PJM Manual 21
Rules and Procedures for Determination of Generating Capability

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System Planning Department

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Appendix B: Calculating Capacity Values for Intermittent Capacity Resources

B.1 PURPOSE:
This appendix describes the procedure for the calculation of capacity values for all intermittent capacity resources such as wind and photovoltaic generators.

B.2 DEFINITIONS

1. Capacity Value for an intermittent capacity resource represents that amount of generating capacity, expressed in MW, that it can reliably contribute during summer peak hours and which can be offered as unforced capacity into the PJM capacity markets.

2. “Capacity Factor” for an intermittent capacity resource is a factor based on historical operating data and/or the Class Average Capacity Factor, and is used in the calculation that determines an intermittent capacity resource’s Capacity Value.
3. The intermittent capacity resource's “Net Maximum Capacity” is the manufacturer's output rating less the Station Load where “Station Load” refers to the amount of energy that is consumed to operate all auxiliary equipment and control systems.

4. Intermittent capacity resources with three or more years of applicable operational data are referred to as “Mature.” Those with fewer than three years of data are “Immature.”

5. “Class Average Capacity Factor” is a factor that is used only in the calculations for the Capacity Value of an immature intermittent capacity resource. Class average capacity factors shall be determined and periodically updated by PJM based upon review of operating data for similar units and/or engineering studies for future installations.

6. “Hourly output” is the average of the metered outputs, in MW, integrated over a one-hour period.

7. “Summer Day” is defined as any day from June 1 through August 31, inclusive.

8. “Summer Period” is the period from June 1 through August 31, inclusive.

9. “Peak Hours” are those ending 3, 4, 5, and 6 PM Local Prevailing Time.

10. “Summer Peak Hours” means all “Peak Hours” for all of the “Summer Days”.

11. “Summer Calculation Hours” means all “Summer Peak Hours” for which PJM did not direct the resource to reduce its output.

**B.3 CALCULATION PROCEDURE**

1. General Approach - The calculation of a capacity value for a particular intermittent capacity resource for a particular year is performed by first computing its unique single year capacity factors for each of the prior three summers. An intermittent resource may consist of a number of individual generating units metered and interconnected at a single point. Groups of wind turbines meeting these criteria are referred to as wind energy projects. Those single year capacity factors are based upon operating data for each of those summers, or in the case of an
immature intermittent capacity resource, the single year
capacity factor is assigned the value of the Class Average
Capacity Factor for each summer where there is no or
incomplete data. The mean of single year capacity factors for
each of the prior three years results in a Capacity Factor
representative of the three prior years. That Capacity Factor,
when multiplied by the current Net Maximum Capacity yields the
current capacity value for that intermittent capacity resource.
This two step process accommodates any changes in the Net
Maximum capacity that may have occurred during the prior
three summers of operation. A detailed outline of this approach
(addressing both mature and immature intermittent capacity
resources) is as follows:

A. Sum all of the “hourly outputs” for each of the summer calculation
   hours in the year that is three years prior to the current year.
B. Then, for each of those same summer calculation hours, sum the Net
   Maximum Capacity values.
C. For non-wind intermittent resources, any hour in which the output of
   the facility has been reduced, wholly or in part, due to a constraint on
   the transmission or distribution system or by order of the PJM system
   operator, both the hourly output and the Net Maximum Capacity for
   the constrained hour will be omitted. The resource owner must notify
   the PJM Resource Adequacy Planning Department of those curtailed
   hours via email to eGADS@pjm.com by September 30 each year.
D. For wind intermittent resources, any hour in which the output of the
   facility has been reduced, wholly or in part, due to a constraint on the
   transmission or distribution system or by order of the PJM system
   operator, the hourly data for the curtailed hours will be replaced, in
   part, with five minute data from the PJM state estimator for each five
   minute period without constraints and, for the five minute periods with
   constraints, values will be determined by linear interpolation using the
   nearest five minute data surrounding the constrained period(s).
E. The quotient of the summed summer calculation hour outputs (a)
   divided by the summed summer calculation hour Net Maximum
   Capacities (b) will yield a single year capacity factor for that year.
F. If there is no or incomplete operating data for one or more of the
   summers (immature Intermittent capacity resource) then the single
   year capacity factor for each of those years is assigned the value of the
   Class Average Capacity Factor.
G. Repeating steps (A) through (D) above for each of the two intervening
   years (current year minus 2, and current year minus 1) will generate
   two more single year capacity factors, one for each of those years.
H. The Capacity Factor to be used in the current year is the mean (arithmetic average) of the three single year capacity factors calculated in steps (C) and (D) above.

I. Capacity factors shall be calculated annually following the summer peak period and be applicable for the delivery year beginning the following June.

J. Currently effective class average capacity factors are 13% for wind and 38% for solar units.

K. Owners of immature intermittent units may substitute an alternate class average capacity factor with suitable documentation and approval by PJM.

L. The current Capacity Value is then calculated by multiplying the applicable Capacity Factor from (G) above by the current Net Maximum Capacity of the intermittent capacity resource.
Revision History

Revision 09 (05/01/2010)

Added requirement to document cases where unit winter ratings are less than summer ratings.

Clarified language regarding correction of observed test data to rated site ambient conditions.

Changes to Appendix B to specify that, in the calculation of an intermittent resource’s capacity value, any hours during which PJM directed the resource to reduce its output are excluded.
Revision 08 (01/01/2010)
Revisions approved by stakeholders at November 30, 2009 MRC meeting and awaiting FERC approval by February 1, 2010 (received FERC approval in January, 2010):

- Removed all references to the Winter Net Capability Test Exemption Program.
- Revision to Appendix A allowing submission of ambient weather-adjusted data from the summer verification test in place of an actual winter verification test.

Revision 07 (06/01/2008)
Clarification of capacity verification testing corrections to average ambient conditions described in Section 2.

- Clarification of test duration requirements for various unit types in Appendix A.
- Revision to Appendix B to add Solar Class Average Capacity Factor of 38%.
- Elimination of Appendix B-1 and combination of wind and solar calculation methodology into Appendix B.

Revision 06 (04/01/2008)
Revision to Appendix B-1 to indicate change of Wind Class Average Capacity Factor to 13%.

- Clarification of existing practices regarding performance of seasonal verification tests.

Revision 05 (06/01/07)
Revisions for the implementation of the Reliability Pricing Model and general clean-up.

- Added Section 1: Requirements
- Added Definition of Installed Capacity (ICAP)
- Data Submittal: Added Occasions Requiring Submittal of Verification Test

Revision 04 (08/15/05)

Appendix A: Part B-4 Added Duration of Test or Operational Status to Satisfy Test Requirements

Revision History

- Removed all references to Non-Utility Generators (NUGs)
- Included references and links to Winter Net Capability Test Exemption section of PJM Manual for Pre-scheduling Operations (M-10)
- Removed all data input instructions and sample forms from part C, Reporting of Appendix A: Net Capability Verification Guidelines and inserted link to Appendix B: PJM Net Capability Verification Test User Manual of PJM eGADS User Manual (M-23)

Revision 03 (04/30/04)

Attached two files:
- The first is Appendix B which addresses Intermittent Capacity Resources in general.
- The second is Appendix B-1. This addresses Capacity calculations for wind generation which is the first intermittent capacity resource under the category of Intermittent Capacity Resources.

Revision 02 (11/21/03)

Changed all references from “PJM Interconnection, L.L.C.” to “PJM.”

Renamed Exhibits I.1 through 10.1 to Exhibit 1 through Exhibit 5.

Reformatted to new PJM formatting standard.

Renumbers pages to consecutive numbering.

Revision 01 (08/23/00)

Manual updated to reflect use of eCapacity system and to remove Available Capability, Limited Energy Resources and Transmission Limitations sections. These will be addressed in sections of the PJM Manual for Installed Capacity: Generation Data Systems dealing with generation availability. Appendices A and B of the 10/14/98 version have also been removed since they dealt with Limited Energy and Transmission Limitation procedures.

Revision 00 (10/14/98)

This is the first release of the PJM Manual for Rules and Procedures for Determination of Generating Capability (Green Book) under new format.