

PJM Manual 21:

Rules and Procedures for Determination of
Generating Capability

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Prepared by
System Planning Department

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Approval

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Current Revision

Revision 12 (1/1/2017):

- Cover to Cover Periodic Review
- Added more detail to testing requirements, acceptance testing for newly constructed units and re-wording of Net Capability terms
- Added references to capacity interconnect rights and added testing rules for non-hydro storage
- Removed reference to wind and solar as intermittent units (per Manual 18) include units other an just wind and solar capacity resources

Introduction

Welcome to the **PJM Manual for Rules and Procedures for Determination of Generating Capability**. In this Introduction, you will find the following information:

- What you can expect from the PJM Manuals in general (see “About PJM Manuals”).
- What you can expect from this PJM Manual (see “About This Manual”).
- How to use this manual (see “Using This Manual”).

About PJM Manuals

The PJM Manuals are the instructions, rules, procedures, and guidelines established by the PJM for the operation, planning, and accounting requirements of the PJM and the PJM Energy Market. The manuals are grouped under the following categories:

- Transmission
- PJM Energy Market
- Generation and Transmission Interconnection
- Reserve
- Accounting and Billing
- PJM Administrative Services
- Miscellaneous

For a complete list of all PJM manuals, go to the Library section on PJM.com.

About This Manual

Purpose

The PJM Manual for **Rules and Procedures for Determination of Generating Capability** is one of a series of manuals within the Reserve group of manuals. These rules and procedures for determining the capability of generating units on the systems of PJM have been adopted to provide uniformity for planning, operating, accounting and reporting purposes, and have been designed to meet the following requirement in the coordinated operation of PJM:

- **Net Capability** of generating units installed in, scheduled for installation in or transacted into the PJM Control Area is required for planning and reporting purposes and for use in accounting for deficiencies of a Party to obligations under the Operating and Reliability Assurance Agreements of PJM.

The rules and procedures recognize the difference in types of generating units involved as resources within the PJM Capacity Markets processes and the relative ability of units to maintain output at stated capability over a specified period of time. Factors affecting such ability include fuel availability, stream flow for hydro units, reservoir storage for hydro and pumped storage units, mechanical limitations, system operating policies.

The PJM Manual for ***Rules and Procedures for Determination of Generating Capability*** consists of the two sections and two attachments. These are listed in the Table of Contents beginning on page 2.

Intended Audience

The intended audiences for the PJM Manual for ***Rules and Procedures for Determination of Generating Capability*** are:

- PJM Board of Managers - The PJM Board of Managers is responsible for the administration and approval of the forecast obligation and techniques for its determination.
- PJM Markets and Reliability Committee (MRC) - Members are responsible for the review and submittal of the obligations to the PJM Board of Managers.
- PJM Market Implementation Committee (MIC) – Members initiate and develop proposals to advance and promote competitive wholesale electricity markets in the PJM region for consideration by the Markets and Reliability Committee.
- PJM Planning Committee - Members are responsible for reviewing PJM Capacity Adequacy Planning staff recommendations on reserve requirement matters and the parameters used in their determination.
- PJM Resource Adequacy Planning Staff - PJM staff are responsible for the compilation, review and processing of the acceptance and verification tests as well as the continual collection and review of generating unit event and performance records via the Generating Availability Data System (GADS).
- PJM Market Services – PJM staff are responsible to assess generation resource rating test failure penalties under the RPM process.
- Parties to Other PJM Agreements - The staff of these Parties are responsible for supplying load and generator data in the required format and time period to assist in the calculation and submittal of required quantities.
- Generator Availability Analyzers - Industry personnel charged with reviewing and interpreting the impacts of generator unavailability on the reliability and markets of their respective systems.

References

There are several references to other documents that provide background or additional detail. The PJM Manual for ***Rules and Procedures for Determination of Generating Capability*** does not replace any information in these reference documents. The following documents are the primary source of specific requirements and implementation details:

- Amended and Restated Operating Agreement of PJM Interconnection, L.L.C.
- PJM Reliability Assurance Agreement
- PJM Open Access Transmission Tariff (OATT)
- PJM Manual for Pre-Scheduling Operations (M-10)
- PJM Manual for Generator Operational Requirements (M-14D)
- PJM Manual for PJM Capacity Market (M-18)

- PJM Manual for Load Forecasting and Analysis (M-19)
- PJM Manual for Generator Resource Performance Indices (M-22)
- PJM Manual for Billing (M-29)
- PJM eGADS User Guide

Using This Manual

We believe that explaining concepts is just as important as presenting procedures. This philosophy is reflected in the way we organize the material in this manual. We start each section with an overview. Then we present details, procedures or references to procedures found in other PJM manuals. The following provides an orientation to the manual's structure.

What You Will Find in This Manual

- A Table of Contents that lists two levels of subheadings within each of the sections.
- An approval page that lists the required approvals and a brief outline of the current revision.
- Sections containing the specific guidelines, requirements, or procedures including PJM actions and PJM Member actions.
- A section at the end detailing all previous revisions of this PJM manual.

Section 1: Requirements

1.1 Installed Capacity (ICAP)

Installed Capacity (ICAP) of a generation resource is defined as the summer net capability of a generating unit as determined in accordance with PJM manual **M-21, Rules and Procedures for Determination of Generation Capability** and within the capacity interconnection right limits of the bus to which it is connected. The ICAP for any generating unit is the sum of the summer based capacity modifications (CAPMODs) in the RPM Capacity Markets system for that date. The ICAP is equivalent to the claimed installed capacity in eGADS and the Summer Net Capability defined in section 2.2 of this document.

Regarding Wind and Solar Capacity Resources, the information regarding the calculation of their capacity value can be found in Appendix B of this manual.

Occasions Requiring Submittal of Acceptance or Verification Test

1. Verification tests for all PJM capacity resources (other than hydro, wind and solar) are to be submitted for both summer (June-July-August) and winter (December-January-February) test periods. Hydroelectric generators need only submit summer verification tests and hydroelectric generating units have only one test period (June-July-August) during the year.
2. A recent summer verification test is to accompany any CAPMOD increasing the ICAP of a generating unit. This test must meet or exceed the requested ICAP and the ICAP of the generating unit cannot be greater than the generating unit's capacity interconnection rights.
3. A recent summer verification test is to accompany any return of a generating unit from a "mothballed" state. The included test must meet or exceed the requested ICAP and the ICAP of the generating unit cannot be greater than the generating unit's capacity interconnection rights.
4. A recent summer verification test is to accompany any existing generating unit being included in the PJM capacity markets for the first time or returning to the PJM capacity markets after an absence. The included test must meet or exceed the requested ICAP and the ICAP of the generating unit cannot be greater than the generating unit's capacity interconnection rights.
5. Acceptance tests for newly constructed generating units must be completed prior to the new generating unit's initial CAPMOD effective date in the PJM Capacity Markets. These tests must be corrected to summer conditions (pursuant to Section 2 of this document) and must meet or exceed the newly constructed generating units ICAP. In cases where a newly constructed generating unit's participation in the PJM Capacity Markets increases by a series of CAPMODs, new acceptance test(s) must be conducted no greater than 30 days after any subsequent CAPMOD effective date(s). Once the generating unit is declared fully operational and has entered all of its intended CAPMODs, a final acceptance test must be performed to prove its ICAP. Failure to meet or exceed the ICAP in the final acceptance test will be remedied by a CAPMOD for the shortfall effective as soon as practical. Also, a derating event for the shortfall must be entered into the PJM eGADS system that starts and ends on the respective CAPMOD effective

dates. A final acceptance test, conducted within the summer test period, will also be accepted as the summer verification test for that year as long as it is corrected for summer conditions (pursuant to section 2 of this document); likewise, a final acceptance test, performed within the winter test period, will be accepted as the winter verification test for that year as long as it is corrected for winter conditions (pursuant to section 2 of this document).

6. In all of the cases above except 5, the recent summer verification test must have been conducted within the 12 months prior to the CAPMOD effective date.
7. In all of the cases above except 5, if a recent summer verification test is not available, then a new verification test must be performed within 30 days of the CAPMOD effective date. This test needs to be corrected for summer conditions (pursuant to section 2 of this document) and if the Corrected Net Test Capacity does not meet or exceed the ICAP, a CAPMOD in the amount of the difference must be entered into the RPM system effective as soon as practical. Also, a derating event for the difference must be entered into the PJM eGADS system that starts and ends on the respective CAPMOD effective dates.

Capacity Interconnection Right Limitations

1. All increases in capability are subject to limitations of capacity interconnection rights (CIRs) to the bus to which the generating unit is currently or about to be connected as verified by the Interconnection Analysis department of PJM. If CIRs for the generating unit(s) were issued on a revenue meter basis, then Net Capability testing must be verified on all generating units behind that respective revenue meter, simultaneously. For the purposes of this document, a project, that is issued CIRs with multiple generating units behind a single revenue meter, will be considered a single generating unit. CIR retention is determined based on the largest Corrected Net Test Capacity of the last three years' summer verification tests. If the largest Corrected Net Test Capacity of a generating unit's summer verification test of the prior three years falls short of the existing CIR value for that generating unit, the generating unit will lose the difference in CIRs effective the next February 1. CIR retention will be analyzed based on only those summer verification tests performed within the summer test period. Results of out of period tests cannot be used in CIR retention calculations. Any increase in CIRs can only be attained by initiating an Interconnection Request and executing an ISA (or WMPA) with PJM.

Late Data Submittal Charges

1. In accordance with Schedule 6 (Plans to Meet Capacity Obligations), Schedule 12 (Data Submittals) and Schedule 13 (Data Submission Charges) of the Reliability Assurance Agreement, a data submission charge of \$500/day can be applied to any data not submitted in accordance with published deadlines. The deadlines¹ for verification test result submittal are September 20 for the summer test period and March 20 for the winter test period.

¹ These dates are intended to coincide with the PJM eGADS data reporting deadline for those months.

Impacts of Test Results

1. **Successful Test Result** –A successful test result is one in which the Corrected Net Test Capacity is equal to or greater than the claimed installed capacity (ICAP) for the applicable test period and conducted within the respective test period.
2. **Failed Test** – A failed test is one in which the Corrected Net Test Capacity is less than the claimed installed capacity (ICAP) for the applicable test period. This case will result in a forced outage or derating in the amount of the difference between the claimed installed capacity (ICAP) and the Corrected Net Test Capacity being applied to the generating unit in question retroactive from the beginning of the respective test period and lasting until either a) a successful out of period test is conducted, b) a reduction in the claimed installed capacity (ICAP) of the generating unit is in effect (if and only if the capability is not to be restored, in accordance with section 2.1.12 of this document), or c) the beginning of the next test period. Examples of the application using the summer test period are:
 - a. **A notice of a Capacity Modification (CAPMOD) is received and approved for reducing the claimed installed capacity of the generating unit to the Corrected Net Test Capacity effective August 31 @ 0000 hours.** A forced outage or derating as described above is entered for the generating unit starting June 1 @ 0000 hours and ending August 31 @ 0000 hours (the outage or derating ends when the CAPMOD begins).
 - b. **The beginning of the next test period.** No test outside the test period (June-July-August) or CAPMOD are received. A forced outage or derating as described above is applied to the generating unit starting June 1 @0000 hours and ending December 1 @ 0000 hours (December 1 begins the winter test period).
 - c. **An out of period test is conducted.** A successful out of period test is conducted on October 15 commencing at 1700 hours and ending at 1900 hours. A forced outage or derating as described above is applied to the generating unit starting June 1 @ 0000 hours and ending October 15 @ 1900 hours.
3. **Failure to Submit Test** - Failure to submit a verification test (conducted within the respective test period), unless exempted by GADS support personnel, will result in a full forced outage being applied to the generating unit in question retroactively from the beginning of the applicable test period and will remain in effect until either a successful out of period test is conducted or the next test period begins. For example, a generating unit not submitting a verification test for the summer test period will have a full forced outage applied retroactively starting June 1 @ 0000 hours of the year of the test period and ending December 1 @ 0000 hours of that same year (ending December 1, the beginning of the winter test period), unless a test is received prior to December 1. The results of this outage will be applied going forward and no retroactive adjustments to PJM Markets will be made. Also, a Generation Resource Rating Test Failure Charge, per PJM manual, M-18, PJM Capacity Market, will be assessed if a verification test shortfall is not accompanied by a derating in the eGADS system and the event was not submitted by the generating units owner or agent.

Section 2: Net Capability

2.1 General

1. Net Capability shall mean the number of megawatts of electric power which can be delivered by an electric generating unit without restriction by the owner under the conditions and criteria specified herein and shall be determined as the gross output of the unit less power used for unit auxiliaries and other station use required for electrical generation and any power required to serve host process load. In the case where auxiliary load, station use and/or process load is apportioned across multiple units at a plant, the apportioned auxiliary load, station use and/or process load during the test must be commensurate with the apportioned auxiliary load, station use and/or process load during summer conditions (summer conditions are delineated in section 2.2, item 2 of this document).
2. Without restriction means that Net Capability values so determined are available for utilization at the request of PJM for supply of operating capacity and energy before any operating procedures are placed in effect anticipatory to a voltage reduction on the PJM system except as such utilization may at times be limited in duration by water or fuel availability. If the Net Capability, at times, is limited by water or fuel availability, the Net Capability should be based on the expected streamflow or expected fuel availability.
3. The determination of the Net Capability of a combined-cycle unit will depend on the structure of the complete unit and its components. The steam turbine and combustion turbines shall adhere to the existing guidelines set forth in this reporting manual. In the case of thermally dependent components, the determination of the Net Capability shall require the operation of both combustion turbine and steam components simultaneously. The output of the components can be netted to determine the combined-cycle unit net capability.
4. The determination of the Net Capability of a steam unit shall recognize the use of any procedures for increasing unit output such as turbine over-pressure, boiler overrating, cycle modification or any others which are normally utilized in operation.
5. The determination of Net Capability for a combustion turbine unit shall be consistent with the owner's policy with respect to maximum outputs.
6. The determination of Net Capability for a hydro (with storage and/or pooling capability) or pumped storage unit shall recognize the head available giving proper consideration to operating restrictions and the reservoir storage program during a normal cycle at the expected time of the PJM peak.
7. The determination of Net Capability for a storage (non-hydro) unit shall recognize the MWH energy available, giving proper consideration to other market activities for which the storage (non-hydro) unit may be committed during the expected time of the PJM peak.
8. The determination of Net Capability for a hydro unit (without storage and pooling capability) shall be based on the expected head and streamflow at the expected time of the PJM peak.

9. The determination of the Net Capability of a nuclear unit shall recognize its nuclear fuel management program and any restrictions (except as noted in 15 below) imposed by regulatory authority.
10. The Net Capability of a planned steam or combined-cycle unit shall be based on the manufacturer's guarantee or estimate of performance. The Net Capability of a planned combustion turbine or combined-cycle unit shall give recognition to the elevation of the unit location, the type of fuel available for use, and the owner's policy with respect to the maximum output. The Net Capability of a planned hydro unit shall be based on the expected head and/or streamflow in accordance with items 6 or 8 above. The Net Capability of a planned storage (non-hydro) unit shall be based on the MWH energy available, given proper consideration to other market activities in which the unit may be participating at the expected time of the PJM peak.
11. After a unit is in operation, its Net Capability shall be based on current operating performance or test results. Both Summer and Winter Net Capability values shall be confirmed annually. If adequate data is available from normal operation to confirm Net Capability during the summer or winter test period, no test is required to be performed, as long as actual operating data from the respective test period is used. Units for which the foregoing data is not available shall be tested to confirm Summer and Winter Net Capability. Winter Net Capability Tests may utilize the latest Summer Net Capability test data corrected for winter conditions. When a known change occurs in the Net Capability of a unit, or is indicated by operating data or test results, it shall become effective as soon as possible except as noted in items 12 and 15 below.
12. The Net Capability of a unit shall not be reduced to reflect unplanned deratings or temporary capacity restrictions provided it is the intention of the owner to restore the reduced capability. The time of this restoration may depend on availability of parts and scheduling of an outage required for repairs. If the owner does not intend to restore the reduced capability by the end of the next Delivery Year, a reduced Net Capability value may become effective at the request of the owner. The owner shall make the required changes via the Capacity Modifications (CAPMOD) process of the PJM Capacity Market.
13. All or any part of a unit's capability that can be sustained for a number of hours of continuous operation commensurate with PJM load requirements, specified as 10 hours, shall be considered as unlimited energy capability. All or any part of a unit's capability shall be considered as limited energy capability only for those periods in which it does not meet the foregoing criteria for sustained operation. Such limited energy capability will be used to meet the energy requirements of PJM and depending on the extent to which it meets these requirements such capability may be reduced as provided in Schedule 9 of the Reliability Assurance Agreement (RAA).
14. Each generation owner shall be responsible for the determination and reporting of Summer and Winter Net Capability. The first notification is through completion of Attachment N of the Open Access Transmission Tariff (Form of Feasibility Study Agreement) and sending this application to the Interconnection Analysis Department of PJM. The second notification, if approval is received, is via the CAPMOD procedures of the PJM Capacity Market. The Resource Adequacy Planning Department of the PJM

RTO shall be responsible for the establishment of test procedures required to confirm such values including any amount which could be treated as limited energy capability.

15. The Net Capability reported for a generating unit shall in no case exceed an amount determined by the owner in accordance with items 1, 2 and 14 above but for PJM accounting purposes may initially be less than that amount. The extent of any such reduction in reported capability may be determined by the company in such manner as will permit the most effective use of its own resources.

2.2 Summer Net Capability

1. The Summer Net Capability of each generating unit shall be based on summer conditions and on the power factor level normally expected for that generating unit at the time of the annual summer PJM peaks.
2. Summer conditions shall reflect the 50% probability of occurrence (approximated by the mean) of ambient site conditions at the time of the last 15 years' summer PJM peaks. Site conditions shall be based on plant records or local weather bureau records coincident with the dates and times of the last 15 years' summer PJM peaks, updated no less than every five years. When local weather records are not available, the values shall be estimated from the best data available.
3. The determination of the Summer Net Capability of fossil and nuclear steam units shall be based on, where applicable, the expected condenser intake water temperature under summer conditions, the expected temperature of once-through or open cooling systems under summer conditions as well as the performance of cooling towers under summer conditions.
4. The determination of the Summer Net Capability of combustion turbine units shall be based on, where applicable, the ambient air temperature and humidity under summer conditions.
5. The determination of the Summer Net Capability of hydro (with storage and/or pooling capability) and pumped storage units shall be based on operational data or test results taken once each PJM delivery year during the summer test period under summer conditions.
6. The determination of the Summer Net Capability of storage (non-hydro) units shall be based on the expected inventory of energy given other market activities for which the storage (non-hydro) unit may be committed under summer conditions.
7. The determination of the Summer Net Capability of hydro units (without storage and/or pooling capability) shall be based on operational data or test results taken once each PJM delivery year during the summer test period. The Summer Net Capability shall be based on the expected head and streamflow under summer conditions.
8. The determination of Summer Net Capability of combined-cycle units shall be based on, where applicable, the expected intake water temperature of once-through or open cooling systems under summer conditions and/or the performance of cooling towers and combustion turbines under summer conditions.

2.3 Winter Net Capability

1. The Winter Net Capability of each generating unit shall be based on winter conditions and on the power factor level normally expected for that generating unit at the time of the annual winter PJM peaks. The winter rating shall be equal to or greater than the summer rating unless documentation is supplied to support the exception.
2. Winter conditions shall reflect the 50% probability of occurrence (approximated by the mean) of ambient site conditions at the time of the last fifteen years' winter PJM peaks. Site conditions shall be based on plant records or local weather bureau records coincident with the dates and times of the last fifteen years' winter PJM peaks, updated no less than every 5 years. When local weather records are not available, the values shall be estimated from the best data available.
3. The determination of Winter Net Capability of fossil and nuclear steam units shall be based on, where applicable, the condenser intake water temperature under winter conditions, the temperature of once-through or open cooling systems under winter conditions as well as the performance of cooling towers under winter conditions.
4. The determination of Winter Net Capability of combustion turbine units shall be based on, where applicable, the ambient air temperature and humidity under winter conditions.
5. The determination of the Winter Net Capability shall be waived for all hydro and pumped storage units.
6. The determination of the Winter Net Capability of storage (non-hydro) units shall be based on the expected inventory of energy given other market activities for which the storage (non-hydro) unit may be committed under winter conditions.
7. The determination of Winter Net Capability of combined-cycle units shall be based on, where applicable, the expected intake water temperature of once-through or open cooling systems under winter conditions and/or the performance of cooling towers and combustion turbines under winter conditions.

Appendix A: Net Capability Verification Guidelines

A.1 Purpose

These guidelines are to supplement the requirements set forth in the PJM manual, ***M-21, Rules and Procedures for Determination of Generating Capability*** by setting forth requirements for Net Capability verification, reporting and review of results to ensure uniform and consistent compliance.

1. Philosophy of Net Capability Verification
 - a. Responsibility
 - i. Generation owners are responsible to comply with these requirements at their own expense.
 - ii. Test data are to be submitted to the Resource Adequacy Planning department (RAP) of PJM via the eGADS system. This requirement applies to both discrete tests and to tests that use actual operating data.
 - b. Exceptions and Deviations.
 - i. Exceptions to and deviations from these Net Capability verification guidelines shall be by RAP approval. These exceptions shall be requested in writing by the generating entity prior to the end of the respective test period for known occurrences such as, but not limited to, environmental restrictions and fuel limitations.
2. Net Capability Verification
 - a. Net Capability verification is to demonstrate the Net Capability of each unit(s) and for CIR retention. If that Net Capability was not demonstrated during the test period, a reduction or derating in eGADS shall be enacted to account for the deficiency. CIR retention is determined based on the largest Corrected Net Test Capacity of the prior three years' summer verification tests conducted during the summer test period. If the Corrected Net Test Capacity in any of the three prior years meets or exceeds the CIR level, CIRs are retained. Results of out of period tests cannot be used in CIR retention calculations.
 - b. Both Summer and Winter Net Capability shall be confirmed annually during the respective test periods:
 - i. The summer test period shall be the first day of June through the last day of August.
 - ii. The winter test period shall be the first day of December through the last day of February. Alternatively, data used to satisfy the Summer Net Capability test may be used to satisfy the winter test requirements after adjustment to the appropriate winter conditions.
 - c. If adequate data is available from normal operation to confirm Net Capability values and to satisfy the reporting requirements during the respective test period, data from normal operation can be used for that period's verification test. Units for which

the foregoing data is not available shall be required to specifically test to confirm Summer and Winter Net Capability values. A test shall include any unit brought on-line or a unit that is on-line and its mode of operation altered for the specific purpose of capability verification. All verification tests, including those based on actual operating data, shall be corrected for the respective summer or winter conditions. Cooling water and ambient conditions typically do not affect the performance of hydroelectric, pumped storage, non-hydro storage, fuel cell and diesel (including other reciprocating engine type) units; hence these types of units are exempt from the aforementioned correction criteria. However, if streamflow or fuel availability is affected, appropriate corrections for summer and/or winter conditions must be applied. The updated peaks, called the PJM Peak Hour History, are published by the Resource Adequacy Planning department after each respective test period and are posted on this PJM webpage: <http://www.pjm.com/planning/resource-adequacy-planning/resource-reports-info.aspx>

- d. The duration of acceptance and verification tests shall be two (2) contiguous hours for nuclear, fossil steam and combined-cycle units, one (1) contiguous hour for hydro, pumped storage, non-hydro storage, simple cycle combustion turbine, fuel cell, and diesel (including other reciprocating engine type) units. If actual operating data is used for any acceptance verification test, the data must be contiguous for the aforementioned unit types and durations.
- e. If a unit does not meet its stated Summer or Winter Net Capability due to a temporary condition that existed prior to the conduct of the test, the deficiency shall be covered by an appropriate reduction (outage or derating) from the date of the problem. If a capability deficiency is uncovered during this verification, a reduction (outage or derating) covering the deficiency shall be entered into the PJM eGADS system retroactive from June 1 or December 1 for summer and winter test periods, respectively.
- f. Net Capability verification is required outside of the test period when a reduction (outage or derating) in eGADS occurred prior to or during the test period which prevented demonstration of maximum Net Capability. The Net Capability shall be demonstrated by either actual operating data or by performing a test outside of the respective test period. Any unit may correct a test shortfall using an out of period test provided that a) the original test was not caused by a lack of fuel availability or other restriction(s) agreed upon in the generating unit's operating licenses or agreements, or b) the original test was not caused by lack of head, streamflow or other restriction(s) agreed upon in the generating unit's operating licenses or agreements.
 - i. If an out of period test is to be conducted for the summer test period, the out of period test must be conducted between September 1 @0000 hours and December 1 @0000 hours. Likewise, if actual operating data is used in lieu of a formal test, the actual operating data must be within the aforementioned dates.
 - ii. If an out of period test is to be conducted for the winter test period, the out of period test must be conducted between March 1 @0000 hours and June 1 @ 0000 hours. Likewise, if actual operating data is used in lieu of a formal test, the actual operating data must be within the aforementioned dates.

Appendix B: Calculating Capacity Values for Wind and Solar Capacity Resources

B.1 Purpose

This appendix describes the procedure for the calculation of capacity values for all wind and solar capacity resources. This procedure is done in place of verification tests.

B.2 Definitions

1. The Capacity Value for a wind or solar 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. The “Capacity Factor” for a wind or solar 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 a wind or solar capacity resource’s Capacity Value.
3. The wind or solar 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. Wind or solar 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 wind or solar 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 wind or solar capacity resource for a particular year is performed by first computing its unique single year capacity factors for each of the prior three summers. Single year capacity factors are based upon operating data for each of those summers, or in the case of an immature wind or solar 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 wind or solar 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 wind or solar 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 solar resources, any hour in which the output of the solar resource 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 GADSSUPPORT@pjm.com by September 30 each year.
- d. For wind resources, any hour in which the output of the wind resource 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 5minute data from the PJM state estimator for each 5minute period without constraints and, for the five minute periods with constraints, values will be determined by linear interpolation using the nearest 5minute 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 wind or solar 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 posted to the PJM website on this webpage: <http://www.pjm.com/planning/resource-adequacy-planning/resource-reports-info.aspx>
- k. Owners of immature wind and solar units may substitute an alternate class average capacity factor with suitable documentation and approval by PJM.

- I. The current Capacity Value is then calculated by multiplying the applicable Capacity Factor from (g) above by the current Net Maximum Capacity of the wind or solar capacity resource.

Revision History

Revision 11 (03/05/2014):

- Added general administrative updates. Added requirement that hydro and pumped storage units must perform ratings test during Summer verification window. Added clarification that all generators, with the exception of hydroelectric, pumped storage and diesel units, must adjust their ratings test for ambient conditions beginning June 1, 2014. Changes were endorsed at the 2/27/14 MRC meeting.

Revision 10 (10/01/2013):

- Added specific instructions for calculating capacity factors for wind resources when hourly output is constrained over summer peak hours.

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. Update to list of Manuals.

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 (06/01/2007):

- 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
- Data Submittal: Added reference to need to adhere to injection right limitations when increases in Installed Capacity (ICAP) are requested
- Appendix A: Part B-4 Added Duration of Test or Operational Status to Satisfy Test Requirements

Revision 04 (08/15/2005):

- 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 (04/30/2004):

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 (11/21/2003):

- 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.
- Renumbered pages to consecutive numbering.

Revision 01 (08/23/2000):

- 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 (10/14/1998):

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