Summer 2021 Resource Reliability Risk Assessment

RF performs a seasonal summer resource adequacy assessment based on data provided by PJM and MISO. This article shares some highlights from MISO, PJM and RF assessments. For the upcoming summer of 2021, both MISO and PJM are expected to have an adequate amount of resources to satisfy their respective planning reserve requirements. This report summarizes the statistics that support our analysis, along with an outage risk. The outage risk assessment further assesses the capability of both MISO and PJM to meet their planning reserve requirements under a random outage scenario based on actual GADS outage data. This analysis also concluded that there should not be an issue of resources supplying demand within the RF Region this summer.

PJM Capacity and Reserves

Net capacity Resources[1]	185,031 MW
Projected Peak Reserves	44,586 MW
Net Internal Demand (NID)	140,445 MW
Planning Reserve Margin	31.7%

As listed in the table above, the anticipated PJM forecast planning reserve margin of 31.7% is greater than the required PJM planning reserve margin requirement for the 2021 planning year of 14.7%. Although the planning reserve margin for this summer is slightly lower than the 2020 forecast level of 32.2% and is due to a slight increase in Net Internal demand (NID) when compared to last year.

MISO Capacity and Reserves

Net Capacity Resources	141,443 MW
Projected Peak Reserves	25,083 MW
Net Internal Demand (NID)	116,360 MW
Planning Reserve Margin	21.6%

[1] Net capacity resources include existing certain generation and net scheduled interchange.

The MISO forecast planning reserve margin of 21.6%, seen in the table above, is greater than the required MISO planning reserve margin requirement of 18.3% for the 2021 planning year. The planning reserve margin for this summer is lower than the 2020 forecast level 24.8% and is mostly due to decrease in net capacity resources in MISO's market.

RF Footprint Resources

Net Capacity Resources	201,883 MW
Projected Peak Reserves	40,522 MW
Net Internal Demand (NID)	161,361 MW
Total Internal Demand (TID)	170,783 MW

Since PJM and MISO are projected to have adequate resources to satisfy their respective forecasted reserve margin requirements, the RF Region is projected to have sufficient resources for the 2021 summer period as seen in the table above.

Random Generator Outage Risk Analysis

The following analysis evaluates the risk associated with random generator outages due to an unexpected unit loss that may reduce the available resources below the load obligations projections of PJM or MISO. Reports and/or other data released by PJM, MISO or NERC for this same period may differ from the data reported in this assessment. This is due to different assumptions that were made by RF from the onset of the analysis. This analysis differs from NERC's in the fact that RF used actual historical Generator Availability Data System (GADS) data from a rolling five-year period, which provided a range of outages that occur during the summer period. The NERC Analysis polls the assessment area and requests the average forced outages for June through September weekdays, over the past three years. The forecasted maintenance outages used in this analysis are derived from PJM and MISO for the summer months.

Exhibits 1 and 2 are based on forecasted summer 2021 demand and capacity resource data for the PJM and MISO RTOs. The daily operating reserve requirement for PJM and MISO at the time of the peak demand is also included as a load obligation. The range of expected generator outages is included for scheduled and random outages. The

random outages are based on actual GADS outage data from May, June, July, August and September of 2016 through 2020.

The committed resources in PJM and MISO are represented by the Resources bar in shades of blue and only include the net interchange that is a capacity commitment to each market. Additional interchange transactions that may be available at the time of the peak are not included as they are not firm commitments to satisfying each RTO's reserve margin requirement.

The firm demand and the demand that can be contractually reduced as a DR are shown in shades of green. The firm demand constitutes the NID, with Total Internal Demand including the DR. The daily Operating Reserve requirement (shown in yellow) is between the NID and DR bars. There are two sets of stacked Demand bars on the chart, one representing the 50/50 demand forecast and one representing the 90/10 demand forecast. The 50/50 demand forecast projects a 50% likelihood that demand exceeds 140,445 MW. The 90/10 demand forecast is a more conservative model, projecting a 10% chance that demand exceeds 149,526 MW. Since DR is utilized first to reduce the load obligation when there is insufficient capacity, this part is at the top of the Demand bar. In the event that utilization of all DR is not sufficient to balance capacity with load obligations, system operators may first reduce operating reserves prior to interrupting firm load customers.

While scheduled outages during the summer are generally minimal, there are scheduled outages planned during the summer that are reflected in the amount of Scheduled Maintenance (colored gray) in the Outage bar. The remainder of the Outage bar represents the entire range of random outages (pink shows 100% of the random outages; rose shows less than 100% down to 10% of the random outages; and red shows less than 10% down to 0.1% of the random outages on the chart) which occurred during the five-year reference period.

In Exhibit 1, the top of the 90/10 Demand obligation bar for PJM represents TID with operating reserves. The 2% line between the Outage bar and the 90/10 Demand bar represents the probability that there will be an amount of outages that will require Demand Response resources to be utilized. This means that there is a probability of utilizing Demand Response during high demand (90/10).

Exhibit 1 - 2021 Summer PJM Resource Availability Risk Chart

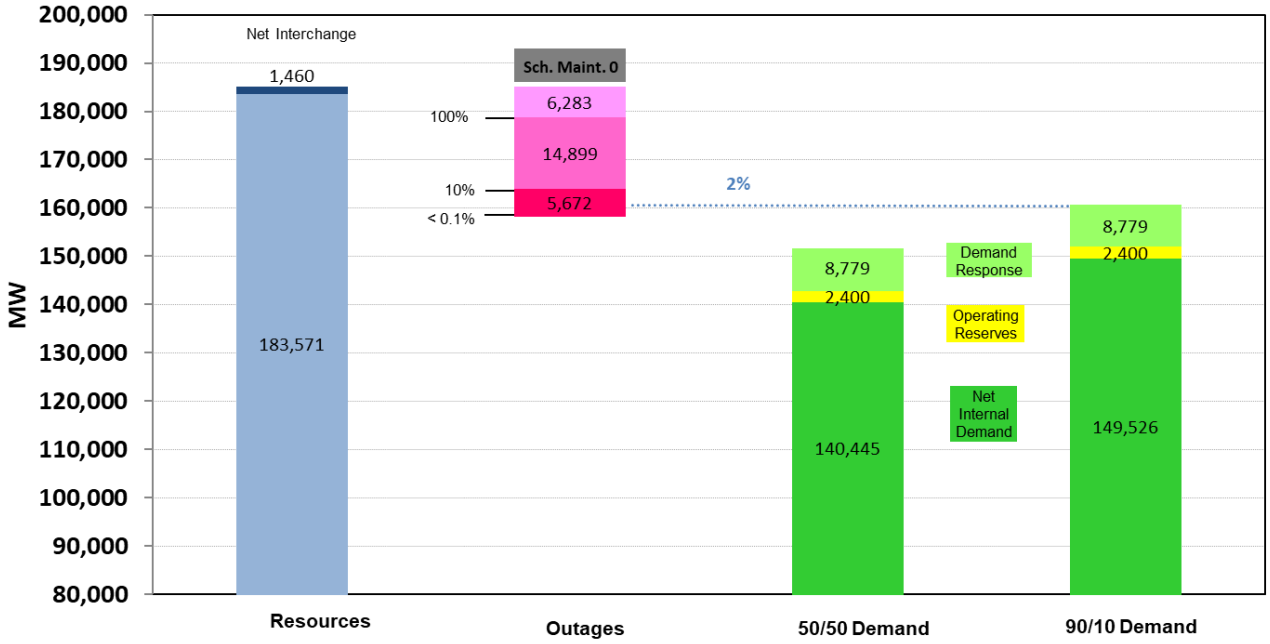
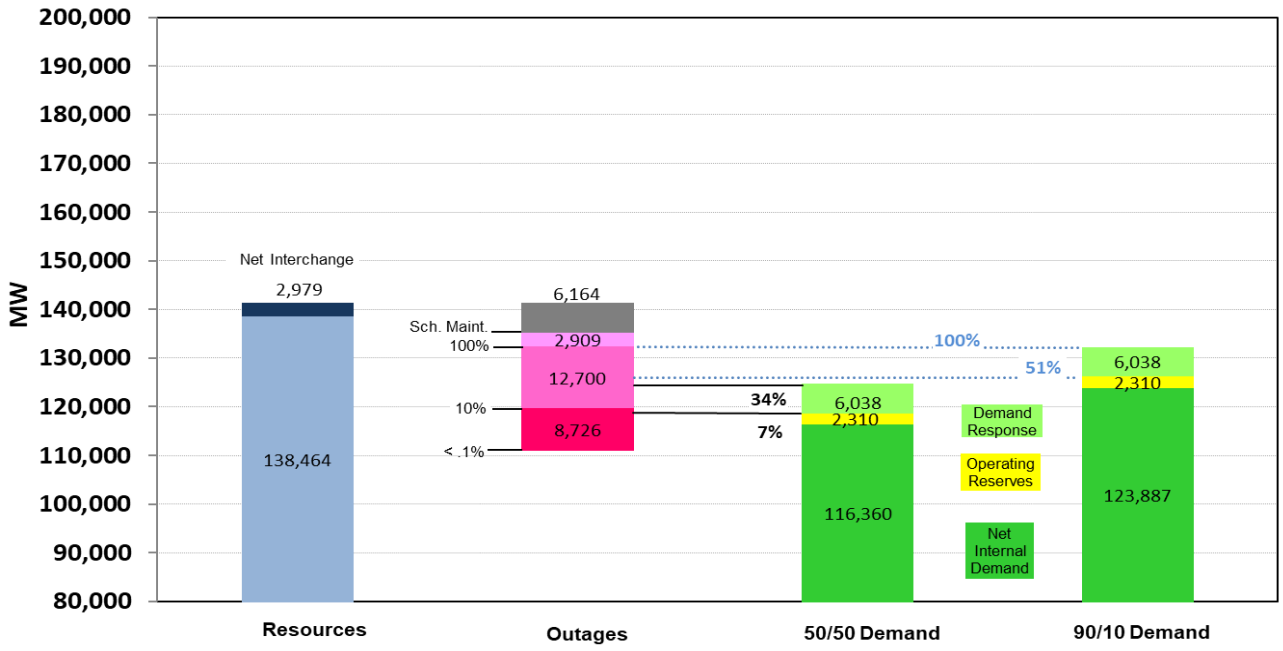


Exhibit 2 contains the information to perform the same analysis for MISO. The top of the 50/50 Demand obligation with DR and Operating reserves is 34%. During normal operating conditions, there will be a 34% probability that there will be an amount of outages that will require DR resources to be utilized. The top of the 90/10 demand obligation with the operating reserves has a 100% probability that DR will be required during high demand.

Exhibit 2 - 2021 Summer MISO Resource Availability Risk Chart



In the following discussion of the random outages, the analysis of random outages exceeding certain reserve margin targets is presented as a probability. These probabilities are not based on a true statistical analysis of the available daily random outage data. Rather than statistical probabilities, these numbers represent the percentage of the daily outages during the five prior summer periods that would have exceeded the reserve margin that is listed. They are discussed as probabilities as a matter of convenience in describing the analysis results.

To the left side of the range of random outages are the probability percentages related to the amount of random outages that equal or exceed the amount of outages shown above that line on the Outage bar. Moving from top to bottom of the Outage bar represents an increasing amount of random outages, with a decreasing probability for the amount of random outages. In the PJM chart (Exhibit 1), the random outages represented by the bar above the 100% point is 6,283 MW. This means the probability of there being at least 6,283 MW of random generation outages is 100%. Similarly, in the MISO Chart (Exhibit 2) at the 10% point, the outages represented by the bar above the 10% point is 21,182 MW (6,283 MW + 14,899 MW). There is a 10% probability that there will be at least 21,182 MW of outages. As shown by the probabilities and corresponding amounts of random outages, the distribution of random outages is not linear throughout the range of outages observed.

To the right of the Outage bar are the probabilities of the random generation outages that correspond to different levels of demand obligation.