PJM Manual 14D:

Generator Operational Requirements

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Prepared by
Operations Planning Division

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Approval

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Current Revision

Revision 43 (02/26/2018):

- Revised Section 11 Generator Data Confidentiality Procedures to clarify wording and included parameter data to be provided to a Transmission Owner for system restoration planning purposes
  - Revised Exhibit 11 therein
- Revised Attachment J: Generator Data Release Matrix to reflect changes in Section 11
  - Added column for generator parameters
- Revised Sections 10.2, 10.3.2 and 11.1: References to Manual 33 updated

Introduction

Welcome to the *PJM Manual for Generator Operational Requirements*. In this Introduction you will find information about PJM Manuals in general, an overview of this PJM Manual in particular, and information on how to use this manual.

About PJM Manuals

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

- Transmission
- PJM Energy Market
- PJM Regional Transmission Planning Process
- 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

The *PJM Manual for Generator Operational Requirements* is one of the PJM procedure manuals. This manual focuses on the generator markets and operations requirements for generating entities to connect to the PJM system and their responsibilities as signatories to the Operating Agreement of PJM Interconnection, L.L.C.

This manual also refers to other PJM manuals, which define in detail the telecommunication protocols, redundancy requirements, accuracy and periodicity of data, generator obligations, reporting requirements, market participation requirements, and accounting procedures established to ensure reliable operation.

The *PJM Manual for Generator Operational Requirements* consists of 12 sections, 14 attachments (labeled A through N), and one appendix (Appendix A). All are listed in the table of contents beginning on page 2.

Intended Audience

The intended audiences for this PJM Manual for Generator Operational Requirements are:

- Applicants to the Operating Agreement of PJM Interconnection, L.L.C.
- Generation Owners or those interested in siting and building generation in the PJM Balancing Authority.
- Operations planning staff and plant personnel for generating entities
- PJM Members

- PJM staff

References

There are other PJM documents that provide both background and detail on specific topics. These documents are the primary source for specific requirements and implementation details. This manual does not replace any of the information in those reference documents. The references for the *PJM Manual for Generator Operational Requirements* are:

- PJM Operating Agreement
- PJM Manual for Control Center and Data Exchange Requirements (M-01)
- PJM Manual for Transmission Operations (M-03)
- PJM Manual for Energy Management System (EMS) Model Updates and Quality Assurance (QA) (M-03A)
- PJM Manual for Pre-Scheduling Operations (M-10)
- PJM Manual for Energy & Ancillary Services Market Operations (M-11)
- PJM Manual for Balancing Operations (M-12)
- PJM Manual for Emergency Operations (M-13)
- PJM Manual for Generation and Transmission Interconnection Process (M14-A)
- PJM Manual for PJM Regional Transmission Planning Process (M-14B)
- PJM Manual for Generation and Transmission Interconnection Facility Construction (M14-C)
- PJM Manual for Rules and Procedures for Determination of Generating Capability (M-21)
- PJM Manual for Open Access Transmission Tariff Accounting (M-27)
- PJM Manual for Operating Agreement Accounting (M-28)
- PJM Manual for Billing (M-29)
- PJM Manual for Administrative Services for the PJM Interconnection Agreement (M-33)
- PJM Manual for Training and Certification Requirements (M-40)
- eDART User Guide
- eGADS User Manual

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 the “big picture.” Then we present details, procedures or references to procedures found in other PJM manuals.

What You Will Find In This Manual

- A table of contents that lists two levels of subheadings within each of the sections and attachments
- 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
- Attachments that include additional supporting documents, forms, or tables
- A section at the end detailing all previous revisions of this PJM Manual

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Section 1: Generator Markets and Operations

Welcome to the Generator Markets and Operations section of the PJM Manual for Generator Operational Requirements. This section presents the following information:

- A summary of the Markets and Operations phase of the Generator Interconnection Process (see "Generator Interconnection Process: Markets and Operations Phase").
- Rules for assigning a commercial plant/unit name to new generation (see "*Generator Commercial Naming Convention*").

1.1 Generator Interconnection Process: Markets and Operations Phase

The Generator Markets and Operations phase is initiated during the Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA) implementation phase of the generator interconnection process. The Interconnection Coordination (IC) Project Manager coordinates the activities of PJM Internal Coordination (Operations Planning, System Operations, Member Relations, PJM*net*, EMS) and the Generation Owner to complete the Generator Markets and Operations activities during this phase. After the ISA and CSA implementation phase, PJM team leadership is transferred from the IC Project Manager to PJM Member Relations (see Attachment H for Implementation Team Role Clarity Diagram).

The table below describes PJM Generator Markets and Operations interconnection process flow and timeline (see Attachment G for PJM Markets and Operations Process Flow Diagram).

Activity	Duration		Manual Reference
	Activity	Cumulative	
Activity 1: PJM Interim Capacity Study A. System planning updates new generation project list with current generator in-service date	**(1-10d)** **10 days**	**10 days**	**-**
Activity 2: EMS Model Update A. PJM Transmission and Interconnection Planning provides modeling information and commercial name for plant & units to System Operations B. System Operations submits Model Change requests to Engineering Support for database updates	**(11-80d)** **70 days**	**80 days**	**Section 4**

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Activity	Duration		Manual Reference
	Activity	Cumulative	
C. New database tested & installed on production EMS			
Activity 3: Establish Metering Plan A. PJM Client Manager sets up meeting to discuss new generation with customer • (Project Schedule • Revenue and real-time options • PJM metering requirements • Business plan for unit B. Customer applies for PJM Tools Accounts based on business plan C. Confirm metering plan between Market Settlements, Operations Planning & Market Operations D. Finalize Point Exchange List	**(81-100d)** **20 days**	**100 days**	**Section 4**
Activity 4: PJM*net* Installation A. PJM*net* Telecommunications form sent to customer B. PJM*net* form filled and returned by customer C. Customer and PJM technical staff work together to establish the applicable type of connectivity D. PJM*net* Installation completed	**(101-190d)** **90 days**	**190 days**	**Section 4**
Activity 5: Metering & Communications Installation	**(181–190d)** **10 days**	**190 days**	**Section 4**

Activity	Duration		Manual Reference
	Activity	Cumulative	
A. Customer Firewalls complete (if applicable) B. Communication paths for RTU & GMS complete C. PJM Real-Time Operations Support Department and Customer verify telemetered data accuracy.			
Activity 6: Data Exchange Testing A. Begin Testing with PJM B. Verify data exchange accurate C. Communications Online	**(191-200d)** **10 days**	**200 days**	**Section 6**
Activity 7: Confirm Voice, Communications & Dispatch Operations A. PJM technical staff and customer initiates installation of data communications & circuit testing B. Facilities Department installs voice communications for dispatch services	**(191-200d)** **10 days**	**200 days**	**Section 6**
Activity 8: Member Relations review Operations Requirements A. Pre-scheduling and Scheduling Requirements B. Unit Commitment C. Dispatching of Generation D. Switching Requirements E. Training and PJM TO Operator and Generation Dispatcher Certification F. Critical Information and Reporting Requirements	**(191-200d)** **10 days**	**200 days**	**Section 7**

Activity	Duration		Manual Reference
	Activity	Cumulative	
G. Compliance with Synchronization and Disconnection Procedures			
Activity 9: PJM review of Data & Markets A. Market Settlements & operations approve unit plans and establish market accounts	**(201-210d)** **10 days**	**210 days**	-
Activity 10: Capacity Status Granted A. Customer applies for Cap Mod status via eRPM B.PJM Resource Adequacy Planning grant capacity status	**(211-215d)** **5 days**	**215 days**	-

Exhibit 1: Generator Markets and Operations Process Flow and Timeline

1.2 Generator Commercial Naming Convention

New generation in PJM is assigned a commercial plant or unit name by PJM and the developer prior to its incorporation in the PJM model. The commercial names must be initiated at the execution of the Interconnection Service Agreement or even earlier based on the nature of the project. The following convention has been established for assigning commercial plant or unit names to new generation projects:

1. The commercial names will be assigned by PJM in collaboration with a representative from the developer, PJM Interconnection Projects, Resource Adequacy Planning, Market Settlements and Generation Departments.

2. Where possible, the commercial names will be associated with the assigned name given by the plant owner to maintain consistency during construction and the future operation of the plant.

Note:
The name of the developer is generally recognized as unacceptable as future projects by the same developer may cause similar confusion.

3. In the event that existing units are already named after the assigned name given by the plant owner, and it is deemed inappropriate to add additional sequential numbers to the existing units' naming convention, a local geography name (in a Township, Borough

or Town designation) or PJM substation will be used based on the physical location of the generation.

4. In the event that a local geography name has already been used in another part of PJM, a local landmark will be identified and used for the PJM naming convention.

5. In any event, the generator name will be unique and differentiate itself from other names already used within the PJM system, or neighboring systems if known.

6. The assigned PJM name will be circulated by the Generation Department to Interconnection Projects, Resource Adequacy Planning, Member Relations, Performance Compliance and Market Settlements departments for sign off/ approval before publication to all of PJM and the customer. After the final sign off is received, the Generation Department will circulate the name, queue number, etc. to all PJM appropriate parties and the customer.

Section 2: Responsibilities of Generation Owners

Welcome to the *Responsibilities of Generation Owners* section of the *PJM Manual for Generator Operational Requirements*. In this section you will find the following information:

- A listing of significant obligations of Generation Owners in the PJM Balancing Authority (see "*Generator Owners' Responsibilities*").

2.1 Generator Owners' Responsibilities

A Generation Owner in PJM is a Member that owns or leases with rights equivalent to ownership facilities for the generation of electric energy that are located within the PJM Balancing Authority. Membership in PJM entails execution of the Operating Agreement and satisfactions of the data requirements, operational and market coordination, committee support and financial obligations contained within the agreement.

The responsibilities for a Generator Owner within PJM that are defined below are required to maintain the safe and reliable operation of the PJM Interconnection. The generator owner under PJM's direction takes all actions possible to maintain PJM Interconnection reliability. The responsibilities identified below are consistent with the NERC Reliability Functional Model and NERC Reliability Standards.

This list is a collection of significant operational responsibilities and obligations of a Generator Owner that are included in the PJM OA, PJM RAA, PJM West RAA and the PJM Procedure manuals. It is not intended to be an all-inclusive list of every responsibility and obligation of a Generator Owner.

A Generator Owner:

- Is subject to applicable code of conduct and other applicable confidentiality agreements. (PJM OA Schedule 1, Section 1.7.4a)
- Takes action to maintain local reliability and public safety. (PJM OA Schedule 1, Section 1.7.4a)
- Operates generation system facilities under the direction of PJM. (PJM OA Schedule 1, Section 1.7.4f,g)
- Operates generation facilities in accordance with all federal and state regulations and PJM procedures. (PJM OA Schedule 1, Section 1.7.4f)
- Maintains generation facilities in accordance with good utility practice and PJM standards. (PJM OA Schedule 1, Section 1.7.4h)
- Establishes capability of its generation facilities and provides this information to PJM if the facilities are designated PJM capacity resources. (PJM Manual M-21)
- Provides annual baseline and real time updates of fuel limited generating units to PJM during emergency conditions. (PJM Manual M-13, Section 6.4 and Section 7.3.5 of this manual)
- Complies with the data information and metering requirements established by PJM. (PJM Manual M-14D, Section 4 and PJM Manual M-01)

- Maintains assigned voltage schedules and responds promptly to specific requests and directions of the PJM dispatcher or the Transmission Owner (TO) dispatcher in event of low/high voltage situations. (PJM Manual M-12, Section 5 and PJM Manual M-03, Section 3)
- Follows directions from the TO for switching interconnection points.
- Helps maintain a reliable transmission system by providing reactive capability curve information to PJM as soon as the information is available. (PJM Manual M-14D, Attachment D and Attachment E)
- Complies with procedures called for by PJM or the TO in event of operating limit violations and other emergency conditions. (PJM Manual M-13)
- Provides real-time operations information to PJM in compliance with PJM procedures. (PJM Manual M-14D, Section 4 and PJM Manual M-01)
- Provides information about planned, maintenance and unplanned outages of generation facilities to PJM. (PJM Manual M-10, Section 2)
- Supplies engineering data for generating unit models to PJM. (PJM Manuals M-14A and 14B)
- Develops, documents, and communicates operator guidance, as necessary. (PJM Manual 40)
- Plans and coordinates generation outages. (Manual M-10, Section 2)
- Works with PJM to mitigate identified reliability concerns for planned generation outages. (PJM Manual M-10, Section 2)
- Large generating plant owners with market operations centers (MOCs) must maintain continuous staffing and meet all of the communication and information system requirements defined by PJM. (PJM Manual M-01 and PJM OA Schedule 1, Section 1.7.5)
- Personnel Requirements (PJM Manual M-40)
- Generation Dispatchers shall:
    - Be competent and experienced in the routine and abnormal operation of generators within interconnected systems.
    - Be accountable to take any action required to maintain the safe and reliable operation of the generation facility.
    - Have thorough knowledge of PJM procedures and their application.
    - Have a working knowledge of NERC Reliability Standards and how they coordinate with PJM manuals.
    - Have an understanding of routine protection schemes for PJM generation facilities.
    - Have knowledge of how to evaluate desired system response to actual system response.

- Have knowledge of and be able to evaluate and take action on equipment problems in generation facilities.
- Have knowledge of the general philosophy of system restoration and the philosophy and procedures of their company as well as that of the pool.
- Have initial and continuing training that addresses the required knowledge and competencies and their application in system operations.
- Have current PJM Generation Dispatcher Certification

- Plant Personnel should have a working knowledge of switching and tagging procedures for the generation facility.
  - Develops, documents, and maintains switching and tagging procedures. (OSHA 29 CFR Part 1910.269)
  - Is accountable for directing station forces in generation system switching activities.
  - Follows up on significant system events with an investigative process to analyze, document and report on operating abnormalities. (PJM Manual M-13)
  - Generator owners providing black start services will follow procedure outlined by PJM. (PJM Manual M-10, Section 2, PJM Manual M-12, Section 4 and PJM Manual M-36)

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Section 3: Control Center Requirements

Welcome to the *Control Center Requirements* section of the *PJM Manual for Generator Operational Requirements*. In this section you will find the following information:

- A description of the generation control center categories within PJM (see "*PJM Control Center Categories for Generating Entities*").
- A summary of control center requirements for generation owners (see "*Control Center Requirements for Generating Entities*").
- Voice communication requirements for generation owners (see "*Voice Communication Requirements for Generating Entities*").

This section presents a summarized version of the requirements for control centers established by generating entities for reliable operation in the PJM Balancing Authority. For more details, please refer to the *PJM Manual M-1 for Control Center and Data Exchange Requirements*.

3.1 PJM Control Center Categories for Generating Entities

PJM Members may be involved with transmission operations, generation operations, load service operations, and/or PJM Energy Market participation. For each of these operations, a different control center category has been designated.

For generation operations, the control center category is the Market Operations Center (MOC), which is established by participating generating entities to facilitate their responsibilities regarding the reliability of the PJM RTO.

For each of the services listed, data is exchanged between the MOC, PJM and one or more of the other PJM member control center categories –Transmission Owners (TOs), Load Service Centers (LSCs), and Marketing Centers, corresponding to Regional Transmission Owners, Load Serving Entities and Marketers.

- Generation Scheduling Services
- EMS Services
- Historical EMS Data Services
- Energy Transaction Services
- Long-term Planning Services
- PJM Administration Services

3.2 Control Center Requirements for Generating Entities

This section discusses the control center requirements for the PJM generating entities, which are similar to those of other PJM members. For efficient and reliable participation in the PJM RTO, the following requirements for the members' control center computer systems, communications, facilities, and staffing have been established.

3.2.1 Computer System Requirements

The generation owner's MOC serves as the primary operating link to the PJM control center and includes computer system hardware and software that supports their responsibilities under the Agreement. The list below summarizes the computer system requirements for all PJM member control center categories including the MOC.

The control center is required to:

- Achieve a 99.95% availability level for its computer hardware and software
- Prepare and implement a backup and archiving plan
- Follow PJM computer system security procedures
- Follow PJM system maintenance procedures
- Ensure expansion capability of its computer system

3.2.2 Communications Requirements

Telecommunications (voice and data) circuits, which must be reliable and secure, should be tested regularly and/or monitored online, with special attention given to emergency channels.

3.2.3 Facilities Requirements

The MOC facility considerations include the physical space housing operations staff and, if appropriate, a computer room, communications room, and power supply area. The specific implementation of control center facilities considerations should be appropriate for the nature of the computer systems and communications equipment installed. The following list summarizes the facilities requirements for a generation owner.

The control center is required to:

- Provide an environment suitable for its equipment and personnel
- Ensure a stable and secure supply of AC power for its equipment
- Restrict access to its work area to avoid distractions
- Establish a protocol for information flow to control room personnel
- Install smoke and fire detection and protection equipment
- Comply with PJM backup procedures

3.2.4 Control Center Staffing Requirements

MOCs should be staffed 24 hours a day, 7 days a week, with 99.9% availability of personnel who are trained for all normal and emergency situations that are anticipated. Training courses for operations, technical staff and maintenance personnel should be conducted. The PJM Member Relations Department can provide assistance, as required, for training related to PJM operations. Refer to PJM Manual M-40, Training and Certification Requirements for additional information.

As of March 1, 2003, PJM requires all generation and transmission operators who operate on PJM systems to undergo the PJM Certification examination. Further details are provided in PJM Manual M-40 Training and Certification Requirements and Section 6 of this manual.

For details on MOC control room operator staffing levels and operational guidelines as well as staffing guidelines in the event of loss of an EMS, please refer to the PJM Manual M-1 for *Control Center and Data Exchange Requirements*.

3.3 Voice Communication Requirements for Generating Entities

This section summarizes the PJM requirements for primary voice and facsimile communications and alternate voice communications for control centers including the MOCs established by generating entities. Refer to PJM Manual for Control Center and Data Exchange Requirements (M-1), Section 4, Voice Communications for additional details and requirements.

3.3.1 Dispatch Voice and Facsimile Communications

The dispatch voice system provides high-priority voice communications between PJM and various PJM Members. The dispatch voice system consists of the All Call system, ring down circuits, and manual dial circuits. Communications via facsimile machines is another means of exchanging information between PJM operations, accounting, and planning personnel and all categories of PJM Members.

3.3.2 Alternative Voice Communications

The dispatch voice system (All Call, Ring Down, and manual dial) is designed to provide voice communications during normal circumstances. Should the PJM primary All Call System, Ring Down, Manual Dial, and Facsimile Communication fail, the following systems provide alternative communication capabilities in the event the normal system is not effective for some reason:

- Business Voice System
- Cellular Telephones
- Satellite Telephones

Section 4: Data Exchange and Metering Requirements

Welcome to the *Data Exchange and Metering Requirements* section of the PJM Manual for *Generator Operational Requirements*. In this section you will find the following information:

- Description of computer system data exchange methodology and requirements. (See "*Computer System Data Exchange*").
- Rules pertaining to generator metering. (See "*Data Exchange and Metering Requirements*").

4.1 Computer System Data Exchange

4.1.1 PJM*net* Communications System

PJM*net* is the primary wide-area private network for secure Control Center data communication to and from PJM. PJM*net* will support:

- Inter-Control Center Communications Protocol (ICCP) data links to Control Centers.
- SCADA links to plants via remote terminal units (RTUs) using Distributed Network Protocol (DNP3.0 Implementation Level 2 over TCP/IP).

PJM*net* is a robust multi-protocol label switching (MPLS) network that connects member Control Centers and plants to PJM's dual redundant Control Centers. Private voice and data permanent virtual circuits (PVCs) are provided to link to PJM's dual redundant Control Centers. The number of physical interfaces and their capacity will be determined by the impact of the member's facilities on overall PJM Operations.

A Voting Member (as defined in the Operating Agreement), for their generation assets as described in Exhibit 3: Guidelines for Metering Installation, will receive one PJM*net* connection. A Voting Member has the option to request that PJM provide, at the Voting Member's sole cost and expense, up to five additional PJM*net* connections.

For installation of PJM*net*, new generator participants are required to complete and return the PJM*net* Telecommunications Request Form (*see* Attachment B). The PJM Client Manager assigned to the generation project will provide the latest PJM technical specifications and PJM technical personnel contacts as required to establish data and voice communications to PJM.

4.1.2 Jetstream

Jetstream is a data system to connect remote assets and PJM to satisfy real-time, market and other data transactions. Small generators, load response assets and other market participants can communicate with the PJM Energy Management System through the Jetstream system. The connecting network is the Internet and the data protocol is DNP3. High levels of security are provided using Transport Layer Security and a Public Key Infrastructure. This system is described in technical and procedural documents which can be found at: http://www.pjm.com/markets-and-operations/etools/jetstream.aspx

4.1.3 Energy Management System (EMS)

Information is exchanged between the PJM Interconnection L.L.C. (PJM) EMS computers and the EMS systems of PJM Members. Please note that the following description of EMS-to-EMS Data Communications is based on Member company systems that support both Generation and

Transmission functions; a Generation Control Center or a Transmission Control Center would need to support the appropriate subset of these functions. The system primarily supports real-time functions such as PJM Balancing Authority network monitoring, generation control, and security analysis.

4.1.4 PJM EMS Communication Protocols

All new Control Center to Control Center links will be implemented using the Inter-control Center Communications Protocol (ICCP) standard. ICCP is a comprehensive, international standard for real-time data exchange within the electric power utility industry. It is intended to support inter-utility, real-time data exchange critical to the operation of interconnected systems.

4.1.5 EMS Data Exchange

EMS data is exchanged between each Member's system and the PJM EMS computer system, on one of several fixed cycles, as well as on demand, by exception, and interactively.

- The EMS data sent cyclically from PJM Members to the PJM includes:
  - Data needed for the PJM control programs
  - Data needed for monitoring generation
  - Data needed for monitoring transmission
  - Data needed for monitoring interchange
- The EMS data sent cyclically from the PJM EMS to each PJM Member's EMS includes:
  - System control data
  - Generation and transmission information required for monitoring and security analysis programs
  - Area Regulation data

Cyclic data exchanged at the fast scan rate (two seconds) is used to develop the PJM Area Control Error (ACE) and associated individual PJM Member Area Regulation megawatt values. Cyclic data exchanged at a slower scan rate (ten seconds) is used to develop dispatch control values, security monitoring, and data tracking.

PJM Members are responsible for the accuracy of the data they send to PJM. Refer to Manual M-01, Control Center and Data Exchange Requirements, Section 3 & Section 5 for data accuracy requirements for real-time and revenue data.

Hourly MWh readings data must be the same values that are recorded in the history registers of the revenue meters at the metered locations. Billing data has a higher overall accuracy requirement than real time data. Regular calibration of PJM Member metering is necessary to keep the data as accurate as possible. Further information may be found in Section 5 of the PJM Manual M-01, Control Center and Data Exchange Requirements.

Data exchanged either by exception, on demand, or interactively between PJM Member's and the PJM's EMS systems include:

1. Breaker, disconnect and line status changes, with associated data quality code information.
2. Alarm messages in text and data format.

The following exhibit summarizes the data requirements and exchange rates for the cyclic data exchanged between PJM EMS and PJM Members' EMS systems.

Data	Exchange Rates
From PJM Members to PJM	
Data needed for PJM Control Programs (AGC tie-line MW, TREG, CREG,UNITREG, LOADBP, Locally Sampled Frequencies) This includes Generation MW telemetry for all units participating in the PJM regulation market	Fast Scan Rate (2 seconds)
Data needed for monitoring generation (Generation MW/MVAR Telemetry)	Slow Scan Rate (10 seconds)
Data needed for monitoring transmission (Line/Transformer Flows, Voltages)	Slow Scan Rate (10 seconds)
Breaker, disconnect, and line status changes	By Exception (on event)
From PJM EMS to PJM Member's EMS	
AGC Regulation Signals	Fast Scan Rate (2 seconds)
AGC Individual Unit MW set Points	Slow Scan Rate (10 seconds)
Dispatch control values	Slow Scan Rate (10 seconds)
Generation MW/MVAR Telemetry	Slow Scan Rate (10 seconds)

Exhibit 2: Summary of EMS Data Requirements and Exchange Rates

Each PJM Member is responsible for determining data-quality indicators for all data transmitted to PJM. Both failed individual values and any value calculated using a failed point must be flagged. When a point fails for an extended period, a manual update of the point's value is necessary once every thirty minutes to keep the data as accurate as possible.

4.1.6 EMS Model

New generators of more than 10 MW or any new capacity resource intending to set real-time LMP must be explicitly modeled in the PJM EMS network model. The EMS network model is updated as described in PJM Manual 3A, Energy Management System (EMS) Model Updates and Quality Assurance (QA).

4.1.7 SCADA—Supervisory Control and Data Acquisition

The PJM SCADA system allows bi-directional exchange of analog data, digital data, and, in some cases, accumulator data between small generators and the PJM EMS. In the PJM EMS

data may be processed immediately, stored in local historians, or forwarded to sub-systems like PJM Settlements.

Sample Configurations

The wide variety of possible Members dictates that the system cannot be locked into a fixed configuration. Member size and type of installation (new or existing) determine the installation configuration and possible features.

Some of the possible configurations are shown below. All metering installations below accommodate one or more metering points. Please note that the following table is a guideline only. Specifics of the installation may dictate an alternate configuration.

		Metering Installation				
Connection Type	**Aggregate Generator Size**	**Intelligent Electronic Device**	**Data Model**	**Configuration**	**Monitoring Period**	**Protocol**
Internet SCADA	Very Small (<10 MW)	Data Concentrator	All data types available OR Collect MWh and MVARh only	Dedicated TCP/IP with encryption gateway over secure Internet.	varies	DNP 3.0
Internet SCADA	Small (10–100 MW)	Data Concentrator	All data types available	Dedicated TCP/IP with encryption gateway over secure Internet.	varies	DNP 3.0
PJM*net*	Medium (>100–500 MW)	Data Concentrator	All data types available	Dedicated TCP/IP with single router to redundant PJMnet.	2 – 10 Second Periodic	DNP 3.0 or ICCP
PJM*net*	Large >500 MW)	Data Concentrator, SCADA, EMS or GMS	All data types available	Dedicated TCP/IP with dual routers to redundant PJMnet – Single Local Area Network	2 – 10 Second Periodic	DNP 3.0 or ICCP

Exhibit 3: Guidelines for Metering Installation

The table below shows the types of equipment necessary for exchanging data with PJM.

Situation	Real-Time & Billing Metering	Operational Changes Sent via	Generator Bidding
Minimum Changes/ Minimum Cost	Via Host Utility; MWh entered in **Power Meter** for PJM billing.	Host Utility.	Via Host Utility
<10 MW injection to grid or unit runs infrequently.	RTU at plant, single DNP network connection with encryption gateway.	Internet, through **Markets Gateway**	Internet, through **Markets Gateway**
>10 MW and <100MW injection to grid; unit runs continuously.	RTU at plant, single DNP network connection with encryption gateway.	Internet, through **Markets Gateway**	Internet, through **Markets Gateway**
>100 MW and <500MW injection to grid; unit runs continuously.	RTU at plant, redundant network connection, single router.	Internet, through **Markets Gateway**	Internet, through **Markets Gateway**
>500 MW injection to grid; unit runs continuously	RTU at plant or ICCP via SCADA system, redundant ICCP or DNP network connection, dual routers.	Internet, through **Markets Gateway**	Internet, through **Markets Gateway**
Control Center for Multiple Units	Install metering and use SCADA System; redundant ICCP network connection to PJM, dual routers.	Internet, through **Markets Gateway**	Internet, through **Markets Gateway** and **PJM*net***

Exhibit 4: Equipment Types for Data Exchange with PJM

The following exhibit displays a typical multi-unit metering and data flow configuration.

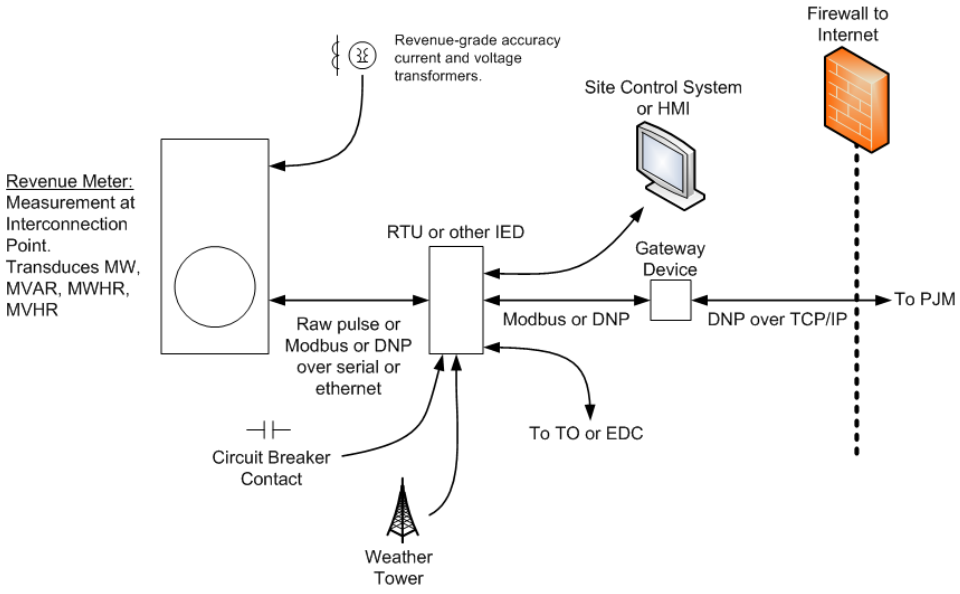


Exhibit 5: Typical Internet DNP Configuration

The following exhibit shows PJM precision requirements for real-time and revenue metering information. Refer to PJM Manual M-01, Control Center and Data Exchange Requirements for additional details.

Real Time Instantaneous Data Sent To PJM	
Frequency	1/1000th of HZ (i.e. 60.001 Hz)
Voltage	1/10th of kV (i.e. 69.1 kV)
Real Power MW	1 MW integer (i.e. 52 MW) required, but PJM will accept greater precision if available
Reactive Power MVAR	1 MVAR integer (i.e. 42 MVAR) required, but PJM will accept greater precision if available

Real Time Instantaneous Data Sent To PJM	
Individual Unit MW base point from Security Constrained Economic Dispatch (SCED)	1/10th of MW (i.e. 323.1 MW)
Regulation Signal (AR)	1 MW integer, + or – (i.e. 10 MW) but PJM will send smaller signals to certain sites such as renewable resources, etc.

Revenue Data Sent To PJM	
MWh Delivered and Received	1/1000th of MWh (i.e. 20.001 MWh)
MVARh Delivered and Received	1/1000th of MVARh (i.e. 15.002 MVARh)

Exhibit 6: PJM Real-Time and Revenue Data Precision Requirements

4.2 Data Management and Metering Requirements

4.2.1 Data Management and Security

Each Generator shall supply the necessary planning and operating data required to accurately model, schedule, and monitor the PJM system. Specific data requirements for power system applications, production cost and reliability assessment are located in the PJM Manual for PJM Regional Transmission Planning Process (M14B), Attachment H – Power System Modeling Data. This data must include, but is not limited to:

- Expected unit operations and desired market service/segment.
- Stability study data.
- Step-up transformer data (impedance and tap setting).
- Relay settings and generator protection package.
- Generator operating curves and associated test data (reactive/saturation).
- Special operating restrictions (including environmental).
- Identification of equipment ownership and maintenance responsibilities.
- Test data for metering calibration, backup communications, and relays.
- Any other data required to certify a generator as eligible to participate in a specific market segment or service.

The Generator shall also provide telemetered data to the Supervisory Control and Data Acquisition (SCADA) system or via ICCP to the PJM Energy Management System computers. Computer systems and metering shall be consistent with PJM practices, and compatible with PJM computer and communication systems.

Examples of this required data include: MW, MVAR, MWh, voltage, and equipment status (i.e., open/close). The data is to be provided in accordance with standards contained with the *PJM Manuals for Control Center and Data Exchange Requirements (M-01), Pre-Scheduling Operations (M-10), Energy & Ancillary Services Market Operations (M-11),* and *Balancing Operations (M-12)*. PJM may require the ability to disconnect the facility from the PJM system via the Transmission Owner's SCADA system.

It is required that data be sent to PJM automatically. In the event that the data is not automatically received by PJM, the generator operator shall call PJM with the required data at intervals specified by PJM. The generator operator must correct any problems associated with the failure of data-transmission equipment within a reasonable time.

The Generator and Transmission Owner shall promptly exchange all information relating to all conditions which affect (or could affect) the operations of any facility reporting data.

The Generator shall communicate the outage of any data communication equipment connecting the facility to the PJM system in accordance with the following requirements:

- Each facility will be assigned to one of the PJM Transmission Owners as its primary contact, unless arrangements are made to communicate information directly to PJM. The assignment is based upon the voltage level of the connection to the Transmission System and the geographic location of the facility.
- All planned and maintenance outages of data communications equipment requiring the involvement of PJM personnel must be requested by the Generator. All information must be in a format defined by PJM. Refer to Section 3: Data Exchange Requirements of manual M-01, Control Center and Data Exchange Requirements, specifically Section 3.8 Planning, Coordination, and Notification of System Changes and Events.
- Advance notification of planned and maintenance outages must meet the requirements defined in the PJM Manual for Pre-Scheduling Operations (M-10).

Additional specific data requirements are defined in other sections of this manual. All records must be retained in accordance with NERC, FERC and PJM data retention requirements. All back-up voice and data communication plans and test procedures must be documented and provided to PJM.

4.2.2 Metering Plan

In order to establish a metering plan for new generation, a PJM Client manager is assigned. A kick-off meeting between the client manager and the generation owner will be held to discuss the following issues:

- Project schedule including testing/commercial dates
- Options for providing real-time and revenue data
- Business plan for the unit(s) - The new participant is required to apply for the necessary PJM Tools accounts based on the individual business plan.
- PJM metering requirements - To satisfy these requirements, all generators connecting to the PJM system are required to install and operate metering and related equipment capable of recording and transmitting all voice and data communications. Specific data metering requirements depend on the size and business plan of the generator connecting to the PJM system.

Several factors determine the real-time telemetry to PJM requirements for a generator. The following table shows the criteria for which a generator may be required to provide real-time telemetry to PJM. If one or more of the criteria are true for that generator, then telemetry is required.

Criteria	Real-Time Telemetry Requirements
Generators participating in the PJM market as capacity resources	Real and reactive power
Generators 10 MW (Maximum Facility Output) or larger	Real and reactive power

Criteria	Real-Time Telemetry Requirements
Generators greater than 1 MW (Maximum Facility Output) and connected at a bus operating at 50 kV or greater	Real and reactive power
Solar parks 3 MW (Maximum Facility Output) or greater	Real and reactive power (see Section 12.2 for additional requirements)
Distributed generators (such as, the treatment of many units dispersed over a wide area as one aggregated unit) modeled less than 10 MW (Maximum Facility Output)	Real and reactive data at the BES injection point of accuracy within 10% of hourly MWh settlements data (revenue meter or accumulator data)

Generators not meeting any of the criteria above are generally not required to supply real-time telemetry to PJM. However, PJM may require real-time telemetry from any generator based on specific topology, network security, operations or market needs. Generators that are not required to supply real-time (two-second scan) metering will not be eligible to set real-time LMP. Revenue-related information is necessary for very small units. This information can be obtained from the local utility or manually read by the customer and supplied to PJM via Power Meter. If desired, a direct connection to PJM can be established.

Generators that are required to supply real-time and revenue information can supply this through the local utility's connection to PJM, or if desired, via a direct connection from the generator to PJM. Real-time information will be collected at a two- ten second data rate, and revenue information will be collected hourly. The revenue information represents the accumulated energy for the previous hour.

The required revenue information is necessary to satisfy the needs of PJM's Market Settlements program. The real-time information is required for PJM's Energy Management Applications (State Estimator, Security Analysis, etc.).

4.2.3 Metering for Individual Generators

PJM does not require generator owners to directly connect to PJM, but leaves this as an option if it enhances the owner's ability to participate in PJM markets and functions. A generation owner has a number of options with respect to information acquisition and transmission.

At the most basic level, a generator owner can negotiate data transmission to and from PJM through the local utility or transmission facilities owner. This allows the generator owner the flexibility to use already proven and acceptable methods of data transfer to minimize initial start-up costs and procedures, while meeting all of the current requirements for providing data to PJM. This basic communication can be supplemented with the use of the Internet-based PJM Tools such as inSchedule and Data Viewer, further expanding the data transfer capabilities between the customer and PJM without a direct connection to PJM.

A generator owner may decide that direct connection to PJM makes the best business sense, so facilities have been provided to make that connection as simple and cost effective as possible. The generator owner that decides to connect directly to PJM will be required to meet requirements determined by the net MW produced and the markets in which the generator owner decides to participate.

Additionally, information about PJM's operational status and other types of non- market sensitive data can be directly communicated through these same facilities. This type of communication is not required but is provided by PJM as a value-added service to enhance participation in PJM markets.

PJM's data requirements are described in two categories: real-time information and non-real time information. Either or both of these types of data can be directly communicated to PJM depending on the customer requirements and operating agreement with the local utility.

Real-Time Data

Real-time or instantaneous information is defined as data required by PJM that determines system security and stability as well as congestion and LMP. The minimum data model for real-time data transmission requires:

- Instantaneous Net (+/-) MW for each unit, measured on the low-side of generator step-up transformer
- Instantaneous Net (+/-) MVAR for each unit, measured on the low-side of generator step-up transformer
- Distributed generators modeled at less than 10MW must provide Instantaneous Net (+/-) MW and MVAR at aggregation point (BES injection point) based on an agreed upon algorithm.

Additional transmitted data may include bus voltages, circuit breaker status, and other data.

Account Metering

Non-real-time or revenue information is needed by PJM's applications and systems that determine Grid Accounting and Energy Interchange such as Power Meter. The minimum data-model for revenue data transmission requires:

- Hourly Compensated MWh delivered for each unit.
- Hourly Compensated MWh received for each unit.
- Hourly Compensated MVARh delivered for each unit (not currently required).
- Hourly Compensated MVARh received for each unit (not currently required).

Note:
The MVARh revenue information will be considered a requirement in the event that PJM implements a Reactive Power Market.

Additional information on PJM Metering requirements may be found in Sections 3 and 5 of the *PJM Manual M-01,* Control *Center and Data Exchange Requirements*.

Data Communications Systems and Requirements

Data communications systems and requirements are dependent on the type of facilities connected to PJM, category of generator(s) based on Net MW, and market participation. The Generator owner with facilities directly connected to PJM must, at a minimum, provide PJM with the contact name and voice phone number of person or persons responsible for the continuous operation of that equipment.

Additionally, the Generator owner with multiple connected facilities may have to provide centralized contact and control information to minimize confusion and downtime resulting from equipment failure. Additional data or control room functionality may be necessary and will be determined on a per-generator basis. For additional information regarding these requirements refer to PJM Manual M-01, Control Center and Data Exchange Requirements.

For questions about Data and Metering Requirements, contact the PJM Client Manager or PJM's Member Relations at 610-666-8980.

4.3 Synchrophasor Communication System

The PJM Synchrophasor Communication system allows PJM to collect and manage data from phasor measurement devices unit(s) (PMU) which include the standalone phasor measurement units (PMUs) device, or Relays and Digital Fault Recorders (DFRs) with phasor measurement capabilities from individual generators or Market Operation Centers (MOC). Synchrophasor measurement devices PMUs are required at all new generator interconnections 100MW or larger that entered PJM’s interconnection queue on or after October 1, 2012. It shall also include the communication system capable of carrying the phasor measurement data to a phasor data concentrator (PDC), and then transport the information continuously to PJM; as well as store the data locally for a minimum period of 30 days.

A Phasor Data Concentrator (PDC) shall be located at either the Member's generation site or MOC, and, after collecting data from the phasor measurement devices PMUs, communicate with PJM‘s Synchrophasor system using C37.118 data transfer protocol.

4.3.1 Phasor Measurement Device Unit Requirements

A phasor measurement device PMU is a device which measures the electrical wave forms on the electricity grid in real-time, using a common time source for synchronization.

- The performance of phasor measurement device PMU must comply with the current revisions of standards such as IEEE C37.118. The protection (P) performance class PMU is preferred.
- The phasor measurement device PMU shall have the capability to calculate sequence values for voltage and current Phasor data; as well as to provide the sequence synchrophasor values to a PDC at the minimum rate of 30 scans per second. (For all calculation purposes Phase A shall be used as the reference phase.)
- The phasor measurement device PMU shall have GPS (UTC) synchronization function either through an internal or external GPS receiver. All data recorded shall be in the Coordinate Universal Time (UTC).
- The phasor measurement device PMU shall be able to automatically switch to local clock in the event of the loss of GPS signal, and resynchronize automatically when GPS signal is available.
- The phasor measurement device PMU data stream shall indicate whether it is using GPS clock or local clock. NOTE: Default data stream should be synced to the GPS clock, with local clock serving as a backup.
- Accuracy and resolution of time synchronization shall be equal or under 1 micro second to UTC. The phasor measurement device PMU should be able to locally store collected or calculated data at the minimum rate of 30 frames per second.

- The phasor measurement device PMU shall be installed on the Customer Facility side of the generator step-up transformer (low side) unless it is a non-synchronous generation facility, in which case the device shall be installed on the Customer Facility side of the Point of Interconnection (POI).

4.3.2 Phasor Data Concentrator (PDC) Requirements

The PDC at the generation station or the MOC (GO PDC) is the central point of collection, management, storage, and distribution of PMU data for authorized real-time and non-real time uses.

- The performance of the GO PDC should comply with the current revisions of standards such as IEEE C37.118.
- The GO PDC shall be able to consolidate and synchronize data from all connected PMUs before sending it to PJM; including unaligned data.
- The GO PDC shall have capability of assigning positive sequence reference to any phase (rotate it by 120 or 240 degrees on per signal basis).
- All data streaming from the GO PDC to PJM PDC shall be in compliance with IEEE C37.118 communication standards.
- The GO PDC should have the capability to down sample PMU signal before transmitting it to PJM PDC and to configure the down sampling rate.
- For packets arriving later than expected time, the GO PDC should flag such packets and store their UTC arrival time.
- The GO PDC should be able to locally store all incoming data at the minimum rate of 30 frames per second for minimum two weeks.
- The GO PDC should be able to retrieve and provide locally stored data per PJM's request.
- The GO PDC should have a clock that is synchronized to UTC. It is recommended that this clock be an external GPS clock. Resolution and accuracy of time synchronization at Substation PDC should be equal or under 1 micro second to UTC.

4.3.3 Network Requirements

A high-speed real-time data acquisition network is required to simultaneously transfer the PMU data to PJM Valley Forge and Milford control centers. This telecommunications network is independent of the existing SCADA network operated for PJM's EMS at its control centers. End-to-end (GO PMU to PJM PDC) latency should be less than or equal to 100 milliseconds. The GOs data acquisition, processing and communications systems should be designed to achieve the 100 millisecond Latency limit. In most cases, transmitting phasor data with SCADA (RTU and ICCP) data together is permitted over the same PJMNet Connection designated for the Generation Owner.

4.3.4 Data Exchange and Management Requirements

PJM maintains configuration information for each phasor measurement device PMU and PDC connected to the Synchrophasor system. This configuration information is used to accurately interpret the data collected from the generators. The generator should register its phasor measurement device PMU and PDC with PJM by using the registration form located at http://

www.pjm.com/markets-and-operations/ops-analysis/synchrophasor-technology.aspx. The generator should use NERC-assigned 5 Digit ID Codes for phasor measurement the devices that are reported to PJM.

Generators interconnected with and synchronized to the transmission system must provide PJM all necessary and requested information through PJM Synchrophasor system, to assure that the electrical system can be operated in a safe and reliable manner.

This data includes, but is not limited to:

- Generator terminal voltage and voltage phase angle (for wind generating plants, measurements at POI are acceptable)
- Generator terminal current and current phase angle (for wind generating plants measurements at POI are acceptable)
- Frequency and rate of change of frequency (ROCOF)

All data items, regardless of type, are collected and disseminated at a frequency of 30 frames per second and should be sent to PJM with associated data quality codes in compliance with IEEE C37.118 communication standards. (See 4.3.1 Phasor Measurement Device Unit Requirements)

The generation owner will report to PJM the outage of any data communication equipment connecting the facility to PJM system to the following email address: phasoroutage@pjm.com (or other approach as determined by the PJM Phasor Data Quality Task Force.) Please reference M01 section 3.3.2 for more details.

Section 5: Participation in PJM Markets

Welcome to the *Participation in PJM Markets* section of the *PJM Manual for Generator Operational Requirements*. In this section you will find the following information:

- Description of marketing options available to Generator Owners (see "*Marketing Options*").
- Description of required/mandatory services (see "*Ancillary Services*").
- Description of PJM marketing tools that are currently available (see "*Marketing Tools*").
- Description of the PJM two-settlement system (see "*Description of the Two-Settlement System*").
- Role of Generation in the PJM pre-scheduling and scheduling processes (see "*Pre-Scheduling and Scheduling*").
- Description of the resource commitment process (see "*Resource Commitment*").

5.1 Marketing Options

There are several marketing options available to generator owners in the PJM Interconnection, L.L.C. (PJM) Balancing Authority, but not every generating unit qualifies to participate in every PJM market. The marketing options available to generation owners depend on the physical characteristics of the unit(s) as well as the business philosophy of each owner. Additional information on all of the PJM markets may be found at the heading "Markets & Operations" on the PJM web site.

5.1.1 PJM Wholesale Energy Market

The PJM wholesale energy market includes both day-ahead and real-time markets.

- In the day-ahead market, Locational Marginal Prices (LMPs) are calculated for each hour of the next operating day based on generation offers, demand bids, and bilateral transaction schedules submitted in advance. The next-day schedule is developed using least-cost, security-constrained resource commitment and security-constrained economic dispatch programs.
- During the operating day, 5 minute and hourly clearing prices are determined by the actual system operations security-constrained economic dispatch in the real time market.
- For more information about the PJM Wholesale Energy Market see PJM Manual M-11, Energy & Ancillary Service Market Operations.

5.1.2 PJM Regulation Market

The PJM Regulation Market provides PJM participants with a market-based system for purchase and sale of the Regulation ancillary service, which provides short-term load balancing capability to the system.

Generators may choose to participate in the PJM Regulation Market. Qualification for this program requires each participating resource to achieve specified performance standards and to be equipped with Automatic Generation Control (AGC). Please refer to PJM Manual M-11,

Energy & Ancillary Services Market Operations, Section 3 and PJM Manual M-12, Balancing Operations, Section 4 for more information.

For more details on regulating unit eligibility and the regulation market business rules, please refer to the PJM Manual M-11, Energy & Ancillary Services Market Operations.

5.1.3 PJM Reserve Markets

The PJM Reserve Markets provide PJM participants with a market-based system for purchase and sale of the Synchronized Reserve, Non-Synchronized Reserve, as well as Day Ahead Scheduling Reserves. Please refer to PJM Manual M-11, Energy & Ancillary Services Market Operations, Sections 4, 4b, and 11 for more information.

5.1.4 PJM Capacity Market

Refer to PJM Manual M-18, PJM Capacity Market for information related to this market.

5.2 Ancillary Services

The following ancillary services are provided by PJM in coordination with the generating entities and are required/mandatory services, calculated after-the-fact in the billing process.

5.2.1 Reactive Supply and Voltage Control from Generating Sources Service

In order to maintain transmission voltages on the Transmission Provider's transmission facilities within acceptable limits, generation facilities under the control of the Balancing Authority operator are operated to produce or absorb reactive power. Thus, Reactive Supply and Voltage Control from Generation Sources must be provided for each transaction on the Transmission Provider's transmission facilities.

The amount of reactive supply and voltage that must be supplied with respect to the Transmission Customers transaction will be determined based on the reactive power support necessary to maintain transmission voltages within limits that are generally accepted in the region and consistently adhered to by the Transmission Provider. The charges for such service are shown in Schedule 2 of the PJM Open Access Transmission Tariff. Also, new generators have the option of filing with FERC to receive a revenue stream for their reactive output.

After consultation with the Generator Owner regarding necessary step-up transformer tap changes, PJM will provide documentation to the Generator Owner specifying the required tap changes, a timeframe for making the changes, and technical justification for these changes. The Generation Owner shall provide notification to PJM when the changes have been implemented. Generation Owners shall update reactive capability curves (D-curves) via eDART to ensure PJM and TO EMS Security Analysis results are accurate.

5.2.2 Regulation and Frequency Response Service

Regulation and Frequency Response service provides the continuous balancing of resources (generation and interchange) with load and maintains the Interconnection frequency at sixty cycles per second (60 Hz). Within PJM, Regulation and Frequency Response service is accomplished through the Regulation Market, which is described in this section under *“Marketing Options.”*

5.3 Marketing Tools

Additional information on all PJM Marketing tools can be found on the PJM web site under Markets & Operations/PJM Tools.

5.3.1 Markets Gateway

This is the Market User Interface for participating in the PJM Wholesale Energy Markets, specifically the Day-Ahead Market, the PJM Regulation Market, and the PJM Synchronized Reserve Market. Users may submit resource-specific generation offers with operating details, fixed or price-sensitive demand bids, as well as bilateral transactions and financial increment and decrement bids. The PJM Markets Gateway interface also enables viewing public and private day-ahead results and managing portfolios, please refer to the Markets Gateway User Guide and Markets Database Dictionary for more information.

5.3.2 PJM inSchedule

This tool is used by Generation Owners in PJM to submit their internal PJM energy schedule data. All PJM internal transactions, including load and generation interchange adjustment modeling and implicit internal spot market schedules, are handled through the PJM inSchedule system. New users who are PJM Members may register to use eRPM and inSchedule by submitting the User Registration form from the login screen.

5.3.3 PJM eRPM

This electronic tool enables a competitive installed-capacity market and fulfills the data reporting requirements for generation owners with granted capacity status. Users of eRPM can view peak loads and obligations in any zone, shop for PJM installed capacity, and create bilateral transactions to buy or sell unit-specific or capacity credits. New users may register to use eRPM by submitting the User Registration form from the login screen.

5.3.4 eDART

The Dispatcher Application and Reporting Tool (eDART) provides communication with PJM for generation operators regarding unit outage and reduction requests, updates to reactive capability curves (D-curves), Automatic Voltage Regulator status, Power System Stabilizer status, Governor status, MVAR tests, Supplementary Status Reports (SSRs), Instantaneous Reserve Checks (IRCs), Minimum Generation Reports, and Gen Checkout.

In order to ensure operational model consistency, non-black start generators shall be modeled in eDART similar to the PJM EMS model. All new black start generators shall be modeled individually in eDART and EMS including those that are part of a combined cycle plant.

Additional applications may be integrated in eDART in the future. User registration is available from the PJM web site

5.3.5 eGADS

The Generator Availability Data System (GADS) enables the operators of generation units to submit performance data into PJM records for determination of unit availability. Units are tracked on a rolling twelve-month basis for demand equivalent forced outages (EFORd) to determine their unforced capacity. Operators are required to submit data monthly using the eGADS interface. New plant operators should contact PJM for user set-up.

5.3.6 Data Viewer

Data Viewer is an Internet based system that allows PJM dispatchers and participants to view current and projected system data and emergency procedures information as well as market information. Additionally, Data Viewer feed is an RSS feed of data that users may scrape for data. User registration is available from the PJM web site.

5.4 Description of the Two-Settlement System

5.4.1 Market Participants

For more information about Market Participants please refer to PJM Manual M-11, Energy & Ancillary Services Market Operations.

5.4.2 The Day-Ahead Market

The Day-Ahead Market allows participants to purchase and sell energy at binding day-ahead prices. It also allows transmission customers to schedule bilateral transactions at binding day-ahead congestion charges. These congestion charges are based on the differences in Locational Marginal Prices (LMPs) between the transaction source and the sink.

Load Serving Entities (LSEs) will submit hourly demand schedules, including any price-sensitive demand, for the amount of demand that they wish to lock in at day-ahead prices. Any generator that is a PJM-designated capacity resource must submit a bid schedule into the day-ahead market unless it is self-scheduled or unavailable due to outage.

Other generators have the option to bid into the day-ahead market. Transmission customers may submit fixed or dispatchable bilateral transaction schedules into the day-ahead market and may specify whether they are willing to pay congestion charges or wish to be curtailed if congestion occurs in the day-ahead schedule.

All spot purchases and sales in the day-ahead market are settled at the day-ahead prices. After the daily quote period closes, PJM will calculate the day-ahead schedule based on the bids, offers and schedules submitted using scheduling programs that perform least-cost, security-constrained resource commitment and dispatch for each hour of the next operating day. The day-ahead scheduling process will incorporate PJM reliability requirements and reserve obligations into the analysis. The resulting hourly schedules and LMPs represent binding financial commitments to the Market Participants. Financial transmission rights (FTRs) are accounted for at the day-ahead LMP values.

For more information please see PJM Manual M-11, Energy & Ancillary Services Market Operations.

5.4.3The Real-Time Balancing Market

The Balancing Market is based on real-time operations. It provides financial incentives for generators to follow the real-time economic dispatch instructions issued by PJM.

Generators designated as PJM Capacity Resources that are available but not selected in the day-ahead scheduling may alter their bids for use in the balancing market. If not altered, the original bids remain in effect for the Balancing Market.

Balancing prices are calculated on the actual system operating conditions as described by the PJM state estimator. LSEs will pay balancing prices for any demand that exceeds their day-

ahead scheduled quantities. The LSEs will also receive revenue for demand deviations below their scheduled quantities.

Generators are paid balancing prices for any generation that exceeds their day-ahead scheduled quantities and will pay for generation deviations below their scheduled quantities. Transmission customers pay congestion charges for bilateral transaction quantity deviations from day-ahead schedules. All spot purchases and sales in the balancing market are settled at the balancing prices.

For more information please see PJM Manual M-11, Energy & Ancillary Services Market Operations.

5.4.4 Grid Accounting

There are several services within the Interchange Energy Market for which PJM calculates charges and credits that are allocated among the PJM Members. (Detailed explanations may be found in the PJM Manual M-28, Operating Agreement Accounting.)

PJM provides accounting for these services:

- Spot Market Energy—Energy bought or sold by PJM Members through the PJM Energy Market.
- Regulation—The capability of a specific resource with appropriate telecommunications, control, and response capability to increase or decrease its output in response to a regulating control signal (see **PJM Manual M-12, Balancing Operations**).
- Operating Reserves—The amounts of generating Capacity scheduled to be available for specified periods of an Operating Day to ensure reliable operation.
- Synchronized Reserve—Capability of a specific synchronized generating or demand resource that can be provided within ten (10) minutes (see **PJM Manual M-11, Energy & Ancillary Services Market Operations**).
- Transmission Congestion—The increased cost of energy delivered when the Transmission System is operating under constrained conditions.
- Transmission Losses—Energy requirements in excess of load requirements due to the energy consumed by the electrical impedance characteristics of the Transmission System.
- Emergency Energy—Energy bought from or sold to other Balancing Authorities by PJM due to emergencies either within the PJM Balancing Authority or within the other Balancing Authorities.
- Metering Reconciliation—Metering errors and corrections that are reconciled at the end of each month by a meter error correction charge adjustment.
- Unscheduled Transmission Service—Service that PJM Members can provide to or receive from the New York ISO and are credited or charged according to the Operating Agreement.
- New Jersey – New York (NJ-NY) PAR Facilities—Carrying charges collected from PJM RTOs paid to the New York ISO for the Phase Angle Regulators (PARs) at Ramapo and charged according to the Operating Agreement.

- Capacity Market—Capacity bought or sold through the PJM daily and capacity markets via eRPM.

These services are applicable to the different types of market participation, as shown in the following table. Each service is further broken down in the billing statement (see the PJM Manual M-29, Billing).

	Market Buyers	Market Sellers	Transmission Customers
Spot Market Energy	X	X	
Regulation	X	X	
Reserve Markets	X	X	
Operating Reserves	X	X	
Transmission Congestion			X
Transmission Losses			X
Emergency Energy	X	X	
Meter Reconciliation	X	X	
Unscheduled Transmission Service	X	X	
Capacity Market	X	X	

Exhibit 7: Applicable Services as defined by Market Participation

PJM Energy Market accounting is designed to operate on a balanced basis. That is, the total amount of the charges equals the total amount of credits; there are no residual funds. With certain exceptions, each of the individual services also operates on a balanced basis. Charges and credits for a particular service (such as regulation) offset each other exactly. In certain cases, excess charges or credits in one service category are used to offset charges and credits for another service.

Accounting Input Data

PJM collects information regarding actual operations during the hour. This information is recorded either by the PJM System Operators or by automated systems. The market accounting processes use this information as input data. Other accounting input data is provided from various systems and databases. This information includes data describing PJM Members' installed generating resources, scheduling information for PJM Members' transactions, and Transmission System parameters.

5.5 Pre-Scheduling and Scheduling

One of the principal purposes of the PJM pre-scheduling activities is to establish and maintain the markets database containing current generator information. The database contains

resource-specific information including company, plant, operating limits, resource availability, etc., and is used during pre-scheduling, scheduling and dispatching. This data allows PJM to schedule generation resulting in the lowest overall production cost while maintaining the reliability of the PJM RTO.

Each Generator must advise PJM on a daily basis of its generation schedule and/or bid price for the following day. Generators must abide by these schedules unless approval for deviation is secured from PJM or unless equipment problems beyond the Generator's control prevent operation at the specified schedule.

Specific details concerning the data requirements and deadlines for the pre-scheduling and scheduling processes are contained in the PJM Manuals M-10, Pre-Scheduling Operations and M-11, Energy & Ancillary Services Market Operations.

5.6 Unit Commitment

5.6.1 Process

The resource commitment process includes the Markets Database (formerly the Unit Commitment Database or UCDB) and the functions of Hydro Scheduler and the Dispatch Management Tool (DMT). The Markets Database is a large database containing information on each resource that operates as part of the PJM Interchange Energy Market.

The Resource Scheduling and Commitment (RSC) programs provide an optimized economic commitment schedule for thermal generating units and are the primary tool used to determine commitment of resources that have operating constraints requiring multiple-day operation.

The Hydro Calculator computes hourly reservoir elevations and hydro plant generation from input river flows and hydro plant discharges.

The DMT runs in the corporate computer system and performs accounting and operations functions with respect to combustion turbines. Additional information on the PJM resource commitment process may be found in the following manuals:

- PJM Manual for Pre-Scheduling Operations (M-10)
- PJM Manual for Energy & Ancillary Services Market Operations (M-11)
- PJM Manual for Billing (M-29)

5.6.2 Data Requirements

The two-settlement technical software develops the Day-Ahead Market results based on minimizing production cost to meet the demand bids and decrement bids. The results incorporate PJM Balancing Authority security constraints and reliability requirements necessary for reliable operation.

Two-Settlement Technical Software

The PJM Two-Settlement Technical Software is a set of computer programs performing security-constrained resource commitment and economic dispatch for the Day-Ahead Market. The individual programs are:

1. Resource Scheduling and Commitment (RSC)—Performs security-constrained resource commitment based on generation offers, demand bids, increment offers, decrement bids and transaction schedules submitted by participants and based on PJM Balancing

Authority reliability requirements. RSC will enforce physical resource-specific constraints that are specified in the generation offer data and generic transmission constraints that are entered by the Market Operator.

2. Scheduling, Pricing and Dispatch (SPD)—Performs security-constrained economic dispatch using the commitment profile produced by RSC. SPD calculates hourly unit generation MW levels and LMPs for all load and generation buses for each hour of the next operating day.
3. Study Network Analysis (STNET)—Creates a powerflow model for each hour of the next operating day based on the scheduled network topology, the generation and demand MW profile produced by SPD and the scheduled Tie Flow with adjacent Balancing Authorities. STNET performs AC contingency analysis using the contingency list from PJM EMS and creates generic constraints based on any violations that are detected.

After the close of the generation re-bidding period at 1415, the RSC is the primary tool used to determine any change in steam unit commitment status. Commitment changes are based on minimizing the additional startup costs and costs to operate steam units at economic minimum, as well as providing sufficient operating reserves to satisfy the PJM Load Forecast.

The purpose of this second phase of resource commitment is to ensure that PJM has scheduled enough generation in advance to meet the PJM Load Forecast for the next operating day and for the subsequent six days. CT units are included in the scheduling process and are scheduled in the Day-Ahead Market. However, the decisions concerning actual operation of pool-scheduled CT units during the operating day are not made until the current operating hour in real-time dispatch.

5.7 Generation Transfer Process

In the event that a generation resource changes ownership via transfer or sale, or a generation resource has a transfer of responsibilities, PJM Member Relations shall be contacted in advance of the change by initiating the Generation Transfer process through the PJM Member Community: https://pjm.force.com/Member/s/

PJM's client managers will facilitate the generation transfer process for members in order to effectuate the changes in PJM. Generation Transfer documentation shall be finalized and approved by impacted parties at least five business days prior to the transfer effective date in order to be implemented in PJM's systems and tools. Questions on the process should be directed to PJM Member Relations via http://pjm.com/about-pjm/who-we-are/contact-us.aspx

Section 6: Pre-Operational Requirements

Welcome to the *Pre-Operational Requirements* section of the *PJM Manual for Generator Operational Requirements*. In this section you will find the following information:

- Description of data exchange testing procedures (see "*Data Exchange Testing*").
- Description of required training procedures (see "*Training and PJM TO Operator and Generation Dispatcher Certification*").
- Pre-operational requirements of Generation for coordination with dispatch (see "*Coordination with Dispatch*").

6.1 Data Exchange Testing

6.1.1 Introduction

PJM interfaces with a wide range of different customer systems. Procedures for verifying that these systems are ready to go into production operation vary by type of system, its functionality, the number of data points, etc. For purposes of illustration, test requirements for a Generation Management System (GMS) are provided here. A GMS is typically the most comprehensive system used for generator interconnection, and therefore, has the most comprehensive testing requirements.

By definition, a GMS provides a centralized control center interfacing via remote terminal units to numerous generating locations. This data is then sent to PJM via the Inter-control Center Communication Protocol (ICCP) link.

6.1.2 Test Requirements for Member Company New Generator Management Systems (GMS)

In general, PJM is responsible for testing data connections between a Member Company's GMS hardware and PJM's computers. PJM generally does not test communication between a Member's remote terminal units (RTUs) and the Member's GMS computers. When using a new GMS system, the Member Company should test input of all RTU information/data into their GMS before involving PJM.

Communication testing by PJM uses the TEST System, which tests the communication of information from the Member's GMS database into the PJM database. If changing from the previous GMS to the new one, testing will be enhanced if all of the data available in the existing GMS is simultaneously available to the new GMS. Where possible, testing of any new GMS should be done from the company's parallel test system connected to the PJM TEST system.

PJM does not require that any RTU be connected to the Member's GMS during testing with PJM's TEST system. The Member Company may have as many RTUs connected to their (new) GMS as they wish while testing with PJM's TEST system. Testing with PJM's TEST shall not reduce the availability of accurate telemetry to PJM's Operational EMS.

The Member Company must comply with these PJM naming and telemetry conventions (if applicable to the installation):

- Transmission line MW and MVAR
- Transformer MW and MVAR

- Generating unit MW and MVAR
- Station kV
- Frequency
- Transformer taps

In addition, the Member Company must support transmission of breaker/disconnect status. Testing should include several scheduled/intentional communication re-starts initiated by both PJM and the testing company.

After the Member Company has successfully completed testing with PJM's TEST System, PJM will schedule the test of the company's new GMS with all telemetry available. The test should comply with the following criteria:

- Real-time metering via ICCP data link connection must be in place before testing in order to maintain reliability of the PJM Balancing Authority.
- The Member Company must make known when its test period is starting.
- During this time, the Member Company shall maintain the old GMS in such a state that it can be restored in total within one hour upon demand by the PJM Supervising Dispatcher if the new GMS is not performing to the Dispatcher's satisfaction.

Link-up time for ICCP Links: The link shall be 99.5% operational or higher. PJM shall qualitatively judge whether or not the data is acceptable.

6.1.3 Communications Considerations

For companies using the ICCP protocol, the following specific items should be considered:

- The requirements for communication with PJM over can be obtained from your PJM Project Manager.
- The ICCP association form must be received by PJM for PJM to properly configure the link before any testing can start.
- Before testing with PJM's TEST system, it is desirable for the Member Company's vendor to communicate with the PJM DEV system.
- The Member company and PJM must take special precautions to prevent the Member company test GMS from communicating directly to the PJM Real-Time EMS system.

6.1.4 Offline Test

- Both companies will bring the data link up between the Member Company and PJM and verify that all sessions for ICCP are up.
- Both companies will compare values between the Member company and PJM such as:
    - Line and transformer flows: All 500 kV, 345 kV, selected 230 kV and tie lines (MW and MVAR),
    - Generator values
    - Testing Company Totals
    - Frequency

  - Individual Unit MW base points from (SCED)
  - Regulation signals
  - Breaker status
  - Voltages
  - Transformer taps
  - Pond levels
- Both companies will check the points in the various reporting cycles to see that they are updating at the proper scan rate.
- PJM will have the Member company tel-fail several lines, including facilities at different voltage levels. Companies will compare values, singly and several at once, adjacent and separated in the PTID list. Both companies check for the appropriate flag set in the status code section of the Value Table for the corresponding PTID.
- PJM will have the Member Company restore tel-fails and compare values.
- PJM will have the Member company tel-fail breaker status out-of-service for selected breakers and then restore, checking status each time.
- PJM will have the Member company change status on a device and verify.
- PJM will bring up various PJM EMS displays and check values.
- PJM will change scheduled frequency (e.g., 59.98 Hz). Member Company will verify the change.
- PJM will change Individual Unit MW basepoints. Member Company will verify the change.
- PJM will suspend regulation. Member Company will verify they are receiving a zero regulation signal.
- PJM will unsuspend regulation. Member Company will verify they are receiving the regulation signal the PJM is dispatching.
- PJM will cause the ACE signal to go from a lower to a raised position. Member Company should verify both the correct value and direction.

6.1.5 Online Test

The Online Test involves the connection of the Member Company's new GMS system to the PJM's RT EMS system. The communications should be accurate and reliable. All systems will be closely watched by the test director over a period of time. During this test, repeat as many steps as possible from the Offline Test above when the new link is brought on line.

6.1.6 Dispatcher Testing Procedure and Computer-to-Computer Testing

Verify Key Control Items on PJM's Displays

- PJM will request the Member Company to tel-fail a value for one of their transmission facilities.
- Check for the appropriate flags and status on applicable PJM EMS displays.

- PJM will change scheduled frequency (e.g. 59.98 Hz) and verify that the Member Company received the change. PJM will return the frequency signal to normal.

Verify Network Applications

PJM will verify that the State Estimator Application operates properly with the member's equipment included in the PJM Network Model. Specifics of this verification will be based on the overall impact of the member's equipment on the PJM system.

Verify Accounting Data

After confirming connectivity to the customer's metering equipment, PJM will verify the validity and accuracy of individual test data being transmitted. Test data will also be made available from SCADA to Markets Settlements to verify that it is being accurately transmitted.

The generation owner must designate the applicable network model bus(es) at which each revenue meter is to be priced. Once accounting data is successfully being stored in the Market Settlements Database, the generation owner and the Market Settlements staff will compare the accounting data being sent from the generator to the data being received by the PJM settlements system to confirm that it is being transferred accurately.

Verify Real-Time Operational Scheduling

After confirming connectivity, use the Unit Hourly Update page (in Markets Gateway) with the current date to simulate a change in a unit's operational status. PJM will verify that the change was received.

6.2 Training and PJM TO Operator and Generation Dispatcher Certification

6.2.1 Training

Refer to Training Requirements in PJM Manual M-40, Training and Certification Requirements.

6.2.2 PJM TO Generator and Generation Dispatcher Certification

Refer to Certification Requirements in PJM Manual M-40, Training and Certification Requirements.

6.3 Coordination with Dispatch

6.3.1 Operation

Every Generator interconnected with and synchronized to the transmission system must at all times coordinate operation with PJM and the Transmission Owner, providing all necessary and requested information and equipment status, to assure that the electrical system can be operated in a safe and reliable manner.

This coordination includes, but is not limited to:

- Supplying generator net-MW and MVAR output.
- Supplying frequency and voltage levels.
- Scheduling the operation and outages of facilities including providing advanced notification.

- Coordinating the synchronization and disconnection of the unit with the PJM or local system operator.
- Providing data required to operate the system and to conduct system studies.
- Providing documented start-up and shutdown procedures including ramp-up and ramp-down times.
- Following PJM-directed plant operation during emergency and restoration conditions.
- Following PJM-directed operation during transmission-constrained conditions.

Note:
For distributed generators modeled at less than 10MW, PJM requires the generators to be able to follow PJM direction via SCADA or an agreed upon alternative method.

6.3.2 Communication

To ensure reliable operations and responsiveness, Generators must be properly staffed to support a 7-day, 24-hour contact for communications. Data must be sent to PJM automatically. In the event that the data is temporarily not received by PJM, the Generator Operator must call PJM with the operating data at intervals specified by PJM. The Generator Operator shall correct any problems associated with the failure of equipment within a reasonable time.

The Generator and Transmission Owner shall promptly exchange all information relating to all conditions which affect (or could affect) the operations of any facility reporting data.

The Generator shall communicate the outage of any electrical equipment connecting the facility to the PJM system in accordance with these requirements:

- Each facility will be assigned to one of the PJM Transmission Owners as its primary contact, unless arrangements are made to communicate this information directly to PJM. This assignment is based upon the voltage level of the connection to the Transmission System and the geographic location of the facility.
- All planned and maintenance outages of electrical equipment requiring involvement of PJM personnel must be requested by the Generator. The appropriate information must be in a format defined by PJM.

6.3.3 Test Energy

Test energy is energy generated for a predetermined period by a new resource interconnecting with the PJM Balancing Authority for the first time. The test energy period starts with Stage Two energization (initial synchronization of generator to the transmission system per ICSA). Depending on the size and nature of the generating unit(s), this period may be a matter of hours or days.

Providers of test energy are not required to participate in the Day-Ahead (DA) energy market. Test energy compensation can be obtained at Real-Time (RT) Locational Marginal Price (LMP).

Market participation & compensation can only occur if proper metering and modeling are completed as specified in other parts of this manual and the Power Meter account is active.

Day-Ahead energy market participation is optional to mitigate RT deviations from DA position.

Before providing interconnected test energy, Generators must:

1. Have in place an executed Interconnection Service Agreement with PJM and the interconnected Transmission Owner.
2. Provide PJM with an accurate Test Schedule, including times and output of unit.
3. Provide notification to PJM Dispatch Operations at least 20 minutes prior to a change-in-state of each generating unit.
4. Provide the PJM Dispatch Operations and the Market Settlements department accurate information as to when unit will be available for commercial use and in which markets it intends to do business.

If metering is not in place and verified via test, then an InSchedule internal bilateral transaction may be used to support any agreement between the generator owner and the transmission owner. This is an option PJM provides to the parties involved but is not a requirement.

Upon completion of the test period and when the generator is determined to be available for commercial operation, each unit is subject to other voice and data test requirements which are discussed in other sections of this manual.

6.3.4 Other Requirements

The Generator Owner shall develop operating principles and procedures for its facility, coordinated with PJM requirements and provide the necessary training and certification for appropriate employees. Generators must provide for the necessary communication of information between the Generator and PJM. This information includes generator data for each generating unit, unit step-up transformer and auxiliary transformer.

Each Generator shall develop operating practices and procedures, coordinated with PJM, for normal and emergency operation and assistance in remedial action. These practices and procedures must incorporate the applicable standards and requirements contained in the PJM Manuals and the NERC Reliability Standards.

Each Generator shall have and follow a voltage schedule provided to them by the local Transmission Owner or the PJM default voltage schedule as per PJM Manual M-3, Transmission Operations, Section 3.11.

Conditions may be encountered on the PJM system, which require participation in remedial action. These include, but are not limited to: actual or contingency flow or voltage-limit violations, violation of synchronous stability limits, low or high frequency, voltage reductions, system blackouts, and maximum and minimum generation conditions.

Each Generator shall immediately notify PJM of any condition that inhibits operating in a reliable manner or in a manner previously agreed upon. Such conditions include, but are not limited to the availability of fuel, inability to operate due to labor restrictions, equipment, environmental or weather-related problems.

To ensure that all PJM personnel responsible for the design and operation of the PJM system are familiar with equipment configurations, capabilities, and operating parameters, PJM may request, and the Generator shall provide in a timely manner, detailed information about the type, nature, and operating characteristics of the facility and all related equipment.

The Generator must keep and maintain accurate and complete records for Generator interconnection facilities. These records must contain information regarding the operation and maintenance of all equipment and must be consistent with good industry practice. The data in

these records must be sufficient for PJM to comply with applicable regulatory requirements. The Generator must make these records available to PJM for inspection and copying as PJM may request.

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Section 7: Generator Operations

Welcome to the *Generator Operations* section of the *PJM Manual for Generator Operational Requirements*. In this section you will find the following information:

- Description of the dispatching process (see "*Dispatching of Generation*").
- Switching requirements for all equipment a Generator Resource owns, operates or controls (see "*Switching Requirements*").
- Generator information and reporting requirements (see" *Critical Information and Reporting Requirements*").
- Requirements and procedures for Generator synchronization and disconnect (see "*Synchronization and Disconnection Procedures*").

7.1 Dispatching of Generation

7.1.1 Generator Real-Power Control

The Generator must deliver the electric energy generated by the facility to PJM at the point(s) of interconnection in the form of 3 phase, 60-Hertz alternating current at the nominal system voltage at the point of interconnection.

Generators and their protective systems (relaying, V/Hz, etc.) should meet the frequency guidelines listed in PJM Manual M-36, System Restoration, section 2.3, to coordinate with system preservation under-frequency load shedding. Additionally, generators and their protective systems should be capable of operation at over-frequency up to 61.7 Hz for a limited duration. Refer to NERC Reliability Standard PRC-024, Generator Frequency and Voltage Protective Relay Settings.

At no time shall the operation of the generating facility, including the associated generators or any of their auxiliary devices, result in an electrical output in which harmonic distortion exceeds the recommended limits contained in IEEE Standard 519, which defines voltage waveform and harmonic content.

All generators, including pseudo tied or dynamically scheduled generating resources, should operate on unrestricted governor (or equivalent electronic speed control device) control to assist in maintaining interconnection frequency, except for the period immediately before being removed from service and immediately after being placed in service.

Governor outages during periods of operations must be kept to a minimum. If a governor or equivalent electronic speed control device for any unit, regardless of resource type, is out of service or unable to react to a change in system frequency, it must be immediately reported to PJM via eDART as a governor outage. When a generator governor is not available, the unit output should not fluctuate from pre-scheduled output unless otherwise directed.

With exception of nuclear generators, all generating resources with gross plant / facility aggregate nameplate rating greater than 75 MVA are requested to ensure that, in the absence of technical or operational considerations, the generator governor (or equivalent electronic speed control device) and Distributed Control System (DCS) settings provide dead bands that do not exceed +/- 36 mHz, and droop settings that do not exceed 5%. Should a generating resource be unable to meet these criteria, the generating resource's actual settings and reasons for being unable to meet these criteria shall be forwarded to PJM. System conditions permitting,

Generators must respond immediately to a PJM request directing a change in generation output and must proceed at a rate which is within 2% of the generator's stated ramp-rate, until the prescribed output is reached.

7.1.2 Voltage and Reactive Control

Over-voltage and under-voltage protection systems must be capable of allowing abnormal system operations within PJM post-contingency operating limits. Momentary voltage fluctuations are permitted provided they neither disturb service provided by PJM or the Generator on their respective systems nor hinder PJM from maintaining proper voltage conditions on its system.

All Generators must install and have available generator field-excitation regulators (voltage regulators). The reactive output of the generator must be regulated in the manner specified by PJM and/or the Transmission Owner. The PJM Transmission Owners or PJM must supply and communicate voltage schedules and a low and high voltage bandwidth to all Generation Owners/Operators in its zone meeting the following criteria:

- individual generating units greater than 20 MVA
- generators that aggregate to 75MVA or greater that are connected to a common bus
- black start generators
- any other Generation Owners/Operators that request a voltage schedule

PJM shall be copied on the voltage schedules that are issued by the Transmission Owners to the Generator Owners/Operators via the email address voltageschedules@pjm.com.

Non-synchronous generating facilities which entered the New Service Queue on or after November 1, 2016 are required to provide dynamic reactive power and follow the assigned voltage schedule. (FERC Order No. 827 - Reactive Power Requirements for Non-Synchronous Generation.)

In accordance with PJM Manual M-3, Transmission Operations, section 3.11, a voltage schedule shall be provided to newly connected generators prior to commercial operation.

Generator Owners/Operators shall comply with the assigned voltage schedule in automatic voltage control mode (AVR in service and controlling voltage). Generator Owners/Operators are required to maintain the same voltage schedule if an AVR is out of service unless directed otherwise. PJM allows for different voltage control modes of operation for generators (voltage, reactive power, and power factor) provided that the Transmission Owner or Generator Owner/Operator has been granted an exemption request following the process identified in PJM Manual M-3, Transmission Operations, section 3.11. These voltage control operating modes are described in the following section.

AVR Operating Mode	Expected Generator Response
Automatic controlling voltage (voltage schedule)	Reactive output varies based on the grid system needs to maintain the reference voltage within the assigned voltage schedule's bandwidth up to the reactive capabilities of the generator. This is the standard voltage control operating mode for most generators in PJM.

AVR Operating Mode	Expected Generator Response
Automatic controlling MVARs (MVAR schedule)	Reactive output remains steady based on scheduled MVARs
Automatic controlling power factor (power factor schedule)	Reactive output varies based on the real power output of the generator to maintain a constant ratio of real power versus apparent power (constant power factor)
Manual	Reactive output varies based on the manual adjustments made by the plant operator

See PJM Manual M-3, Transmission Operations, section 3.11 for details on the process to exempt a generator from following a voltage schedule or operating its AVR in a mode other than automatic controlling voltage.

Generation Owners/Operators must coordinate any voltage schedule issues (including stability, automatic voltage regulator and power system stabilizer outages) with PJM and the PJM Transmission Owner. In the event that automatic voltage regulating devices are out-of-service, the Generator shall provide manual voltage regulation to maintain the prescribed voltage schedule. The Generator must notify PJM and the Transmission Owner with as much lead-time as possible prior to performing all voltage regulator and power system stabilizer maintenance. Notifications of unplanned outages on automatic voltage regulators (AVR) and/or power system stabilizers (PSS) must be communicated to PJM verbally and via eDART and to the Transmission Owneras soon as possible but no later than within 30 minutes of the occurrence. If the status of the AVR or PSS has been returned to normal within 30 minutes of such change, then the Generator Operator is not required to notify PJM and the Transmission Owner. For modeling accuracy the provision of telemetered AVR and PSS status points by Generator Operators to PJM is preferred.

Note:
Typical operation of a Power System Stabilizer (PSS) is such that the Automatic Voltage Regulator (AVR) must be in service in automatic mode for the PSS to be operational. In addition, the PSS is typically enabled but not active until the unit achieves a predetermined power output. Notification to PJM for PSS outages shall be made when the AVR and/or PSS is manually disabled or when equipment malfunction results in the PSS being unable to operate normally.

When PJM determines that system conditions warrant a change, the Generator may be requested to deviate from the predetermined voltage or reactive power schedule. PJM may direct a facility to operate in lead, lag, or unity power factor as long as the direction is within the unit's capability.

During an emergency, the Generator must participate in a voltage reduction declared by PJM and operate the facility at the voltage level requested by theTransmission Owner. Unless PJM requests a manual adjustment, the Generator must maintain the facility's automatic voltage regulator(s) in service during an emergency.

Note:
Refer to PJM Manual M-3, Transmission Operations, section 3.11 for additional information on Generator Voltage Schedules and Operations. Real-time criteria to exempt generators from following a voltage schedule within the defined bandwidth are detailed in Notes 2 and 3.

7.1.3 Notification to PJM for Reactive Power Resource Status during Unit Start-up

Generators may elect to operate their AVR in manual mode when synchronized and producing MW's during startup until minimum load is achieved (or during shutdown as applicable) in order to ensure overall unit stability (or based upon other physical equipment limitations). For those units that register as a Generator Operator in accordance with the NERC Statement of Compliance Registry Criteria, if PJM Dispatch received real-time notification of the generator start-up or shutdown no additional notifications to PJM regarding AVR status will be required unless the AVR is not returned to automatic mode once minimum load is achieved.

7.1.4 Generator Operation under Constrained System Conditions

Under normal conditions, each Generator limits its generating output to the value specified in the pre-scheduling information for that hour or to the value directed by the PJM control signal. However, when the system is constrained, PJM may direct the Generator to deviate from these values any time reliability principles and standards are violated.

Where practical, PJM will direct all non-cost measures to be implemented prior to requesting Generators to redispatch. Specific details concerning operation of the transmission system under constrained conditions can be found in the PJM Manual M-3 for Transmission Operations.

7.1.5 Generator Operation under Emergency Operating Conditions

Each Generator must limit its generating output to the value specified by its pre-scheduling information for that hour or to the value directed by PJM. PJM has the authority to direct deviation from the pre-scheduled values any time applicable reliability principles and standards are violated.

In order to maintain system reliability during emergency operations, it is critical that Generators respond to directives from PJM. Typical directives are outlined in the PJM Manual M-13 for Emergency Operations. Note that these directives may require a Generator to provide additional operational data required by PJM for supplementary system analysis.

In general, a Member's responsibilities during emergency operation include:

- Taking other actions, as requested or directed by PJM, to manage, alleviate, or end an emergency.
- Cooperating with each other and PJM to carry out the emergency procedures and to implement requests and instructions received from PJM for the purpose of managing, alleviating, or ending an emergency.
- Providing notification and other information to governmental agencies as appropriate.
- Collecting, storing, and providing data and other information to PJM to facilitate preparation of reports required by governmental or industry agencies as a result of an Emergency.
- Cooperating and coordinating with PJM and other PJM Members in the restoration of all or parts of the Bulk Electric System in the PJM Balancing Authority.

Additionally, a PJM Generation Owner controlling the output of a Capacity Resource must take or arrange for any or all of the following actions, when directed by PJM, to manage, alleviate or end an emergency:

- Reporting the operating status and fuel situation.
- Canceling testing and maintenance.
- Reducing non-critical plant load.
- Directing personnel to unattended generation sites.
- Starting (including black-start) and loading generation, as directed.
- Reducing output to emergency minimum generation.
- Shutting down generation.
- Interrupting sales for delivery to loads outside the PJM Balancing Authority.
- Selling energy to other Balancing Authorities as requested during emergency conditions in other Balancing Authorities.
- Maintaining records of emergency actions taken and the results achieved.

During an emergency (as determined/declared by the Transmission Owner (TO) or by PJM) the Generator shall respond as promptly as possible to all directives from the TO or PJM. These directives may relate to actual or contingency thermal overload of electrical circuits or actual or contingency high/low voltage conditions.

The TO or PJM may also direct the Generator to:

- Increase or decrease the facility energy and/or reactive output
- Connect or disconnect the facility from the PJM electrical system, and/or
- Deviate from the prescribed voltage or reactive schedules.

If safety or system reliability conditions warrant, the TO may isolate the facility from the PJM electrical system without prior notice to the Generator or upon such notice as is possible under the circumstances. The TO shall advise the Generator as soon as possible of any forced outages of the PJM electrical system that affect the facility's operations.

The Generator and PJM shall maintain communications and contact during all PJM or TO emergency operations. When the TO or PJM has determined that the emergency conditions have been alleviated, the TO or PJM shall inform the Generator and allow the facility to return to normal operations.

To safely restore the Transmission System following the outage of any facility, the facility isolated from the PJM electrical system shall be allowed to reconnect only under the direction of the TO or PJM. In all cases, the facility shall be made ready to return to service and provide energy to the PJM system as soon as possible.

Criteria for determining certain emergency conditions are reviewed in the following tables.

Capacity Shortage Procedures			
Condition	**Alert**	**Warning**	**Initiation**
Maximum Emergency Generation Alert	Requested in Operating Plan on prior day.		When demand is greater than highest normal bid.
Unit Start-up Notification Alert	Placing units in state of readiness		When anticipating shortage of operating capacity, stability issues or constrained operations for future periods.
Primary Reserve	Reserve is less than primary requirement.	Reserve is less than primary requirement but greater than spinning reserve.	
Load Management Curtailment			When generation is not available to meet forecast demand.
Voltage Reduction	Estimated reserve is less than forecast spinning reserve requirement.	Synchronized reserve less than spinning requirement.	When load relief is needed to maintain tie schedules or relieve transmission constraints.
Voluntary Customer Load Curtailment	Forecasted reserve indicates a probable need for this action.		When earlier procedures have not produced needed load relief.
Radio / TV Appeal			When earlier procedures have not produced needed load relief.
Manual Load Dump		Reserves are less than largest contingency.	When earlier procedures have not produced needed load relief.

Exhibit 8: Criteria for Determining Capacity Storage Emergency Conditions

Light Load Procedures			
Condition	**Alert**	**Warning**	**Initiation**
Minimum Generation Advisory			Issued 1 to 2 days in advance to provide an informational only notice that a Min Gen Alert/Action is likely
Minimum Generation Alert	To provide alert that system conditions may require the use of emergency procedures		When expected generation levels are within 2500 MW of normal minimum generation limits
Compile report of Emergency Reducible Generation (ERG)			Prior to Light Load Period
Reduce all units to normal minimum generation			During the Light Load Period
Minimum Generation Emergency Declaration		To notify members further generation reductions are needed to meet the minimum load during the valley period.	At determination of PJM dispatcher
Minimum Generation Event		PJM declares event and requests percentage of ERG as needed (stepped process) to maintain system control	When utilization of ERG is necessary to match the decreasing load
Cancellation			Takes place in reverse order of implementation as PJM load begins to exceed generation and actions taken are no longer necessary

Exhibit 9: Criteria for Determining Light Load Emergency Conditions

7.1.6 Black Start

The TO must have and maintain the capability and authority to perform system restoration using all generators that are included in their restoration plans. Voice communication (-to-plant)

tolerant of major power system failures is the minimum requirement to achieve black start. Private communication systems on un-interruptible power supplies (UPS) and radio systems are examples of this type of system. The current satellite-phone voice communication from PJM to the TOs meets the minimum requirements for PJM-to-TO communication. The current PJM approach of communicating directly through the satellite (avoiding the ground station) is designed to be tolerant of major power system failures. Black Start unit operators shall not permit their fuel inventory for Critical Black Start CTs to fall below 10 hours – if it falls below this level, unit operators shall notify PJM and place the unit in Max Emergency.

Specific details concerning procedures that PJM follows to ensure, monitor, and perform accounting for Black Start Service can be found in the PJM Manual M-10 for Pre-Scheduling Operations, PJM Manual M-12, Balancing Operations, and PJM Manual M-27, Open Access Transmission Tariff Accounting.

7.2 Switching Requirements

A Generator is responsible for switching all equipment it owns, operates, or controls. A trained person must be available within a maximum of two hour notice for the purposes of performing switching. Specified devices isolating the facility from the Transmission System shall be switched by the Generator or the Transmission Owner(according to the configuration and contract) whenever requested by PJM. These devices must be locked if applicable and tagged to provide adequate safety.

The Generator's switching procedures shall at all times be followed precisely by the Generator and be closely coordinated between the Generator and the Transmission Owner. Either party (Generator orTO) must provide a written copy of in-effect switching procedures to the other party upon request.

If requested by the Generator, specified Transmission Ownerdevices shall be operated and tagged by the Transmission Owneraccording to the Transmission Owner's switching and tagging practices and safety rules. Transmission Owner switching and tagging practices and safety rules shall apply to all situations involving the Transmission Owner and any Generator personnel involved with Transmission Owner switching and tagging.

7.3 Critical Information and Reporting Requirements

PJM is responsible for coordinating and approving requests for necessary outages of generation and transmission facilities. This assures the reliable operation of the PJM Balancing Authority. PJM maintains records of outages and outage requests for these facilities.

The procedure begins when a designated resource owner and/or an entity acting on their behalf submits an outage request via eDART. The outage request is recorded electronically and can be accepted or rejected by the PJM Dispatcher. Refer to the PJM Manual M-10, Pre-Scheduling Operations for information on the outage request procedure and request tracking via eDART.

It is important to emphasize that PJM does not schedule or determine when outages should take place. PJM only accepts or rejects the requests for outages submitted by Members. It is the responsibility of each Generator to determine its own best schedule of outages.

Outage requests are honored by PJM on a first come-first served basis. Requests are rejected only when they affect the reliability of the PJM Balancing Authority.

Generation Owners that own transmission equipment such as circuit breakers, capacitor banks, etc., do not have the capability to submit outage requests on transmission equipment in eDART. As a result, for Reportable Transmission Facilities in each TO zone, the Generation Owner must notify the affected Transmission Owner who must then submit outage requests to PJM via eDART for this generation-owned equipment as soon as practical after they are informed of the outage. It is the responsibility of the Generation Owner to keep the Transmission Owner updated on the status of this equipment.

Generation Owners shall notify PJM verbally and via eDART of any scheduled or emergent conditions on common internal plant equipment, or external generator-owned switchyard equipment, which results in a single contingency that would cause an outage of multiple generation resources within a minute of each other. Examples of common mode conditions include, but are not limited to, station service transformer outages and switchyard configuration changes that result in multiple generation resources sharing one critical piece of equipment.

7.3.1 Planned Outage

A Generator Planned Outage is the scheduled removal from service, in whole or in part, of a generating unit for inspection, maintenance or repair with the approval of PJM. The Generator shall provide PJM with written notice of its intent at least thirty days prior to performing planned maintenance of the facility, including turbine, generator, and boiler overhauls or inspections, testing, nuclear refueling, etc. Planned Outages usually occur during those seasons of the year when the peak demand on the power system is lowest and are not to be scheduled during the PJM Peak Period Maintenance Season.

When feasible, the Generator shall provide PJM with written notice of its intent at least thirty days prior to testing protective apparatus associated with generator interconnection facilities, including circuit breakers, relays and auxiliary equipment. PJM personnel or designated Transmission Ownerpersonnel may observe such testing.

The Generator shall notify PJM and the Transmission Ownerof its intent to remove electrical equipment from service by 10:00 a.m., three working days prior to the start of the planned outage.

An additional notification to PJM and the Transmission Owner is required at least 20 minutes before the planned outage begins.

PJM may request the Generator to delay or reschedule the planned outage if system-reliability conditions warrant.

To the extent practical, PJM will provide to the Generator advance notice of PJM's intention to perform planned maintenance on reportable PJM transmission facilities that may affect the Generator's operations.

7.3.2 Maintenance Outage

A Generator Maintenance Outage is the scheduled removal from service, in whole or in part, of a generating unit in order to perform necessary repairs on specific components of the facility with the approval of PJM. A maintenance outage is an outage that may be deferred beyond the next weekend but requires that the Capacity Resource be removed from service before the next planned outage. Characteristically, these outages may occur throughout the year, have flexible start dates, are much shorter than planned outages, and have a predetermined duration

established at the start of the outage. The duration of these outages is normally limited during the PJM Peak Period Maintenance Season.

7.3.3 Unplanned Outage

A Generator Unplanned (Forced) Outage is an immediate reduction in output or capacity or removal from service, in whole or in part, of a generating unit by reason of an Emergency or threatened Emergency, unanticipated failure, or other cause beyond the control of the owner or operator of the facility. The Generator may not remove any equipment from service without prior notification to PJM and the Transmission Owner(TO) except in the case where equipment must be disconnected from the system without PJM approval to prevent injury to personnel or damage to equipment.

However, if the Generator has any advanced knowledge of an unplanned outage, the Generator shall notify the TO with as much lead-time as practical. For reliability reasons, the Generator shall notify the TO as soon as reasonably possible of the following:

- The starting time of the unplanned outage.
- The energy reduction resulting (or expected to result) from the unplanned outage.
- The estimated time the equipment incurring the unplanned outage is expected to return to service.
- The time the Generator equipment is actually returned to service.
- The reason for the outage.

The Generator must submit a record of the events and circumstances giving rise to the unplanned or forced outage to PJM as soon as reasonably possible. The Generator must also notify PJM of any unusual operating conditions which may result in the reduction of output or tripping of multiple generators offline.

In addition, the Generator must notify PJM of any system conditions, whether a result of equipment failure or mandated restrictions (plant, governmental, etc.), which may result in potential generation reduction or controlled shutdown of any generator. Also, any conditions which may affect the availability of a resource providing PJM Black Start Service must be reported to PJM.

Additional details regarding Planned, Maintenance, and Unplanned outages can be found in the *PJM Manual M-10, Pre-Scheduling Operations*.

7.3.4 Generating Unit Reactive Capability Reporting

Generating Unit Reactive Power is a primary method of providing voltage support on the PJM system. A lack of deliverable Generating Unit Reactive Power, which is relied upon to be available based on reported Reactive Capability, can result in PJM system reliability problems including voltage collapse. Whereas, proper reporting can result in controlled measures, such as generation adjustment in lieu of unanticipated load shedding to address inadequate Reactive Power Reserves. The following requirements are applicable only for units physically located within the PJM RTO footprint.

Generating Unit Reactive Capability is a measurement of the reactive power able to be delivered by a generating unit to the transmission system. It is defined by the MW versus MVAR points of a generator reactive capability curve (D-curve). To help maintain a reliable

transmission system, each Generation Owner/Operator must provide capability curve information to PJM via eDART as soon as the information is available. The Transmission Ownerfor the Transmission Zone where the unit is located will be automatically notified via eDART, as well as any other Transmission Ownerswith eDART authority to receive automatic notification for the unit. For real-time changes, each Generation Owner should also notify PJM and the respective TO via phone. "Continuous Unit Reactive Capability Curve" data must be provided as follows via eDART:

- *Continuous Unit Reactive Capability Curve (required to provide)* - data that provides the realistic usable reactive output that a generating unit is capable of delivering to the PJM Interconnection and sustaining over the steady state operating range of the unit.

The PJM EMS Real-Time and Study Network Applications, Seasonal PJM Operating Studies, and PJM Planning Studies use Continuous Unit Reactive Capability Curves for actual pre-contingency steady-state analysis and for simulated post-contingency security analysis.

The Generator Operator shall notify PJM as soon as practical, but within 30 minutes of any temporary unit performance issues, including reactive capability derates or status or capability change on any generator Reactive Power resource, such as the status of each automatic voltage regulator and power system stabilizer and the expected duration of the change in status or capability and a status or capability change on any other Reactive Power resources under the Generator Operator’s control and the expected duration of the change in status or capability. If the unit’s reactive capability or status of the AVR or PSS status has been returned to normal within 30 minutes of such change, then the Generator Operator is not required to notify PJM and theTransmission Owner. Separate notifications and eDART tickets are required for each automatic voltage regulator outage and each power system stabilizer outage.

The Generating Unit Reactive Capability determination should reflect planned unit modifications and real-time limitations caused by system voltages, unit transformer tap position setting, temperature, operating conditions and restrictions, station auxiliary equipment, generator terminal bus voltage limitations, auxiliary bus voltages limitations, and operating procedure limits. There may be different limiting conditions for either leading or lagging reactive capability.

Planned modifications (tap changer adjustment, GSU replacements, turbine modification, etc.) that impact generator reactive capability should be communicated to the impacted TO and PJM as far in advance as possible but no later than the return of the unit from the outage. Changes should be communicated via eDART.

To ensure accuracy of generator reactive capabilities that may result from planned unit modifications, a critical input to PJM and Transmission Owner security analysis packages, PJM requires that each Generation Owner/Operator review and confirm their unit reactive capability data via eDART on a bi-annual basis. PJM and the Transmission Owners should then verify accuracy of unit reactive capabilities modeled in their respective EMS systems. The bi-annual review periods are defined as follows:

- Pre-Summer Review: From April 1 through April 30, Generator Owners should review their unit reactive capabilities in eDART. From May 1 through May 31, PJM and Transmission Owners should review EMS reactive capabilities based on the updated data in eDART and make any applicable changes.
- Pre-Winter Review: From October 1 through October 31, Generator Owners should review their unit reactive capabilities in eDART. From November 1 through November

30, PJM and Transmission Owners should review EMS reactive capabilities based on the updated data in eDART and make any applicable changes.

See Attachment D for a detailed description of the PJM Generating Unit Reactive Capability Curve Specification and an explanation of the PJM Reactive Capability Reporting Procedures.

A reactive test shall be performed as soon as practical following any planned upgrades which impact a unit's reactive capability. Estimated or calculated reactive capability data (D-curve) must be provided as an interim measure until a reactive test can be performed.

PJM requires periodic verification of reactive capability via real-time testing. See Attachment D for PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures and Attachment E for a detailed description of the PJM requirements for Generator and Synchronous Condenser Reactive Capability Testing.

7.3.5 Fuel and Emissions Reporting

Background and Intent

PJM needs data concerning unit fuel reserves for it to reliably operate the PJM Balancing Authority and its associated markets. This is especially true during periods of severe weather and/or times when there are external fuel constraints (e.g., coal strike, oil embargo, gas pipeline interruptions, etc.).

It is the intent of this procedure to require all generation resources to report fuel data so that in severe situations, PJM can continue to make the calls that are in the best interest of all its members. In contrast with past procedures, where PJM could have used this data to restrict the output of various generators based upon their fuel limitations without financial compensation, PJM will now use the information to assist the market in providing solutions to emergency situations.

PJM's authority to require all generation resource owners to provide these reliability based reports is found in the PJM Operating Agreement (Sections 11.3 Member Responsibilities, 11.3.1 General, and 1.10 Emergency, line ii) and referenced in the NERC Reliability Standard, EOP-11, Emergency Operations.

Seasonal Fuel and Emissions Reporting

Prior to going into the winter season, PJM may notify and request from all members with generation resources, by unit report of fuel and emission information. This survey will be issued via eDART and will request information such as but not limited to each unit's:

- available primary fuel
- available secondary fuel
- projected fuel inventory (in terms of MWh)
- typical fuel inventory (in terms of MWh)
- average amounts of fuel per delivery (in terms of MWh)
- delivery frequency
- amount of firm gas schedules
- run time limitations due to environmental/emission restrictions

- etc.

While some of this data may represent broad projections, it will assist in providing a baseline that can be compared to data submitted in the real-time reporting process to assist in determining the severity of specific emergency conditions.

Periodic Fuel and Emissions Survey

Depending on the severity of the weather forecasts, projected fuel availability, responses to the Seasonal Fuel and Emission Survey or other reasons, PJM may request on a periodic basis (such as monthly or as-needed) updated responses to the Seasonal Fuel and Emission Survey questions for a subset of units. This information is intended to assist in the Operations Planning Process. These Periodic Surveys will be issued via eDART.

Real-Time Reporting

When PJM receives a severe cold weather forecast or foresees a potential fuel crisis (e.g. embargo, strike, gas pipeline interruption, etc.), real-time updates of fuel limited units will be requested of members via Part G of the Supplementary Status Report (see Attachment C of PJM Manual for Emergency Operations M-13). This data will also be reported in other situations when a Supplementary Status Report is requested, such as Capacity Shortage emergencies. Refer to PJM Manual for Emergency Operations M-13, Section 6.4 Fuel Limitation Reporting for additional information on Real Time Reporting.

7.4 Synchronization and Disconnection Procedures

The Generator must obtain approval from PJM at least 20 minutes prior to synchronizing the facility to, or disconnecting the facility from, the PJM electrical system. In addition, the Transmission Owner must be notified when synchronizing or disconnecting from the Transmission Owner’s system. The only exception is when equipment must be disconnected from the system without PJM approval to prevent injury to personnel or damage to equipment. If the disconnection occurs without prior PJM approval, the Generator shall immediately notify PJM and the TO as to the cause, energy reduction, and the expected return time. The Generator must notify PJM prior to attempting a restart if the unit was operating for PJM and tripped or was scheduled to operate for PJM and failed to start. PJM will then assess if the unit should be restarted for system reliability or economics and notify the Generator.

The Generator must keep the TO and PJM dispatchers informed at all times of the facility's availability or any change in status. Additional requirements appear in the PJM Manuals for Pre-Scheduling Operations M-10, Energy & Ancillary Services Market Operations M-11, Balancing Operations M-12, and Control Center and Data Exchange Requirements M-01.

The facility shall normally be operated with all of the Generator's protective relays (primary or back-up) in service whenever the facility is connected to, or operating in parallel with, the PJM electric system. The facility may operate for a limited time to perform maintenance with one set of redundant relaying in service. PJM and the Transmission Ownershall be notified of such occurrences.

7.5 Cold Weather Generation Resource Preparation

Welcome to the Cold Weather Generation Resource Preparation section of the PJM Manual for Generator Operational Requirements. In this section you will find the following information:

- Description of the Generation Resource Operational Exercise.
- Usage of the Generation Resource Cold Weather Checklist.

7.5.1 Generation Resource Operational Exercise

In preparation for winter operations, PJM will request that generation resource owners/operators ("resource owner") exercise some of their generation resources to determine whether they are capable of reliably operating and responding to PJM's dispatch instructions. This exercise will be conducted prior to the onset of cold weather to assist in identifying and correcting start-up, operational, and fuel switching (if applicable) problems. Alternatively, a generation resource owner may elect to self-schedule a resource to validate its cold weather operation.

Prior to November 1 of each year and on a two week rolling basis through mid-December as described below, PJM will compile a list of generation resources eligible to participate in the exercise. Generation resources will initially be eligible if they have not been operated by PJM or the resource owner on either the generation resource's primary fuel, alternate fuel, or both for eight weeks or more prior to November 1. Generation resources having any MWs that cleared as Capacity Performance for the current Delivery Year are not eligible to participate in the Generation Resource Operational Exercise and thus will not be scheduled by PJM for this exercise, but may elect to self-schedule to verify cold weather operation. Eligibility will be reviewed and a revised list will be compiled every two weeks through mid-December. PJM will provide the list to the generation resource owner's representative (PJM Operating Committee representative, PJM System Operations Subcommittee Representative or its designee) by November 10. By November 20 or the first business day thereafter of each year, the generation resource owner will provide PJM the list of generation resources that the owner wants to exercise, and the following information, in order to qualify to participate in the exercise:

1. The preferred and alternate dates and times, and the fuel that the generation resource owner is willing to operate the generation resource on within the month of December; and,
2. The minimum MW and minimum run time to be used during the exercise. (Note: If the minimum MW or minimum run time submitted by the generation resource owner is different than the Markets Gateway applicable parameter(s) the generation resource owner must include a justification for the difference.)

If a generation resource is initially determined to be eligible by PJM as of October 31, but subsequently operates between November 1 and the date the generation resource is scheduled to participate in the exercise, the generation resource will no longer be eligible to participate. PJM will review on a two week rolling basis the operation of generation resources and if a generation resource has not operated within the most recent eight week period PJM may add that generation resource to the eligibility list and inform the generation resource owner to determine if the generation resource should be included in the exercise. Generation resources such as nuclear powered, wind turbines, hydro powered, and large super critical steam generation resources would normally be excluded from this exercise since these types of generation resources are expected to be operating during the winter season prior to an extreme winter event, and normally would not be inactive after November 1.

PJM will only schedule eligible generation resources if they will be operating as pool-scheduled resources on their cost-based schedules for the duration of the exercise per the Tariff. For that

reason, generation resources that expect to operate economically in the month of December will be excluded from the list of resources that can participate in the exercise.

Within the month of December, PJM will notify the generation resource owner in advance by 1000 EPT the day prior that a generation resource the owner has selected will be scheduled to operate for the next day. An informational eDART ticket should be submitted by the generation resource owner documenting that the generation resource has been scheduled to operate under the cold weather operational exercise.

For multiple CT combined cycle units that are modeled as one unit in Markets Gateway and intend to exercise one CT on the alternate fuel while operating the remaining CT(s) on the primary fuel, the cost based offer to be made available in Markets Gateway should reflect the weighted average cost of the primary and alternate fuels during the period of the exercise. When the exercise is complete, the generation resource owner should notify the PJM Dispatcher to enable the unit to return to the normal offer data.

If the projected temperature in the Transmission Zone in which the generation resource is located is above 35 degrees Fahrenheit on the day the generation resource is scheduled to exercise, PJM may elect to cancel the operation of the generation resource. In such case, the generation resource owner has the option to self-schedule the generation resource if desired.

PJM will track and analyze generation resource performance as a result of this exercise and compare it with historical GADS data to gauge the effectiveness of this exercise and make recommendations for any potential changes to the exercise.

On a day-ahead basis, PJM will post the total amount of generation scheduled hourly to operate under this exercise. The total MW of generation expected to be included daily in this exercise will not be greater than approximately 1000 MW.

PJM has established a special email address (mailto:coldweathergenprep@pjm.com) to correspond with the generation resource owner's designated representatives participating in this exercise.

Summary of Actions

PJM Actions:

1. Prior to November 1 of each year, PJM will compile a list of generation resources eligible to participate in the exercise.
2. PJM will provide the list to the generation resource owner's representative (PJM Operating Committee representative, PJM System Operations Subcommittee Representative or its designee) by November 10.
3. PJM will review on a two week rolling basis through mid-December the operation of generation resources and if a generation resource has not operated within the most recent eight week period PJM may add that generation resource to the eligibility list and inform the generation resource owner to determine if the generation resource should be included in the exercise.
4. Eligible resources that elect to participate and are pool-scheduled by PJM, will operate and be compensated on their cost based schedule for the duration of the exercise per the Tariff.

5. Within the month of December, PJM will notify the generation resource owner in advance by 1000 EPT the day prior that a generation resource the owner has selected will be scheduled to operate for the next day.
6. If the projected temperature in the Transmission Zone in which the generation resource is located is above 35 degrees Fahrenheit on the day the generation resource is scheduled to exercise, PJM may elect to cancel the operation of the generation resource.
7. PJM will track and analyze generation resource performance as a result of this exercise and compare it with historical GADS data to gauge the effectiveness of this exercise and make recommendations for any potential changes to the exercise.
8. On a day-ahead basis, PJM will post the total amount of generation scheduled hourly to operate under this exercise.
9. PJM will limit the daily amount of generation exercised to no more than 1,000 mw each day. PJM will prioritize the list based on factors such as last operation date; past winter performance; and fuel selection.

PJM Member Actions:

1. By November 20 or the first business day thereafter of each year, from the eligibility list that PJM provided, the generation resource owner will identify the generation resources that the owner wants to exercise, and the following information, in order to qualify to participate in the exercise:
   a. The preferred and alternate dates and times, and fuel that the generation resource owner is willing to operate the generation resource on within the month of December; and,
   b. The minimum MW and minimum run time to be used during the exercise. (Note: If the minimum MW or minimum run time submitted by the generation resource owner is different than the Markets Gateway applicable parameter(s) the generation resource owner must include a justification for the difference.)
2. All generation resource owners, including Capacity Performance resource owners have the option to self-schedule the generation resource if desired and be compensated as a self-schedule resource as per the Tariff.
3. An informational eDART ticket should be submitted by the generation resource owner documenting that the generation resource has been scheduled to operate under the cold weather operational exercise. In addition, PJM prefers that any unit that elects to self-schedule to perform a cold weather operational exercise also submit an informational eDART ticket documenting the exercise. All tickets submitted via eDART for the cold weather operational exercise should use the cause code “Cold Weather Preparation Exercise.”
4. Within five working days following the exercise, the generation resource owner for units that were scheduled by PJM shall report via a form provided by PJM the results of the exercise and any problems encountered. (Link to cold weather exercise feedback form.) The type of information to be provided by the generation resource owner would include information, if applicable, about the type of problems encountered that resulted in the test not being successful, such as issues with fuel handling, control systems, circuit

breakers, emission equipment, etc. Also included would be an identification of follow-up actions performed to allow the unit to return to normal service and if the unit was retested after repairs were made. In addition, PJM prefers that any unit that elected to self-schedule a cold weather operational exercise submit a report on the results of the exercise via the same form.

7.5.2 Generation Resource Cold Weather Checklist

Attachment N of this Manual M14D contains the PJM generation resource Cold Weather Preparation Guideline and Checklist. This Checklist, or a similar one developed and maintained by the generation resource owner, should be used annually prior to the winter season to prepare its generation resources for extreme cold weather event operation. Between November 1st and December 15th of each year, the generation resource owner's representative shall verify via eDART that the represented generation resources have completed the items on the checklist, or a substantially equivalent one developed by the generation owner.

Section 8: Wind Farm Requirements

Welcome to the Wind Farm Requirements section of the *PJM Manual for Generator Operational Requirements M-14D*. In this section you will find the following information:

- Description of wind farm data requirements.
- Description of PJM wind power forecasting service.
- Refer to Attachment L, Jointly Owned Resource Communication Model and Attachment M, Wind Unit Dispatchability Check List for additional wind farm requirements.

8.1 Computer System Data Exchange

The PJM SCADA system allows PJM to communicate directly with individual generators or Generation Control Centers. A data concentrator (e.g. Remote Terminal Unit, Generator Management System, etc.) is located at the Member's site, and, after collecting data from the industrial metering equipment, communicates with PJM's SCADA system using either DNP(Distributed Network Protocol) or ICCP (Inter-Control Center Protocol) consistent with PJM Control Center Requirements Manual (M-01).

Every generator interconnected with and synchronized to the transmission system must at all times coordinate operation with PJM and the Transmission Owner, providing all necessary and requested information and equipment status, to assure that the electrical system can be operated in a safe and reliable manner. Attachment L, Jointly Owned Resource Communication Model defines coordination models that are considered acceptable.

This coordination includes, but is not limited to:

- Supplying low-side generator net-MW and MVAR output.
- Supplying meteorological data (wind speed, wind direction, temperature, pressure and humidity). Wind speed and direction required.
- Scheduling the operation and outages of facilities including providing advanced notification.
- Coordinating the synchronization and disconnection of the wind farm with PJM and Transmission Owner.
- Coordinating the dispatching of a generation unit utilizing the wind "curtailment indicator."
- Providing data required to operate the system and to conduct system studies.
- Providing documented start-up and shutdown procedures including ramp-up and ramp-down times.
- Following PJM-directed plant operation during emergency and restoration conditions.
- Following PJM-directed operation during transmission-constrained conditions.

All data items, regardless of type, are collected and disseminated at a frequency of 10 seconds or less.

Each PJM Member is responsible for determining data-quality indicators for all data transmitted to PJM. Both failed individual values and any value calculated using a failed point must be

flagged. When a point fails for an extended period, a manual update of the point's value may be necessary to keep the data as accurate as possible. The generator shall communicate the outage of any data communication equipment connecting the facility to PJM Dispatch.

8.2 Wind Farm Data Requirement for Wind Power Forecasting

PJM's wind power forecaster requires data points from the wind farms to accurately forecast the wind power. The following are the data requirements for wind farms:

8.2.1 Initial Data Requirements

The wind farms are required to provide the following data points for each turbine as part of their initial set up so they can be properly modeled within the wind power forecasting Tool.

- General turbine information
- Class of turbine
- Capacity of turbine
- Power generation threshold rates (i.e. minimum / maximum wind speed)
- Manufacture power curves of individual wind turbines
- Geographic location (decimal degrees longitude and latitude) of wind farm site or each turbine if available.
- Hub height of wind power facility
- Aggregate historic data (measured MW output, outage information, and wind speed at hub height) for existing facilities that connect to PJM Transmission or bid into the PJM market.
- Ambient temperature operating limits and information regarding installation of "cold weather packages" to increase thermal limit capabilities during extreme cold weather conditions.

Note:
Aggregate Reactive Capability Curve (D-curve) is required to ensure accuracy of PJM's EMS Security Analysis results.

8.2.2 Aggregate Real Time Output

The wind farms are required to provide the real time aggregate wind farm MW output along with other data points. This output should be telemetered at low-side and high side-net of the wind farm.

8.2.3 Real Time Meteorological Tower (or mutually agreed upon alternative source)

The wind power forecasting accuracy is highly dependent on the availability of the real time meteorological tower data for tuning the forecaster model. Each wind farm must install at least one meteorological tower (or wind speed and direction from selected turbines' anemometer and wind vane) in the farm and provide real time meteorological data to PJM though ICCP or DNP link. Depending upon the topology and the accuracy of the wind power forecast, PJM may request addition of more meteorological towers at a wind farm site.

The height of the meteorological tower should be same or close to the hub height of the wind turbine. The generation owner should calibrate and check the accuracy of the met tower every year as per standard.

The meteorological data shall include the following parameters:

Parameter	Units	
Wind Speed	meters/second	Required
Wind Direction	decimal degrees from true north	Required
Temperature	Fahrenheit	Required
Pressure	Hectopascals	Required
Humidity	percent	Accepted

8.2.4 Generator Outage Reporting (Aggregate Turbine availability)

PJM is responsible for coordinating and approving requests for outages of generation and transmission facilities, as necessary, for the reliable operation of the PJM RTO. PJM maintains records of outages and outage requests for these facilities.

The electronic Dispatcher Application and Reporting Tool (eDART) provides communication with PJM for generation operators regarding unit outage requests, updates to reactive capability curves (D-curves), and AVR statuses. Additional applications may be integrated in eDART in the future. User registration is available from the PJM Web site.

In eDART, a wind farm is modeled as a single unit with a capability equal to the sum of all turbines at full manufacturer's nameplate MW rating. Wind farm aggregate turbine outage/derate information is required to validate and enhance the accuracy of the wind power forecast. Generation owners should not provide outage tickets related to wind speed since specific turbine parameters will be modeled within the forecast tool.

See the PJM Manual for Pre-Scheduling Operations (Manual 10) Section 2 Outage Reporting for the generation outages reporting.

Note:
Due to the impact of planned/unplanned turbine outages on wind power forecast accuracy, wind resources shall report any outage of one megawatt or more with duration of one hour or longer. Outages shall be submitted on aggregate plant capacity by outage type.

8.2.5 Grid Capacity Limit (Constraints or Economic Curtailments)

PJM is responsible for capturing congestion and economic curtailment directives and providing the data as inputs into the wind power forecasting tool.

8.2.6 Wind Power Forecast

PJM will collect the wind turbine/farm locations' real-time aggregate power output and meteorological data from the wind farms. The data will then be sent to the wind power forecaster along with wind farm curtailment/outage information. All data shared with the wind power

forecast vendor is treated as confidential. The wind power forecaster will collect all of the data from PJM and other outside sources, such as global and regional weather forecasts, and after processing the data will send PJM the wind power forecast and all associated data for the individual or aggregate wind farms as designated by PJM.

PJM does four different types of forecasts for each individual or aggregate wind farm. All the examples consider the current time to be T.

1. Short Term Forecast (T + 6): Update wind power forecast with a frequency of every ten minutes and forecast interval of five minutes for the next six hours (6) for the individual or aggregate wind farms as designated by PJM.
2. Medium Term Forecast ((T + 6) + 42): Update wind power forecast with a frequency and interval of every hour for the next forty two hours (42) for the individual or aggregate wind farms as designated by PJM.
3. Long Term Forecast (((T + 6) + 42) + 120): Update wind power forecast with a frequency and interval of every hour for the next one hundred twenty hours (120) for the individual or aggregate wind farms as designated by PJM.
4. Ramp Forecast: (T + 6): Update wind power ramp forecast with a frequency of every ten minutes and forecast interval of five minutes for the next six hours (6) for the individual or aggregate wind farms as designated by PJM.

8.3 Forecast Data Usage

8.3.1 Real-time Reliability Assessment

PJM will use the Short-Term wind power forecast to evaluate current day congestion and to ensure that sufficient generation resources are available to respond to real-time or projected fluctuations in wind power output.

8.3.2 Day-ahead Reliability Assessment

PJM will use the Medium-Term wind power forecast to predict day-ahead congestion and mitigating strategies and to ensure that sufficient generation resources are scheduled within PJM to meet forecast load, transaction schedules and PJM reserve requirements. PJM may choose to use the updated version of the day-ahead wind power forecast provided by the forecaster after 1700 hours and before 1800 hours.

The Long-Term wind power forecast may be used to analyze weekend or long holiday conditions.

8.3.3 Real-time Operating Reserve Settlement

PJM will use the Short-Term wind power forecast in the calculation of Lost Opportunity Cost for wind resources in real-time. Further detail on the calculation can be found in Manual 28.

Section 9: Generator Deactivations

Welcome to the *Generator Deactivations* section of the *PJM Manual for Generator Operational Requirements.* In this section you will find the following information:

- Description of the PJM deactivation process (see *"Generator Deactivation Process"*).
- Methodology for compensation to Generators required to remain in service for reliability (see *"Compensation to Generators Requested to Remain in Service for Reliability"*).
- An exhibit showing the process flow diagram for generator deactivation.

9.1 Generator Deactivation Process

This section reviews the steps and timeline for the PJM generator deactivation process, and the potential results of the process. This section also reviews the methodology of compensation to generators requested to remain in service for reliability.

9.1.1 Generator Deactivation Request

Any generator owner, or designated agent, who wishes to retire a unit from PJM operations must initiate a deactivation request in writing to the PJM Generation Manager via the email address generatordeactivation@pjm.com no less than 90 days in advance of the planned deactivation date. Black start resources require up to 2 years advanced notice to maintain the rolling 2-year commitment per the PJM Tariff. This notice will include, at a minimum, the following information:

- Indication of whether the unit is being retired or mothballed;
- The desired date of deactivation;
- A good faith estimate of the amount of a project investment and the time period the generator would be required to be out of service for repairs, if any, that would be required to keep the unit in or return the unit to operation.

PJM Generation Department will notify PJM Planning, PJM Markets and the Independent Market Monitor. PJM will also notify the appropriate transmission owner(s) of the request with the agreement of the generation owner or designated agent. PJM will initiate preliminary analysis of the request.

Note that only official requests to deactivate a unit are subject to the following procedures and timelines. All official requests are subject to public posting on the PJM Web site. Any requests to analyze potential retirements will be treated as unofficial requests, and the PJM deactivation process will not begin until an official public request is received.

9.1.2 Initial Analysis

PJM Planning will perform an initial analysis of the request. PJM Planning will perform standard RTEP/MAAC analysis for the affected summer peaks. PJM Planning will also identify maintenance and appropriate sensitivity analyses to be performed in addition to standard tests. PJM will review planned system reserve levels and conduct appropriate deliverability analysis. In addition, the Independent Market Monitor will analyze the effects of the proposed deactivation with regard to potential market power issues.

9.1.3 Analysis Results

The initial analysis has the following potential outcomes: (1) No reliability or market power issue identified, (2) Reliability or market power issue identified, or (3) Economic or congestion impact identified (PJM identifies potential for additional congestion due to the deactivation).

No Reliability or Market Power Issue Identified

- If no reliability or market power issue identified, the generator can retire as soon as practicable.
- Black start resources will forfeit a maximum of 1 year of revenues per existing tariff. If the unit is a black start resource, PJM will identify feasible alternative sites, and request tariff based bids to replace black start. A bid to re-power (improve) existing resource will be considered. The lowest cost replacement black start resource will be selected.

Reliability or Market Power Issue Identified

- PJM will notify the generator owner, or its designated agent, within 30 days of the deactivation request if a reliability issue has been identified. This notice will include the specific reliability impact resulting from the proposed deactivation of the unit, as well as an initial estimate of the period of time it will take to complete the Transmission upgrades necessary to alleviate reliability impact
- Within 60 days of the original deactivation request, the generator owner or designated agent, will provide PJM with an update estimate of any project cost and the period of time for which the unit would be required to be out of service for repairs, if any, that would be required to keep the unit in, or return the unit to, operation.
- Within 75 days of the original deactivation request, PJM will provide an updated estimate of the period of time it will take to complete the Transmission upgrades necessary to alleviate reliability impact
- Within 90 days of initial deactivation request, PJM will inform the generator owner, or designated agent, and post on its web site full details of the transmission upgrades that will be required in order to allow the unit to deactivate.
- Black start resources will forfeit a maximum of 1 year of revenues per existing tariff. If the unit is a black start resource, PJM will identify feasible alternative sites, and request tariff based bids to replace black start. A bid to re-power (improve) existing resource will be considered. The lowest cost replacement black start resource will be selected.

Economic or Congestion Impact Identified

- If PJM identifies an economic or congestion impact (e.g., potential for additional congestion due to the deactivation), the generator can retire as soon as practicable.
- Black start resources will forfeit a maximum of 1 year of revenues per existing tariff. If the unit is a black start resource, PJM will identify feasible alternative sites, and request tariff based bids to replace black start. A bid to re-power (improve) existing resource will be considered. The lowest cost replacement black start resource will be selected.
- Any economic impacts will be analyzed through the existing FERC approved economic planning process.

9.2 Compensation to Generators Requested to Remain in Service for Reliability

Upon receipt of notification from PJM that a generating unit will be requested to operate past its desired deactivation date, the generator owner may file with FERC for full cost recovery associated with operating the unit until it may be deactivated. The cost calculations may be reviewed with PJM prior to filing at the election of the generation owner.

In the alternative, the generator owner, or its designated agent, may choose to receive avoided cost compensation according to the Deactivation Avoidable Cost Credit in Part V of the PJM Tariff. Avoidable expenses are incremental expenses directly required for the operations of a unit proposed for deactivation. The two major components to the avoid cost formula contained in the Tariff are:

- Categories of costs that are avoidable expenses
- Limited amount for necessary investment to keep unit in operable condition

Avoidable expenses do not include variable costs recoverable under cost-based offers to sell energy in PJM Interchange Energy Market. Additional investment over and above the limited component in the avoided cost formula must be filed as a separate rate. All inquiries regarding avoidable expenses are to be directed to the PJM Market Monitor

If the generation owner, or designated agent, chooses the compensation according to the Deactivation Avoidable Cost Credit in Part V of the PJM Tariff, compensation to the generator will begin as of the day following the filing, and will be net of revenues from the PJM markets. All revenues from the PJM markets and unit-specific bilateral contracts will be net of marginal cost of service recoverable under cost-based offers to sell energy from operating capacity of the PJM Interchange Energy market, not less than zero

- A 10% adder will initially be applied to the avoidable costs, and this adder will increase in future years. Applicable adders for future years are detailed and defined in Part V of the PJM Tariff.

Costs (avoidable cost rate minus net revenues) will be allocated as an additional transmission charge to the zone(s) for which the Transmission Owner(s) will be assigned the cost of the transmission upgrade.

If a generation owner, or designated agent, chooses to file for full cost of service with FERC, PJM begins crediting the generator the amount approved by FERC, on the timeline ordered by FERC as part of the approval. PJM also allocates the costs associated with these credits according to FERC order.

The following exhibit displays the generation deactivation process flow:

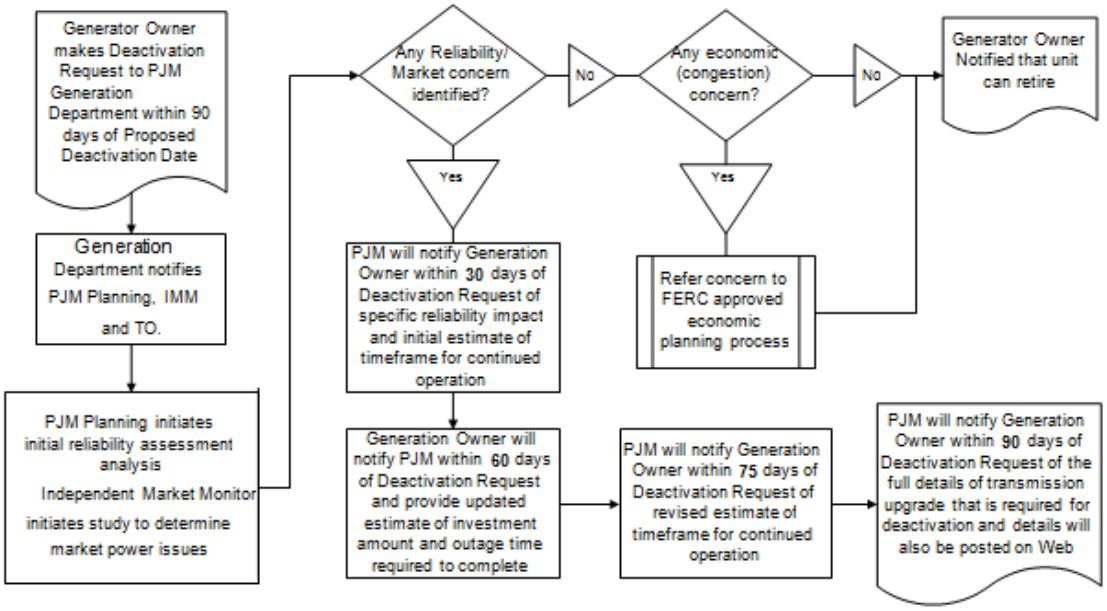


Exhibit 10: Generation Deactivation Process Flow

Section 10: Black Start Generation Procurement

Welcome to the *Black Start Generation Procurement* section of the *PJM Manual for Generator Operational Requirements.* In this section you will find the following information:

- Description of the PJM black start selection process.
- Description of the PJM incremental black start RFP process.
- Description of the PJM Reliability Backstop process.

10.1 Black Start Selection Process

The following section outlines the PJM black start selection process.

10.1.1 Frequency

PJM will issue an RFP for black start generation every five (5) years, which would be open to all existing and potential new black start units on a voluntary basis. The first five year selection process will result in black start solutions that will be effective as of 4/1/2015. Black start solutions from subsequent five year selection processes will be effective on April 1 each five years thereafter.

10.1.2 Selection Process

The following steps A through H outline the various selection process phases to be implemented prior to the effective date for each five year selection process. The timeframes indicated represent time estimates (in calendar days or months) for each major phase (or multiple overlapping phases). Based on the aggregate of timeframes indicated, the selection process will be initiated no later than 24 months prior to each five year selection process effective date.

A. Validate Critical Load

PJM will send critical load data to generation owners and Transmission Owners (“TOs”) for validation. Critical Load requirements will be in accordance with PJM Manual M36, Attachment A. PJM to work with generation owners and TOs to reconcile differences and update accordingly.

Targeted time: 30 days

B. Develop Technical Requirements for Request for Proposal (“RFP”)

PJM will coordinate technical requirements for RFP with TOs, including MW requirements, MVAR capability, and geographic details.

Targeted time: 30 days

C. Issue RFP for resources interested in supplying new Black Start

PJM will post the black start RFP on the PJM website with notifications to the appropriate stakeholder groups. Interested bidders should review the guidelines posted on the PJM Black Start Services RFP page titled “General Guidance: Black Start RFP Response Content” for guidelines on content of proposals.

The RFP notification will also advise that all bids submitted for black start resources must be cost-based bids consistent with Schedule 6A of the PJM OATT. Details of the required cost components for each prospective black start replacement bid are provided in PJM Manual M27.

Prospective RFP proposals:

Existing black start units would offer at the current rate. Existing compensated black start units do not need to respond to the RFP - the assumption is that they will continue to provide black start service at the current rate (Formula Rate or Cost Recovery Rate), but are not guaranteed to be selected to provide black start going forward, if reductions in critical load indicate that the black start service is no longer needed.

If existing units are not interested in supplying black start service going forward, they would need to submit a black start termination notice in accordance with the PJM OATT, Schedule 6A.

New black start resources in Generation Interconnection Queue would be eligible to respond to the RFP.

Existing units that would require upgrades to provide black start service would be eligible to respond to the RFP.

Submission Window for RFP bids to be submitted: 90 days

D. RFP Proposal Evaluation

PJM will work with the TOs to evaluate proposals and select viable black start solutions based on the basis of critical load requirements, identified pursuant to M36, location, cost and operational considerations (amount, start time, etc.).

Units on a cost recovery rate would automatically be selected for the length of the recovery period. Units on bilateral contracts with TOs would be automatically selected for use in those zones.

PJM will work in collaboration with TOs to select black start solutions for each zone in accordance with the criteria outlined in Attachment A of PJM Manual 36, Section 4.6 of PJM Manual 12 and Schedule 6A of the OATT (black start units do not need to be located in the same physical zone as the TO zone in which they will support).

PJM utilizes the following evaluation criteria in the RFP selection process. Preferred black start solutions typically include units located in close proximity (from a transmission topology perspective) to PJM-defined critical loads, which are loads to support quicker starting CT’s and Combined Cycle units, nuclear safe shutdown loads, and electric-powered gas compressor stations. In addition, RFP proposals for natural gas black start units with dual fuel capability and/or primary firm gas transportation contracts will be given a higher level of consideration in the RFP evaluation process. In the event that proposals received by PJM do not satisfactorily meet the fuel assurance criteria outlined below, PJM will request that the resource owners resubmit proposals with adequate demonstration of dual fuel capability and/or primary firm gas transportation contracts (for gas units).

1. Technical Feasibility
    a. Reliability Analysis / EOP-005 Studies

i Feasibility of power flow study results, including operating within thermal and voltage limits, black start unit has adequate reactive capability to handle line charging of cranking path and critical load requirements.

ii Feasibility of dynamic simulation study results, including operating within voltage, frequency and stability limits.

b. Unit Location / Characteristics

i Geographically and electrically diverse from other black start resources in the TO zone.

ii Within TO zone or cross zonal black start.

iii Interconnection voltage level.

iv Type of generator (e.g. Simple Cycle CT, Hydro, etc.)

v Unit can serve multiple transmission outlets or support redundant cranking paths.

vi Unit can provide black start to more than one TO zone

vii Age of Unit

c. Operational / Environmental Restrictions

i Limitations such as slow ramp to minimum load after synchronizing, minimum load requirements for stabilizing load, turn down ratio, other operational limitations.

ii Environmental permit change needed to operate at emergency minimum output during restoration, other environmental limitations.

iii Unit is able to meet minimum run hour requirements per OATT Schedule 6A (16 hours or as indicated in TO Restoration Plan).

iv Unit's historical availability (GADs).

d. Black Start Testing Requirements

i Is unit able to meet PJM black start testing requirements, (e.g. ability to close to a dead bus in 180 min., ability to operate at reduced loads during testing while islanded)?

ii Or, are testing exemptions required (e.g. special switching, stabilizing loads, breaker closing to a live bus, load banks).

2. Fuel Assurance

a. Fuel Type / Fuel diversity

b. Dual fuel capability / availability, including logistics assessment such as:

i Can unit start on both primary or secondary fuel alone?

ii Is start-up fuel required before running on primary or alternate fuel?

iii Special switching requirements to move from primary to alternate fuel (or vice versa)

c. Onsite fuel storage

d. Primary firm gas transportation contract vs. secondary firm or interruptible gas contracts; single vs. multiple gas pipeline access.

3. Cost / Schedule
   a. Annual Revenue Requirements (Capital Costs, Net Present Value comparison)
      i Capital Costs / Black Start MWs
      ii Net Present Value / Black Start MWs
   b. Black Start commitment period (20 yr./15 yr./ 10 yr./ 5 yr.)
   c. Cost recovery method – Base Formula Rate, NERC CIP Rate, Capital Recovery Factor Rate, FERC Rate.
   d. Proposed Black Start Service date to requested in service date

E. Verify Feasibility of Black Start Units Selected

PJM, with TO input, will identify black start cranking paths and black start units to source Critical Loads.

PJM, with TO input, will perform dynamic simulations and reactive/voltage studies on cranking paths, and if issues are identified on cranking paths which would prevent a potential black start unit from performing in accordance with PJM Manual M36, other black start units will be considered.

F. Review of Cost Recovery components

PJM will perform cost evaluation for each option and review cost recovery components provided for proposed black start solutions in accordance with PJM OATT, Schedule 6A.

Length of commitment would remain a minimum of 2 years (or longer based on capital recover time). Compensation for units not electing to recover black start capital costs is based on the PJM OATT Schedule 6A formula rate. Compensation for units electing to recover black start capital costs would be based on the PJM OATT Schedule 6A Capital Recovery rate based on the age of the unit. Black Start unit owners may also choose to file for recovery of actual costs directly with FERC.

IMM will verify cost data during selection process and verify annual revenue requirement (actual cost).

G. Review Selection Process Results with TOs

If reliability criteria are met, PJM will discuss any localized reliability issues, or any other special considerations with TOs, and address accordingly.

If reliability criteria are not met, proceed to Black Start Incremental RFP Process, detailed in Section 10.2

If reliability criteria are met, but there is disagreement on units selected, PJM will work with TOs to resolve differences. If differences cannot be resolved, the Dispute Resolution Process may be initiated under the PJM Operating Agreement and PJM Manual M33.

TO may elect to procure additional black start outside of PJM OATT and Selection Process.

PJM will inform State Commissions about the results of selection process (general results, not unit specific)

Targeted time for Steps D through G: 6 months

H. Implementation of Black Start Solutions

PJM will notify new black start units that were selected through the process described in this Manual. Notification will include authorizing construction work to proceed as required for any new black start resources selected.

TOs will incorporate the use of black start generation and cranking paths into their restoration plans and submit revised restoration plans to PJM.

PJM and TO will add cranking paths to internal PJM tools.

PJM will provide current black start units that are not selected with a one year termination notice.

Targeted time for Step H: 13 months

10.2 Black Start Incremental RFP Process

The Incremental RFP process shall be triggered by one or more of the following events ("triggering events"):

1. Notification of termination by the black start unit owner (whether termination is due to deactivation of the black start unit or that the black start unit owner no longer seeks to provide black start service) in accordance with Schedule 6A of the PJM OATT;
2. Identification by Transmission Owner (TO) or PJM of new or changed black start needs as a result of a review of its restoration plan;
3. Procurement of black start resources in the event that the Black Start Selection Process described in Section 10.1 of this Manual fails to procure adequate black start resources to meet reliability criteria for procuring black start as provided for in PJM Manual M36.

Upon the occurrence of any of the triggering events listed above, PJM will begin discussions with the TO to identify whether black start resources are needed in light of the existence of one of the triggering events.

1. If PJM and the TO determine that there is sufficient redundancy of black start resources in the region, consistent with the minimum critical black start requirement defined in Attachment A of PJM Manual M-36 on System Restoration, such that there is no need to replace the terminating black start unit in the restoration plan, PJM will initiate a final review and approval through the SOS-T committee of the TO's restoration plan and advise the TO whether such plan is adequate without a replacement black start unit. In the event that PJM and the TO do not agree on whether there is a need to replace the terminating black start unit in the restoration plan, PJM will initiate a review with SOS-T for additional technical assessment, and if after the SOS evaluation, an agreement is not yet achieved, the PJM Dispute Resolution process will be employed. Please refer to Section 4 of the PJM Manual for Administrative Services for the PJM Interconnection Operating Agreement (M33) for more details about the PJM Dispute Resolution process.
2. If PJM and the TO determine that there is a need to procure black start resources due to a black start termination/deactivation or a change in black start need, PJM shall proceed

with the process defined in Section 10.2.1 to replace the withdrawing or deactivating black start resource.

3. If PJM and the TO determine that there is a need to procure black start resources due to failure of an RTO Wide Black Start RFP, PJM shall proceed with the process defined in Section 10.2.2 to address the black start resource need.

Timeline: Within 30 calendar days of receiving the termination request.

10.2.1 First Incremental RFP Process

1. After PJM and the TO determine that there is a need to procure black start resources based on one or more of the triggering events, PJM will post online a notification about the need for a new black start resource along with the location and capability requirements. Please refer to Attachment A of the PJM Manual for System Restoration (M36) for more details on the selection criteria for black start resources. This notification will also advise that all bids submitted for the black start resource must be cost-based bids consistent with Schedule 6A of the PJM OATT. Details of the required cost components are provided in PJM Manual for Open Access Transmission Tariff Accounting (M27) and Schedule 6A of the PJM OATT.
2. This posting should be made within 30 calendar days of a triggering event, and will mark the beginning of the First Incremental RFP which will last 90 calendar days from the date of the notification. The posting will also advise that PJM will be reviewing pending generator interconnection projects and other projects that are received within the Market Window.
3. PJM will review each Generation Interconnection Request pending under Part IV of the PJM Tariff at the time a Market Window is opened (as described above) and each response by black start units, each Interconnection Request it receives during the First Incremental RFP Market Window, to evaluate whether the project proposed in the request could meet the black start criteria for which the First Incremental RFP was issued.
4. The TO will also have the option of negotiating a cost based bi-lateral contract with a generator owner for black start services. The TO may provide the alternative as one of the bids for the black start replacement that will be evaluated by PJM pending FERC approval of the bilateral contract.
5. If PJM and the TO determines that more than one of the proposed projects within the First Incremental RFP meets the black start criteria, the most cost-effective resource for the black start replacement will be chosen, provided the identified resource accepts and maintains designation as a black start unit under Schedule 6A of the PJM OATT. Submitted projects costs must be consistent with Schedule 6A of the PJM OATT.
6. Any black start resources identified as a result of the First Incremental RFP will be notified by PJM, and PJM and the TO will coordinate with the black start unit owner for its acceptance under the PJM tariff as a black start unit.

10.2.2 Second Incremental RFP Process

If the First Incremental RFP, or RTO Wide RFP, fails to procure adequate black start resources to meet the reliability criteria, PJM will initiate a Second Incremental RFP process to obtain

black start resources. The Second Incremental RFP will follow the process described in Section 10.2.1, but PJM and the TO may modify the location and capability requirements for the black start resource, if necessary, to allow more resources to become viable as replacements. At this point, the TO will be notified of failed First Incremental RFP, or RTO Wide RFP, to allow them to begin preparation of a black start solution should the Reliability Backstop in Section 10.3 be necessary.

Any black start resources identified as a result of the Second Incremental RFP will be notified by PJM, and PJM and the TO will coordinate with the black start unit owner for its acceptance under the PJM OATT as a black start unit.

If no projects are identified under the Second Incremental RFP, PJM and the TO will investigate implementation of the Reliability Backstop as described in Section 10.3.

10.2.3 Implications for Terminating Black Start Units

This section applies to black start units procured during the First or Second Incremental RFP for the purpose of replacing a black start unit(s) that is terminating. If it is determined that a black start resource procured under either the First or Second Incremental RFP will not be available prior to the proposed termination date of the black start unit PJM will use the following process.

1. PJM will identify whether there is a need to request that the generator continue to provide black start service beyond the planned termination date, pending procurement of black start resources during the Incremental RFP process. Within 30 days of the black start unit owner's notification of the proposed deactivation or withdrawal of the black start unit from providing black start service, PJM will notify the GO whether there is a need for the black start unit proposed for deactivation or withdrawal to continue operating beyond its proposed deactivation date or withdrawal date.
2. In the event that such notice requests that a black start unit proposed for withdrawal from providing black start service (but which is not deactivating) continue operating, the notice shall request that such unit voluntarily fulfill its commitment period to provide black start service.
3. In the event that the notice requests that a black start unit proposed for deactivation continue operating, the notice shall provide an estimate of the time period that the black start unit is needed to operate beyond its proposed deactivation date.
4. Within 30 calendar days of such notice by PJM, the black start unit owner shall notify PJM whether the black start unit will continue operating beyond its proposed deactivation date or withdrawal date.
5. A black start unit proposed for deactivation that operates beyond its deactivation date shall be compensated pursuant to the deactivation procedures set in Section 8 of this Manual, and in Part V of the PJM OATT.
6. A black start unit proposing to withdraw from providing black start service (but which is not deactivating) that continues providing black start service for its commitment period shall receive black start service revenues pursuant to Schedule 6A of the PJM OATT but will not be eligible for compensation pursuant to Part V of the PJM OATT.
7. In the event that, through the First or Second Incremental RFP process described above, a replacement black start resource is identified, and so long as any other mitigation measures identified by PJM under Part V of the PJM OATT are in place, PJM, as soon as practicable, shall notify the black start unit owner of such replacement, that its black

start unit no longer will be needed for reliability, and the date the black start unit may withdraw from providing black start service or deactivate without affecting reliability.

10.3 Black Start Reliability Backstop Process

10.3.1 Reliability Backstop Process Step 1

PJM and TO discuss the black start shortage and the possibility of triggering the Reliability Backstop RFP.

The triggers for the Reliability Backstop process are:

1. A Black Start generation shortage in a TO zone; AND
2. Two failed RFPs (no technically viable solutions to address the Black Start shortage are identified or cost recovery terms that do not conform to the PJM OATT):
   a. Two failed Incremental RFPs, or
   b. Failed RTO Wide RFP and one failed Incremental RFP; AND
3. No cross-zonal solutions available; AND
4. No RTEP transmission solutions available (e.g., operational performance baseline upgrade).

Targeted Timeline: Within 5 days of determination of failed Second Incremental RFP

10.3.2 Reliability Backstop Process Step 2

PJM, TO and affected State(s) will discuss the Black Start shortage situation including the benefits and costs of the TO proposal and the implications of the shortage of Black Start to the restoration plan. Considering these discussions, PJM will determine whether to issue Reliability Backstop RFP. If Reliability Backstop RFP is not issued, PJM will actively monitor the Black Start shortage.

In the event that PJM and the TO do not agree on the decision concerning the Reliability Backstop RFP, PJM will initiate a review with the SOS-T for additional technical assessment and if after the SOS-T evaluation, an agreement is not yet achieved, the PJM Dispute Resolution process will be employed. Please refer to Section 4 of the PJM Manual for Administrative Services for the PJM Interconnection Operating Agreement (M33) for more details about the PJM Dispute Resolution process.

Targeted Timeline: Within 10 days of determination of failed 2nd RFP

10.3.3 Reliability Backstop Process Step 3

Once PJM determines that the Reliability Backstop Process is required, it will issue the Reliability Backstop RFP. As part of this online notification, the TO solution will be made public (except for information that is Critical Energy Infrastructure Information). The TO solution may be owned by the TO, by a generation owning affiliate or contracting for by the TO with a generation owning third party. The TO has the obligation to submit a solution proposal within the Reliability Backstop RFP. The RFP will indicate that any proposed Black Start unit, whether it is a TO proposed unit, or a GO proposed unit, will be used for Black Start purposes only. The unit will NOT participate in the capacity market, energy market or other ancillary service markets except Black Start. The unit will run for Black Start and Black Start testing purposes only.

The Reliability Backstop RFP will be conducted on an accelerated schedule of 30 days.

Targeted Timeline: Within 15 days of determination of failed 2nd RFP

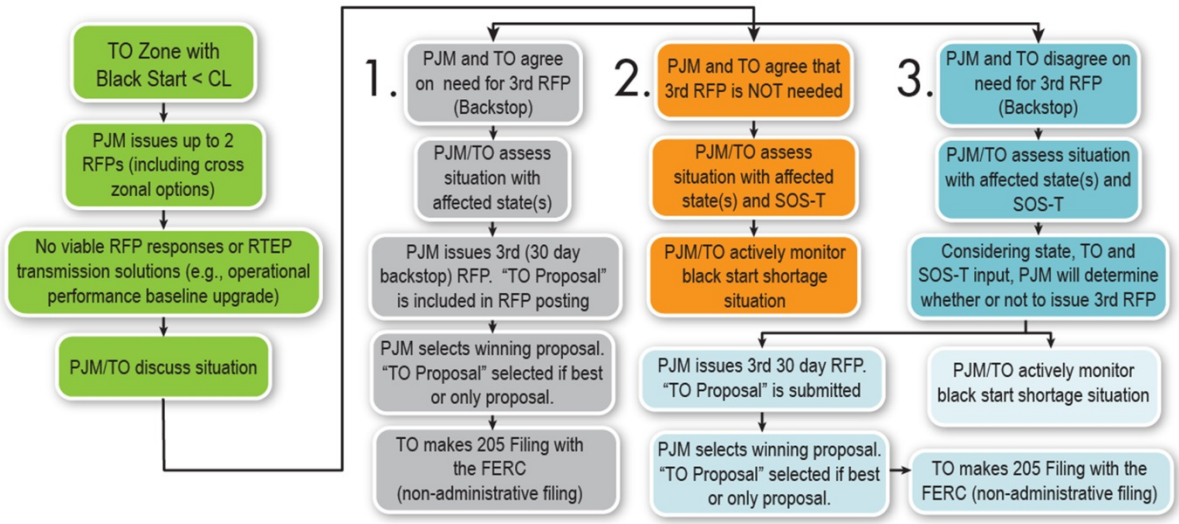
10.3.4 Reliability Backstop Process Step 4

PJM will evaluate any responses from the Reliability Backstop RFP in comparison with the TO solution. If the TO solution is the only option received (or the best option received), it will be implemented.

It will be the responsibility of the TO to submit a filing with FERC under the Federal Power Act, as necessary, to recover costs (capital costs, ongoing O&M costs, depreciation and/or fuel) as Transmission Assets. Such cost recovery would be in Attachment H for TO owned generation, or such other revenue requirement filed with and accepted by FERC, or as contracted for outside of the PJM OATT, Schedule 6A. For GO owned BS, recover through Schedule 6A of the PJM OATT or FERC filing.

Any Black Start generation acquired in the Reliability Backstop RFP (regardless of ownership or cost recovery method) must adhere to all Black Start testing and performance requirements as described in PJM OATT, Schedule 6A and the PJM Manuals.

10.3.5 Reliability Backstop Process Flow Chart



Section 11: Generator Data Confidentiality Procedures

Welcome to the Generator Data Confidentiality Procedures section of the PJM Manual for Generator Operational Requirements. In this section you will find the following information:

- Description of the PJM generator data confidentiality procedures for a Transmission Owner (TO) to obtain confidential generator data from PJM.

11.1 Generator Data Confidentiality Procedures

In order for PJM to perform reliability analyses and system restoration planning, generators are required to provide real time, scheduled outage, and unit parameter data to PJM. While PJM has the overall reliability responsibility for the PJM RTO, local Transmission Owners have a similar responsibility to monitor and assess the reliability of their transmission systems and distribution systems, and to develop and maintain system restoration plans. In order for the Transmission Owners to perform their local reliability functions, Transmission Owners need certain data about the generators to formulate a realistic basis for the analysis and plans. The Terms & Conditions covering the confidentiality of the data are contained in the PJM Operating Agreement, Section 18.17.7 (Disclosure of Generator Data to Transmission Owners).

The following Generator Data Confidentiality Procedures pertain only to real time data (real time MW, MVAR, unit status, and reactive capability data), scheduled outage data (start date/time, return date/time, and derate for planned and maintenance outages), and unit parameters (including, but not limited to, unit start-up times, ramp rate, start-up auxiliary load profile and emergency low load operation capabilities).

Transmission Owners require both real time and generator data to perform their reliability and planning functions. These transmission owner functions include, but are not limited to:

1. Real time EMS applications: state estimator and security analysis
2. Transmission Owner’s real time role
3. Transmission outage scheduling process
4. Reliability study and training
5. System restoration planning

The Transmission Owner that demonstrates a need for specific data may request that PJM provide real time data (MW, MVAR, unit status, and reactive capability data), future scheduled outage data, and certain parameter data for units identified in a Transmission Owner restoration plan. The Generator Owner may request that PJM provide a list of TOs receiving real time data, future scheduled outage data, and/or certain parameter data from their generator(s).

11.1.1 Generator Data within a Transmission Owner’s Zone

For generators within a Transmission Owner’s zone for which PJM presently receives data, PJM will make this data available to the TO. For a new unit, this data is made available to the Transmission Owner as soon as it is added to the PJM systems.

11.1.2 Generator Data outside a Transmission Owner's Zone

For generators outside a Transmission Owner's zone for which PJM presently receives data, PJM will make this data available to the TO following a review of the reason for the request.

The Transmission Owner initiates the process by sending an email to the PJM Generation Department via the email address RTGenData@pjm.com along with Attachment J "Generator – Data Release Matrix" detailing which generator(s) are included in the request. The TO request must also explain why data is being requested for generators outside the TO's zone. Upon approval of the request, PJM will provide the generator data to the TO and will inform the Generator Owner (GO) that the data has been provided when the request has been completed. PJM will use the eDART contact as identified in the eDART survey , as the contact for this communication.

The most common reasons for a TO request data outside its zone are:

- The Transmission Owner's existing EMS model already includes the generator(s).
- The Transmission Owner is expanding their EMS model and would like to add the new generator(s).
- The generator is identified in a Transmission Owner restoration plan.

11.1.3 Dispute Resolution

The process for appeal is to follow the PJM Dispute Resolution Process. Further information about this process may be found in Section 4 of PJM Manual M-33, Administrative Services for the PJM Interconnection Operating Agreement.

11.1.4 Generator Data Sharing Process Flow

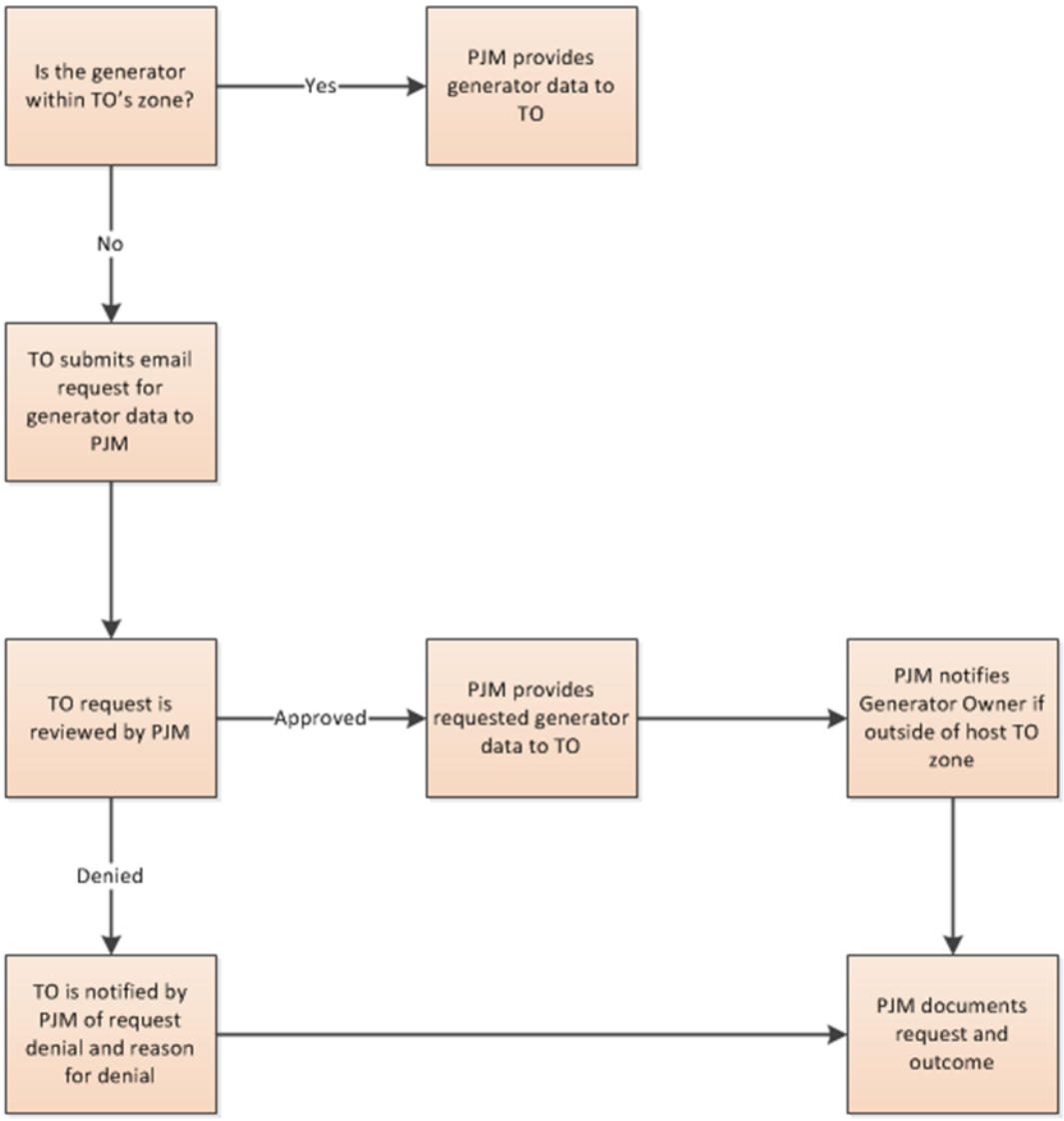


Exhibit 11: Generator Data Sharing Process Flow

Section 12: Solar Park Requirements

Welcome to the Solar Park Requirements section of the *PJM Manual for Generator Operational Requirements M-14D*. In this section you will find the following information:

- Description of solar park data requirements.
- Description of PJM solar power forecasting service.

12.1 Computer System Data Exchange

The PJM SCADA system allows PJM to communicate directly with individual generators or Generation Control Centers. A data concentrator (e.g. Remote Terminal Unit, Generator Management System, etc.) is located at the Member's site, and, after collecting data from the industrial metering equipment, communicates with PJM's SCADA system using either DNP (Distributed Network Protocol) or ICCP (Inter-Control Center Protocol) consistent with PJM Control Center and Data Exchange Requirements Manual (M01).

Every generator interconnected with and synchronized to the transmission system must at all times coordinate operation with PJM and the Transmission Owner, providing all necessary and requested information and equipment status, to assure that the electrical system can be operated in a safe and reliable manner. Attachment L, Jointly Owned Resource Communication Model defines coordination models that are considered acceptable.

This coordination includes, but is not limited to:

- Supplying low-side generator gross-MW and MVAR output.
- Supplying meteorological data (measured solar irradiance, back panel temperature, ambient air temperature, wind speed, and wind direction – see table in Section 12.2.3 for listing of requirements.)
- Scheduling the operation and outages of facilities including providing advanced notification.
- Coordinating the synchronization and disconnection of the solar park with PJM and Transmission Owner.
- Providing data required to operate the system and to conduct system studies.
- Providing documented start-up and shutdown procedures including ramp-up and ramp-down times.
- Following PJM-directed plant operation during emergency and restoration conditions.
- Following PJM-directed operation during transmission-constrained conditions.

All data items, regardless of type, are collected and disseminated at a frequency of 10 seconds or less.

Each PJM Member is responsible for determining data-quality indicators for all data transmitted to PJM. Both failed individual values and any value calculated using a failed point must be flagged. When a point fails for an extended period, a manual update of the point's value may be necessary to keep the data as accurate as possible. The Generator shall communicate the outage of any data communication equipment connecting the facility to PJM Dispatch.

12.2 Solar Park Data Requirement for Solar Power Forecasting

PJM's solar power forecaster requires data points from the solar parks to accurately forecast the solar power. The following are the data requirements for Solar Parks:

12.2.1 Initial Data Requirements

The solar parks are required to provide the following data points for all panels as part of their initial set up so they can be properly modeled within the solar power forecasting tool.

- AC installed capacity (Maximum Facility Output) of plant (MW)
- DC installed capacity of plant (MW)
- For fixed panel sites:
  - Azimuth angle of panels (decimal degrees from true north)
  - Altitude angle of panels (decimal degrees from horizontal plane)
- For tracking sites:
  - Tracker type (single or dual axis)
  - Tracker make and model
- Geographic location of center point of solar park site (decimal degrees longitude and latitude)
- Geographic location of meteorological data sensors (decimal degrees longitude and latitude)
- Manufacturer and model of the PV panels
- Aggregate historic data (measured MW output, outage information, irradiance, and temperature) for existing facilities that connect to PJM Transmission or bid into the PJM market.

Note:
Aggregate Reactive Capability Curve (D-Curve) is required to ensure accuracy of PJM's EMS Security Analysis Results.

12.2.2 Real Time Output

All solar parks greater than or equal to 3 MW (Maximum Facility Output), regardless of voltage level of connected bus, are required to provide the real-time solar park MW/MVAR output along with other data points. This output should be telemetered at low-side gross. High-side net may also be required as dictated by PJM's model. If a solar park is collocated with an energy storage facility such as a battery, then separate metering is required for each component in order to preserve solar forecast accuracy.

12.2.3 Real Time Meteorological Station (or mutually agreed upon alternative source)

The solar power forecasting accuracy is highly dependent on the availability of the real time meteorological station data for tuning the forecaster model. Each solar park must install at least one meteorological station in the park and provide real time meteorological data to PJM though

ICCP or DNP link. Depending upon the topology and the accuracy of the solar power forecast, PJM may request addition of more meteorological stations at a Solar Park site.

The generation owner should calibrate and check the accuracy of the meteorological station every year as per standard.

The meteorological data shall include the following parameters:

Parameter	Units	Requirement or Accepted
Irradiance	Watts/meter^2	Required for plants with Maximum Facility Output of 3 MW or higher
Back Panel Temperature	Fahrenheit	Required for plants with Maximum Facility Output of 3 MW or higher
Ambient Air Temperature	Fahrenheit	Accepted
Wind Speed	meters/second	Accepted
Wind Direction	decimal degrees from true north	Accepted

12.2.4 Generator Outage Reporting

PJM is responsible for coordinating and approving requests for outages of generation and transmission facilities, as necessary, for the reliable operation of the PJM RTO. PJM maintains records of outages and outage requests for these facilities.

The electronic Dispatcher Application and Reporting Tool (eDART) provides communication with PJM for generation operators regarding unit outage requests, updates to reactive capability curves (D-curves), and AVR statuses. Additional applications may be integrated in eDART in the future. User registration is available from the PJM Web site.

Solar park outage/derate information is required to validate and enhance the accuracy of the solar power forecast.

See the PJM Manual for Pre-Scheduling Operations (Manual 10) Section 2 Outage Reporting for the generation outages reporting.

Note:
Due to the impact of planned/unplanned solar resource outages on solar power forecast accuracy, solar resources shall report any outage of one megawatt or more with duration of one hour or longer. Outages shall be submitted on aggregate plant capacity by outage type.

12.2.5 Solar Power Forecast

PJM will collect each solar park's real-time aggregate power output and meteorological data from the solar park. The data will then be sent to the solar power forecaster along with Solar Park curtailment/outage information. All data shared with the solar power forecast vendor is treated as confidential. The solar power forecaster will collect all of the data from PJM and other outside sources, such as global and regional weather forecasts, and after processing the

data will provide PJM with the solar power forecast and all associated data for the individual or aggregate solar parks as designated by PJM.

PJM does three different types of forecasts for each individual or aggregate solar park. All the examples consider the current time to be T.

1. Short Term Forecast (T + 6): Update solar power forecast and irradiance forecast with a frequency of every ten minutes and forecast interval of five minutes for the next six hours (6) for the individual or aggregate solar parks as designated by PJM.
2. Medium Term Forecast ((T + 6) + 42): Update solar power forecast and irradiance forecast with a frequency and interval of every hour for the next forty two hours (42) for the individual or aggregate solar parks as designated by PJM.
3. Long Term Forecast (((T + 6) + 42) + 120): Update solar power forecast and irradiance forecast with a frequency and interval of every hour for the next one hundred twenty hours (120) for the individual or aggregate solar parks as designated by PJM.

12.3 Forecast Data Usage

12.3.1 Real-time Reliability Assessment

PJM will use the Short-Term solar power forecast to evaluate current day congestion and to ensure that sufficient generation resources are available to respond to real-time or projected fluctuations in solar power output.

12.3.2 Day-ahead Reliability Assessment

PJM will use the Medium-Term solar power forecast to predict day-ahead congestion and mitigating strategies and to ensure that sufficient generation resources are scheduled within PJM to meet forecast load, transaction schedules and PJM reserve requirements. PJM may choose to use the updated version of the day-ahead solar power forecast provided by the forecaster after 1700 hours and before 1800 hours.

The Long-Term solar power forecast may be used to analyze weekend or long holiday conditions.

Attachment A: New Generator Checklist

This checklist is a guideline to be used by new generation connecting to the PJM system as a Capacity Resource or Non-Capacity Resource. It is not all inclusive and not all functions noted are applicable to every generator. Contact PJM's Member Relations Client Manager for additional information.

Operations	Status Date	
	Needed	Complete
Dispatch		
Control		
Plant Operation		
Emergency Procedures		
PJM Communications		
Restoration		
Loading Reserves		
Regulation		

Data	Status Date	
	Needed	Complete
Telemetry[1]		
Markets Gateway[2]		
Outages		
Voltage Schedule		
Reactive Capability Curve		
Meter Error Correction		

[1] Real Time and integrated meter data
[2] Daily Schedule and bids, cost curves, start and no-load costs, etc.

Data	Status Date	
	Needed	Complete
Synchrophasor Communication System		

Market	Status Date	
	Needed	Complete
Energy Transactions		
- Within PJM		
- Outside of PJM		
Capacity Transactions		
FTRs		
Synchronized Reserve		
Regulation		
Black Start		

Administrative	Status Date	
	Needed	Complete
Membership Application [3]		
Interconnection Agreement		
Firm Transmission Service [4]		

[3] Membership Application – http://pjm.com/about-pjm/member-services/member-forms.aspx
[4] Firm Transmission Service Application – http://pjm.com/about-pjm/member-services/member-forms.aspx

Administrative	Status Date	
	Needed	Complete
Non-Firm Transmission Service[5]		
Billing Contact Information Form		
Committee Registration Forms		
Capacity Transaction Authorization[6]		
eRPM Registration[7]		
inSchedule Registration		
Markets Gateway Registration		
Power Meter Registration		
FTRCenter Registration		
OASIS Registration		
eGADS Registration		
Data Viewer Registration[8]		
eDART Registration[9]		

Training	Status Date	
	Needed	Complete
PJM Overview		
eRPM		
inSchedules		

[5] Non-Firm Transmission Service Application – http://pjm.com/about-pjm/member-services/member-forms.aspx
[6] Capacity Transaction Authorization Form – http://pjm.com/~/media/documents/manuals/m18.ashx
[7] eRPM/inSchedules Registration – https://esuite.pjm.com/mui/
[8] Data Viewer Registration – https://esuite.pjm.com/mui/
[9] eDART Registration – https://esuite.pjm.com/mui/

Training	Status Date	
	Needed	Complete
FTRCenter, Power Meter, Markets Gateway		
OASIS		
eGADS, eDART, MIRA, Generator Outage Reporting		
Unit Commitment		
LMP		
Operations		
Dispatcher		
Communications		
Emergency Procedures		
Market Settlements		

Systems/Communications	Short Term Date	
	Needed	Complete
Communications		
Telemetry		
ICCP EMS Links/PJM DNP Net/Jetstream		
Metering Links		
Synchrophasor Links		
PJM*net*		
Frame Relay		
ISDN Backup		
Voice		
Generator ALL CALL		

Systems/Communications	Short Term Date	
	Needed	Complete
POTS		
Systems/Applications		
EMS		
System Changes		
Modeling		
PJM Testing		
Integration Testing		
Unit Commitment (Markets Gateway)		
System Changes		
Permission to view existing data		
Testing		
Two-Settlement (Markets Gateway)		
System Changes		
Testing		

Exhibit 12: New Generation Checklist

Attachment B: New PJM*net* Customer Implementation Voice/Data Communications Template





Objective

The completion of this document will provide PJM with the information necessary to configure and install the required voice and data communications necessary for you, our new customer, to communicate with PJM. PJM will assume total responsibility for the coordination efforts required to acquire and implement the appropriate telecommunications circuits.

Customer Information	
PJM Member Name	
Customer Business Name	
Customer Business Address	
Customer Business Contact	
Telephone Number	
Fax Number	
Email Address	
Customer Technical Representative	
Customer Technical Representative Email	
Customer Technical Representative Fax Number	
Total Number of MW at site/For which site is responsible	
Site Access Hours	
Site Access Requirements	

Site Circuit Information	
Desired hardware install by date	

Desired circuit fully operational date	
Area code and exchange telephone number where circuit is to be terminated:	
Location Name	
Street	
City	
State	
Zip Code	
Site Point of Contact	
Telephone Number	
Email Address	
Fax Number	
Circuit Termination	
Floor/Room Number/Name	
Telephone Number (within 5 feet of router)	

Note:
For the purposes of remote router support POTS lines need to be installed for each router.

Number Assigned	
Number Assigned	

Site Circuit Termination Design	YES	NO
Diverse Telecommunications Entrance Facilities into Site	□	□
Telecommunication carrier demarcation location different from install location	□	□
Termination capacity currently exists	□	□

Demarcation Extension to be performed by	□ None	□ Telco	□ Site Staff

Circuit Configuration (provided by PJM)				
□ Physical Address DS1	□ Port Speed	□ CIR		
Date Site Survey Completed				
□ PVC to PJM Primary Control Center	□ PVC to PJM Emergency Backup Control Center			
Circuit Notes:				
PJM Supplied Hardware Information				
□ Very Large (A)	□ Large (B)	□ Medium (C)	□ Small (D)	
Communication Protocol	□ ICCP	□ DNP	□ EMS	□ SCADA
PJMnet Router Type:				
Gateway devices required (DNP implementations only) □ Yes □ No				

Note:
Note for electrical facilities that have a major impact on PJM operations: PJM requires the computer hardware and software at each control center should achieve a long-term 99.95% availability level for those critical functions directly affecting the successful operation of PJM. Redundant hardware configurations with either automatic or rapid manual failover schemes are generally necessary to achieve 99.95% availability. In addition, reliable AC power source(s) and communications are also necessary. Members should keep this requirement in mind when designing these systems.

Customer Site Environment Information		
Site Power Configuration (diversity/redundancy)	YES	NO
Separate Equipment Breakers	□	□
Separate Electrical Panels for Equipment	□	□
Uninterruptible Power Supply	□	□
120v/60 Hz AC Power Available	□	□
If no AC power is available, please describe available power:		

Voice Modules PJM*net* will provide a voice-over IP (VOIP) output from each router for future voice communication with PJM. PJM will be using a conventional dial plan for the PJM*net* VOIP circuits (will match the corresponding public switched network phone number).				
What type of facility will you have connected to the router?				
□ PBX	□ Standard Phone	□ Trader Turret System		
If a PBX Connection, please specify port type:		□ FXS	□ FXO	□ E&M

Note:
An FXO connection to the router is preferred because any standard phone can be connected to the router in case of a PBX failure.

Hardware Notes:	
Date Site Survey Completed:	

Network Information			
Network Address			
Subnet Mask			
IP Address for PJM Router			
Will this network be protected by a firewall?		□ Yes	□ No
Will the firewall be providing Network Address Translation (NAT)?		□ Yes	□ No
Will the firewall be in service during router installation?		□ Yes	□ No
Please provide a contact for the firewall administrator:			
Name			
Phone			
Can IP 10.134. be used by PJM?	□ Yes	□ No	

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If yes, supply a 10.34.xx address that will be used as a loop back address. -10.34.		
Please list what devices (RTU, Meter< FEP, etc.), device type (DNP, ICCP) IP Address will be monitored:		
Device Name/Type	Communications Protocol	IP Address

Attachment C: New PJM Customer Voice/All Call Communications Request Form

Objective

This document will provide PJM with the information necessary to implement voice (two-way) and All Call (one-way) communications, which are essential for operation of the PJM grid.

Customer Information

PJM Member Name: _____

Customer Contact

Name: _____

Street: _____

City, State, Zip code: _____

Telephone: _____

Email Address: _____

Customer Type: (check the one that applies)

Generation Transmission Dispatch Center Demand Side Response

PJM Transmission Zone(s) of Operation _____

Site Information

Total Number of MW at Site for which site is responsible: _____

Desired date of operation: _____

Location where the phone call is received

Location name: _____

Street: _____

City, State, Zip code: _____

Two Way Voice Communication Information

Primary **dedicated** phone number for PJM Dispatch Operations to call: _____

Secondary **dedicated** phone number for PJM Dispatch Operations to call: _____

PJM All Call Information

(PJM requires a Primary phone number dedicated solely to PJM for operation and emergency communications. All Call may not terminate in voice mail, ACD or answering systems)

Primary number: _____

Secondary Number: _____ Cellular: YES NO

(May be shared lines or cellular numbers, indicate if cellular)

Tertiary Number: _____ Cellular: YES NO

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(May be shared lines, indicate if cellular)

Approval

Please provide your PJM Contact's name: _____

Contact Engineering Technicians at engtechs@pjm.com for technical assistance or questions in completing this for

Attachment D: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures

The purpose of this attachment is to provide further explanation of the PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures that are discussed in this manual Section 7: *Generator Operations*. This section also applies to Synchronous Condensers. The following requirements are applicable only for units physically located within the PJM RTO footprint or Reliability Coordinator area.

Specifications

Listed below are the specifications for the Continuous Generating Unit Reactive Capability Curve (D-curve) as required to be entered into PJM's eDART system.

1. In general, the following data for each point on the curve must be specified:
    a. The "Unit Net MW Output" provided to the system, as measured at the low-side of the unit step-up transformer, excluding any station service load fed off the unit terminal bus, consistent with the PJM EMS model.
    b. The "Unit Minimum Net MVAR Limit" at the specified "Unit Net MW Output", consistent with the PJM EMS Model."
    c. The "Unit Maximum Net MVAR Limit" at the specified "Unit Net MW Output", consistent with the PJM EMS model.
2. The "Unit Minimum and Maximum Net MVAR Limits" must indicate the realistic, usable capability that is sustainable during continuous long-term unit operation. This sustainable continuous capability is based on actual operating experience (or testing) and takes into consideration any normal unit or plant restrictions at 95 degrees Fahrenheit ambient or above. Therefore, the reactive capability derived results is the proven sustainable reactive capability, rather than merely reflecting the design limits of the unit.
3. A sufficient number of curve points must be provided to accurately model the full operating range and capability of the unit as described above. (Refer to the guidelines noted below in Exhibit 12 for additional details.)

Data Requirements

1. A minimum of two curve points and a maximum of eight curve points must be provided for generating units and synchronous condensers. PJM prefers that eight points be provided to match PJM's EMS State Estimator program requirement.
2. If less than eight points are provided, PJM will expand the curve to eight points by incrementing the MW point by one MW each time to achieve an eight point curve. The MVAR points for each of these additional MW points will be equal to those at the highest MW point provided.
3. The "Unit Maximum Net MVAR Limit" must be greater than (or equal to) the "Unit Minimum Net MVAR Limit" for each curve point.
4. The "Unit Minimum Net MVAR Limit" may be equal for any number of adjacent curve points.

5. The “Unit Maximum Net MVAR Limit” may be equal for any number of adjacent curve points.
6. The “Unit Net MW Output” must be increasing from the first to the last point.
7. Company shall use test or operational data to construct D-curve at min output points. If test or operational data is unavailable at the minimum output, engineering judgment shall be used for the D-curve values.
8. For units that operate as synchronous condensers, an entry is required for a zero MW point that indicates the reactive capability when in condensing mode.

Data Format

Data should be provided to PJM in the format shown in the exhibit below via eDART.

	MW	Minimum MVAR	Maximum MVAR
Point 1			
Point 2			
Point 3			
Point 4			
Point 5			
Point 6			
Point 7			
Point 8			

Exhibit 13: PJM Unit Reactive Capability Curve Data Format

Referring to Exhibit 12 above, to enhance PJM’s State Estimator solution, the following guidelines for submitting new and revised permanent and temporary D curves into eDART should be followed.

1. MW value at Point 1 should be equal to or less than the typical minimum economic output of the unit. For a unit that has synchronous condensing capabilities this MW point should be zero and the Point 2 MW value should be the typical minimum economic output of the unit.
2. Intermediate MW values at Points 2 – 6 should be potential operating points of the unit. For example, these values could be the same as the points on the unit’s economic dispatch curve.
3. MW value at Point 7 should be equal to the typical maximum economic output of the unit.

4. MW value at Point 8 should be the maximum possible unit output considering ideal operating conditions such as winter ambient temperatures, low cooling water temperatures, optimum fuel conditions, etc.
5. For units that are “non-dispatchable” where the typical minimum economic and maximum economic outputs are equal, enter MW values at each point one MW above the previous value ending with the typical economic maximum value at Point 7 and the maximum possible unit output at Point 8.

Refer to the following link for examples of eDART D-curves for several unit types including synchronous condensers: http://www.pjm.com/~/media/documents/manuals/manual-links/m14d/d-curve-examples.ashx

PJM Unit Reactive Capability Curve Reporting Process for Permanent Changes

1. Each Generation Owner/Operator must continually provide accurate permanent capability curve changes to PJM via eDART as soon as the information is available. The “New Default” field should be checked in eDART.
2. Once the accuracy of the submitted reactive capability curve is verified, PJM will permanently update the PJM Unit Reactive Capability Curves in use by PJM Operating/Planning Studies and PJM EMS Network Applications programs.

Real-Time PJM Unit Reactive Capability Reporting Process for Temporary Changes

1. Whenever a PJM unit’s reactive capability is limited or reduced (or is planned to be limited or reduced) for any reason, the generator’s owner/operator must immediately enter a temporary ticket via eDART. For real-time changes, the generator’s owner/operator must also notify the PJM Power Dispatcher (PD) and respective TOby phone.
2. Excluding the time period when a generator is in the startup or shutdown mode, whenever a PJM unit’s Automatic Voltage Regulation (AVR) status is off (or is planned to be off), the generator’s owner/operator must immediately enter a ticket via eDART. For real-time changes, the generator’s owner/operator must also notify the PJM Power Dispatcher (PD) and the respective TO by phone.
3. The PJM PD will receive the ticket and either temporarily update the unit’s reactive capability curve in use by the PJM EMS Network Applications, or will temporarily set the unit’s AVR status in use by the PJM EMS Network Applications to “OFF” for the specified time period.
4. The generator’s owner/operator must immediately modify the eDART ticket and notify the PJM PD and respective TO by phone whenever the unit’s normal reactive capability or AVR is restored (or is anticipated to be restored).
5. The PJM PD will either restore the unit’s normal reactive capability curve in use by the PJM EMS Network Applications, or will set the unit’s AVR status in use by the PJM EMS Network Applications to “ON”. The PJM PD will then close the unit reactive ticket.

PJM Reactive Reserve Check (RRC)

In real-time, PJM uses the Reactive Reserve Check (RRC) to assess the RTO’s and its member’s position with respect to dynamic and static reactive (var) power. The RRC process,

including generator owner responsibilities, is described in PJM Manual M03, Transmission Operations, Section 3.12.

Attachment E: PJM Generator and Synchronous Condenser Reactive Capability Testing

E.1 Objective

The objective of reactive capability testing is to improve the transmission system reliability by accurately determining generator and synchronous condenser reactive capability on a regular basis. PJM requires testing to be coordinated between PJM, the testing facility and the local Transmission Owner's (TO) to ensure that the impact on system operations is minimized. Testing is intended to demonstrate reactive capability for those conditions where reactive reserves or voltage control would be required. It is the intent of these procedures to align with NERC Reliability Standard MOD-025-2 so separate tests to meet the NERC requirements and the PJM requirements are not needed. However, certain differences will remain between M14D, Attachment E and MOD-025-2 to provide continuity with PJM requirements and to provide data for real-time operational needs.

E.2 General Requirements

Note that the term "facilities" throughout this Attachment E includes individual generating units, aggregated generating plants including wind farms and solar projects, and synchronous condensers. The requirements in this attachment apply to all applicable facilities within the PJM RTO footprint. The requirements do not apply to PJM capacity or energy resources that are physically located outside the PJM RTO footprint or Reliability Coordinator area, or to energy storage installations such as batteries or flywheels.

- The following facilities are required to perform reactive capability testing:
  - Individual generating units with a gross nameplate rating greater than 20 MVA and directly connected to the Bulk Electric System
  - Generating plants/facilities with a gross aggregate nameplate rating greater than 75 MVA including variable resources such as wind, solar, run of river hydro, etc.
  - Synchronous condensers with a gross nameplate rating greater than 20 MVA and directly connected to the Bulk Electric System
  - All generating units providing PJM Black Start Service
  - All other individual units/facilities will verify the reactive capability reported in the PJM eDART system on a periodic basis consistent with PJM Manual 14D.
- Generation Owners and Transmission Owners of synchronous condensers are required to test approximately 20% of their applicable facilities annually, totaling 100% of their applicable facilities over a 66 month period. More frequent testing may be done if the owner so chooses.
- The MOC for the operating company of a joint owned generating facility is responsible for scheduling the tests and updating the applicable eDART D-curves as required.
- For the maximum lagging test at maximum real power output for generators and the maximum lagging test for synchronous condensers, the PJM reactive capability testing period will begin on May 1 and continue through September 30. The preferred testing times during these months is between 1200 – 1800 hours on weekdays.

- For the maximum leading test at minimum real power output the preferred time for testing fossil steam units, nuclear units, combined cycle plants, and hydro units that operate as synchronous condensers is during the off peak hours (2300 – 0700 hours EPT) anytime during the year.
- For all other required reactive testing, the owner will determine the best time to conduct the tests. Testing may be conducted in conjunction with other testing (including real power testing), provided all other requirements of the reactive capability tests are met. Facilities should be tested with all auxiliary equipment needed for normal operation in service.
- As an alternative, data collected during routine operation of the facility is acceptable, provided all test requirements are met.
- The tests required are functional and do not require special instrumentation. They are designed to demonstrate that the ratings can be obtained for the time periods required under normal operating conditions for the equipment being tested.
- Projected system conditions must permit the unit/facility to operate at the required real power and reactive power output without adversely impacting system operations.
- PJM will consider other test periods on a case by case basis, so long as proposed testing periods do not adversely impact system operations.

Note:
Procedures for real-power testing are contained in PJM Manual, 21 - Rules and Procedures for Determination of Generating Capability and the PJM eGADS User Manual**.** Also, refer to PJM Compliance Bulletin CB023, which references the submittal of real and reactive power verification data.

E.3 Testing Requirements

- For all applicable generating facilities except variable resources such as wind and solar, maximum over-excited (lagging) and maximum under-excited (leading) reactive capability tests at the maximum real power output the facility is expected to operate (e.g. Economic Maximum) are required. The maximum lagging reactive capability test should be conducted for a minimum of one hour. Data for the maximum leading reactive capability test may be recorded as soon as a limit is encountered.
- For variable resources such as wind and solar, maximum over-excited (lagging) and maximum under-excited (leading) reactive capability tests are required. At least 90% of the wind turbines or photovoltaic inverters at a site must be on-line during the tests. Data for these tests may be recorded as soon as a limit is encountered.
- For all applicable generating facilities except nuclear powered generating units and variable resources such as wind and solar, maximum over-excited and maximum under-excited reactive capability tests at the minimum real power output the facility is expected to operate (e.g. Economic Minimum) are required. Data for these tests at minimum real power output may be recorded as soon as a limit is encountered.
- Applicable hydroelectric generating facilities (e.g. run of river, pumped storage) shall perform maximum leading and maximum lagging tests at maximum real power output and at minimum real power output. The maximum lagging reactive capability test at

maximum real power output should be conducted for a minimum of one hour. Data for maximum leading at maximum real power output and for tests at minimum real power output may be recorded as soon as a limit is encountered.

- For synchronous condensers the over-excited reactive capability test should be conducted for a minimum of one hour. Data for the under-excited reactive capability test may be recorded as soon as a limit is encountered.
- For all applicable generating facilities that may operate for PJM as synchronous condensers to provide reactive support, the maximum over-excited (lagging) and maximum under-excited (leading) reactive capability tests shall also be performed with the unit operating in the synchronous condensing mode. The maximum lagging reactive capability test should be conducted for a minimum of one hour. Data for maximum leading reactive capability may be recorded as soon as a limit is encountered.

TESTING REQUIREMENTS SUMMARY

UNIT TYPE	MW OUTPUT	MVAR OUTPUT	TEST DURATION
FOSSIL, HYDROELECTRIC & BLACKSTART	MAX	MAX LAG	ONE HOUR
	MAX	MAX LEAD	WHEN LIMIT REACHED
	MIN	MAX LAG	WHEN LIMIT REACHED
	MIN	MAX LEAD	WHEN LIMIT REACHED
SYNCHRONOUS CONDENSER or GENERATOR THAT OPERATES IN THE SYNCHRONOUS CONDENSING MODE TO PROVIDE REACTIVE SUPPORT	-	MAX LAG	ONE HOUR
	-	MAX LEAD	WHEN LIMIT REACHED
NUCLEAR	MAX	MAX LAG	ONE HOUR
	MAX	MAX LEAD	WHEN LIMIT REACHED
VARIABLE (E.G. WIND AND SOLAR) (Testing done with at least 90% of turbines or inverters on line)	VARIABLE	MAX LAG	WHEN LIMIT REACHED
	VARIABLE	MAX LEAD	WHEN LIMIT REACHED

- For generating units of 20 MVA or less that are part of a plant greater than 75 MVA in aggregate, record data either on an individual unit basis or as a group. Units providing PJM Black Start Service shall provide test data on an individual unit basis.
- A steady real power output shall be maintained during the test.
- Generation or synchronous condenser stations that have multiple facilities that require testing shall perform tests on only one facility at a time. The remaining operating facilities at the station shall operate normally.

- Facilities are to be tested with the automatic voltage regulator operating in service and while maintaining the voltage within normal operating limits on the system bus (pre- and post-contingency voltage limits).
- To achieve optimal test results, deviations from the assigned voltage schedule may be allowed with permission from PJM and the TOTO. Coordination between the facility owner, the TO, PJM, and other facilities in the area will be required in order to allow the facility being tested to demonstrate its maximum reactive capability while maintaining system voltages within acceptable limits.
- For hydrogen-cooled generators and synchronous condensers, the hydrogen pressure should be raised to the normal operating pressure. If the facility cannot be operated at its normal hydrogen pressure the test shall be postponed until this condition is corrected.
- When the maximum over-excited and under-excited reactive output during the test is achieved, the MW and MVAR outputs at the generator/synchronous condenser terminals (low-side gross), auxiliaries, the generator/synchronous condenser step-up transformer (GSU) primary (low-side net, after auxiliaries), and the GSU secondary (high-side net) should be recorded. All other applicable data on the reporting forms shall also be recorded.
- If metering is unavailable, it may be necessary to calculate some of these quantities. A note should be provided in the “Remarks” section of the data reporting forms for points which are calculated.
- PJM will evaluate the reported values as compared to the default eDART D-curve values and contact the owner as required to validate the data. The test data will normally serve as the basis for modifying the default reactive curves within eDART.
- During the test, the scheduled and actual voltages at the system bus and the generator/synchronous condenser terminals should be recorded. In addition, nameplate GSU/Synchronous Condenser SU transformer impedance, MVA rating, primary and secondary voltage ratings and available tap settings, and existing tap setting should be provided.
- The reasons for any limit to reactive capability during the test should also be specified (for example, reactive capability curve limit, minimum excitation limiter settings, field current limitation, generator/synchronous condenser voltage, auxiliary bus voltage, system voltage limits, generator/synchronous condenser vibration, generator/synchronous condenser temperatures, hydrogen pressure restriction, shorted rotor turns, operating procedure limit, etc.) in the remarks section.

E.4 Notification and Reporting Requirements

E.4.1 MOC (or TO if testing a synchronous condenser) Actions

- Proposed testing dates/times should be communicated via eDART to PJM Dispatch, PJM Reliability Engineer and the TO no later than noon 3 business days prior to the test, ensuring testing impacts are incorporated into day-ahead studies. PJM and TOs will consider shorter notification times and try to accommodate reactive testing while ensuring that operating limits are not violated.

- The test notification shall be submitted using a “MVAR Test” Ticket which should include the test duration, notes in the Description field on the type of test or tests that are planned to be performed, as well as any additional relevant information for the test.
- Prior to the test scheduling, the MOC (Generation Owner) or TO (Synchronous Condenser Owner) shall verify with the plant and the PJM Reliability Engineer that telemetered MW and MVAR data is accurate and consistent. This data check shall be done comparing the plant data that will be recorded at the plant and entered on the test forms, the MOC data (TO data for Synchronous Condenser), and PJM’s data to insure accuracy and consistency between all entities. If issues are identified, they are required to be resolved before proceeding with testing the facility. If the test is performed and data inconsistencies are discovered during PJM’s analysis of the test, a retest may be required.
- Any scheduled or unscheduled maintenance work on the facility scheduled for testing which may affect the reactive capability of the unit must be complete and all related eDART tickets cleared prior to contacting PJM for the purpose of initiating the study process.
- The MOC (or TO for synchronous condenser testing) will contact PJM Reliability Engineer at least three hours prior to the start of the scheduled testing in order to initiate the real-time study process.
- Real-time testing must be coordinated with the TO and PJM Power Dispatchers. At least 30 minutes notice should be provided to allow PJM and the TO operators to adjust the system to ensure testing does not result in voltage limit violations.
- The TO will coordinate any required transmission mitigation steps to resolve internal generating plant limitations as reported by the plant or the MOC with PJM Reliability Engineer.

Note:
If during the test a unit is unable to achieve its stated capability due to external operational limitations or internal operational limitations caused by an external condition, such as high or low transmission system voltage, the plant or the MOC must communicate this issue to the TO and the PJM Reliability Engineer prior to completing the test. The TO and PJM will work together and attempt to adjust the transmission system voltage and mitigate the external condition. If the actions of the TO and PJM cannot mitigate the external operational limitations or internal operational limitations caused by an external condition the PJM Reliability Engineer will provide confirmation to the MOC that their unit(s) did not meet the stated reactive capability due to an external limitation, and no further actions will be required of the MOC for said unit(s). The PJM Reliability Engineer will document that the unit could not achieve its stated capability due to an external limitation and will log the external limitation on the applicable eDART reactive test ticket.

- If testing must be canceled or rescheduled, the MOC (or TO for synchronous condenser testing) will inform the PJM Reliability Engineer as soon as possible.
- The MOC (or TO for synchronous condenser testing) will coordinate the implementation of their portion of the exit strategy with PJM, if required.

- Facility Owner shall enter and save reactive testing results in eDART by creating a Reactive Result Ticket within 30 calendar days after completion of the testing. If portions of the test are completed on separate days (e.g. tests at minimum output completed on day 1 and tests at maximum output completed 90 days later) all test data shall be entered and saved within 30 days after each portion of the test, and eDART D-curves updated appropriately. All portions of reactive testing on a facility shall be completed within six calendar months after the initial test, with result data entered and saved on a Reactive Result Ticket and ticket status set to PJM Review; otherwise, PJM will consider the test invalid. Separate notifications are required if portions of the testing are planned to be done on separate days.

E.4.2 TO Actions

- The appropriate TOs will conduct studies in accordance with established company procedure in order to determine the effect of scheduled testing on their systems.
- The TO should contact the PJM Reliability Engineer with any possible concerns regarding the scheduled testing.
- The TO support staff will ensure that the TO operators are aware of scheduled reactive capability tests and communicate the pre-studied mitigating action plan.
- Prior to studying the test, the TO will verify, with the PJM Reliability Engineer and the generating station or synchronous condenser station, the expected MW and MVAR output levels of the unit during testing, and ensure that the AVR is in service.
- The TO will contact the PJM Reliability Engineer no later than two hours and 15 minutes prior to the scheduled test start time in order to discuss the results of their studies and the mitigating steps required, if any.
- The TO will discuss, coordinate, and implement any actions necessary as required by mitigation strategies with PJM prior to the start of testing.
- The TO will communicate MVAR output step changes to the testing facility in coordination with PJM. In general, MVAR step changes should be no greater than 100 MVAR increments.
- If testing must be canceled or rescheduled, the TO will inform PJM Reliability Engineer as soon as possible.
- The TO will coordinate the implementation of their portion of the exit strategy with PJM, if required.
- The TO will coordinate all actions through the PJM Reliability Engineer or Power Dispatcher.

E.4.3 PJM Actions

- All testing requests will be reviewed by the PJM Reliability Engineers and Power Dispatchers to ensure that there is no conflict between the testing and any planned transmission outage. PJM will give the MOC (or TO for synchronous condenser testing) a suggestion for a more appropriate date and time to conduct the test, if necessary.
- The PJM Reliability Engineer and Power Dispatcher will review and approve the test in accordance with the established PJM procedure.

- The PJM Reliability Engineer will ensure that PJM dispatch is aware of scheduled reactive capability tests and communicate the pre-studied mitigating action plan to PJM control room staff.
- Once the PJM Reliability Engineer is contacted by the MOC (or TO for synchronous condenser testing), they will contact the TOs of all regions concerned in order to initiate the transmission study process. They will verify the expected unit output levels with the MOC (or TO for synchronous condenser testing) and ensure that the AVR is in service.
- The PJM Reliability Engineer will re-evaluate the pre-studied mitigating action plan prior to test commencement and communicate any necessary adjustments to the impacted parties.
- The PJM Reliability Engineer and/or Dispatch will discuss possible mitigation strategies with the appropriate TOs.
- The PJM Reliability Engineer will contact the MOC (or TO for synchronous condenser testing) no later than two hours prior to scheduled testing to inform them whether mitigation steps will be required.
- The PJM Reliability Engineer will coordinate with the appropriate MOCs and TOs in order to implement the selected mitigation strategy.
- The PJM Reliability Engineer will coordinate with the TO and MOC in making MVAR output step changes with the testing unit.
- If the testing must be cancelled or rescheduled, PJM Reliability Engineer will contact the MOC and TOs as soon as possible.
- The PJM Reliability Engineer will coordinate the implementation of the exit strategy with the MOC and TOs, if required.
- The PJM Reliability Engineer will coordinate all actions and communications between the MOC and TOs.

E.5 Test Cancellation

PJM dispatch and/or the impacted parties may cancel the generator reactive capability testing for the following reasons:

- Internal planning issues.
- Emergency procedures.
- Inability to control actual or post-contingency voltage issues created by scheduled testing.
- Any operating issues created on TO equipment not monitored by PJM.

Cancellation of the reactive capability test will be communicated to all impacted parties.

PJM will document all cancellations and terminations including the party responsible and the reason for the cancellation or termination.

E.6 Voltage Schedules

Adjustments may need to be made to local voltage schedules in order to accommodate the scheduled testing. These adjustments will be considered and studied on a case by case basis.

To obtain better test results, units at the same location of the testing unit may elect to operate at the upper or lower end of their assigned voltage schedule's bandwidth.

Operating beyond the assigned voltage schedule may be acceptable based on PJM's real-time and contingency analysis. All parties must be informed and in agreement prior to this occurring.

PJM will discuss the changes with the appropriate TO and if the recommendation does not cause a violation of a defined limitation, the TO should implement the PJM request.

PJM will retain its control of the reactive facilities, such as transmission capacitors, LTCs, and generator MVAR output.

If internal plant or TO limits restrict the request, PJM dispatch will study the limitations and recommend changes if appropriate.

If the recommended changes cannot be implemented due to equipment or facility limitations, other options will be considered, including test cancellation or rescheduling.

E.7 Exit Strategy

E.7.1 Risk

PJM will not allow scheduled reactive capability testing to place the system in an unacceptable state. However, there is always the possibility of equipment failure resulting in unplanned situational constraints that would require immediate remedial action.

E.7.2 Requirements

The following are steps that will be considered and agreed upon prior to allowing the scheduled reactive capability testing:

- Each scheduled test will be studied and approved on a case by case basis.
- All required mitigation steps will be agreed to and coordinated with all concerned parties, to include PJM Reliability Engineer, the responsible MOC, and the appropriate TOs, prior to the scheduled testing.

E.7.3 Parameters

PJM will NOT allow operation over any applicable post-contingency emergency rating.

PJM will NOT allow operation over any applicable pre-contingency normal rating.

In the event of a facility rating discrepancy between PJM and the TO that cannot be resolved, PJM will default to the most conservative limit.

In the event that the testing results in an unexpected thermal or voltage violation, standard mitigation steps will be taken to return the facilities in violation back to normal limits within applicable timeframes.

The mitigation steps taken will not cause limit violations on any other company's equipment or facilities.

E.8 Post-Test Evaluation

PJM will typically analyze the reactive capability test results within 60 days of receipt of the test data and provide feedback to facility owners on the status of their reactive capability test results.

PJM will also provide the results of generation reactive capability tests to the appropriate TO operator.

E.8.1 Test Evaluation

PJM will evaluate each facility's reactive capability test results against its stated reactive capability limits modeled within eDART and the PJM EMS. This evaluation will determine which units performed over, under, or within 5% of their stated limits for the maximum lagging test at maximum real power output and the maximum leading test at minimum real power output, as well as what follow-up steps are necessary to ensure that the correct information is modeled within eDART and the PJM EMS.

E.8.2 Facilities Testing Within 5% of Stated Limits

Facilities with test results within 5% of their stated limits for the maximum lagging test at maximum real power output and the maximum leading test at minimum real power output will be considered as having fully demonstrated their stated reactive capability.

PJM will notify the MOC or TO for synchronous condensers that their units achieved their reactive capability, and no further action will be required.

E.8.3 Facilities Testing Over 5% of Stated Limits

Facilities with test results over 5% of their stated limits for the maximum lagging test at maximum real power output and the maximum leading test at minimum real power output will be considered as having fully demonstrated their stated reactive capability.

PJM will notify the MOC or TO for synchronous condensers, that their units exceeded their stated reactive capability and will request that they increase the reactive capability modeled within the PJM EMS by entering a new default eDART MVAR ticket.

E.8.4 Facilities Testing Below 5% of Stated Limits

Facilities with test results under 5% of their stated limits for the maximum lagging test at maximum real power output and the maximum leading test at minimum real power output will not be considered as having demonstrated their stated reactive capability.

PJM will determine which units have not demonstrated their stated reactive capability due to either internal or external operational limitations based on reasons documented within the submitted test results.

For units that claimed external operational limitations, tested during the PJM preferred time frames as noted in Section E.2 and followed the procedure described in the Note under Section E.4.1,

- PJM will perform further analysis to confirm external limitations and possible remedial measures in the event of future attempts by the MOC (or TO for synchronous condensers) to demonstrate the facility's reactive capability.
- If an external limitation is confirmed, PJM will provide confirmation to the MOC (or TO for synchronous condensers) that their facility performed below their stated reactive capability due to external limitations and may not require any further action.
- If no external limitation is confirmed, PJM will require that the MOC (or TO for synchronous condensers) either permanently reduce the reactive capability modeled within the PJM EMS by entering a new default eDART MVAR ticket or retest to demonstrate the stated capability of the facility.

- If the MOC (or TO for synchronous condensers) chooses to retest the facility, PJM will require that a temporary eDART MVAR ticket be submitted that will remain active until the facility demonstrates the original stated capability.

For facilities that claimed internal operational limitations,

- If a facility is unable to achieve its stated capability due to an internal operational limit caused by an external condition (such as high or low transmission system voltages), the plant or the MOC (or TO for synchronous condensers) communicated this issue to the TO and the PJM Reliability Engineer prior to completing the test as per the Note under Section E.4.1, and this communication was verified by PJM, then PJM will inform the MOC (or TO for synchronous condensers) that their facility performed below their stated reactive capability due to external limitations and may not require any further action.
- If the internal operational limitation was caused by an external condition but was not communicated by the plant or MOC (or TO for synchronous condensers) to the TO and PJM, then PJM will require that the MOC (or TO for synchronous condensers) either permanently reduce the reactive capability modeled within the PJM EMS by entering a new default eDART MVAR ticket or retest to demonstrate the stated capability of the facility.
- If the MOC (or TO for synchronous condensers) chooses to retest the facility, PJM will require a temporary eDART MVAR ticket be submitted that will remain active until the facility demonstrates the original stated capability.
- For facilities that tested for the initial time and for facilities that are providing data at maximum leading at maximum real power output and maximum lagging at minimum real power output, owners shall update eDART D-curve data to reflect expected operational reactive capability.

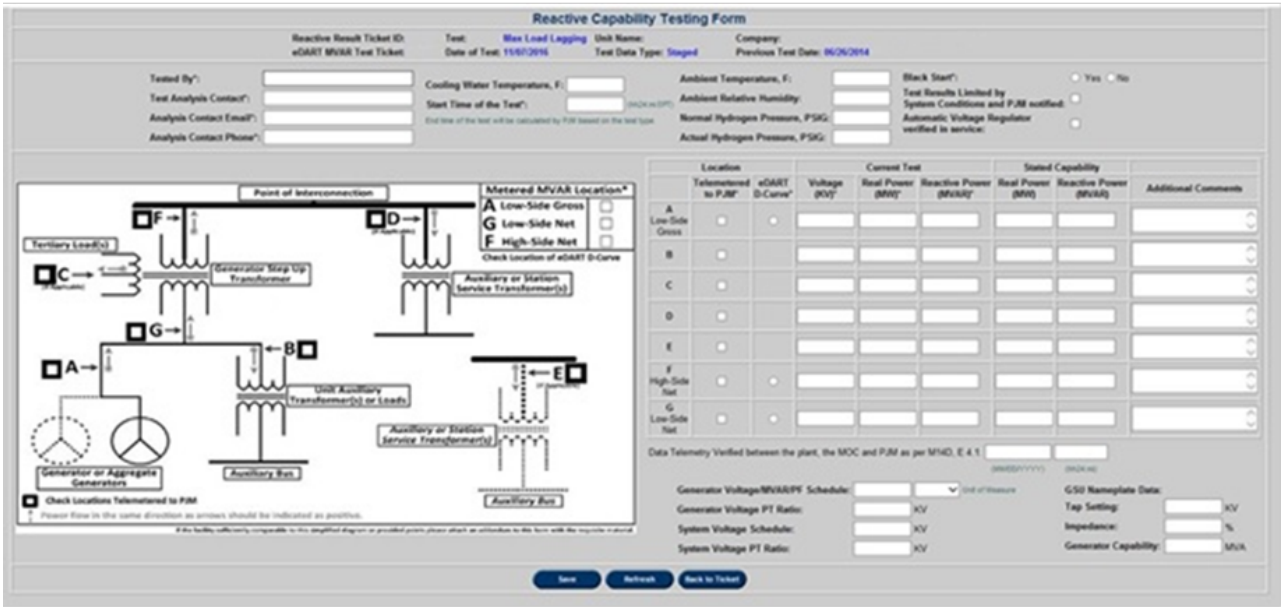
Test Evaluation Summary

Test Outcomes and Required Actions *			
Test Type	Results Within 5% of Stated Limits	Results Outside 5% of Stated Limits	Initial Results at Previously Untested Values
Max Lagging at Max Output Max Leading at Min Output	None Required	Submit New eDART Default Reflecting Tested Values	Submit New eDART Default to Reflect Expected Operational Capability
Max Leading at Max Output Max Lagging at Min Output	None Required	Submit New eDART Default to Reflect Expected Operational Capability	Submit New eDART Default to Reflect Expected Operational Capability
Max Lagging at Sync Cond Max Leading at Sync Cond	None Required	Submit New eDART Default Reflecting Tested Values	Submit New eDART Default to Reflect Expected Operational Capability

* For additional details please refer to text within Attachment E.

E.9 Sample eDART Reactive Capability Testing Form

Sample Screenshot – enter data via eDART



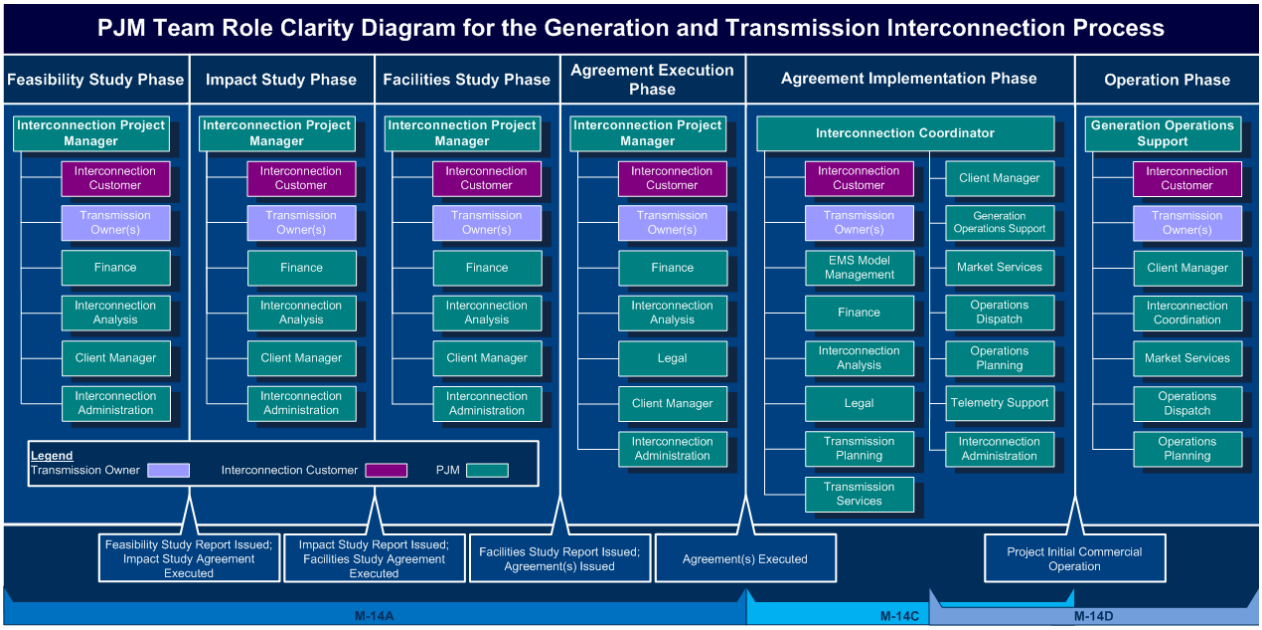
Attachment F: Deleted

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Attachment G: Deleted

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Attachment H: PJM Generation and Transmission Interconnection Planning Team Role Clarity Diagram



Interconnection Team Role Clarity Design

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Attachment I: Deleted

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Attachment J: Generator – Data Release Matrix

Generator – Data Release Matrix M14D – Attachment J

_____ (Transmission Owner) requests the following data from PJM for the following unit(s) of _____ (Generator Owner).

An "X" marked in (the Real Time MW, Real Time MVAR, Unit Status, Reactive Capability or Scheduled Outage Data column) indicates that the Transmission Owner requests such data for reliability purposes. Specific unit parameters being requested for restoration planning purposes should be listed in the Parameter Data column.

□ Check this box the unit is identified in a Transmission Owner's restoration plan

Generator Unit Name	Real Time MW	Real Time MVAR	Unit Status	Reactive Capability	Scheduled Outage Data	Parameter Data

Link to Attachment J: http://pjm.com/~/media/documents/manuals/manual-14d-attachment-j.ashx

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Attachment K: Deleted

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Attachment L: Jointly Owned Resource Communication Model

Dispatch instructions and directives to multiple resource owners delay controlling actions resulting in less efficient market operations and a potential adverse impact to system reliability. Dispatch instructions to a subset of owners at a jointly owned resource may result in customers questioning dispatch instructions or curtailments and additional administrative procedures to ensure fair/equitable reductions to an aggregate plant on a rotating basis. A single SCED basepoint for a jointly owned resource to a single Market Operations Center (MOC) Generation Dispatcher is an effective solution to ensure efficient and reliable operations.

The purpose of this section is to define a dependable real-time communications model to manage jointly owned resources, ensuring:

- A single MOC Generation Dispatcher (single operational contact) for the processing of all real-time dispatch electronic signals and operational issues.
- Specifically for wind resources:
  - Accurate outage data, which is essential for an accurate Wind Power Forecast
  - Prompt wind power reduction via the mandatory use of the “Curtailment Indicator,” which typically would occur as a last resort just prior to emergency procedures.

Note:
The MOC Generation Dispatchers (single operational contact) will need to meet the PJM certification and training requirements outlined in PJM Manual 40: Training and Certification Requirements.

Option 1: PJM Operations would prefer a model where there is a single MOC Generation Dispatcher (single operational contact) responsible for the entire jointly owned resource operations. The single contact would be responsible for all day-ahead and real-time bidding into PJM Systems (Markets Gateway), process an SCED basepoint, real-time communications with PJM Dispatch, as well as providing accurate outage information within eDART. Settlements can be allocated by PJM based on ownership shares.

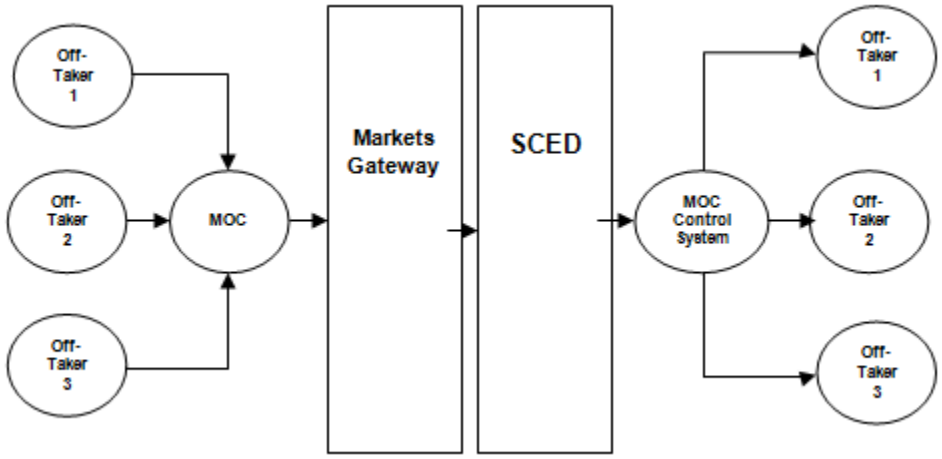


Exhibit 14: Joint Owned Resource Communication Model 1

Option 2: The alternate solution would still require a single MOC Generation Dispatcher (single operational contact) for manual real-time communications with PJM Dispatch, where the operational nature of the situation requires live verbal communications. Each owner/off taker of a jointly owned resource would still be able to interact directly with PJM Dispatch for market related matters, and with Markets Gateway, providing day-ahead offers and hourly updates. The single operational contact would be responsible for all manual real-time communications with PJM Dispatch, as well as providing accurate outage information within eDART. PJM SCED would send individual basepoints to each owner/off taker. Settlements will model individual owner/off takers of a jointly owned resource. Examples of market communications that can be made by individual owner/off takers of a jointly owned resource and examples of manual real-time communications, which must be made by a single operational contact, are set forth below in Exhibit 16. All parties that communicate with PJM Dispatch must meet the training and certification requirements outlined in Manual 40.

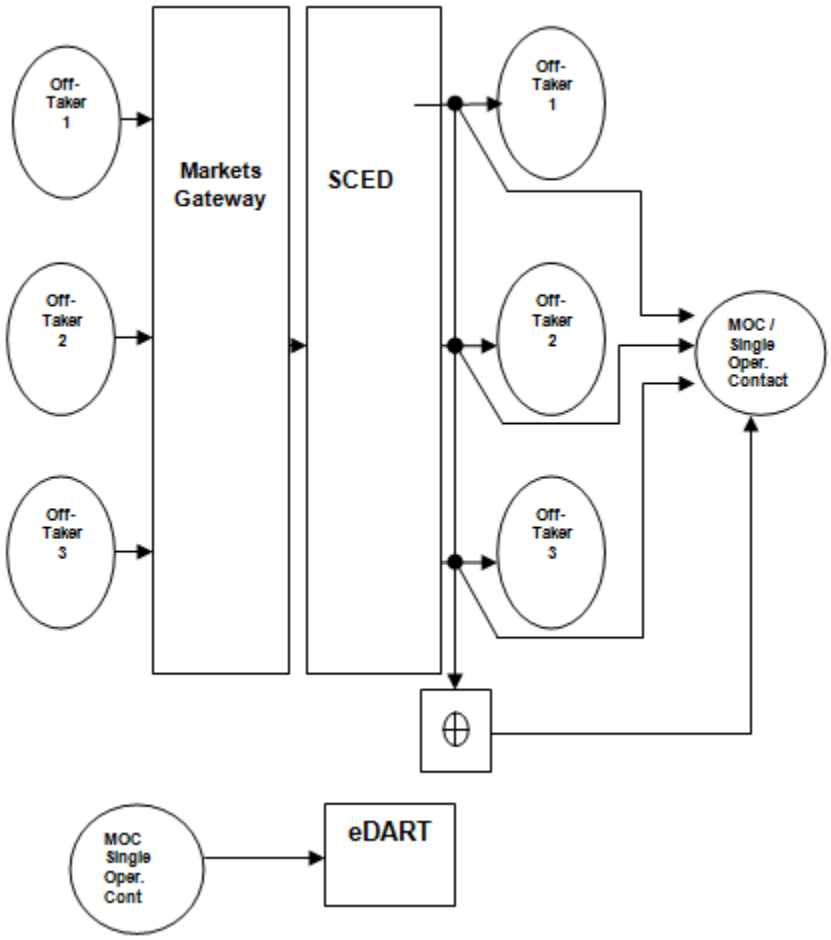


Exhibit 15: Joint Owned Resource Communication Model 2

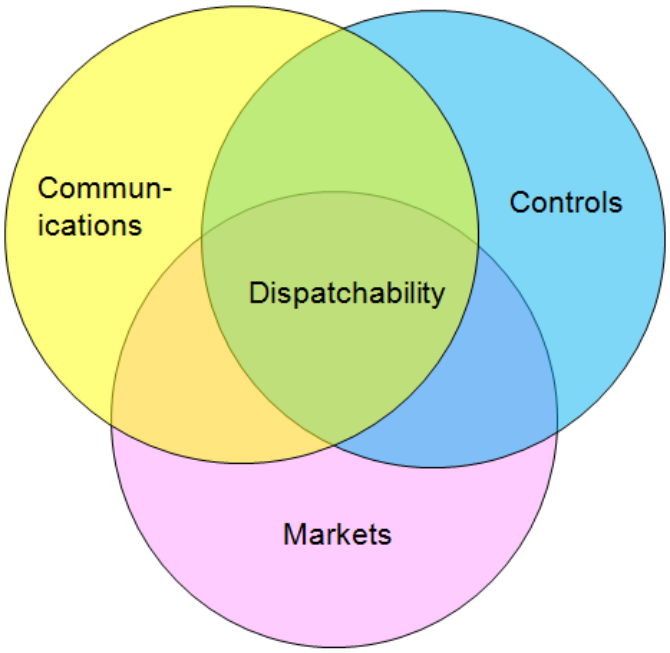
Markets Related Communications with Dispatch (Directed to each Market Operations Center)	Real-Time Communications with Dispatch (Directed to Single Operational Contact)
Scheduling of unit to run	Manual Dispatch (Congestion Management)
Questions about Market Bid information	Emergency Dispatch (Transmission Issues)
Extension of Day Ahead commitment	Loss of Communications
Self-Schedule Status	Unit Synchronizes to system / on line status
Unit is released from dispatch	Unit is ready to follow dispatch base points
Regulation 1. Assignments and status 2. Self-Scheduling	Unit Trips

Markets Related Communications with Dispatch (Directed to each Market Operations Center)	Real-Time Communications with Dispatch (Directed to Single Operational Contact)
3. Testing	
Synchronous reserve assignments	Partial or Complete Outages (Loss of equipment) communicated via eDART
	Testing status (capacity/environmental)

Exhibit 16: Guidelines for Markets and Real-Time Communication between Dispatch and Joint Owned Resource Owners, Option 2.

Attachment M: Wind Unit Dispatchability Check List

In order to ensure resources do not force emergency procedures, they must be dispatchable in the range between the greater of the resources physical minimum operating level or Capacity Interconnection Rights (CIR) and the Maximum Facility Output (MFO), i.e., Fixed Gen flag must not be selected. The three requirements for a unit to be dispatchable are:



Communications

1. The unit must send active MW, Wind Speed and Wind Direction via SCADA/ICCP; values sent to PJM cannot be static or flat-lined for an extended period of time and must be within reasonable limits.
2. The unit must electronically receive control signals, including Economic Basepoint, Curtailment Flag, and the Generator On Reason (GENRUNR).
3. All eDART generator outage tickets must be up to date.

Controls

1. The unit must be capable of following electronic control signals as received, i.e. have the physical controls in place to throttle their turbines / generation or processes to remove turbines from service. Control signals include Economic Basepoint, Curtailment Flag, and the Generator On Reason (GENRUNR).

Markets

1. **All units should follow their Economic Basepoint, even when curtailed by SCED.**
   a. A unit will be dispatched so that its economic basepoint equals its economic max unless the unit is being curtailed. However, the economic basepoint is ramp rate

limited to what the unit can ramp in the next look-ahead interval, at the ramp rate provided by the unit. The look ahead interval is adjustable by system operations based on system conditions and is currently configured at 15 minutes.

b. If the basepoint doesn't make sense,
   i Check EcoMin and EcoMax (see 2 below)
   ii Check Unit Availability status (economic, must run, not available)
   iii Check for manual overrides (fixed gen flag, unit output)
   iv Check data quality (wind forecast; other telemetry must be updating)

2. **All units should update their Economic Minimum and Economic Maximum.**
   a. At least once an hour; more often as the forecast changes.
   b. Eco Min should be less than or equal to unit output and CIR (Eco Min ≤ CIR and ≤ Output).
   c. Eco Max should be greater than or equal to unit output (Eco Max ≥ Output).
   d. If Eco Min equals Eco Max, or if the Fixed Gen flag is set to yes, your dispatched basepoint will reflect back (or mirror) the units current output and the unit is considered not dispatchable.
   e. If a unit is operating above its Eco Max, the dispatch system will send a basepoint to move the unit to Eco Max. The curtailment flag is set if the non-ramp-rate-limited basepoint is below Eco Max or when a unit is marginal and the non-ramp-rate-limited basepoint is below the output of the unit. In either case, the unit will be considered not dispatchable if it continues to operate above its basepoint.

3. **The telemetered Generation Run Reason code (GENRUNR), indicates PJM's 'logged-on' status for the unit:**
   a. These values of GENRUNR mean your unit is dispatchable:
      i 2 or 17 indicate your unit is operating as Economic.
      ii 22 indicates your unit is Company Dispatchable.
   b. These values of GENRUNR indicate your unit is not dispatchable:
      i 16 indicates your unit is Released. Contact PJM Dispatch to have this corrected.
      ii Other on reasons may cause the unit to be considered not dispatchable, i.e. basepoint mirrors current output (see section 2.d above). Contact PJM Dispatch to have this corrected.

PJM Markets Gateway Users Guide:

http://www.pjm.com/~/media/etools/markets-gateway/markets-gateway-user-guide.ashx

Attachment N: Cold Weather Preparation Guideline and Checklist

Introduction

During the January 2014 “Polar Vortex,” PJM experienced extreme cold temperatures in its region that required the use of emergency procedures on multiple days to maintain adequate supply to meet the demand and reserve needs of the system. Coincident with the cold weather and high demand, generator forced outages and failures to start were significantly higher than expected; as high as 22% (~40,000 MW) during the January 6 to 8, 2014 operating days. PJM believes that improvements in the performance of resources during extreme cold weather events is necessary.

Based on previous cold weather events the following is meant to provide generators with a guide to lessen and optimistically eliminate these and similar problems during future cold weather events. This list of suggestions and typical problem areas is not meant to be all-inclusive. Individual entities should review their plant design and configuration, identify areas with potential exposure to the elements, ambient temperatures, or both, and tailor their plans to address them accordingly.

Desired outcome

Identify and prioritize components, systems, and other areas of vulnerability which may experience freezing problems or other cold weather operational issues. This includes critical components and systems that have the potential to:

- Initiate an automatic unit trip,
- Impact unit start-up,
- Initiate automatic unit runback schemes or cause partial outages,
- Cause damage to the unit,
- Adversely affect environmental controls that could cause full or partial outages,
- Adversely affect the delivery of fuel or water to the units,
- Cause other operational problems such as slowed or impaired field devices, or
- Create a safety hazard.

Safety

Safety remains the top priority during winter weather events. Job safety briefings should be conducted during preparation for and in response to these events.

Training

Coordinate annual training in winter specific and plant specific awareness and maintenance training. This may include response to freeze protection panel alarms, troubleshooting and repair of freeze protection circuitry, identification of plant areas most affected by winter conditions, review of special inspections or rounds implemented during severe weather, fuel switching procedures, knowledge of the ambient temperature for which the freeze protection system is designed, and lessons learned from previous experiences or the NERC Lessons Learned program.

Pre-winter season items

- **Personnel preparation**:
  - Hold winter readiness meetings on an annual basis to prepare for severe cold weather operation before the winter begins highlighting preparations and expectations.
  - Assign, prioritize and schedule tasks.
  - Review and act on lessons learned from prior cold weather operation.
  - Communications:
    - Ensure appropriate communication protocols are followed during a severe winter weather event.
    - Identify a back-up communication option in case the primary system is not working (e.g. satellite phone).
    - Ensure communication is discussed as part of the job safety briefing during a severe winter weather event.
  - Prepare and review plant-specific emergency operating plans for winter weather.
  - Review cold weather scenarios affecting critical equipment.
  - Include plant systems, equipment, or protection systems that may have been changed or have degraded over time.
  - Ensure all engineered modification and construction activities are performed such that the changes maintain winter readiness for the plant.
  - Develop a list of critical instruments and transmitters that require increased surveillance during severe winter weather events.
- **Staffing:**
  - Consider enhanced staffing (24x7) during severe winter weather events.
  - Arrange for lodging and meals as needed.
  - Arrange for transportation as needed.
  - Arrange for support and appropriate staffing from responsible entity for plant switchyard to ensure minimal substation equipment and line outages.
  - Consider employing the “buddy system” during severe winter weather events to promote personnel safety.
- **Equipment preparation:**
  - Perform a walk down of the plant to correct and identify:
    - Broken/damaged/degraded doors and windows,
    - Degraded missing lagging on exterior piping,
    - Heat tracing equipment damage,
    - Damaged instrument air lines,

- Locations of standing water
- Review cold weather scenarios affecting equipment.
- Include plant systems, equipment, or protection systems that may have been changed or have degraded over time.
- Consider pre-warming, operating at full speed no load, early start-up, and/or putting on turning gear scheduled units prior to a forecasted severe winter weather event.
- Prepare units that have been off line for lengthy periods of time for start-up and operation during severe winter weather events.
- Develop cooling tower operating procedures for cold weather that specifies the cycling of fans to minimize the forming of icicles.
- Arrange for adequate supply of demineralized water and other plant consumables considering the potential of extended operation on primary or secondary fuel during extreme cold weather and high winds.
- Arrange for adequate supply of fuel (e.g. kerosene) for portable space heaters.
- Arrange for adequate hydrogen supply considering additional losses due to hydrogen seal contraction during cold temperatures.
- Determine the duration that the unit can maintain water, air, or fluid systems above freezing when offline, and have contingency plans for periods of freezing temperatures exceeding this duration.
- Check heat tracing on critical lines and pipes monitored throughout winter weather events to ensure the circuits are functional (evaluate the use of infrared cameras, and other technologies, to inspect critical heat circuits).
- Erect secondary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.
- Review process for ensuring adequate quantities of winter weather and personal protection equipment are available (e.g., heat lamps, heaters, etc.).
- Monitor instrument air systems year–round and maintain or upgrade instrument air drying systems as required to ensure a continuous supply of moisture-free instrument air to control valve actuators, etc.
- Develop a plan for the removal of debris at plant's intake structure given the potential of freezing conditions.
- Determine if start-up times longer than currently modeled in Markets Gateway are required and update PJM dispatch and Markets Gateway if applicable.
- Provide accurate ambient temperature design operating limits for each generating unit that is included in the owners portfolio (including the accelerated cooling effect of wind), and update them as necessary. These limits should take into account all temperature-affected generator, turbine, and boiler equipment,

and associated ancillary equipment and controls. Update PJM's eDART and Markets Gateway systems as appropriate.

- Consider issues that could result in slowed valve/damper operation.
- Ensure that heat tracing, insulation, lagging and wind breaks are designed to maintain water temperature (in those lines with standing water) at or above 40 degrees ambient temperature, taking into account the accelerated heat loss due to wind.
- Evaluate piping insulation and correct deficiencies that may allow water infiltration which would result in freezing during cold weather.
- Install heated blankets on critical water lines as required to prevent freezing.
- Place thermometers in rooms containing equipment sensitive to cold and in freeze protection enclosures to ensure that temperature is being maintained above freezing and to determine the need for additional heaters or other freeze protection devices. Pre-position heaters in known problem areas.
- Evaluate whether there is sufficient electrical circuits and capacity to operate portable heaters, and perform preventive maintenance on all portable heaters prior to cold weather.
- Install temporary heaters and ducting as required to prevent the formation of ice and snow on the surface of air inlet filters.
- Provide adequate inventory of parts and supplies needed for cold weather operation.
- Drain any non-critical service water lines in anticipation of severe cold weather.

o Maintain Substation Equipment:

- Ensure that the SF6 gas in breakers and metering and other electrical equipment is at the correct pressure and temperature to operate safely during extreme cold, and also perform annual maintenance that tests SF6 breaker heaters and supporting circuitry to assure that they are functional.
- Maintain the operation of power transformers in cold temperatures by checking heaters in the control cabinets, verifying that main tank oil levels are appropriate for the actual oil temperature, checking bushing oil levels, and checking the nitrogen pressure if necessary.
- Determine the ambient temperature to which equipment, including fire protection systems, is protected (taking into account the accelerated cooling effect of wind), and ensure that temperature requirements are met during operations.

• **Fuel and environmental preparation:**

o Review fuel quality and quantity

o Consider tuning combustion and environmental controls for operation during winter ambient conditions.

- Test fuel switching equipment and capabilities where applicable including consideration of the following:
  - Time required to switch fuel.
  - Amount of unit reduction required to switch fuel.
  - Unit capacity while on alternate fuel.
  - Operator training and experience.
  - Fuel switching equipment problems
  - Boiler and combustion control adjustments needed to operate on alternate fuel.
  - Availability of alternate fuel supply.
- Consider mitigation measures to alleviate derates during cold weather events due to emission limitations.
- Inform PJM of any limitation of operating hours due to environment permits considering extended operation on alternate fuel.
- Inform PJM of fuel type being used during each operating day for dual fuel units via the PJM Markets Gateway system. Ensure that up to date schedules for the alternative fuels are entered into Markets Gateway in case they are needed during the operating day.
- Review plant environmental permits to determine if there is the potential of requesting discretionary enforcement in support of grid reliability. Refer to Attachment M of PJM Manual M-13, Emergency Procedures http://pjm.com/~/media/documents/manuals/m13.ashx
- Consider issues that could adversely affect the delivery of fuel to the units such as limited fuel delivery trucks, etc.
- Consider need to contact appropriate governmental agencies to approve waivers to allow fuel truck delivery drivers to work extended hours.
- Consider mitigating alternate fuel start-up problems by scheduling at least enough primary fuel for start-up.
- Consider adding kerosene to fuel oil as required to minimize gelling.
- Consider treating coal and limestone systems with anti-freezing solution.

- **Actions when cold weather is forecasted:**
  - Prepare for PJM Cold Weather Alert
  - Review PJM Manual M-13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
  - Review plant special operations instruction (just prior to or during a severe winter weather event)

- Run emergency generators immediately prior to severe winter weather events to help ensure availability.
- Where applicable, consider availability and reliability of black start units during adverse weather and emergency conditions.
- Place in service critical equipment such as intake screen wash systems, cooling towers, auxiliary boilers, intake filter heaters and fuel handling equipment, such as coal and limestone conveyors where freezing weather could adversely impact operations or forced outage recovery.
- Institute operator rounds utilizing cold weather checklists to verify critical equipment is protected – i.e. pumps running, heaters operating, igniters tested, barriers in place, temperature gauges checked, etc.
- Monitor room temperatures, as required to prevent freezing of instrumentation and equipment in enclosed spaces (e.g. pump rooms).

- **Actions during cold weather:**
  - Implement PJM Emergency Procedures as directed
  - Review PJM Manual M-13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
  - Keep PJM up to date on all operational limitations that will or may affect plant output.
- **Actions following cold weather:**
  - Review lessons learned after each winter event and/or season. Include what went well, what needs improvements, suggestions from on duty staff, document and review prior to next cold weather season.
- **Suggestions for additions/improvements to this guideline/checklist:**
  - References:
    - Link to NERC website that includes numerous cold weather event postings including the February 2011 Southwest event reports, various lessons learned, and reliability guidelines for cold weather preparedness and operations:
    - NERC Reliability Guideline: Generating Unit Winter Readiness – Current Industry Practices – Version 2
    - NERC Findings and recommendations from the FERC/NERC Staff Report on the 2011 Southwest Cold Weather Event:
    - PJM Polar Vortex Presentation at FERC Technical Conference, 4/1/14
    - Extreme Winter Weather Events - Training Presentation
    - Lessons Learned, Best Practices and Observations from ReliabilityFirst's 2014 – 2016 Plant Winterization Visits
    - ReliabilityFirst's Review of Winter Preparedness Following the Polar Vortex, November 13, 2015

Appendix A: Behind the Meter Generation Business Rules

Definition and Purpose of Behind-the-Meter Generation (BtMG)

1. The purpose of these rules is to permit market participants operating Behind-the-Meter Generation (BtMG) to receive the associated benefits. These benefits are recognized by allowing such generation to net for the purposes of calculating transmission, capacity, ancillary services, and administrative fee charges.

2. The netting rules for BtMG are set forth in the PJM Open Access Transmission Tariff ("PJM Tariff"), the Amended and Restated Operating Agreement of PJM Interconnection, L.L.C. ("Operating Agreement"), and the Reliability Assurance Agreement Among Load Serving Entities in the PJM Region ("RAA"). These documents filed with the Federal Energy Regulatory Commission will take precedence in the event of any conflict or ambiguity between these rules and the filed documents.

Eligibility for BtM Netting

3. These rules apply to BtMG used by end-use customers, municipal electric systems, electric cooperatives, and electric distribution companies to serve load. The load must be located at the same electrical location as the BtMG, such that no transmission or distribution facilities are utilized to transmit energy from the BtMG to the load. An exception to the prohibition on use of distribution facilities rule is allowed, in cases where permission to use the requisite distribution facilities has been obtained from the owner, lessee, or operator of such facilities. Such permission must be submitted in writing to PJM from the owner, lessee or operator of such distribution facilities.

4. BtMG netting is only available to entities that have Network Integration Transmission Service agreements with PJM.

5. These business rules do not supersede any elements of existing retail service agreements or standby service agreements between an entity and its Load Serving Entity or the Electric Distribution Company to which the associated load is connected.

BtM Netting – General Rules

6. BtMG does not include at any time, any portion of a generating unit's capacity that is designated as a Capacity Resource; or in any hour, any portion of the output of such generating unit that is sold to another entity for consumption at another electrical location or into the PJM Interchange Energy Market.

7. Generation Owners shall not be eligible to receive payments, pursuant to Schedule 2 of the PJM Tariff, for reactive service for portions of generating units upon becoming a BtM Generator. Generation Owners subject to this rule shall cooperate with PJM in making any regulatory filings that may be required to implement this rule.

8. The need for metering for small BtMG will be treated on a case-by-case basis, depending on local operational security needs. For the purposes of this rule, small BtMG shall be individual generating units that are less than 10 MW, or multiple generating units that are collectively less than 10 MW. Generally, these units will not require metering for operational security purposes. Rules for metering are detailed in the PJM Manual for Generator Operational Requirements (M-14D).

9. BtMG that is 10 MW or greater (or has been identified as requiring metering for operational security reasons) must have both revenue metering and telemetering for operational security purposes. Single unit small BtM generators that collectively total more than 10 MW, may be aggregated behind the meter and metered as a single unit to meet this requirement should PJM require metering for the aggregate generation. Rules for metering are detailed in the PJM Manual for Generator Operational Requirements (M-14D). For telemetry and metering to be communicated to PJM the unit must be modeled in the PJM Energy Management System. For modeling rules to fulfill this requirement, please refer to Manual 3A, Section 1.2.1.

10. BtMG will be recognized in PJM transmission and generation adequacy planning models. Load and generation will be modeled separately where practicable.

11. If multiple generation units are located behind the meter, each unit can be designated as either a Capacity Resource or as BtMG on a unit specific basis or on a partial unit basis.

12. A party may change all or a portion of a unit's capability from Capacity and/or Energy Resource status to BtMG status, or from BtMG status to Capacity and/or Energy Resource status (provided the generator has met the applicable requirements for Capacity Resource status), but cannot be used for both purposes simultaneously for a designated portion of a unit's capability. Any portion of a unit that has been qualified as a Capacity Resource is subject to the same requirements as any other PJM Capacity Resource. Because of the number of procedural requirements associated with changing to or from BtMG status, such changes shall be limited to once per year in accordance with the schedule set forth below.

13. A Capacity Resource that changes to BtMG, or a new generator that requests BtMG status will be able to net its full installed capacity value for the first calendar year for transmission and the first Planning Period for capacity. The netting value for all succeeding years will be based on actual generator performance over the 5 CP and 1 CP days.

14. Requests for BtMG changes for transmission charges, black start service, and reactive service must be received by PJM by December 1 and will become effective the following January 1. The change shall remain in effect for a period no less than one calendar year.

15. Requests for BtMG changes for capacity obligations must be received by PJM by December 1 and will become effective the following June 1. The change shall remain in effect for a period no less than one Planning Period.

16. Requests for BtMG changes for energy-based ancillary service charges (i.e., those ancillary services charged on a MWh basis such as regulation, spinning and operating reserves) and for administrative fee charges can be made anytime. The change will become effective on the first of the month following PJM's communication that all logistical modifications (as may be required, for example, to metering or billing/settlement records) have been completed. The change shall remain in effect for a period no less than 12 months from the month the change becomes effective.

17. If a generator is granted BtMG status for one purpose (such as capacity), it must become BtMG for all other purposes described in Rules 14, 15 and 16 above, and in accordance with the timetables established in those rules. A generator that changes its status to BtMG pursuant to Rules 14 and 16 will be deemed to have given notice pursuant to Rule 15 to request BtMG status for capacity obligations for the Planning Period immediately following the Planning Period in which the Rule 14 and/or 15 BtMG request was made/effective., so as to comply with the notice requirements provided in Section 2.5.2 of the PJM Tariff.

18. The timing requirements established in Rules 14, 15 and 16 are not affected by a transfer of ownership; BtMG status changes are only permitted according to the timetable described in Rules 14, 15 and 16 above.

19. If Non-Retail BtMG is subject to a reduced netting credit as described in Rule 34 below, that generator is ineligible to change its behind the meter status until the full effect of that reduction has been fully rolled out.

20. If a Capacity Resource moves behind the meter, its injection rights will be treated the same as if the unit had been deactivated. Those injection rights are defined in Section 230 of the PJM Tariff, generally, and Section 230.3.3 specifically with respect to rights that apply if a generation resource is deactivated.

Participation in Load Management Programs

21. BtMG may participate in all relevant PJM demand side response programs (e.g. the PJM Interchange Energy Market and the PJM Capacity Market (RPM)) under the terms and conditions in effect at the time the BtMG requests participation in the program, subject to Rule 22 below.

22. A generator may be used for Load Management (LM) credit or it can be used to net against load as a BtM generator, but cannot be used for both purposes simultaneously. The election of BtM or LM status must remain in effect for an entire planning period.

23. A BtM generator may participate in the PJM Load Response programs under the terms and conditions in effect at the time the BtM generator requests to participate in the program.

Generation Netted Against Load

24. The load associated with BtMG must have a Load Serving Entity (LSE). The LSE will be responsible for supplying energy, capacity, ancillary services and transmission for that portion of the load not supplied by the BtMG. For the purposes of this rule, the load not supplied by the BtMG shall include load normally supplied by the BtMG during periods when the BtMG is not operating.

a. The capacity obligation for the load will be based on the average of the net load at the site(s) (gross load minus operating BtMG, not to be less than zero) at the time of the Zone's transmission peak (1CP) during the five (5) coincident peak hours, in accordance with the 5CP methodology in effect for the Zone.

b. Network Integration Transmission Service charges will be calculated as the net load at the site(s) (gross load minus operating BtMG, not to be less than zero) at the time of the Zone's transmission peak (1CP).

c. Regulation and Spinning Reserve obligations will be calculated based on the net MWh of load at the site (hourly gross load minus operating BtMG, not to be less than zero) in real time.

d. Day-Ahead Operating Reserves will be charged based on the net amount of load at the site(s) that clear(s) in the PJM Day-Ahead energy market.

e. Balancing Operating Reserve deviations will be measured based on the net change of both the BtMG and the load between day-ahead and real-time.

f. PJM Schedule 9 administrative fees based on real time load and generation will be charged on the net value of load or generation as measured in real time.

25. Under this “netting” arrangement, the EDC and/or LSE will be responsible for reporting both the load and generation information to PJM for use in the load forecast for generators for which metering is required for operational security purposes. The EDC may need to obtain this information from the LSE and both parties are required to cooperate to ensure PJM receives the information.

26. For wholesale market participation, the interconnection requirements will be publicly available and, in cases where parallel operation will exist with the distribution or transmission system, determined by the EDC in accordance with applicable state or other jurisdictional requirements. The generator will be evaluated using the PJM interconnection process only if it is involved in a wholesale transaction.

BtM Netting – Non-Retail Participation

27. Non-Retail BtMG netting provisions apply to behind the meter generation used by municipal electric systems, electric cooperatives, and EDCs to serve load, provided that, if distribution facilities are used to deliver energy from Non-Retail BtMG to load, then permission to use such distribution facilities has been obtained from the owner, lessee, or operator of such distribution facilities. Such permission shall be submitted to PJM in writing from the owner, lessee or operator.

28. All entities using the Non-Retail BtMG option must have a Network Integration Transmission Service agreement with PJM.

29. Non-Retail BtMG netting is subject to a threshold amount. The Non-Retail BtMG threshold is 1,500 MW for calendar year 2006 for transmission charges, black start service, and reactive service, and for the 2006/2007 Planning Period for capacity obligations. Each year thereafter, the Non-Retail BtMG threshold will be increased based on PJM RTO load growth. PJM RTO load growth will be determined based on the most recent forecasted weather-adjusted coincident summer peak divided by the weather-adjusted coincident peak for the previous summer. After applying the load growth factor, the Non-Retail BtMG threshold will be rounded to the nearest whole MW, and that rounded number will be the Non-Retail BtMG threshold for that current year or Planning Period and the base amount for calculating the Non-Retail BtMG threshold for the succeeding year or Planning Period.

30. PJM shall communicate a change in the Non-Retail BtMG threshold through an email to all BtM generators and posting on the PJM website.

31. If the amount of Non-Retail BtMG netting exceeds the Non-Retail BtMG threshold, the amount of Non-Retail BtMG shall be prorated back to the threshold. In such instance, the amount of Non-Retail BtMG eligible for netting by an entity shall be the product of its total Non-Retail BtMG multiplied by the ratio of the Non-Retail BtMG threshold divided by the total amount of the Non-Retail BtMG in the PJM RTO (not to exceed 3,000 MW). [Example: if the Non-Retail BtMG threshold is 1,500 and the total amount of Non-Retail BtMG netting in the PJM RTO reaches 2,000, then 75 percent of an entity’s Non-Retail BtMG would be eligible for netting.]

32. The total amount of Non-Retail BtMG eligible for netting under the BtMG provisions is capped at 3,000 MW. If this cap is reached, no additional Non-Retail BtMG will be eligible for netting. Furthermore, within six months of reaching the cap, PJM shall file with the FERC to justify either continuation of the existing BtMG rules (including any expansion of the rules to include additional MW) or any change to the rules.

33. Each calendar year, netting Non-Retail BtMG resources shall be required to operate during the first ten occurrences of Maximum Emergency Generation (MEG) conditions in the zone in which the resource is located. This obligation applies to an MEG condition called for either generation or transmission emergencies. Notice of an MEG event shall be communicated through the PJM all-call system.

34. For each MEG condition in which netting Non-Retail BtMG is not on a scheduled outage but fails to operate, in whole or in part, the netting associated with that resource for purposes of charges for transmission service, reactive service, black start service, and capacity obligations will be reduced by ten percent of the amount of megawatts the resource failed to produce. The amount of megawatts that the resource failed to produce will be the difference between its full netting credit and its megawatt average output over the MEG period. [Example: if a netting Non-Retail BtM resource is required to operate with an output of 100 MW during a Maximum Emergency Generation condition, but only operates to a level of 75 MW, in the next year, the eligible netting from that resource will be reduced by 2.5 MW, which is the product of the following calculation:[(100 – 75) x .10]].

35. Any reductions in netting will be applied in the succeeding calendar year with regard to transmission service, reactive service, and black start service, and the succeeding Planning Period with regard to netting related to capacity obligations.

36. A generator that moved behind the meter is not eligible to move back in front of the meter until the impact of the reduced netting penalty described in Rule 34 above has been rolled out.

37. Non-Retail BtMG may not schedule a unit outage in the months from June through September.

BtM Adjustment Process

38. Parties seeking a BtMG adjustment of any type must notify PJM at BTMG@pjm.com. The BtMG request must contain the following information:

- Contact name, company, email address and phone number
- Name of generation unit(s) and EIA plant and unit identification numbers
- Summer net dependable rating of the unit(s)
- Name of the applicable Load Serving Entity and Electric Distribution Company
- If applicable, written approval from the owner, lessee or operator of a distribution facility used to deliver energy from the BtM generator to load
- For non-retail BtM generation, the phone number to be added to the PJM all-call list

39. PJM will respond to the request and coordinate data and information flow between all affected parties (customer, LSE, EDC, etc.) to determine eligibility, peak load adjustments, etc.

Revision History

Revision 42 (12/22/2017):

- Periodic Review
- Multiple Locations – administrative changes - replaced Local Control Center with Transmission Owner and replaced LCC with TO
- Exhibit 1 and Section 6 – administrative changes – replaced System Operator Certification with PJM TO Operator and Generation Dispatcher Certification for consistency with Manual 40
- Section 4.1.7 - SCADA—Supervisory Control and Data Acquisition – grammatical correction
- Section 4.3 - Synchrophasor Communication System – clarified network requirements, deleted Exhibit 7, revised link to registration form and updated email address used for reporting problems
- Section 5.3.4 eDART – added requirement for non-black start generators to be modeled in eDART consistent with the PJM EMS model. Also, added requirement that all new black start generators be modeled individually in eDART and EMS.
- Section 5.7 Generation Transfer Process – new section relocated from Manual M10
- Section 7.1.1 Generator Real Power Control - revised over frequency level per NERC Reliability Standard PRC-024-2
- Section 7.1.2 Voltage and Reactive Control
    - added requirement that the Transmission Operator copy PJM via email on the voltage schedules assigned to the Generator Owner/Operator
    - added the requirement for non-synchronous generating facilities which entered the New Service Queue on or after November 1, 2016 to provide dynamic reactive power and follow the assigned voltage schedule. (FERC Order No. 827 - Reactive Power Requirements for Non-Synchronous Generation)
    - deleted voltage schedule exemption details and left the reference to the process as described in M3.
    - clarified that AVR & PSS outage notifications must be made verbally and via eDART
    - clarified the wording in the note related to Power System Stabilizers
- Section 7.1.6 Black Start – clarified wording regarding the TO's capability and authority during system restoration
- Section 7.3 – Critical Information and Reporting Requirements - added requirement for Generation Owners to notify PJM of any operating conditions that could potentially result in a single contingency causing an outage of multiple generation resources
- Section 7.3.5 Fuel and Emissions Reporting – removed references to capacity resources and added reference to specific EOP standard

- Section 10.1.2 – Black Start Selection Process, D. RFP Proposal Evaluation – updated the criteria including preferences for units that are dual fueled or have firm gas transportation contracts and outlined proposal evaluation criteria
- Attachment N: Cold Weather Preparation Guideline and Checklist – minor revisions based on Version 2 of NERC's Generating Unit Winter Weather Readiness Reliability Guideline. Updated the links to the NERC Guideline and the RF presentation.

Revision 41 (6/1/2017):

- Several locations – administrative change – references to PJM Manual M-3, Transmission Operations, Section 3.3.3, changed to Manual M-3, Section 3.11 to reflect the transfer of the Generator Voltage Schedules section of M-3 from Section 3.3.3 to Section 3.11.
- Section 2.1 – Generator Owners' Responsibilities – administrative change - updated references to other documents
- Section 2.1 – Generator Owners' Responsibilities and Attachment L: Jointly Owned Resource Communication Model – changed references from Generation System Operator to Generation Dispatcher for consistency with PJM Manual, M-40, Training and Certification Requirements
- Section 4.1.5 EMS Data Exchange – revised Exhibit 2 to include requirement for two second generation MW telemetry data for all units participating in the PJM regulation market
- Section 4.2.2 Metering Plan – summarized real-time telemetry requirements in chart format and added requirement for solar farms
- Section 5.4.4 Grid Accounting – administrative change – changed name of PARs from Ramapo to NY-NJ
- Section 5.6.2 Data Requirements – administrative change – corrected end of re-bid period to 1415 hours
- Section 6.3.4 Other Requirements – added requirements to have and follow a voltage schedule
- Section 7.1.1 Generator Real-Power Control – deleted the qualifier "larger than 20 MW" from the requirements to meet the frequency guidelines. Reference FERC Order # 828, Requirements for Frequency and Voltage Ride Through Capability of Small Generating Facilities issued July 21, 2016.
- Section 7.1.1 Generator Real-Power Control – added clarification that governor outages must be reported for all units via eDART
- Section 7.1.2 Voltage and Reactive Control:
    - Added the requirement that newly connected generator facilities be provided a voltage schedule per PJM Manual M-3, Section 3.11.
    - Clarified Automatic Voltage Regulator required operating modes and included more specific reason for requesting an exemption from following a voltage schedule.

  - Added specifics for notifications of Power System Stabilizer outages.
- Section 7.3 Critical Information and Reporting Requirements – added clarification for Generation Owners that own transmission equipment to notify the affected Transmission Owner who must then submit outage requests to PJM via eDART for this generation-owned equipment.
- Section 7.3.4 Generating Unit Reactive Capability Reporting
  - Clarified that these requirements are applicable only for units physically located within the PJM RTO Footprint
  - Clarified language for Pre-Summer and Pre-Winter eDART reactive capability review.
- Sections 8.2.1 Initial Data Requirements & 8.2.3 Real Time Meteorological Tower – Clarified that longitude and latitude are required to be supplied in decimal degrees
- Section 12 – added new section for Solar Park Requirements –Reference FERC Order # 764, Integration of Variable Energy Resources issued June 22, 2012.
- Attachment A: Added voltage schedule and reactive capability curve requirements to New Generator Checklist.
- Attachment D - PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures:
  - Clarified that these requirements are applicable only for units physically located within the PJM RTO Footprint
  - Included guidelines for selecting points on the D-curve to be submitted via eDART
  - PJM Reactive Reserve Check (RRC) – revised description, added reference to Manual 3, Transmission Operations for details and generator owner responsibilities, and deleted Exhibit 19
- Attachment E: PJM Generator and Synchronous Condenser Reactive Capability Testing
  - E2 – General Requirements - Clarified that reactive testing is not required for capacity and energy resources located outside the PJM RTO footprint
  - E3 – Testing Requirements – removed link to Reactive Capability Testing Form
  - E.4.1 – Clarified that maintenance work on the facility that may affect the reactive capability of the units must be completed prior to contacting PJM to initiate the study process.
  - E.4.1 – Note 1 – Added the words “and attempt” in the sentence: “The LCC and PJM will work together and attempt to adjust the transmission system voltage and mitigate the external condition.”
  - E.4.1 - Revised test submittal process to include submitting Reactive Test Results via eDART
  - E.9 Test Tracking – deleted section. No longer required due to addition of submitting test results via eDART.

- o E.10 – renumbered to E.9 and revised to remove sample test submission forms and included eDART screenshot of Reactive Result Ticket.

Revision 40 (01/01/2017):

- 7.3.5 Fuel Limitation Reporting – Updated title, updated Seasonal Reporting section, added a section on Periodic Reporting, and removed details on Real Time Reporting. Deleted Exhibit 11, Sample Data (Fuel Baseline)
- Deleted references to Manual 35, Definitions and Acronyms which has been retired.

Revision 39 (09/01/2016):

- Cover to Cover Periodic review
- Administrative Change – Section 4.2.1, updated reference to M-01 for outage communication.
- Section 4.3.4 Data Exchange and Management Requirements – added details and clarifications of PMU and PDC requirements for new generation facilities.
- Section 7.1.2 Voltage and Reactive Control – replaced PJM System Operations Subcommittee Chair with the email address “VoltageScheduleExemption@pjm.com” for the location where requests for voltage schedule exemptions should be directed to. Also included examples of exemption request types and updated the note referencing M-03, Section 3.3.3 related to real-time exemption criteria..
- Section 7.5.1 Generation Resource Operational Exercise – revised to eliminate Capacity Performance resources from being eligible to participate. Also added link to form used for tracking unit performance
- Section 7.5.2 Generation Resource Cold Weather Checklist – added date to start the Cold Weather Checklist acknowledgement process.
- Administrative Change – Section 8 Wind Farm Requirements, updated Attachment L references to include new name
- Attachment E: PJM Generator and Synchronous Condenser Reactive Capability Testing, added reference to Compliance Bulletin CB023 in Section E.2.
- Attachment G: PJM Generator Markets and Operations Process Flow Diagram – Deleted Attachment – information now included in the interconnection process via PJM’s Client Manager.
- Attachment H - corrected name to PJM Generation and Transmission Interconnection Planning Team Role Clarity Diagram
- Attachment N: Cold Weather Preparation Guideline and Checklist – reviewed and updated and added references f. and g. to ReliabilityFirst’s presentation and report on winter preparedness.
- Appendix A – Added reference to Manual 3a for directions to fulfill telemetry requirement.

Revision 38 (06/01/2016):

- Administrative Change - Updated references from eMKT to Markets Gateway
- Administrative Change – Updated references from eFTR to FTRCenter
- Attachment L: Jointly Owned Resource Communication Model – Revised to include additional details for Option 2.

Revision 37 (12/22/2015):

- Periodic Review
- Administrative Change: Updated references from edata to Data Viewer
- Introduction – Added reference to eDART User Guide and eGADS User Manual
- Exhibit 10 – Included Minimum Generation Advisory and revised Minimum Generation limits to 2500 MW
- Sections 7.3.1, 7.3.2, and 7.3.3 – Added definitions of Generator Planned, Maintenance, and Forced Outages respectively
- Section 7.3.4 - Generating Unit Reactive Capability Reporting – added operating procedure limit as a potential real-time limitation to reactive capability
- Attachment A – Updated per current process and added reference to PJM's Member Relations department
- Attachment D: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures – added additional data requirements for reporting the Continuous Generating Unit Reactive Capability Curve
- Attachment E: PJM Generator and Synchronous Condenser Reactive Capability Testing:
- – E.2 – General Requirements – added preferred time requirements for maximum lagging and maximum leading tests. Also added reference to Manual M-21 for Real Power testing
- - E.3 Testing Requirements – added requirement that the automatic voltage regulator shall be in service during the testing and also that deviations from the assigned voltage schedule may be allowed to optimize test results. Also added that an operating procedure limit may be a reason to limit reactive capability during the test.
- - E.4.1 MOC (or LCC if testing a synchronous condenser) Actions – enhanced requirement for telemetry check prior to preforming a reactive test, highlighted the notation if a unit is unable to achieve its stated capability
- - E.8.4 Facilities Testing Below 5% - added notations about testing during the PJM preferred time frames as noted in Section E.2 and following the procedure described in Note 1 under E.4.1
- - E.10 Sample forms – revised Reactive Capability Testing Form Sheet 1
- Attachment L – Wind Farm Communication Model: Renamed to Joint Owned Resource Communication Model and revised to be applicable to all jointly owned resources

- Attachment M – Wind Dispatchability Check List – Updated URL for Wind Sepcific Requirements for PJM Wind Resources

Revision 36 (10/01/2015):

- Section 7.5.1, Generation Resource Operational Exercise: Revised to require a primary and alternate date for the exercise, clarified combined cycle offers for generators exercising one CT on alternate fuel, and added the requirement for generators to submit results of the exercise to PJM
- Section 7.5.2, Generation Resource Cold Weather Checklist: Revised to report completion of cold weather preparation checklist via eDART.

Revision 35 (07/28/2015):

- Administrative Change - Updated Attachment C: Changed Contact Information to Engineering Technicians at engtechs@pjm.com

Revision 34 (05/01/2015):

- Section 7.1.1, Generator Real-Power Control: Added generator governor and distributed control system dead band and droop setting requirements consistent with the February 5, 2015 NERC Advisory on Generator Governor Frequency Response.
- Administrative change updated references from eTools to PJM Tools.

Revision 33 (02/05/2015):

- The following revisions and deletions made per PJM Operating Committee “TO Data Feed” special meetings (a.k.a. – generator data confidentiality) and resultant PJM Operating Agreement changes approved by FERC, effective February 5, 2015.
  - Revised Section 11, Generator Data Confidentiality Procedures
  - Revised Attachment J, Generator – Data Release Matrix
  - Deleted Attachment I, Generator Data Confidentiality Agreement
  - Deleted Attachment K, Template Letter for a Transmission Owner Seeking Generator Data Within its Zone to be Released by PJM

Revision 32 (12/22/2014):

- Section 7.1.2, Voltage and Reactive Control and Section 7.3.4, Generating Unit Reactive Capability Reporting - revised statements referencing the timing requirements for notifications for status changes on automatic voltage regulators (AVR), power system stabilizers (PSS), or reactive capability. Changes made to provide consistency with revised NERC Standard VAR-002-3, effective 10/1/2014.

Revision 31 (12/05/2014):

- Revised Section 10: Black Start Generation Procurement.

Revision 30 (11/01/2014):

- Section 7.5, Cold Weather Generation Resource Preparation – new section added
- Attachment N, Cold Weather Preparation Guideline and Checklist – new attachment added

Revision 29 (10/01/2014):

- Annual review for 2014
- Section 4, Data Exchange and Metering Requirements: Added Section 4.1.2 Jetstream and renumbered subsequent sections
- Section 5.3.4, eDART: Updated description
- Section 7.1.3, Notification to PJM for Reactive Power Resource Status during Unit Start-up: Added the words “real-time” to align with NERC Reliability Standard VAR-002-2b
- Section 7.3.3, Unplanned Outage: Added reference to reporting conditions that may affect the availability of resources providing PJM Black Start Service
- Section 7.3.4, Generating Unit Reactive Capability Reporting: Clarified that separate notifications are required for each automatic voltage regulator outage and each power system stabilizer outage
- Section 8.2.3, Real Time Meteorological Tower: Revised for consistency with Tariff and Interconnection Service Agreement requirements
- Attachment D, PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures: Revised to include synchronous condensers and generator MVAR testing at minimum output
- Attachment E, PJM Generator and Synchronous Condenser Reactive Capability Testing: Revised title and language to align with NERC Reliability Standard MOD-025-2
- Attachment F, Generator Reactive Capability Test Study Process: Deleted Attachment F due to being outdated and replaced with an internal PJM process.
- Attachment M, Wind Unit Dispatchability Check List, Section III, 2.e: Revised language to reflect a change to the SCED logic to improve constraint control and price formation

Revision 28 (07/01/2014):

- Multiple Locations: Replaced references to eMeter with Power Meter
- Section 4.1.1, PJMnet Communications System and Exhibit 3, Guidelines for Metering Installation: Revised per PJM Operating Committee “Member Communication Issue” special meetings (a.k.a. – additional PJMnet connections) and resultant PJM Operating Agreement and Tariff changes approved by FERC effective April 7, 2014.
- Section 4.3: New section for Synchrophasor Communication System resulting from PJM Tariff changes approved by FERC effective December 26, 2013.
- Attachment A, New Generator Check List: Added references to Synchrophasors

Revision 27 (04/11/2014):

- Two of the eSuite Applications have been renamed. Moving forward EES will be known as ExSchedule and eMTR will be known as Power Meter.

Revision 26 (11/01/2013):

- Section 7.1.2, Voltage and Reactive Control: Added applicability for individual generating units greater than 20 MVA.
- Section 7.3.5, Fuel Limitation Reporting: Replaced outdated reference to NERC Guidelines with reference to NERC Reliability Standards.
- Section 7.4 Synchronization and Disconnection Procedures: Added requirement for generators operating or scheduled to operate for PJM to notify PJM prior to attempting a restart following a trip or failure to start.
- Attachment D: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures: Changed language in Real-Time PJM Unit Reactive Capability Reporting Process for Temporary Changes section for consistency with Sections 7.1.2 and 7.1.3.
- Attachment E: PJM Generator Reactive Capability Testing: Updated Exception Criteria chart and Sentence 6 in the Testing Requirements for Non-Wind Units Greater than 70 MW and Black Start Units section due to changes in the definition of critical load in Manual M-36.

Revision 25 (9/26/2013):

- Section 7.1.5, Generator Operation under Emergency Operating Conditions: Removed note from Capacity Shortage Procedures chart (Exhibit 8) that referenced a delay in implementation of the Unit Start-up and Notification Alert process until PJM tools and software are in place.

Revision 24 (07/01/2013):

- Introduction and multiple sections revised due to outdated references.
- Section 3.3, Voice Communication Requirements for Generating Entities: Updated with current information.
- Section 4, Data Exchange and Metering Requirements: Updated references, technology types, contacts and data requirements.
- Section 5.1, Market Options: Revised to include current reserve and capacity markets.
- Section 6, Pre-Operational Requirements: Updated references and technology.
- Section 7.1.1, Generator Real-Power Control: Revised for consistency with M-36.
- Section 7.1.2 Voltage and Reactive Control: Relocated statement regarding telemetered status of AVR and PSS to this section from Section 7.1.3.
- Section 7.1.3, Notification to PJM for Reactive Power Resource Status during Unit Start-up: Revised to reflect the changes in NERC Standard VAR-002-2b, R1, effective 7/1/2013.

- Section 7.3, Critical Information and Reporting Requirements: Added references to PJM Peak Period Maintenance Season and changed notification time from 30 minutes to 20 minutes for consistency with Section 7.4.
- Section 7.4, Synchronization and Disconnection Procedures: Revised to include notification times for synchronizing and disconnecting generators from the system.
- Section 8, Wind Farms Requirements: Revised to include references to Attachments L & M.
- Attachment A, New Generator Checklist: Updated requirements and references.
- Attachment H, PJM Generation and Transmission Interconnection Planning Process Flow Diagram, Revised for consistency with Manual M-14A.
- Attachment M, Wind Unit Dispatchability Check List: New attachment.

Revision 23 (04/01/2013):

- Revisions endorsed by MRC on 3/28/2013:
- Multiple Sections and Exhibit 12 – changed Power System Coordination Department to Generation Department, changed Customer Relations and Training Department to Member Relations Department, and changed PJM Market Monitoring Unit to Independent Market Monitor
- Section 4.1.4 EMS Data Exchange, Exhibit 2: Added data points required to participate in the PJM Regulation Market
- Section 5 Participation in PJM Markets: Revised language in multiple sections to reference the specific manuals applicable to the energy and ancillary services markets.
- Section 6.2 Training and System Operator Certification: Details replaced with references to PJM Manual M40, Training and Certification Requirements.
- Section 7.1.1, Generator Real-Power Control: Added reference to PJM M36, System Restoration in place of detailed frequencies
- Section 7.1.2 Voltage and Reactive Control: Revised language for clarity and consistency with Manual M-03, Transmission Operations, Section 3.3.3.
- Section 7.1.3 Notification to PJM for Reactive Power Resource Status during Unit Start-up: Added language regarding providing telemetered status of AVR and PSS to PJM.
- Section 7.1.5 Generator Operation under Emergency Operating Conditions, Exhibit 9: Corrected location of the note referencing the Unit Startup Notification Alert.
- Section 7.3.5 Fuel Limitation Reporting, Real Time Reporting: Updated CT information for consistency with Manual M13, Emergency Operations.
- Section 8.1 Computer System Data Exchange: Added reference to Wind Curtailment Indicator.
- Section 9.1.1 Generator Deactivation Request: Added PJM email address where deactivation requests are to be sent.

- Attachment E: PJM Generator Reactive Capability Testing: Added testing requirements for wind generating stations, clarification for nuclear unit minimum MVAr tests and additional language for units that claimed internal operational limitations.
- Attachment L: Wind Farm Communication Model: Added reference to Wind Curtailment Indicator.

Revisions endorsed by MRC on 2/28/2013:

- Section 10 Black Start Generation Procurement: Added new Section 10.1 and revised Section 10.2 per System Restoration Senior Strategy Task Force recommendations approved by the MRC 2/28/2013.

Revision 22 (02/28/2013):

- Administrative Change: update all references of “eSchedules” to “InSchedules”

Revision 21 (10/01/2012):

- Section 7.1.5: Generator Operation under Emergency Operating Conditions: New Alert type called Unit Start-up Notification Alert in Capacity Shortage Procedures Table to align with Manual M10 and M13 revisions.
- Section 8.3: Forecast Data Usage: New section 8.3.3 “Real-time Operating Reserve Settlement” referring to PJM use of Short Term Wind Power Forecast in calculation for Lost Opportunity Cost for Wind resources.
- Section 10.2: Cost-Based Components for Black Start Replacement; Deleted section in its entirety.

Revision 20 (07/20/2011):

- Section 4: Data Exchange and Metering Requirements: Edits to Section 4.1.6 to delete outdated SCADA details.
- Section 6: Pre-Operational Requirements: Edits to Section 6.3.3 to update and clarify test energy requirements for new interconnecting resources.
- Section 7: Generator Operations: Added new Section 7.1.3 to address notification of automatic voltage regulator and power system stabilizer status changes to PJM Dispatch.
- Attachment C: New PJM Customer Voice / All Call Communications Request Form: Replaced form with updated version
- July 22, 2011: Corrected Revision number on page 7.

Revision 19 (10/01/2010):

- Incorporated Wind Farm Communication Model as Attachment L.

Revision 18 (June 1, 2010):

- Revised Attachment D, E, and F to remove redundancy and reorder.

- Modified Attachment E to change requirement to submit completed PJM Leading and/or Lagging Test Form R to PJM within 30 calendar days after completion of the testing (changed from 10 days).
- Added bullet 7 under Section Data Requirements in Attachment D, “Company can either test or apply the best engineering judgment to construct D-curve at min load points.”
- Added a line in Bullet 5 under Section Testing Requirements for both Units Larger than 70 MW and Black Start Units in Attachment E, “This requirement may require a departure from scheduled voltage during the test, provided no adverse effect on the validity of test results can be demonstrated.”
- Revision 17 (01/01/2010):
- Updated section 7.1.2 – language for voltage schedule exemption (VAR-001/002)
- Added language to section 7.1.5 – Black Start units operators shall not permit their fuel inventory for Critical Black start CTs to fall below 10 hours – if it falls below this level, unit operators shall notify PJM and place the unit in Max Emergency

Revision 16 (10/01/2009):

- Section 4: Data Exchange and Metering Requirements: Updated Sections 4.2.2 and 4.2.3 to address metering requirements for distributed renewable generation.
- Section 6: Pre-Operational Requirements: Updated Sections 6.3.1to address operations requirements for distributed renewable generation.
- Section 7: Generator Operations: Edits to voltage schedule details in Section 7.1.2.
- Section 8: Wind Farm Requirements: Minor edit in Section 8.1, updated Section 8.2.4 Generator Outage Reporting.
- Attachment D: PJM Unit Reactive Capability Curve Specification and Reporting Procedures: Updates in PJM Reactive Reserve Check (RRC) section.
- Attachment E: PJM Generator Reactive Capability Testing: Updates throughout “Testing Requirements for Units Larger than 70MW and Blackstart units” section; Replaced Lagging Form R and Leading Form R.
- Attachment F: Generator Reactive Testing Capability Procedures: Updates to Testing Procedure, Study Process Example, Communications and Coordination, Exit Strategy, and Results Reporting sections. Edits include identifying PJM Reliability Engineer as lead PJM coordinator for reactive testing process.

Revision 15 (04/01/2009):

- Section 4: Data Exchange and Metering Requirements: Updated Exhibits 4 and 5 to reflect the use of secure internet for small generators (100 MWs or less).
- Section 8: Wind Farm Requirements: Added new section describing Wind Farm Requirements
- Section 9: Generator Deactivations: Replaced PJM System Operations Generation Manager with PJM Power System Coordination Manager.

- Reactive Testing Attachments E & F: Renamed “Critical Steam” to “Near-term Steam” to avoid confusion with predefined Critical Infrastructure Facilities.
- Reactive Testing Attachments E & F: Added MOC requirement to review telemetered Generator MVAR accuracy with PJM Reliability Engineer in advance of commencing reactive test.
- Replaced “Control Area” with “Balancing Authority” to align with NERC definitions.

Revision 14 (12/17/2008):

- Added existing Behind the Meter Generation Business Rules as Appendix A.

Revision 13 (5/23/2008):

- Section 4: Data Exchange and Metering Requirements
  - Updated Exhibits 4 and 5 to reflect the use of secure internet for small generators (50 MWs or less).
- Section 5 and Section 7
  - Modified to provide clarity regarding requirement to update generator reactive capability curves (D-Curves) following planned unit upgrades.
- Section 7: Generator Operations
  - Changes for new Bulk Electric System definition.

Revision 12 (12/03/2007):

- Provided clarification to Attachment E: PJM Generator Reactive Capability Testing and Attachment F: Generator Reactive Capability Testing Procedures, specifically, the ability to test outside May 1 – September 30th window on an exception basis, requirement to perform lagging test for 1 hour, requirement to report test results to Operations Planning Department within 10 days, and requirement to review accuracy of MVAR telemetry prior to beginning the test.

Revision 11 (08/29/07):

- Section 5: Participation in PJM Markets, Ancillary Services, Reactive Supply and Voltage Control from Generating Sources Service
  - Added requirement for PJM to provide to the Generation Owner documentation of requirements for generator step-up transformer tap changes.
- Section 7: Generator Operations, Critical Information and Reporting Requirements
  - Added requirement for the Generator Operator to notify PJM of a status or capability change on any generator Reactive Power resource.
- Attachment E: PJM Generator Reactive Capability Testing
  - Modified Lagging Form R and Leading Form R to indicate that readings for Hour 2 are entered only if required.

Revision 10 (05/15/2007):

- General Changes:
  - Renamed references to Control Center Requirements and Dispatching Operations Manuals as Control Center and Data Exchange Requirements and Balancing Operations Manuals respectively.
- Section 1: Black Start Replacement Process
  - Changed Generation Department to Power System Coordination Department in section on Generator Commercial Naming Convention.
- Section 8: Generator Deactivations
  - Changed Generation Department to Power System Coordination Department in the text and in the process flow chart.
- Section 9: Black Start Replacement Process - Process Flow Diagram
  - Changed Generation Department to Power System Coordination Department.
- Section 10: Generator Data Confidentiality Process
  - Changed Generation Department to Power System Coordination Department.
- Attachment D: PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures
  - Changed Generation Department to Power System Coordination Department.
- Attachment E: PJM Generator Reactive Capability Testing
  - Clarified testing requirement as 20% of number of eligible assets per year.
- Attachment F: Generator Reactive Capability Testing Procedures
  - Changed Generation Department to Operations Planning Department.
- Attachment K: Template Letter for a TO Seeking Generator Data
  - Changed Generation Department to Power System Coordination Department.

Revision 09 (12/18/06):

- Attachment E: PJM Generator Reactive Capability Testing
  - Updated to reflect new exception criteria for PJM leading/lagging reactive tests.
- Attachment F: Generator Reactive Capability Testing Procedures
  - Updated to reflect new exception criteria for PJM leading/lagging reactive tests.
- References to eMarket changed to eMKT throughout.
- Definition of FTR changed to financial transmission rights (Section 5).
- Introduction trimmed to eliminate redundant information.
- Revision History permanently moved to the end of the manual.

Revision 08 (07/24/06):

- Section 9: Black Start Replacement Process
  - Updated to include new triggers for Black Start Replacement Process.
  - Updated to reference the recently defined Minimum Critical Black Start Requirement.
- Updated PJM List of Manuals (Exhibit 1).

Revision 07 (06/19/06):

- Section 5: Participation in PJM Markets
  - Change “unit” references to “resource” as they apply to Demand Side Response providing Ancillary Services.
  - Change “Spinning” references to “Synchronized” as they apply to Demand Side Resources providing Ancillary Services.
  - Added Attachment F: Generator Reactive Capability Testing Procedures and re-lettered all following attachments.

Revision 06 (12/15/05):

- Update to Attachment C on New PJM Customer Voice/All Call Communications Request Form to reflect most current version of the form.

Revision 05 (08/10/05):

- Added new Section 9: Black Start Replacement Process.
- Moved old Section 9: Generator Data Confidentiality Procedures to Section 10.

Revision 04 (04/12/05):

- Modified Section 8 to include revised Generation Deactivation process and procedures as approved by FERC on January 25, 2005.

Revision 03 (02/01/05):

- Addition of new Section 9 on PJM Generator Data Confidentiality Procedures
- Update to Attachment D on PJM Generating Unit Reactive Capability Curve Specification and Reporting Procedures to incorporate recent changes to the Reactive Reserve Check (RRC) Reporting process.
- Addition of new Attachment E on PJM Generator Reactive Capability Testing. Current Attachments E and F have been renamed to Attachments F and G respectively.
- Addition of new attachment H including the Generator Data Confidentiality Agreement.
- Addition of new attachment I including the Generator – Data Release Matrix
- Addition of new attachment J including a template letter for a Transmission Owner seeking generator data within its zone to be released by PJM

- Update to Section 7 on Generator Operations to include new seasonal review of PJM generator reactive capabilities and reference to new Attachment E.

Revision 02 (03/10/04):

- Added new Section 8 on Generator Deactivations.

Revision 01 (12/31/03):

- Update format
- Renumber exhibits

Revision 00 (04/04/03):

- This revision is the initial release of the PJM Manual for *Generator Operational Requirements (M-14D)*. This manual is one among the four new manuals obtained from splitting the original PJM Manual for *Generator Interconnections and Operations (M-14)*.
- The summary of revisions for this manual follows:
  - Added new Section 1 on Generator Markets & Operations.
  - Added new Section 2 on Responsibilities of Generation Owners.
  - Added new Section 3 on Control Center Requirements based on excerpts from PJM Manual M-01 on Control Center and Data Exchange Requirements (Section 2 & 3).
  - Added new Section 4 on Data Exchange and Metering Requirements based on excerpts from old PJM Manual M-14 on Generation Interconnections and Operations (Sections 2 & 5).
  - Added new Section 5 on Participation in PJM Markets based on excerpts from old PJM Manual M-14 on Generation Interconnections and Operations (Sections 3 & 4).
  - Added new Section 6 on Pre-Operational Requirements based on excerpts from old PJM Manual M-14 on Generation Interconnections and Operations (Sections 4 & 5).
  - Added new Section 7 on Generator Operations based on excerpts from old PJM Manual M-14 on Generation Interconnections and Operations (Sections 4 & 5), PJM Manual M-3 on Transmission Operations (Section 3), and PJM Manual M-13 on Emergency Operations (Section 5).