Discussion of RRS Assumptions

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02/23/2016

Assumptions to be discussed

- Capacity Model: Ambient Derates
  - Total amount in MW
  - Capacity Performance Impact

Capacity Model: Ambient Derates

- Current Practice: 2500 MW worth of ambient derates are modeled in the RRS
  - Ambient derates are not recorded in GADS; therefore, they are not captured in the EFORd metric.
  - Modeled via units on maintenance during the peak summer period
- Background
  - To estimate the MW amount of ambient derates that we should model in the RRS, we decided to analyze the Summer Verification Test data. This approach is cleaner than comparing GADS data with operations/markets historical data.

Capacity Model: Ambient Derates

- Background
  - The Verification Test is performed once every summer for each PJM Capacity Resource
  - Each PJM Capacity Resource is rated based on ambient conditions (temperature) at the generator site at the times of the most recent 15 year PJM summer peaks
  - At the time of the Verification Test however, the ambient conditions may be different than the ambient conditions at which the unit was rated.
  - In such a situation, the unit may output a MW amount different than the MW amount at which the unit is rated.
  - We can use the difference in ambient conditions, represented by the difference in temperature, and the difference in MW output to establish a relationship between temperature and output for units that are sensitive to changes in summer ambient conditions.

Capacity Model: Ambient Derates

- Background
  - For instance:
    - A unit is rated at 200 MW under ambient conditions determined by a temperature of 95°
    - At the time of the verification test, the temperature is 88° and the unit outputs 204.6 MW.

    Slope = (MW Observed - MW Rated) / (T° Observed – T° Rated)

    Slope = (204.6 – 200) / (88° - 95°) = -0.66 MW/ °F
  - We can write the slope as percentage of the unit's ICAP

    X = Slope / ICAP = -0.66 (MW/°F) / 200 MW = -0.0033 or -0.33% (1/°F)

    Assuming a linear behavior, the value X above can be interpreted as: for an increment of 1°F in ambient temperature, the output of the unit decreases by 0.33% of its ICAP

Capacity Model: Ambient Derates

- Background
  - The unit types that are sensitive to changes in output due to changes in ambient conditions are:
    - CC: Combined Cycle
    - CT: Combustion Turbine
    - DS: Diesel
    - NU: Nuclear
    - ST: Steam

Capacity Model: Ambient Derates

- Procedure to Investigate Assumption
  - Using Verification Test data, by unit type, determine derate as percentage of ICAP due to a 1° F increment above the 50/50 temperature (X)
  - Using historical weather data, determine difference in temperature between RTO 50/50 weather and RTO weather associated with majority of LOLE risk (T)
  - Using the product of the above quantities (X * T) by unit type and the units in the 2015 RRS case, calculate the total MW amount of ambient derates in the 2015 RRS case.
  - Compare the computed amount with the current amount of ambient derates modeled in the RRS (2500 MW)

Capacity Model: Ambient Derates

- Procedure to Investigate Assumption

  To address Capacity Performance (CP) Impact:

  – Compare the product of the above quantities (X * T) by unit type with the class average EFORd of the unit type to determine if ICAP decrease due to forced outages is larger than ICAP decrease due to ambient derates

    - Comparison of these two ICAP decreases is a proxy to infer if generators will adjust RPM MW offer to capture ambient derates under CP rules

Capacity Model: Ambient Derates

- Results of Investigation
  - Examination of the last 3 years of Verification Test data yields the following results

Percentage reduction in ICAP due to 1° F increase in ambient temperature:

Unit Type	2013	2014	2015	Avg
CC	0.28	0.46	0.43	0.39
CT	0.49	0.61	0.48	0.53
DS	0.00	0.11	0.00	0.04
NU	0.00	0.04	0.00	0.01
ST	0.06	0.03	0.04	0.04

CC: Combined Cycle
CT: Combustion Turbine
DS: Diesel
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ST: Steam

Capacity Model: Ambient Derates

- Results of Investigation
  - Examination of historical weather data (1995-2015) shows that the temperature difference between a zone's 50/50 weather and weather that is associated with majority of LOLE risk is as follows,

Zone	2015 RRS Gen Share	Delta T° (F)	Zone	2015 RRS Gen Share	Delta T° (F)
AE	0.01	8.22	JCPL	0.03	9.79
AEP	0.17	7.55	METED	0.02	9.56
APS	0.05	8.67	PECO	0.06	9.27
ATSI	0.06	7.84	PENLC	0.04	6.65
BGE	0.03	10.05	PEPCO	0.03	9.73
COMED	0.14	10.44	PL	0.07	8.90
DAYTON	0.02	8.85	PS	0.05	10.27
DPL	0.03	8.32	RECO	0.00	10.27
DQE	0.02	8.47	UGI	0.00	9.45
DUKE	0.02	9.58	VEPCO	0.13	8.16
EKPC	0.01	9.74		**Weighted Avg RTO**	**8.80**

Capacity Model: Ambient Derates

- Results of Investigation
  - Combining the previous results and applying them to the generation data in the 2015 RRS (projected for delivery year 2019/20)

Unit Type	1° F Deration (% of ICAP)	Delta Temperature (°F)	Total Deration (% of ICAP)	Total ICAP in 2015 RRS (MW)	Total Deration in 2015 RRS (MW)
CC	0.39	8.8	3.432	32670	1121.2
CT	0.53	8.8	4.664	26560	1238.8
DS	0.04	8.8	0.352	630	2.2
NU	0.01	8.8	0.088	34240	30.1
ST	0.04	8.8	0.352	72020	253.5
				TOTAL	**2645.9**

Capacity Model: Ambient Derates

- Results of investigation
  - Regarding CP impact on generators' MW offers in RPM, the table below shows that ICAP decrease due to EFORd is larger than ICAP decrease due to ambient derates.

Unit Type	Total Deration (% of ICAP)	Minimum EFORd from Class Avgs Associated with Unit Type (% of ICAP)
CC	3.432	4.98
CT	4.664	10.22
DS	0.352	7.06
NU	0.088	1.99
ST	0.352	8.33

Thus, generators will most likely not adjust their MW offers in RPM to account for ambient derates since, by accounting for forced outages, they have already "covered" the ambient derate risk. **Under CP, a non-performance penalty is incurred only when the generator fails to produce its UCAP value, not if it fails to produce its ICAP value.**

Capacity Model: Ambient Derates

- Results of investigation
  - For instance, a 100 MW CT unit with EFORd = 10.22% will offer 100 x (1-0.1022) = 89.78 MW in RPM, without further decreasing this value to account for ambient derates.
  - In the RRS, the unit will be assumed to be producing 100 MW 89.78% of the time and 0 MW 10.22 % of the time.
  - Due to ambient derations though, instead of a 100 MW, the unit will be producing 100 x (1-0.04664) = 95.336 MW. Thus, we still need to account for ambient derations in the RRS.