Winter Season Resource Adequacy Analysis

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August 4, 2017

Introduction

- Reliability requirements for the RTO and LDAs are calculated based on scenarios and LOLE allocations described in the following slides.
- Results for Scenario 1 are not included because PRISM's forced outage independence assumption is not realistic under winter peak load conditions.

Scenario 2

- Historical Forced Outages & PRISM Planned Outages
  - Winter peak Forced Outages are observed values from the five weekdays of the peak load week of each of the winters over the 9-yr period (DY07-DY15). (45 data points.)
  - Available capacity cumulative distribution is developed by assuming that each of the 45 observations is equally likely to happen. Lumpiness of cumulative distribution is addressed by using linear interpolation
  - Planned Outages are scheduled by PRISM.

Scenario 3

- Historical Forced Outages & Mean Historical Planned Outages
  - Winter peak forced outages and available capacity cumulative distribution are as per Scenario 2.
  - Winter peak Planned Outages are observed values from the five weekdays of each winter peak week over the 9-yr period (DY07-DY15)
    - 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 rest of weeks is based on PRISM.

Scenario 4

- Historical Forced Outages & Max Historical Planned Outages
  - Winter peak forced outages and available capacity cumulative distribution are as per Scenarios 2 and 3.
  - Winter peak Planned Outages are observed values from the five weekdays of each winter peak week over the 9-yr period (DY07-DY15)
    - Specifically, the maximum of the historical values is calculated and assumed to be the amount of Planned Outages in the peak winter week. Planned outages in rest of weeks is based on PRISM.

Scenario 5

- Historical Forced Outages & No Planned Outages on Peak Winter week
  - Forced outages and available capacity cumulative distribution are as per Scenarios 2, 3 and 4.
  - 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).

Scenario 6

- Historical Forced Outages & No Planned Outages in January (peak winter month)
  - Forced outages and available capacity cumulative distribution are as per Scenarios 2, 3, 4 and 5.
  - No Planned Outages are scheduled in the entire month of January (peak winter month). Planned outages in rest of weeks is based on PRISM (adjusted for the planned outages removed from the peak winter month).

Alternative Scenario (Version ‘A’ of each previous scenario)

- A variation of the Historical scenarios is also included. The variation removes Winter 14/15 peak week data (first polar vortex) and replaces it with Winter 15/16 peak week data (second polar vortex).

Summer and Winter Reliability Requirements

- Assumptions
  - Summer is defined as Jun – October plus May from next calendar year. Winter comprises the rest of the months
  - Planned and Forced Outages in accordance with each scenario are only considered for the Winter peak week (rest of 51 weeks use PRISM assumptions)
  - RTO case is based on 2016 RRS for 2020 DY
  - LDA cases are based on 2020 BRA CETO runs

Summer and Winter Reliability Requirements

- Assumptions
  - The RTO's LOLE allocation between Summer and Winter is made according to the table below

Summer LOLE Share (%)	Winter LOLE Share (%)	Summer LOLE (days/year)	Winter LOLE (days/year)	Total Annual LOLE (days/year)
100	0	0.10	0.0001	0.1001
90	10	0.09	0.01	0.1
80	20	0.08	0.02	0.1
70	30	0.07	0.03	0.1

  - The LDAs' LOLE allocation between Summer and Winter is made according to the table below

Summer LOLE Share (%)	Winter LOLE Share (%)	Summer LOLE (days/year)	Winter LOLE (days/year)	Total Annual LOLE (days/year)
100	0	0.04	0.0001	0.0401
90	10	0.036	0.004	0.04
80	20	0.032	0.008	0.04
70	30	0.028	0.012	0.04

Summer and Winter Reliability Requirements

- Methodology
  - Cases are created according to planned and forced outages assumptions dictated by the scenario under consideration
  - For the RTO, the Summer reliability requirement (Summer IRM) is calculated so that Summer LOLE meets the targeted Summer LOLE allocation (0.1 under the 100/0 allocation, 0.09 under the 90/10 allocation, etc)
    - Winter reliability requirement is calculated by subtracting UCAP from the Summer Reliability Requirement until the Winter LOLE meets the targeted Winter LOLE allocation (0.0001 under the 100/0 allocation, 0.01 under the 90/10 allocation, etc)

Summer and Winter Reliability Requirements

- Methodology
  - For LDAs, the Summer reliability requirement (based on the Summer CETO) is calculated so that Summer LOLE meets the targeted Summer LOLE allocation (0.04 under the 100/0 allocation, 0.036 under the 90/10 allocation, etc)
    - Winter reliability requirement is calculated by subtracting UCAP from the Summer Reliability Requirement (effectively, by reducing the Summer CETO) until the Winter LOLE meets the targeted Winter LOLE allocation (0.0001 under the 100/0 allocation, 0.004 under the 90/10 allocation, etc)

Summer and Winter Reliability Requirements

- Additional information
  - A zero in a “Delta Winter RelReq” column means that the Annual reliability requirement cannot be decreased (because the Summer LOLE plus Winter LOLE is greater than the LOLE criterion)
  - Results for some scenarios for some LDAs are identical, namely:
    - Scenario 2 and Scenario 5 for SWMAAC because PRISM schedules no planned outages on the winter peak week (also Scenarios 2A and 5A for SWMAAC)
    - Scenario 2 and Scenario 3 for MAAC and EMAAC because PRISM schedules an amount of planned outages during the winter peak week that is similar to the respective mean historical value (also Scenarios 2A and 3A for MAAC and EMAAC)

Summer and Winter Reliability Requirements

- Results – Scenario 2

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-2251	913	-3078	1461	-5981
MAAC	66385	0	0	190	-2737	410	-3957	660	-3957
EMAAC	36921	0	-2639	120	-4439	270	-4749	460	-5049
SWMAAC	15486	0	-318	40	-1248	90	-1408	150	-1538

Summer and Winter Reliability Requirements

- Results – Scenario 2A

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	-1674	433	-11980	913	-13942	1461	-14990
MAAC	66385	0	-4407	190	-7187	410	-8077	660	-8347
EMAAC	36921	0	-4629	120	-6429	270	-6819	460	-7029
SWMAAC	15486	0	-328	40	-1258	90	-1418	150	-1558

Summer and Winter Reliability Requirements

- Results – Scenario 3

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-463	913	-1328	1461	-4251
MAAC	66385	0	0	190	-2737	410	-3957	660	-3957
EMAAC	36921	0	-2639	120	-4439	270	-4749	460	-5049
SWMAAC	15486	0	0	40	-898	90	-1068	150	-1218

Summer and Winter Reliability Requirements

- Results – Scenario 3A

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-10692	913	-12961	1461	-13701
MAAC	66385	0	-4407	190	-7187	410	-8077	660	-8347
EMAAC	36921	0	-4629	120	-6429	270	-6819	460	-7029
SWMAAC	15486	0	0	40	-908	90	-1098	150	-1228

Summer and Winter Reliability Requirements

- Results – Scenario 4

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	0	913	0	1461	-338
MAAC	66385	0	0	200	-1217	420	-2437	660	-2437
EMAAC	36921	0	-1909	120	-3709	270	-3989	460	-4309
SWMAAC	15486	0	0	40	-348	90	-548	150	-688

Summer and Winter Reliability Requirements

- Results – Scenario 4A

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-7548	913	-9212	1461	-10461
MAAC	66385	0	-2747	200	-5557	420	-6447	660	-6777
EMAAC	36921	0	-3839	120	-5639	270	-6009	460	-6239
SWMAAC	15486	0	0	40	-348	90	-588	150	-698

Summer and Winter Reliability Requirements

- Results – Scenario 5

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
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

Summer and Winter Reliability Requirements

- Results – Scenario 5A

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
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

Summer and Winter Reliability Requirements

- Results – Scenario 6

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-4164	913	-4953	1461	-7846
MAAC	66385	0	-277	200	-3947	420	-5167	670	-5167
EMAAC	36921	0	-3289	120	-5089	270	-5399	460	-5689
SWMAAC	15486	0	-318	50	-1198	90	-1358	150	-1488

Summer and Winter Reliability Requirements

- Results – Scenario 6A

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	-3905	433	-14057	913	-15624	1461	-16653
MAAC	66385	0	-5727	200	-8357	420	-9147	670	-9387
EMAAC	36921	0	-5319	120	-7089	270	-7269	460	-7539
SWMAAC	15486	0	-328	50	-1218	90	-1368	150	-1498

Sensitivity – Maintenance Outages

- Scenarios 2-6 and 2A-6A do not include the impact of Maintenance Outages on the peak winter week
- To capture their impact, historical observed Maintenance Outages were treated as additional Forced Outages
  - In general, Maintenance Outages are difficult to predict and can't be postponed beyond a few days
- Reliability requirements under Scenarios 3 and 3A were recalculated to capture the impact of historical observed winter peak week Maintenance Outages

Sensitivity – Maintenance Outages

- Results – Scenario 3 with Winter Peak Week Historical Maintenance Outages

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-2	913	-1203	1461	-4193
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

Sensitivity – Maintenance Outages

- Results – Scenario 3A with Winter Peak Week Historical Maintenance Outages

		100 / 0 Allocation		90 / 10 Allocation		80 / 20 Allocation		70 / 30 Allocation	
Zone	Annual RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)	Delta Summer RelReq (MW UCAP)	Delta Winter RelReq (MW UCAP)
RTO	167393	0	0	433	-9202	913	-11798	1461	-12365
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