The Effect of Wind Resources on the NYCA IRM & UCAP Markets

Wind generation is generally classified as an “intermittent" or "variable generation" resource with limited dispatchability. The effective capacity of wind generation can be quantified and modeled using the GE-MARS program like conventional fossil-fired power plants. There are various modeling techniques to input wind generation in GE-MARS; the one that ICS has adopted uses historical hourly wind farm generation outputs. This data can be scaled to the nameplate capacity and assigned geographically to new and existing wind generation units.

The effective capacity of wind generation can be either calculated statistically directly from historical hourly wind generation outputs, and/or by using the following information:

- Generation site hourly wind data: This data is translated to power output by using power curves that relate wind speed to generator’s power output for each of the turbines in the wind farm,
- Maintenance cycle and duration,
- and EFOR

In general, wind effective capacity depends mostly on the availability of the wind (fuel), is usually less than 40% of the wind turbine’s nameplate, during the winter the average effective capacity of wind turbines is higher than during the summer, and in both seasons, is significantly lower than conventional fossil-fired power plants.

The IRM calculation using GE-MARS is mostly based on the adequacy of resources during the summer peak days when the average wind speeds are the lowest, therefore the summer effective capacity of the wind farms is of significant importance to estimate their contribution to reliability.

The effective summer capacity for wind farms varies mostly with the geographic location of the farm. Based on the NYISO’s hourly data information obtained from different New York State sites, which ICS uses for the study, a wind farm located on land Upstate has a 10%-11% effective capacity, on land downstate, 30%, and off-shore, 38%. For example, a 100 MW wind farm located off-shore is equivalent to have a conventional fossil-fired power plant of 38 MW with zero EFORd.

Wind generation increases the reliability of the NYCA by adding more resources to the system, which in turn lower the LOLE calculated by the GE-MARS program. Because the amount of nameplate capacity of wind resources added is larger relative to the wind's effective capacity, the system IRM increases.

The effective capacity of a wind farm or turbine is also equal to their UCAP and their nameplate to their ICAP. ICAP can be translated to UCAP by using an EFORd translation factor.

Using the GE-MARS program, the effective capacity of wind generation can be quantified and modeled on the same basis as a conventional fossil-fired power plant using ICAP and an availability or performance considerations. Wind, as well as all generating resources in the NYCA has an expected level of availability – or conversely a level of expected unavailability which is considered when solving the GE-MARS program for LOLE.
The GE-MARS analysis considers seasonal variability in wind generation output relative to periods of peak system load, when generating resources have the greatest impact of overall system reliability as measured by LOLE. This seasonal variability in wind availability results in a low peak availability factor for wind resources in the NYCA.

The NYISO adopted a 90% deration factor for upstate land-based wind generators a 70% deration factor for downstate land-based wind generators and a 62% deration factor for offshore-based wind facilities. Because wind has much higher unavailability compared to fossil generation, the addition of wind generation to the resource portfolio will increase Statewide and Locational ICAP based capacity requirements in the NYCA as calculated by the GE-MARS program.

The NYISO administers the capacity requirements to all loads in the NYCA. In 2002, the NYISO adopted the UCAP methodology for determining system requirements, unit ratings and market settlements. The UCAP methodology uses individual generating unit data for output and availability to determine an expected level of resources that can be considered for system planning, operation and marketing purposes. EFORd is developed from this process for each generating unit and applied to the units DMNC test value to determine the resulting level of UCAP:

UCAP = ICAP * (1-EFORd)

Individual unit EFORd factors are taken in aggregate on both a Statewide and Locational basis and used to effectively "translate" the IRM and LCRs previously determined in the MARS Analysis in terms of ICAP, into an equivalent UCAP basis.

The equivalent EFORd of wind plants is significantly higher than fossil-based resources due to their low peak availability – and accounted for in the GE-MARS analysis. Therefore, adding wind resources to the overall NYCA generation portfolio causes an increase to the overall system EFORd, which in turn translates to a higher overall IRM.

A system that requires a specific level of UCAP to meet its LOLE requirement when resources with higher unavailability are added to the resource mix will need to increase the installed capacity resource base to maintain the same level of UCAP or resource adequacy.

Although the impact of low capacity factor resource additions increases the IRM on an ICAP basis, it should be noted that its effect on a UCAP basis is negligible. As an example of this, take a system with a 10,000 MW ICAP requirement and an EFORd of 10%. Its UCAP requirement (ICAP*(1-EFOR)) would then be 9,000 MW. Suppose we then add

1,000 MW of low capacity factor resource at its summer EFORd of 90%. Because the load carrying capability of this resource is only 100 MW during the summer peak, the ICAP requirement would go up by roughly the non-load carrying component (900 MW). The new ICAP requirement would then become roughly 10,900 MW. The weighted average EFORd of the new system becomes (10,000*0.1 +1,000*0.9)/(10,000+1,000) = 17.3%. The UCAP requirement then becomes 9,014 MW, which is essentially unchanged from the initial 9,000 MW UCAP requirement.