

# PJM Manual 21:

Rules and Procedures for Determination of  
Generating Capability

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System Planning Department

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**Table of Contents**

**Approval.....4**

**Current Revision.....5**

**Introduction..... 6**

    About PJM Manuals..... 6

    About This Manual..... 6

    Using This Manual.....8

**Section 1: Requirements..... 9**

    1.1 Capacity Interconnection Rights..... 9

        1.1.1 Attaining CIRs.....9

        1.1.2 Retaining CIRs..... 9

        1.1.3 Loss of CIRs.....10

        1.1.4 CIR Calculations.....10

        1.1.5 Individual Generating Unit CIR Calculation Example.....10

        1.1.6 Multiple Generating Unit CIR Calculation Example.....10

        1.1.7 CIR Calculations for Wind and Solar Resources..... 11

    1.2 Installed Capacity (ICAP).....12

        1.2.1 Determining Rated Capability (Rated ICAP, Claimed Installed Capacity, etc.).....13

    1.3 Testing.....15

        1.3.1 Acceptance Testing.....15

        1.3.2 CAPMOD Testing.....16

        1.3.3 Capability Verification Testing.....16

        1.3.4 Summer Capability Verification Testing Requirements.....17

        1.3.5 Capacity Interconnection Right Limitations.....20

        1.3.6 Impacts of Test Results.....20

    1.4 Testing Changes Commencing Delivery Year 2022/2023.....22

        1.4.1 PJM Required Simultaneous Multiple Unit Capability Verification Testing.....22

        1.4.2 CIR retention for units subject to PJM Required Simultaneous Multiple Unit Capability Verification Testing.....23

        1.4.3 Simultaneous testing for Capacity Storage and Intermittent Units.....23

        1.4.4 Generator Rating Requirements.....23

**Section 2: Net Capability.....24**

    2.1 General.....24

        2.1.1 Conventional Generating Units.....25

        2.1.2 Capacity Storage Units.....26

        2.1.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)...26

2.1.3-4 Intermittent Units (other than wind and solar).....	27
2.2 Summer Net Corrected Test Capability.....	27
2.2.1 Conventional Generators.....	28
2.2.2 Capacity Storage Units.....	28
2.2.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)...	28
2.2.3-4 Intermittent Units (excluding wind and solar).....	28
2.3 Winter Net Corrected Test Capability.....	29
2.3.1 Conventional Generators.....	29
2.3.2 Capacity Storage Units.....	30
2.3.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)...	30
2.3.3-4 Intermittent Units (excluding Wind and Solar).....	30
<b>Appendix A: Net Capability Verification Guidelines.....</b>	<b>31</b>
A.1 Purpose.....	31
<b>Appendix B: Calculating Capacity Values for Wind and Solar Capacity Resources.....</b>	<b>34</b>
B.1 Purpose.....	34
B.2 Definitions.....	34
B.3 Calculation Procedure.....	34
<b>Revision History.....</b>	<b>37</b>



**Approval**

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## Current Revision

### Revision 14 (08/01/2019):

- Added specific wording, in section 1.1.6, for combined cycle components and other grouped units that report in aggregate pertaining to the CIR evaluation method in section 1.1.5
- Added specific wording for Combined Cycle units with once through cooling in Section 1.3
- Separated run of river hydro units (with pooling/storage/dispatch capability) from the Capacity Storage Resources category to conform to the changes in the OATT

### Revision 13 (05/01/2019):

~~Cover to cover periodic review~~

~~Added a specific reference in the introduction that this manual augments the RAA Schedule 9~~

~~Addition of Capacity Interconnection Rights and Testing section~~

~~Required testing within defined temperature limits~~

~~Commencing with Delivery Year 2022/2023, simultaneous testing requirements for all Manual 18 defined Capacity Storage and Intermittent Resources (excluding wind and solar)~~

~~Commencing with Delivery Year 2022/2023, PJM required simultaneous multiple generator and full plant testing~~

## 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 Reliability Assurance Agreement, Schedule 9.C states:

*“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. This manual is specifically intended to re-inforce and augment Schedule 9 of the Reliability Assurance Agreement.

### 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 Capacity Interconnection Rights

Capacity Interconnection Rights (CIRs) are granted as a function of a control area integration, or the execution of an Interconnection Service Agreement (ISA) or Wholesale Market Participant Agreement (WMPA) as delineated in the specifications section of the respective ISA or WMPA after completion of all required work. Rights may also be granted on interim bases in the ISA or WMPA.

PJM's planning department determines whether the transmission and/or distribution system can receive power commensurate with the CIR level of a generating unit and whether upgrades to the system are needed in order to receive the power therein. CIRs are evaluated under summer peak conditions.

The CIR level of a generating unit is reflective of the net capability of the generating unit at the time of the expected summer peak (this does not include wind and solar units; wind and solar units CIRs are discussed in section 1.1.7 below). Net capability is discussed in section 2 of this manual and cannot be higher than the CIR level; however, it can be lower. CIRs are typically granted on an individual generating unit basis, but, in some cases, can be issued in aggregate at the Point of Interconnection (POI).

#### 1.1.1 Attaining CIRs

CIRs can only be attained or increased by entering the New Services Queue and executing an ISA or WMPA following the study process. These increases are expected to be for improvements to the generating units such as, but not limited to, more efficient components, improved control systems, and for capital projects that restore generating unit capability such as boiler rebuilds and turbine overhauls. If the studies identify any system upgrades are required to obtain the rights, then those upgrades must be completed before the rights are available for use by the generating unit in the market. The three year clock on the new CIR level commences at the beginning of the next summer test period after the CIRs are declared in-service, regardless if the owner exercised the rights in the market or they are interim rights. If CIRs are declared in-service during the summer test period the three year clock will have started on the declared in service date.

#### 1.1.2 Retaining CIRs

CIRs are retained when a generating unit proves its CIR level in the PJM Summer Capability Verification Test once in the most recent consecutive three year period. Out-of-period tests cannot be used for CIR retention calculations; out-of-period tests are described later in this document.

If CIRs are granted on an interim bases, in advance of the studied delivery year identified in the System Impact Study, the three year clock to maintain the rights commences at the beginning of the next summer test period after the CIRs are declared in-service, regardless if the owner exercised the rights in the market or they are interim rights. If CIRs are declared in-service during the summer test period the three year clock will have started on the declared in service date.

### 1.1.3 Loss of CIRs

CIRs are lost when a generating unit fails to prove its CIR level in the PJM Summer Capability Verification Test once in the most recent consecutive three year period. If CIRs are lost, the quantity lost will be the difference between the current CIR level and highest Net Corrected Test Capability proved in the most recent three consecutive years' PJM Summer Capability Verification Test.

### 1.1.4 CIR Calculations

Retention or loss of CIRs is determined by PJM for each generating unit that holds CIRs by performing calculations annually, in the fourth quarter of the calendar year, after the PJM Summer Capability Verification Tests have been submitted to PJM near the end of the third quarter of the calendar year.

### 1.1.5 Individual Generating Unit CIR Calculation Example

A generating unit is granted 105 MW CIRs as a result of a newly executed ISA and is declared in service on 6/1/2018. The generating unit tests to 105.2 MW, 102.5 MW and 103.5 MW in the next three consecutive years PJM Summer Capability Verification Tests. Since the generating unit met its CIR level in the first test year of the most recent three, the generating unit retains its 105 MW of CIRs until the next evaluation of CIRs occurs (in this case the next evaluation will occur in the 4<sup>th</sup> quarter of 2021).

Suppose in the next PJM Summer Capability Verification Test (in the fourth test summer), the unit tests to 103.0 MW. In the 4<sup>th</sup> quarter of 2021, the highest of the most recent three years PJM Summer Capability Verification tests is then 103.5 MW. The generating unit will then lose 1.5 MW of CIRs.

If the new CIR level is below the PJM RPM ICAP value on or after 2/1/2022, the generating unit's owner must CAPMOD the unit down to its CIR level or lower, effective 2/1/2022. This is discussed further in section 1.3.5 under the heading Capacity Interconnection Right Limitations.

### 1.1.6 Multiple Generating Unit CIR Calculation Example

A Combined Cycle generating unit (2 combustion turbine generators and one steam turbine generator) is granted 750 MW CIRs as a result of a newly executed ISA and is declared in service on 6/1/2018. If the three component generators are issued unit specific CIRs (this should be delineated in the executed agreement) their evaluation will follow the rules for individual generating unit CIR evaluation. **Also, if the generating unit is an aggregate of multiple generating units (i.e. combined cycle block or group of units) and it is reported as one unit, its evaluation will follow the rules for individual generating unit CIR evaluation in section 1.1.5 above.**

In this example, the individual units CIRs were not delineated. The combined cycle generating unit tests to 750.0 MW, 745.3 MW and 746.2 MW in the next three consecutive years PJM Summer Capability Verification Tests. Its individual components test as follows:

Unit	Summer 2018 Test	Summer 2019 Test	Summer 2020 Test	Summer 2021 Test
CT1	201.0	200.0	199.0	200.0
CT2	199.0	199.0	199.0	201.0

ST	350.0	346.3	348.2	349.0
Total	750.0	745.3	746.2	750.0

Since the generating unit met or exceeded its CIR level in the first test year of the most recent three, the generating unit retains its 750 MW of CIRs until the next evaluation of CIRs occurs (in this case the next evaluation will occur in the 4th quarter of 2021). The CIRs for each component have now been established after the third year of testing. CT1 has 201.0 MW of CIRs; CT2 has 199.0 MW of CIRs; ST1 has 350.0 MW CIRs; these CIRs in aggregate total 750.0 MW.

Suppose in the next PJM Summer Capability Verification Test (in the fourth test summer), the unit tests to 750.0 MW as shown above. In the 4th quarter of 2021, the highest of the most recent three years PJM Summer Capability Verification Tests is then determined on the individual components of the combined cycle unit rather than the combined components. The CIRs are then evaluated as follows:

The CT1 CIR level was 201.0 MW and its highest test in the most recent three years is 200.0 MW; it loses 1.0 MW of CIRs; its new CIR level is 200.0 MW

The CT2 CIR level was 199.0 MW and its highest test in the most recent three years is 201.0 MW; it loses no CIRs; it retains its existing CIRs of 199.0 MW

The ST CIR level was 350.0 MW and its highest test in the most recent three years is 349.0 MW; it loses 1.0 MW of CIRs; its new CIR level is 349.0 MW

The combined cycle in aggregate now has 748.0 MW of CIRs.

If the new CIR level is below the PJM RPM ICAP value on or after 2/1/2022, the generating unit's owner must CAPMOD the unit down to its CIR level or lower on each component, effective 2/1/2022. This is discussed further in section 1.3.5 under the heading Capacity Interconnection Right Limitations.

### 1.1.7 CIR Calculations for Wind and Solar Resources

CIR calculations for wind and solar resources are based on the summer peak hour capacity factor of each wind/solar resource. CIRs are retained when a wind or solar units highest summer capacity factor of the most recent three summer periods meets or exceeds the capacity factor associated with its CIRs. If a wind or solar units highest capacity factor of the most recent three summers does not meet or exceed the capacity factor associated with its CIRs, the wind or solar unit will lose CIRs in the amount associated with the difference between the highest capacity factor of the most recent three years and the capacity factor associated with its CIRs. For example, if a wind unit with a 100 MW installed capacity is granted 18 MW of CIRs associated with a 18% capacity factor in its ISA or WMPA, and the wind unit, in its first three summers of operation, respectively, produced at capacity factors of 18%, 16% and 17%, there will be no loss of CIRs since the unit achieved its CIR level capacity factor in its first summer of operation. If, in the next summer, it only produces at a 15% capacity factor, it will then lose the difference between the 18% CIR capacity factor and the highest capacity factor of the three most recent years (17%), multiplied by the installed capacity (100 MW); hence the next year, the new CIR level will be 17 MW.

## 1.2 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 PJM eGADS and the Summer Net Capability defined in section 2.2 of this document.

ICAP is also the capability of the generating unit at the expected time of the PJM Summer Peak. This is also referred to as the “rated capability” or “rated ICAP.” Rated capability or rated ICAP is determined by adjusting the generators capability for generator site conditions coincident with the dates and times of the last 15 years PJM summer peaks. **Generator site conditions coincident with the last 15 years’ PJM summer peaks are also known as summer conditions.** Summer Conditions are specifically defined in section 2.2, item 2 of this manual. Generator capability corrected to summer conditions is a proxy for a generators capability at future PJM summer peaks. All generators that are affected by generator site conditions that participate in the PJM Markets must correct their generators capability to summer conditions. Some generating units may not be affected by any of the conditions below; hence, they do not have to correct their capability to those conditions. Generator site conditions include, but are not limited to, dry bulb temperature, relative humidity, wet bulb temperature, dew point temperature, barometric pressure and cooling body temperature (circulating water temperature). It is assumed that all generators have already adjusted their capability for their respective elevation. Additionally, streamflow and forebay (reservoir) elevation (head) are generator site conditions specific to hydroelectric units and state of charge is a generator site condition applicable to battery storage units.

Calculation of ICAP must also take into consideration station service power use and other load, such as, but not limited to, host process load (including steam, mechanical and electrical loads), scrubber load, cooling load, supplemental cooling load and any other load that supports the generating unit. These station service and auxiliary loads should be commensurate with those experienced coincident with the most recent 15 years PJM summer peaks (i.e. under summer conditions). Additionally, if other load is used only under extreme conditions, and those conditions existed during any of the most recent 15 years PJM summer peaks, that load must be accounted for in the ICAP calculation. For example, if supplemental cooling load has been used during 10 of the 15 most recent PJM summer peaks, then two thirds of that load (the average supplemental cooling load used during the 10 years) should be removed from the generators ICAP to account for the expected supplemental cooling load. Additionally, if there is common load that is split among the generators at a plant, such as, but not limited to, scrubber load, that load must also be accounted for in the determination of ICAP.

It is important to remember, if a generators rated ICAP is determined by using a particular set of generator site conditions, the summer/winter capability verification tests, CAPMOD tests and acceptance tests must be corrected for the same set of generator site conditions under summer/winter conditions. In other words, if a generator’s rated ICAP is determined using only dry bulb temperature and relative humidity, then the generators summer/winter capability verification tests, CAPMOD tests and acceptance test must use only dry bulb temperature and relative humidity to correct the tests to summer/winter conditions. If it is desired that

additional generator site conditions be used to correct summer/winter capability verification tests, CAPMOD tests and acceptance tests, then the rated capability (rated ICAP) must be re-determined to include those additional generator site conditions. The generator site conditions under which a generator's rated ICAP is determined are known as rated conditions. Specifically, rated conditions such as, but not limited to, rated temperature, rated relative humidity and rated cooling water temperature are typically submitted with all tests. Observed conditions, those generator site conditions under which the test was performed, are also submitted with all tests.

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

### 1.2.1 Determining Rated Capability (Rated ICAP, Claimed Installed Capacity, etc.)

#### 1. Steam Units

- a. Steam units with only once through cooling must have their ICAP determined by adjusting for cooling body (circulating water) temperature under summer conditions.
- b. Steam units with only wet cooling towers must have their ICAP determined by adjusting for wet bulb temperature under summer conditions. Basically this is an adjustment for temperature and relative humidity; however, barometric pressure can affect the wet bulb temperature and adjustments for barometric pressure are permitted and encouraged.
- c. Steam units with only dry cooling towers must have their ICAP determined by adjusting for dry bulb temperature under summer conditions.
- d. Steam units with both wet and dry cooling towers must have their ICAP determined by adjusting appropriately for the generator site conditions listed in (b) and (c) above under summer conditions.
- e. Steam units with a combination of once through cooling and wet cooling towers must have their ICAP determined by adjusting appropriately for the generator site conditions in (a) and (b) above under summer conditions.

#### 2. Nuclear Units

- a. Nuclear units with only once through cooling must have their ICAP determined by adjusting for cooling body (circulating water) temperature under summer conditions.
- b. Nuclear units with only wet cooling towers must have their ICAP determined by adjusting for wet bulb temperature under summer conditions. Basically this is an adjustment for temperature and relative humidity; however, barometric pressure can affect the wet bulb temperature and adjustments for barometric pressure are permitted and encouraged.
- c. Nuclear units with a combination of once through cooling and wet cooling towers must have their ICAP determined by adjusting appropriately for the generator site conditions in (a) and (b) above under summer conditions.

#### 3. Combustion Turbine Units

- a. Combustion turbine units with no compressor inlet cooling or conditioning must have their ICAP determined by adjusting for dry bulb temperature under

- summer conditions. However, adjustments for relative humidity are permitted and encouraged.
- b. Combustion turbine units with compressor inlet cooling or conditioning must have their ICAP determined by adjusting for wet bulb temperature under summer conditions. Basically this is an adjustment for temperature and relative humidity; however, barometric pressure can affect the wet bulb temperature and adjustments for barometric pressure are permitted and encouraged. Compressor inlet cooling or conditioning includes, but is not limited to, evaporative cooling, use of chillers, fogging or wet compression.
4. Combined Cycle Units
    - a. Combined cycle units with no combustion turbine compressor inlet cooling or conditioning must have their combustion turbine ICAP determined by adjusting for dry bulb temperature under summer conditions.
    - b. Combined cycle units with compressor inlet cooling or conditioning must have their combustion turbine ICAP determined by adjusting for wet bulb temperature under summer conditions. Basically this is an adjustment for temperature and relative humidity; however, barometric pressure can affect the wet bulb temperature and adjustments for barometric pressure are permitted and encouraged. Compressor inlet cooling or conditioning includes, but is not limited to, evaporative cooling, use of chillers, fogging or wet compression.
    - c. Combined cycle units with only once through cooling on the steam components must have their steam unit ICAP determined by adjusting for cooling body (circulating water) temperature under summer conditions.
    - d. Combined cycle units with only wet cooling towers on the steam components must have their steam unit ICAP determined by adjusting for wet bulb temperature under summer conditions. Basically this is an adjustment for temperature and relative humidity; however, barometric pressure can affect the wet bulb temperature and adjustments for barometric pressure are permitted and encouraged.
    - e. Combined cycle units with only dry cooling towers on the steam components must have their steam unit ICAP determined by adjusting for dry bulb temperature under summer conditions.
    - f. Combined cycle units with both wet and dry cooling towers on the steam components must have their steam unit ICAP determined by adjusting for the generator site conditions listed in (d) and (e) above under summer conditions.
  5. Diesel and Reciprocating Engine Units
    - a. Diesel and reciprocating engine units do not need to have their ICAP adjusted for summer conditions since they are rarely affected sufficiently to warrant adjustments for generator site conditions.
  6. Fuel Cell Units
    - a. Fuel cell units do not need to have their ICAP adjusted for summer conditions since they are rarely affected sufficiently to warrant adjustments for generator site conditions.
  7. Pumped Storage Hydroelectric Units

- a. Pumped storage hydroelectric units must have their ICAP determined by adjusting for head (reservoir level/elevation) under summer conditions.
8. Run of River Hydroelectric Units (with pooling/storage/dispatch capability)
  - a. Run of river hydroelectric units (with pooling/storage/dispatch capability) must have their ICAP determined by adjusting for forebay inflows and head (reservoir level/elevation) under summer conditions.
9. Run of River Hydroelectric Units (without pooling/storage/dispatch capability)
  - a. Run of river hydroelectric units (without pooling/storage/dispatch capability) must have their ICAP determined by adjusting for forebay inflows and head (reservoir level/elevation) under summer conditions.
10. Battery Storage Units
  - a. Battery storage units must have their ICAP determined by adjusting for state of charge under summer conditions. Also, all units at the plant must have their rated ICAP based on simultaneous operation.

## 1.3 Testing

There are three types of testing required of generating units in PJM: Acceptance testing, CAPMOD testing and Capability Verification testing. Acceptance testing is required of all newly constructed generators in PJM. CAPMOD testing is required of all generators that increase their ICAP values in the PJM Capacity Markets. Capability Verification testing is required of all generators that participate in the PJM RPM Capacity Markets or have a commitment in those markets. Capability Verification testing is recommended for those generators that hold Capacity Interconnection Rights (CIRs) and do not participate in the PJM RPM Capacity Markets.

### 1.3.1 Acceptance Testing

1. Acceptance tests for newly constructed generating units must be completed prior to any new generating unit's CAPMOD effective date in the PJM Capacity Markets. These acceptance tests can be performed simultaneously with vendor/architect/engineering firm acceptance tests; however, the initial CAPMOD effective date must follow successful vendor/architect/engineering firm acceptance tests and successful emissions testing. In other words, the unit must have a valid emissions permit and have been released to the generator owner by the vendor/architect/engineering firm for participation in the PJM 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 and this ICAP cannot exceed the CIR level delineated in the generating units ISA or WMPA.
2. The newly constructed generators ICAP (Rated ICAP) value must be determined in accordance with section 1.2 of this manual.
3. In cases when a newly constructed generating unit's participation in the PJM Capacity Markets increases by a series of CAPMODs, subsequent acceptance test(s) must be conducted prior to any subsequent CAPMOD effective date(s). Failure to meet or exceed the ICAP in any acceptance test will be remedied by entering a CAPMOD that causes

the PJM RPM Markets ICAP value to be equal to or lower than the Net Corrected Test Capacity in the Acceptance test; however, the ICAP value must not exceed the CIR level delineated in the generating units ISA or WMPA.

4. A final acceptance test, conducted within the summer test period, will also be accepted as the Summer Capability Verification test for that year as long as it is corrected for summer conditions (pursuant to section 2 of this document) and meets the requirements of section 1.3.4 of this manual.

### 1.3.2 CAPMOD Testing

1. In cases when a generating unit's ICAP increases in the PJM Capacity Market by a CAPMOD, a CAPMOD test must be conducted within 30 days of the CAPMOD effective date. If the CAPMOD effective date is within the summer test period (June 1-August31) the summer capability verification test (pursuant to section 2 of this document) can be used in lieu of a separate CAPMOD test.
2. The new ICAP (the sum of the CAPMODs to date) must be determined in accordance with section 1.2 of this manual.
3. This excludes new generating units that have submitted acceptance tests in, or prior to, the summer test period. Units in this category must follow the acceptance test guidelines in section 1.3.1 above.
4. A recent Summer/Winter Capability Verification test is to accompany any CAPMOD increasing the Summer/Winter 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.
5. A failed test that does not meet or exceed the ICAP after a CAPMOD must be remedied by a CAPMOD down 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.

### 1.3.3 Capability Verification Testing

1. Verification tests for all PJM capacity resources (other than hydro, wind and solar) are to be submitted for both summer and winter test periods. Hydroelectric generators need only submit summer verification tests and hydroelectric generating units have only one test period, the summer test period, during the year. Wind and solar units' capability verification are discussed in Appendix B of this manual.
2. The summer test period starts at June 1 @0000 hours local plant time and ends at September 1 @0000 hours local plant time.
3. The winter test period starts at December 1 @0000 hours local plant time and ends at March 1 @0000 hours local plant time.
4. 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.



5. 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.
6. In cases (4) and (5) above, the recent Summer Capability Verification test must have been conducted within the 12 months prior to the CAPMOD effective date.
7. In cases (4) and (5) above, 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. If the CAPMOD effective date is within the summer test period (June 1-August 31) the summer capability verification test (pursuant to section 2 of this document) can be used in lieu of a separate CAPMOD test. 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

#### 1.3.4 Summer Capability Verification Testing Requirements

1. Steam and Nuclear Units
  - a. For units with once through cooling only, tests should be conducted when the site cooling body water temperature is within 5°F of rated cooling body water temperature. Rated cooling body water temperature is equal to the average site cooling body water temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated cooling body water temperatures. The correction should be delineated separately on the test form in PJM eGADS; both the cooling body observed and rated water temperatures should also be submitted.
  - b. For units with only wet cooling towers, tests should be conducted when the generator site wet bulb temperature is within 10°F of rated wet bulb temperature. Rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated wet bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity and the wet bulb temperature should also be submitted for both observed and rated conditions.
  - c. For units with only dry cooling, tests should be conducted when the generator site dry bulb temperature is within 20°F of rated dry bulb temperature. Rated dry bulb temperature is equal to the average site dry bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated dry bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature should also be submitted for both observed and rated conditions.
  - d. For units with a combination of once through cooling and wet cooling towers, tests should be conducted when the generator site cooling body water is within 5°F

of rated cooling body water temperature. Rated cooling body water temperature is equal to the average site cooling body water temperature coincident with the last 15 years PJM summer peaks and rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated cooling body water temperatures and observed and rated wet bulb temperatures. This correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity, wet bulb temperature and cooling body water temperature should also be submitted for both observed and rated conditions.

## 2. Combustion Turbine Units

- a. For units with compressor inlet cooling (chillers, fogging, evaporative cooling, wet compression, etc.), tests should be conducted when the generator site wet bulb temperature is within 10°F of rated wet bulb temperature. Rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated wet bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity and the wet bulb temperature should also be submitted for both observed and rated conditions.
- b. For units without compressor inlet cooling, tests should be conducted when the generator site dry bulb temperature is within 20°F of rated dry bulb temperature. Rated dry bulb temperature is equal to the average site dry bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated dry bulb temperatures. If corrections for relative humidity are desired, corrections for both can be calculated as long as rated conditions include both dry bulb temperature and relative humidity. The corrections should be delineated separately on the test form in PJM eGADS; the dry bulb temperature and relative humidity should also be submitted for both observed and rated conditions.

## 3. Combined Cycle Units

- a. For combustion turbine components with compressor inlet cooling (chillers, fogging, evaporative cooling, wet compression, etc.), tests should be conducted when the generator site wet bulb temperature is within 10°F of rated wet bulb temperature. Rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated wet bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity and the wet bulb temperature should also be submitted for both observed and rated conditions.
- b. For combustion turbine components without compressor inlet cooling or conditioning, tests should be conducted when the generator site dry bulb temperature is within 20°F of rated dry bulb temperature. Rated dry bulb temperature is equal to the average site dry bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated dry bulb temperatures. It is encouraged and permitted to also

- correct for relative humidity although it is not mandatory. The correction(s) should be delineated separately on the test form in PJM eGADS; the dry bulb temperature and relative humidity should also be submitted for both observed and rated conditions.
- c. For steam components with once through cooling only, tests should be conducted when the site cooling body water temperature is within 5°F of rated cooling body water temperature. Rated cooling body water temperature is equal to the average site cooling body water temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated cooling body water temperatures. The correction should be delineated separately on the test form in PJM eGADS; both the cooling body observed and rated water temperatures should also be submitted.
  - d. For steam components with a combination of once through cooling and wet cooling towers, tests should be conducted when the generator site cooling body water is within 5°F of rated cooling body water temperature. Rated cooling body water temperature is equal to the average site cooling body water temperature coincident with the last 15 years PJM summer peaks and rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated cooling body water temperatures and observed and rated wet bulb temperatures. This correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity, wet bulb temperature and cooling body water temperature should also be submitted for both observed and rated conditions.
  - e. For steam components ~~units~~ with wet cooling towers ~~on their steam components~~, tests should be conducted when the generator site wet bulb temperature is within 10°F of rated wet bulb temperature. Rated wet bulb temperature is equal to the average site wet bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated wet bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature, relative humidity and the wet bulb temperature should also be submitted for both observed and rated conditions.
  - f. For steam components ~~units~~ with dry cooling ~~on their steam components~~, tests should be conducted when the generator site dry bulb temperature is within 20°F of rated dry bulb temperature. Rated dry bulb temperature is equal to the average site dry bulb temperature coincident with the last 15 years PJM summer peaks. Tests need to be corrected for performance due to the difference between observed and rated dry bulb temperatures. The correction should be delineated separately on the test form in PJM eGADS; the dry bulb temperature should also be submitted for both observed and rated conditions.
4. In cases where multiple conditions must be met on any generating unit, the following generator site condition test correction hierarchy must be followed:
    - a. If there is once through cooling, the test must be performed within 5°F of rated cooling body water temperature.
    - b. If there is no once through cooling and there is wet cooling, the test must be performed within 10°F of rated wet bulb temperature.

- c. If there is dry cooling or no inlet cooling, the test must be performed within 20°F of rated dry bulb temperature.
5. All Units in section 1.3.4.1, 1.3.4.2 and 1.3.4.3 above
  - a. If it is impractical to test the unit types above, within the temperature and humidity limits delineated above, testing can occur without adherence to the aforementioned temperature and humidity limits as long as the testing start time is 10 am or later and the testing end time is 10 pm or earlier on any day from July 7th through August 31st.
  - b. If testing has been completed per section 1.3.4.4.54.a above and at a later date, within the summer test period, the generator can meet the temperature requirements listed in sections 1.3.4.1, 1.3.4.2 or 1.3.4.3 above, a re-test is not required.
  - c. For the purposes of this document “wet cooling” shall mean any wet cooling used in cooling circulating water or combustion turbine inlet cooling of any type.
6. Units other than those cited in sections 1.3.4.1, 1.3.4.2 and 1.3.4.3 above
  - a. All units other than those cited in sections 1.3.4.1, 1.3.4.2 and 1.3.4.3 above can test in any set of hours as long as the test start time is on or after June 1 @0000 hours and the test end time is on or before September 1 @0000 hours.

### 1.3.5 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 Resource Adequacy Department of the PJM Interconnection. If CIRs for the generating unit(s) were issued on a revenue meter basis, then Net Capacity testing must be verified on all generating units behind that respective revenue meter, simultaneously. For the purposes of capability testing only, 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 a new ISA or WMPA. (see section 1.1 of this document for complete details on CIRs)

### 1.3.6 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, item 4 of this document), or c) the beginning of the next test period. Out of period tests cannot be performed to remedy a shortfall caused by lack of resources or environmental constraints, such as, but not limited to, streamflow, head, lack of fuel, opacity, thermal discharge limits or emissions limits. Also, a Generation Resource Rating Test Failure Charge, per PJM Manual 18, PJM Capacity Market, will be assessed if a verification test shortfall is not accompanied by a derating in the eGADS system and a derate event was not submitted by the generating units owner or agent. Examples of applying the failed test rules 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.
4. **Late Data Submittal Charges** - 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 deadlines for verification test result submittal are September 20 for the summer test period and March 20 for the winter test period.

5. **RPM Resources that are aggregates of multiple generating units** – Typically, units that are thermally dependent (Combined Cycle and Cross Compound units) are tested simultaneously as one generating unit even though there are multiple generators associated with the unit as a whole. This allows the aggregated unit to pass the capability verification test in aggregate even though one or more individual components may not. This allows the excess of units in the aggregate to offset the deficiency of the other units in the aggregate. This is allowed so that thermally dependent units do not have to take a component derate for test failures as specified in section 1.3.7.2 of this manual. This has been specifically for units that are thermally dependent and test simultaneously. This treatment is allowed for any aggregated RPM resource that has interdependency as long as all resource components (i.e. all units at the plant) are tested simultaneously. Typically, these resource types are hydroelectric units that get their energy from a common water source (streamflow and/or head) or landfill gas generators that get their landfill gas from a common landfill gas collection system. However, once an aggregate test is performed, the units in that aggregate must continue to test in aggregate for all future capability verification tests until they disaggregate in RPM.

## 1.4 Testing Changes Commencing Delivery Year 2022/2023

The following changes in this section will become effective on June 1, 2022 and they are being delineated here as a reminder that these requirements will be in effect for any generating unit that participates in any auction for Delivery Year 2022/2023 and later.

### 1.4.1 PJM Required Simultaneous Multiple Unit Capability Verification Testing

1. PJM, at its discretion, can require multiple generating units to perform simultaneous Capability Verification tests during the Summer Test Period. This is to ensure that all shared auxiliary, common and process load is accounted for during Capability Verification tests. This also ensures proper testing for units with common cooling intakes and that share cooling water and auxiliary equipment.
2. PJM will limit the number of plants subject to simultaneous testing to a maximum not to exceed ten per summer test period and notify each plant owner/agent prior to the summer test period which generating units and plant(s) have been chosen for simultaneous testing. PJM will also specify a period of time in which the simultaneous tests must be performed. This period of time will be no less than a contiguous fourteen day period for each set of generating units.
3. Keep in mind, that CIR retention calculations for units that are subject to simultaneous multiple unit Capability Verification testing for three or more consecutive summer test periods, are based on sum of the multiple generating units Net Corrected Test Capacities (the actual corrected summer test value) and the sum of multiple generating units CIRs (see Section 1.1.2 of this manual).
4. Coordination between PJM Dispatch and the Generator Owner will be necessary for testing units whether they are scheduled day ahead or real time and it is important for both the Generator Owner and the PJM Dispatcher to maintain open communications. It is also incumbent upon the Generation Owner to ensure its preparation for the generator/plant testing has been executed properly. PJM will facilitate test coordination with other dependent resources, e.g. run of river hydro units. There may be times

that testing cannot be accommodated by PJM Dispatch because of constraints or other system issues. If PJM Dispatch cannot accommodate the testing, extension of the delineated testing period in the PJM required simultaneous testing request can be granted only for those capacity verification tests specifically delineated under section 1.4.1 of Manual 21. If an extension is needed because PJM Dispatch could not accommodate simultaneous testing under Manual 21, section 1.4.1, please email [gadssupport@pjm.com](mailto:gadssupport@pjm.com) and request an extension of the delineated time period.

#### **1.4.2 CIR retention for units subject to PJM Required Simultaneous Multiple Unit Capability Verification Testing**

In cases where simultaneous multiple unit testing (discussed in section 1.4.1 above) was required of the same set of units for three consecutive summer test periods, CIR retention will be determined on the sum of the multiple unit Net Corrected Test Capacities and the sum of the multiple unit CIRs. CIR evaluation will then occur based on the highest test year of the three and the individual unit Net Corrected Test Capacities of that highest year will be used.

#### **1.4.3 Simultaneous testing for Capacity Storage and Intermittent Units**

Capacity Storage and Intermittent units, as defined in Manual 18, located at the same plant must perform their summer and winter capability verification tests simultaneously. This excludes Wind and Solar units. There may be additional testing parameters that are collected with the summer and winter verification tests for the aforementioned units types. These parameters are, but are not limited to: forebay elevation(s), discharge rate(s), tailwater elevation(s), reservoir elevation(s) and volume(s), state(s) of charge, etc..

#### **1.4.4 Generator Rating Requirements**

Section 1.2 of this manual states that ICAP is the capability of a generating unit at the expected time of the PJM Summer Peak. It is intended that adjusting ICAP to summer conditions is a proxy for a generators ICAP during future PJM summer peaks. By definition, rating all generators at a plant based on conditions coincident with the last 15 years' PJM summer peaks, all generators should then be rated coincident with those conditions and hence, be rated for simultaneous operation. However, this is not specifically delineated in section 1.2 of this manual. Commencing Delivery Year 2022/2023 all generating units at a plant must be rated for simultaneous operation. This is to account for shared auxiliary loads and any interdependence therein.

## 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 at the time of the summer PJM peak.
3. After a unit is in operation, its Net Capability shall be based on current operating performance or test results. Specifically, once a generator has historical operating data, it is expected that the data be used to render more appropriate rated ICAP values by updating them no less than once every five years (refer to section 2.2, item 2 of this manual). It is preferred that the rated ICAP values be updated more often, when changes to rated ICAP are realized. 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 4 and 7 below.
4. 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 (CAPMOD down) 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.
5. 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 that cannot be sustained for a number of hours of continuous operation commensurate with PJM load requirements, specified as 10 hours, shall be considered as limited energy capability. 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).

6. 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.
7. 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 5 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.

### 2.1.1 Conventional Generating Units

1. Adjustments for generator site conditions (delineated in section 1.2 of this manual) under summer and winter conditions must be used to determine generator Net Capability (rated ICAP).
2. The determination of the Net Capability (rated ICAP) 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.
3. The determination of the Net Capability (rated ICAP) 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. If these procedures are used for determining Net Capability (Rated ICAP), then they should also be used for their respective Summer/Winter Capability Verification tests.
4. The determination of the Net Capability (rated ICAP) of a nuclear unit shall recognize its nuclear fuel management program and any restrictions (except as noted in section 2.1, item 4 above) imposed by regulatory authority.
5. The determination of Net Capability (rated ICAP) for a combustion turbine unit shall be consistent with the owner's policy with respect to maximum outputs.

6. The determination of Net Capability (rated ICAP) for a reciprocating engine unit or fuel cell unit shall be consistent with the owner's policy with respect to maximum outputs and on the type(s) of fuel used.
7. The Net Capability (rated ICAP) of a planned steam or combined-cycle unit shall be based on the manufacturer's guarantee or estimate of performance corrected for the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).
8. The Net Capability (rated ICAP) 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 and the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).
9. The Net Capability (rated ICAP) of a planned reciprocating engine unit or fuel cell unit shall be consistent with the owner's policy with respect to maximum outputs and on the type(s) of fuel used.

### 2.1.2 Capacity Storage Units

1. The determination of Net Capability (rated ICAP) 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 under summer conditions.
2. The determination of Net Capability (rated ICAP) 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. All units at the respective plant must be rated for simultaneous operation under the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).
3. The Net Capability (rated ICAP) of a planned hydro (with storage and/or pooling capability) or pumped storage unit shall be based on the expected head and/or streamflow in accordance with item 1 above. All units at the respective plant must be rated for simultaneous operation under the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).
4. The Net Capability (rated ICAP) 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 under summer conditions. All units at the respective plant must be rated for simultaneous operation under the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).

### 2.1.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)

1. The determination of Net Capability (rated ICAP) for a run of river hydro unit (with pooling/storage/dispatch capability) 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 under summer conditions.

2. The Net Capability (rated ICAP) of a planned run of river hydro unit (with pooling/storage/dispatch capability) shall be based on the expected head and/or streamflow in accordance with item 1 above. All units at the respective plant must be rated for simultaneous operation under the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).

### **2.1.3-4 Intermittent Units (other than wind and solar)**

1. The determination of Net Capability (rated ICAP) 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 under summer conditions.
2. The Net Capability (rated ICAP) of a generating unit consuming landfill gas shall be based on the availability of landfill gas at the expected time of the PJM peak under summer conditions.
3. The Net Capability (rated ICAP) of a planned hydro unit (without storage and pooling capability) shall be based on the expected head and streamflow at the expected time of the PJM peak under summer conditions. All units at the respective plant must be rated for simultaneous operation for the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).
4. The Net Capability (rated ICAP) of a planned generating unit consuming landfill gas shall be based on the availability of landfill gas at the expected time of the PJM peak under summer conditions. All units at the respective plant must be rated for simultaneous operation under the expected site conditions coincident with the last 15 years PJM summer peaks (i.e. under summer conditions pursuant to section 1.2 of this manual).

## **2.2 Summer Net Corrected Test Capability**

1. The Summer Net Corrected Test Capability of each generating unit shall be based on the actual generator site conditions observed at the time of the summer test.
2. Summer conditions shall reflect the 50% probability of occurrence (approximated by the mean) of generator site conditions coincident with the dates and times 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. Generator site conditions include, but are not limited to, dry bulb temperature, relative humidity, wet bulb temperature, dew point temperature, cooling body (circulating water) water temperature and barometric pressure. If tests are corrected using any of the above parameters observed during the test, rated site conditions must also include those same parameters. In other words, if only wet bulb temperature and barometric pressure are used to render a correction, the rated ICAP must be determined using only wet bulb temperature and barometric pressure coincident with the dates and times of the last 15 years PJM summer peaks. These conditions under which rated ICAP is determined are known as rated conditions.

3. The Summer Net Corrected Test Capability is the Summer Net Test Capability plus the correction (if any) for observed generator site conditions (those conditions present at the generator site at the time of the test).

### 2.2.1 Conventional Generators

1. The determination of the Summer Net Corrected Test Capability of fossil and nuclear steam units shall be based on, where applicable, the actual observed condenser intake water temperature, the actual observed temperature of once-through and/or open cooling systems as well as the actual observed performance of cooling towers during the summer test
2. The determination of the Summer Net Corrected Test Capability of combustion turbine units shall be based on, where applicable, actual observed generator site conditions during the summer test.
3. The determination of Summer Net Corrected Test Capability of combined-cycle units shall be based on, where applicable, the actual observed intake water temperature of once-through or open cooling systems and/or the actual observed performance of cooling towers and combustion turbines during the summer test.
4. The determination of the Summer Net Corrected Test Capability of reciprocating engine units or fuel cell units shall be based on operational data or test results taken once each PJM delivery year during the summer test.

### 2.2.2 Capacity Storage Units

1. The determination of the Summer Net Corrected Test 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. The Summer Net Corrected Test Capability shall be based on the actual head and/or streamflow during the summer test.
2. The determination of the Summer Net Corrected Test Capability of storage (non-hydro) units shall be based on the actual inventory of energy given other market activities for which the storage (non-hydro) unit may be committed and the actual state of charge during the summer test.

### 2.2.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)

1. The determination of the Summer Net Corrected Test Capability of run of river hydro units (with pooling/storage/dispatch capability) shall be based on operational data or test results taken once each PJM delivery year during the summer test. The Summer Net Corrected Test Capability shall be based on the actual head and/or streamflow during the summer test

### 2.2.3-4 Intermittent Units (excluding wind and solar)

1. The determination of the Summer Net Corrected Test 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. The Summer Net Corrected Test Capability shall be based on the actual head and/or streamflow during the summer test.

2. The determination of the Summer Net Corrected Test Capability of units consuming landfill gas shall be based on operational data or test results taken once during the summer test. The Summer Net Corrected Test Capability shall be based on the actual landfill gas production during the summer test. If the generating unit is a combustion turbine it shall also be based on, where applicable, actual generator site conditions during the summer test.

## 2.3 Winter Net Corrected Test Capability

1. The Winter Net Corrected Test Capability of each generating unit shall be based on the actual generator site conditions observed at the time of the winter test.
2. Winter conditions shall reflect the 50% probability of occurrence (approximated by the mean) of generator 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. Generator site conditions include, but are not limited to, dry bulb temperature, relative humidity, wet bulb temperature, dew point temperature, cooling body (circulating water) water temperature and barometric pressure. If tests are corrected using any of the above parameters observed during the test, rated site conditions must also include those same parameters. In other words, if wet bulb temperature and barometric pressure are used to render a correction, the rated conditions must also be based on wet bulb temperature and barometric pressure coincident with the last 15 years PJM winter peaks.
3. The Winter Net Corrected Test Capability is the Winter Net Test Capability plus the correction (if any) for observed generator site conditions (those conditions present at the generator site at the time of the test).
4. Winter capability verification tests can be satisfied by correcting the most recent summer capability verification tests to winter conditions.

### 2.3.1 Conventional Generators

1. The determination of the Winter Net Corrected test Capability of fossil and nuclear steam units shall be based on, where applicable, the actual observed condenser intake water temperature during the winter test, the actual observed temperature of once-through or open cooling systems during the winter test as well as the actual observed performance of cooling towers during the winter test.
2. The determination of the Winter Net Corrected Test Capability of combustion turbine units shall be based on, where applicable, the actual observed generator site conditions during the winter test.
3. The determination of Winter Net Corrected Test Capability of combined-cycle units shall be based on, where applicable, the actual observed intake water temperature of once-through or open cooling systems during the winter test and/or the actual observed performance of cooling towers and combustion turbines during the winter test

4. The determination of the Winter Net Corrected Test Capability for reciprocating engine units or fuel cell units shall be based on operational data or test results taken once each PJM delivery year during the winter test.

### 2.3.2 Capacity Storage Units

1. The determination of the Winter Net Corrected Test Capability shall be waived for hydroelectric (with storage and/or pooling capability) and pumped storage units.
2. The determination of the Winter Net Corrected Test Capability of storage (non-hydro) units shall be based on the actual inventory of energy given other market activities for which the storage (non-hydro) unit may be committed and the actual state of charge during the winter test.

### 2.3.3 Run of River Hydroelectric Units (with pooling/storage/dispatch capability)

1. The determination of the Winter Net Corrected Test Capability shall be waived for run of river hydro units (with pooling/storage/dispatch capability).
- 2.

### 2.3.3-4 Intermittent Units (excluding Wind and Solar)

1. The determination of the Winter Net Corrected Test Capability shall be waived for hydroelectric (without storage and/or pooling capability) units.
2. The determination of the Winter Net Corrected Test Capability of units consuming landfill gas shall be based on operational data or test results taken once during the winter test. The Winter Net Corrected Test Capability shall be based on the actual landfill gas production during the winter test. If the generating unit is a combustion turbine it shall also be based on, where applicable, the actual observed generator site conditions during the winter test.

## 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. See section 1.1 of this manual for complete CIR details.
  - 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 Capability Verification test may be used to satisfy the Winter Capability Verification 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 capability verification test. Units

for which the foregoing data is not available shall be required to specifically test to confirm Summer 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 capability verification tests, including those based on actual operating data, shall be corrected for the respective summer or winter conditions. 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, CAPMOD and capability verification tests shall be two (2) contiguous hours for nuclear, fossil steam and combined-cycle units. The duration of acceptance, CAPMOD and capability verification tests shall be 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, CAPMOD or capability 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 (rated ICAP) 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 remedy 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 used in the test 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 used in the test 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 delineated in the resources ISA or WMPA 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 (UCAP) 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.

2. 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 generation” 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](mailto: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 5 minute data from the PJM state estimator for each 5 minute period without constraints and, for the five minute periods with constraints, values will be determined by linear interpolation using the nearest 5 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 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.
3. 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.
4. Capacity factors shall be calculated annually following the summer peak period and be applicable for the delivery year beginning the following June.
5. 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>

6. Owners of immature wind and solar units may substitute an alternate class average capacity factor with suitable documentation and approval by PJM.
7. 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 13 (05/01/2019):**

- Cover to cover periodic review
- Added a specific reference in the introduction that this manual augments the RAA Schedule 9
- Addition of Capacity Interconnection Rights and Testing section
- Required testing within defined temperature limits
- Commencing with Delivery Year 2022/2023, simultaneous testing requirements for all Manual 18 defined Capacity Storage and Intermittent Resources (excluding wind and solar)
- Commencing with Delivery Year 2022/2023, PJM required simultaneous multiple generator and full plant testing

### **Revision 12 (01/01/2017):**

- 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) to include units other than just wind and solar capacity resources

### **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 Capacity, 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.