	0	0	190	-2727	410	-3957	660	-3957
EMAAC	36921	0	-2639	120	-4439	270	-4639	460	-5039
SWMAAC	15486	0	0	40	-698	90	-918	150	-1068

All numbers are in UCAP MW

Observation: The RTO winter requirement must be equal to the RTO summer requirement to satisfy the “1 in 10” LOLE criterion under both the 100/0 and 90/10 seasonal risk allocations.

The table below shows the summer and winter reliability requirements for the RTO and for three LDAs. The requirements are shown under four different allocations of LOLE risk between the summer and winter seasons.

The analysis replaces generator performance data from the 2014 Polar Vortex event with data from the 2015 Polar Vortex event.

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq
		RTO	167393	0	0	433	-9202	913	-11798
MAAC	66385	0	-3767	190	-6617	410	-7457	660	-7807
EMAAC	36921	0	-4209	120	-6019	270	-6359	460	-6619
SWMAAC	15486	0	0	40	-698	90	-928	150	-1068

All numbers are in UCAP MW

Observation: The RTO winter requirement must be equal to the RTO summer requirement to satisfy the “1 in 10” LOLE criterion under the 100/0 seasonal risk allocation. If the RTO summer requirement is increased by 433 MW, the RTO winter requirement could be reduced by 9,202 MW (90/10 Risk Allocation).

- Forced outages are modeled as in Scenario 3.
- No Planned Outages are scheduled in the peak winter week. Planned outages in rest of weeks is based on PRISM (adjusted for the planned outages removed from the peak winter week).
- The analysis includes generator performance data from both the 2014 and 2015 Polar Vortex events.

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
	Annual	Delta Summer	Delta Winter	Delta Summer	Delta Winter	Delta Summer	Delta Winter	Delta Summer	Delta Winter
Zone	RelReq	RelReq	RelReq	RelReq	RelReq	RelReq	RelReq	RelReq	RelReq
RTO	167393	0	0	433	-4164	913	-4953	1461	-7846
MAAC	66385	0	-277	200	-3947	420	-5167	660	-5167
EMAAC	36921	0	-3289	120	-5089	270	-5399	460	-5689
SWMAAC	15486	0	-318	40	-1248	90	-1408	150	-1538

Same as Scenario 5 except it replaces generator performance data from the 2014 Polar Vortex event with data from the 2015 Polar Vortex event.

Zone	Annual RelReq	100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
		Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq	Delta Summer RelReq	Delta Winter RelReq
RTO	167393	0	-3472	433	-13538	913	-15066	1461	-16172
MAAC	66385	0	-5727	200	-8407	420	-9367	660	-9477
EMAAC	36921	0	-5319	120	-7109	270	-7289	460	-7559
SWMAAC	15486	0	-328	40	-1258	90	-1418	150	-1558

- Review summer and winter reliability requirements with the PC on 8/10.
- Continue to evaluate operational risks in winter such as increasing penetration of gas generation.
- Continue to investigate winter load forecast model.
- Deliverables to the MRC
 - September - October meetings