



Working to Perfect the Flow of Energy

PJM Manual 40

Certification and Training Requirements

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Prepared by

System Operations Division

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PJM Manual 40

Certification and Training Requirements

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System Operator Training

Current Revision

Revision 10 (6/23/2010):

- Annual review of Manual.
- Added additional detail to section 1.4 Compliance Monitoring of Certification
- Added additional clarity to Section 2.6 – Training Requirements for Demand Response Resources Supplying Regulation or Synchronized Reserve
- Added new Section 2.7 - Training Requirements for Storage Resources Supplying Regulation or Synchronized Reserve
- Miscellaneous clarifying changes to Section 4.

Introduction

Welcome to the ***PJM Manual for Certification and Training Requirements***. In this Introduction, you will find the following information:

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

About PJM Manuals

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

- Transmission
- PJM Energy Market
- Generation and transmission interconnection
- Reserve
- Accounting and Billing
- PJM administrative services

For a complete list of all PJM Manuals, go to www.pjm.com and select *–Manuals–* under the *–Documents–* pull-down menu.

About This Manual

The ***PJM Manual for Certification and Training Requirements*** is one of a series of manuals. This manual focuses training and certification requirements for PJM Members (operators in Local Control Centers and Market Operation Centers) as well as requirements for PJM system operators. The manual also describes the training PJM offers for its members. PJM System Operator training, qualification process and ongoing training are also presented.

The ***PJM Manual for Certification and Training Requirements*** consists of four sections. The sections are listed in the table of contents beginning on page ii.

Intended Audience

The intended audiences for the ***PJM Manual for Certification and Training Requirements*** are:

- Applicants to the Operating Agreement of PJM Interconnection, L.L.C.
- PJM Members

- PJM staff

References

There are some other reference documents that provide both background and detail. The ***PJM Manual for Certification and Training Requirements*** does not replace any of the information in these reference documents. These documents are the primary source for specific requirements and implementation details. The references for the ***PJM Manual for Certification and Training Requirements*** are:

- PJM Manual for Control Center Requirements (M-01)
- PJM Manual for Transmission Operations (M-03)
- PJM Manual for Pre-Scheduling Operations (M-10)
- PJM Manual for Scheduling Operations (M-11)
- PJM Manual for Dispatching Operations (M-12)
- PJM Manual for Emergency Operations (M-13)
- PJM Manual for System Restoration (M-36)
- PJM Manual for Definitions and Acronyms (M-35)

Using This Manual

Because we believe that explaining concepts is just as important as presenting the procedures, we start each section with an overview. Then, we present details and procedures. This philosophy is reflected in the way we organize the material in this manual. The following paragraphs provide an orientation to the manual's structure.

What You Will Find In This Manual

- A table of contents that lists two levels of subheadings within each of the sections
- An approval page that lists the required approvals and a brief outline of the current revision
- Sections containing the specific guidelines, requirements, or procedures including PJM actions and Market Participant actions
- Attachments that include additional supporting documents, forms, or tables in this PJM Manual
- A section at the end detailing all previous revisions of this PJM Manual

Section 1: Certification Requirements

Welcome to the *PJM Systems* section of the ***PJM Manual for Certification and Training Requirements***. In this section you will find the following information:

- Descriptions of the PJM Certification Requirements for system operators.
- Compliance monitoring process for PJM Certification
- NERC Certification requirements for system operators

1.1 PJM System Operator Certification

PJM has instituted a System Operator Certification Program to promote the reliability of the PJM systems. The Certification Program went into effect as of March 1, 2003.

Objectives of PJM System Operator Certification

Ensure PJM, Local Control Center and Market Operation Center operators have a baseline level of knowledge, awareness and familiarity with applicable PJM procedures, tools, tasks, and related power system operation theory in accordance with and in support of applicable NERC and regional standards during normal, emergency and restoration operational conditions.

Supplement NERC Certification requirements by focusing on the details of PJM procedures, tools and tasks required for safe, reliable system operation.

Who and When

All generation and transmission system operators must be PJM certified if they:

- operate on the PJM RTO systems
- communicate directly with any PJM control center and
- perform daily operations-related functions at the direction of the PJM System Operators during normal, emergency and/or system restoration states.

PJM system operators must also be PJM certified per the requirements detailed in Section 4 of this manual.

New System Operators: New system operators (who begin operating on the PJM systems after March 1, 2003) and system operators with companies integrating into PJM will have a maximum of twenty four months to become PJM certified after they begin operating on the PJM RTO systems.

After 7/1/09, new MOC or LCC system operators will have a maximum of 12 months to become certified after they begin operating on the PJM RTO systems. During this 12 month period, if the operator is operating on the system and not PJM-certified, they must work under direct supervision of a PJM Certified operator, either in person or via an on-call arrangement.

After 7/1/2010, new LCC system operators must become PJM Transmission certified prior to independently operating on the PJM system. An uncertified operator may participate in on-

the-job training, as defined in the company's training program, under the direct, in-person supervision of a certified operator.

Certification Examinations

There are two PJM Certification Exams: one for Generation System Operators and the other for Transmission System Operators. Details are as follows:

- System Operators who participate in the real time operations of the PJM system by dispatching generation (PJM capacity resources) and performing other generation-related real time duties of a Market Operation Center (MOC) and PJM Master Coordinator and Generation Dispatchers are required to complete and pass the PJM Generation Examination.
- System Operators who participate in the real time operations of the PJM transmission systems and perform other transmission-related real time duties of a Local Control Center (LCC), and PJM Power Directors and Reliability Engineers are required to complete and pass the PJM Transmission Examination.

Dual Certification

System operators operating on the PJM system who perform both generation and transmission tasks must be PJM certified in both generation and transmission. Since there is no overlap of the Content Outlines, a combination examination is not available. Any individual may apply for, pay the appropriate fees and complete both the PJM Generation and the Transmission Examinations. Passing a PJM certification exam is the **ONLY** way for an individual to achieve initial PJM System Operator Certification.

Term of Certification

A PJM System Operator certificate is valid for five years. After 7/1/09, PJM System Operator certificates are valid for three years.

Recertification

There are two ways a PJM System Operator Certificate can be renewed;

- Before the certificate for a PJM certified system operator expires; apply for, take and pass the same PJM certification exam for which they hold a valid certificate: Generation System Operator or Transmission System Operator.
- To renew a 5 year certificate, on a rolling five year basis complete at least two hundred (200) hours of NERC approved CEH training related to the PJM credential which has been recorded in the PJM Learning Management System (LMS). Those who fail to get credit for 200 continuing training hours per five year period must apply for, take and pass the appropriate PJM exam before their current PJM certificate expires.
- After 7/1/09, to renew a 3 year certificate, on a rolling three year basis complete at least one hundred forty (140) hours of NERC approved CEH training related to the PJM credential which has been recorded in the PJM

Learning Management System (LMS). This 140 CEH must include a minimum of 30 CEH of simulation training. Those who fail to get credit for 140 total continuing training hours per three year period or 30 simulation hours per three year period, must apply for, take and pass the appropriate PJM exam before their current PJM certificate expires. If an operator has more than the required 140 CEH credits at the time of request for renewal, PJM will allow up to 30 CEH credits to be carried over to the next 3 year period. No hours will be carried over in any of the CEH category classifications (i.e., Simulation, Standards, or EOP hours).

- Operators who intend to re-new their PJM certification through CEH training must between 60 days and 30 days before the expiration of the certificate complete an Application to Renew a PJM Certificate by CEH and email the completed form to TrainingSupport@pjm.com. After verification, Trainingsupport@pjm.com will notify the operator of renewal and new expiration date.
- Links to all training forms can be found on the Member Training Liaison webpage (<http://www.pjm.com/training/member-training-liaison.aspx>)
- Operators with PJM LMS accounts will receive a notice of their PJM certificate expiration and can renew by responding to the notice.

Prerequisites

There are no training or work experience requirements that candidates must satisfy before they can apply to sit for a PJM certification exam.

PJM Generation Certification Exemption

Small Generation Plant Operators may request exemption from PJM Generation Certification requirements if their company meets all of the following criteria:

- 1) Operate a total of 75 MW or less of generation (nameplate capacity) within PJM markets.
- 2) Do not actively participate in the Regulation or Synchronized Reserve markets
- 3) Do not operate a Black-start unit
- 4) Do not operate units identified as NERC CIP critical assets
- 5) Do not operate BES facilities using RFC or SERC definitions of BES facilities

Request for exemption should be sent to trainingsupport@pjm.com.

Operators receiving exemption from PJM Generation Certification would still have the following training requirements:

- 1) Initial training to be completed within one year of participating in PJM Real-time operations including:
 - a. GEN-101, GEN-201, OPS-101
 - i. Note: Content may be adjusted based on training needs of individual company

- b. Operators must successfully complete an Operator Readiness Final Exam on the content covered in these training courses.

- 2) Continuing training requirement of 24 CEH hours over a rolling 3-year period.

These companies that are exempt from PJM Certification requirements still must provide PJM with a training liaison in accordance with Appendix 4 of this manual.

Note: Exemption from PJM Certification requirements does NOT exempt that company from any other PJM requirements.

Further Information on PJM System Operator Certification

For further information on PJM System Operator Certification go to:

<http://www.pjm.com/training/certification/sys-op-cert.aspx>

1.2 Temporary Waiver of PJM Training Requirements

Situations lasting 3 months or longer within a calendar year may arise which can prevent a system operator from fulfilling assigned work duties and satisfying the applicable PJM Training Requirements.

In such cases, the Training Liaison must on behalf of the operator submit a letter requesting a temporary Waiver from the PJM Training Requirements with a supporting statement by the entity's Manager of the System Operations or equivalent. The letter must provide a thorough explanation of the circumstances preventing the operator from satisfying the Training Requirements. The letter must be emailed to TrainingSupport@pjm.com

The Training Liaison will receive an acknowledgement that the email has been received within 5 business days and will also receive an email of the final determination of the request for Waiver within 10 business days.

The terms of the waiver, if granted will be suited to the specifics of the case.

The Training Liaison is required to advise TrainingSupport@pjm.com of the date when the operator resumes normal duties and can participate in training.

1.3 NERC Certification Requirements

All PJM system operators, at all operating positions, are required to be NERC certified at the levels outlined in Section 4 of this manual prior to assuming shift responsibilities in accordance with NERC Standard PER-003 Operating Personnel Credentials.

PJM requires any LCC operator who is required to be PJM Transmission certified to also be NERC Certified. These operators are required to obtain the NERC Transmission Operator Certification, Balancing and Interchange/Transmission Operator Certification, or Reliability Coordinator Certification. The NERC Transmission Operator Certification is recommended as it is more applicable to the functions performed by LCC operators. Operators currently certified at the Reliability Coordinator or Balancing and Interchange/Transmission level may maintain their certification at this level or convert their certification to a Transmission Operator certificate. The Balancing Operator certificate will not be acceptable for LCC operators.

All TO operators must be NERC-certified by 12/31/2011. All operators currently NERC-certified are required to maintain their certification in accordance with the NERC System Operator Certification Program requirements.

Any new operator hired after 12/31/2011 must be NERC-certified prior to taking independent shift responsibilities. New operators will be allowed up to one year of operations in a “training mode” without NERC Certification. During this time period, these operators must be working under the direct supervision of a PJM/NERC Certified operator and not taking independent direction from PJM.

If a TO operator allows their NERC or PJM Certification to expire, they must be removed from their operating shift responsibilities until such time that they can accumulate the required CEH credits to renew their NERC/PJM Certification.

Renewal of NERC certification will follow the existing NERC processes. The renewal process will be between NERC and the certified operator through the NERC SOCCED database (<https://socced.nerc.mcgware.com>)

1.4 Compliance Monitoring of Certification

PJM will perform the following checks to verify compliance with the certification requirements for operators requiring NERC, PJM Transmission and/or PJM Generation certification.

Monthly compliance will be measured on the last day of the month. Monthly checks will be made on the following requirements:

- Valid (current) PJM Certification (in the appropriate category) held by all operators with 24 months or greater in position (excluding new companies that have not reached the two year anniversary date of starting operations in PJM).
- After 7/1/09, valid PJM Certification (in the appropriate category) held by all operators with 12 months or greater in position (excluding new companies that have not reached the one year anniversary date of starting operations in PJM).
- After 7/1/10, valid PJM Transmission Certification held by all LCC operators (prior to date operator takes shift)
- After 12/31/2011, valid NERC Certification (Transmission or Reliability) held by all LCC operators (prior to date operator takes shift)

If an exception to any of the above requirements is found:

- The Member “Training Liaison” is contacted to verify and/or resolve the exception.
- If exception is verified but not resolved, the company’s System Operator Subcommittee member, or equivalent, is contacted to try to resolve. A general report on certification compliance will be given at the System Operator Subcommittee meetings.

- Resolution to the exception will include the submission of a mitigation plan outlining how the company will meet the certification requirement. This plan must be submitted within 30 days of notification of the exception and contain the following items:
 - Scope of the exception (name(s) of operators, length of exception)
 - Initial certification exception or renewal exception
 - Date of scheduled exam or scheduled training as required
 - Expected date to fully meet certification requirement
 - Contact information for operations management at company
- PJM will evaluate the details and milestones of the mitigation plan. If approved, these milestones will provide the timing of subsequent compliance checks to verify the details of plan are being carried out. If not approved, PJM will request the required additional information needed to complete the mitigation plan. If the company does not submit a mitigation plan or consistently fails to meet the deadlines outlined in the mitigation plan, the issue will be referred to escalating levels of company and PJM management for resolution.

Section 2: Training Requirements

Welcome to the *Training Requirements* section of the **PJM Manual for Certification and Training Requirements**. In this section you will find the following information:

- Initial training requirements for Market Operations Center operators.
- Continuing training requirements for Market Operations Center operators.
- Compliance monitoring process of training requirements for Market Operations Center operators.
- Initial training requirements for Local Control Center operators.
- Continuing training requirements for Local Control Center operators.
- Compliance monitoring process of training requirements for Local Control Center operators.
- NERC Training Requirements
- Training requirements for Demand Response resources participating in PJM's Synchronized Reserve and Regulation markets

2.1 Overview

In order to promote the reliability of the PJM system, system operators participating in real time operations on the PJM system at the direction of the PJM System Operator must know and understand their assigned roles and responsibilities in the operation of the PJM system and be able to perform their assigned duties using the PJM eTools according to PJM procedures as detailed in the PJM Manuals.

PJM sponsors a variety of training courses for system operators to ensure all system operators have the opportunity to learn the principles and specifics required to operate on the PJM system. In addition, PJM offers an annual continuing education program known as the PJM System Operator Seminar which serves as the forum to keep all system operators up to date on new and revised operating procedures and tools, refreshers on critical topics including emergency and system restoration procedures, awareness of relevant operating events and industry events and trends.

All system operators participating in real time operations on the PJM system must also complete Emergency Operations Preparedness training activities including drills, table-top exercises, simulations, and instruction on identified training topics referenced in Appendix 1. On a rotating basis all system operators should participate in PJM Emergency Procedures and System Restoration Drills which are conducted twice yearly.

Minimum training requirements have been established for Local Control Center (LCC) operators, Market Operations Center (MOC) operators, and PJM system operators, effective January 1, 2006. The requirements address initial training, as well as on-going training. Additional information on the tracking of approved training is found in Appendix 4: Continuing Education Hour (CEH) Tracking Process.

2.1.1 Objectives of PJM System Operator Training Requirements

Ensure PJM, Local Control Center and Market Operation Center operators have a baseline level of knowledge, awareness and familiarity with applicable PJM procedures, tools, tasks, and related power system operation theory in accordance with and in support of applicable NERC and regional standards during normal, emergency and restoration operational conditions.

Ensure PJM, Local Control Center and Market Operation Center operators maintain the required knowledge, skills and abilities to perform their jobs related to PJM procedures, tools and tasks.

Ensure PJM, Local Control Center and Market Operation Center operators are up to date and familiar with changes in PJM and NERC procedures, standards and requirements.

2.2 Training Requirements for MOC Generation System Operators

MOC Generation System Operators are defined as System Operators who participate in the real time operations of the PJM system by dispatching generation (PJM capacity resources) and performing other generation-related real time duties of a Market Operation Center (MOC).

2.2.1 Initial PJM MOC System Operator Training

Minimum required:

- Effective January 1, 2006, new MOC and PJM system operators must successfully complete the following PJM sponsored training within one year of participating in PJM real time operations: Generation 101, 201, 301 and Operations 101 course series, or the Generation track of the PJM Interconnection Training Program (ITP). Completion of a course is measured by receipt of a certificate of completion for the course.
- Effective January 1, 2006, all new MOC and PJM system operators must successfully complete (receive a certificate of completion for) the Generation track of the ITP or equivalent within two years of participating in real-time PJM operations. See Appendix 2 for ITP topics.
- Note: Experienced MOC system operators only need to complete the Generation 101, 201, 301, and Operations 101 courses series within one year of taking shift and participating in PJM operations. An experienced MOC system operator is defined as an individual who has two or more years of prior experience participating in real time operations before assignment of PJM real time duties.

Strongly recommended is successful completion of the ITP Standard or Generation Track within the first year of participating in PJM system operations. Also recommended is completion of the System Dynamics Extended Training Class following completion of the ITP (see Appendix 2 for ITP topics).

2.2.2 MOC System Operator Continuing Training

Effective January 1, 2006:

Beginning the first full calendar year after assuming shift responsibilities in real-time PJM operations, all MOC system operators shall complete at least fifty four hours (~ 18/year) per rolling three-year calendar period of Refresher, Operations and Markets Updates and Emergency Operations Preparedness training by the following or its equivalent:

- Attendance and successful completion of relevant activities of the annual PJM System Operator Seminar (or equivalent).
- Completion of company and PJM sponsored Emergency Preparedness activities including drills, table-top exercises, simulations, and instruction on identified training topics referenced in Appendix 1 and 2. On a rotating basis, all system operators should participate in PJM Emergency Procedures and System Restoration Drills.

As part of the continuing training on Refresher, Updates and Emergency Preparedness training, the following training topics are mandatory and must be completed by all MOC system operators. These topics are typically reviewed at the System Operator Seminar.

- PJM System Operator Communications Protocols and Crew Resource Management
- PJM Markets and Ancillary Services
- PJM Emergency Procedures

2.2.3 Determination of Equivalent Training

PJM recognizes that member companies have rigorous training programs that provide similar training identified in the PJM sponsored training courses. Additionally, there may be third party suppliers of relevant, quality training. These training courses will be considered for equivalency if they meet the criteria of the NERC Continuing Education Program (CEP) and are NERC CEH approved, and contain topics that support the PJM certification credential. Appendix 1 and 2 contain topic lists that can be used as a guide. Additionally Appendix 3 contains a System Operator task checklist that can serve as a reference to draw from when creating training content. Member courses submitted as equivalent to meeting PJM training requirements will be handled as follows:

- PJM Training will accept company training courses as equivalent if they are approved for NERC CEH and identified as acceptable Emergency Operations Preparedness activities. Note: NERC Learning Activities that are ONLY approved for Professional Hours cannot be used in meeting PJM Certification and Training Requirements.

2.2.4 MOC Compliance Monitoring

PJM will perform the following checks to verify compliance with the training requirements for MOC operators requiring generation certification.

Monthly compliance will be measured on the last day of the month. Monthly checks will be made on the following requirements:

- Completion of PJM Gen/Ops Training Series for new operators with 12 months in position.
- Completion of the Generation track of the ITP (or PJM approved equivalent) for new operators with 24 months in position.

Annual compliance will be measured on the last day of the year. Annual checks will be made on the following requirements:

- Completion of at least 54 hours of NERC CEH approved training for the previous 36 months for all operators with at least 36 months in position. Compliance for new operating companies will be measured on the first anniversary dates of the start of company operations in PJM. Checks will be made on the following requirements:
 - First-year anniversary—Completion of the PJM Gen/Ops Training Series by all operators with at least 12 months in position.

If an exception to any of the above requirements is found:

- The Member –Training Liaison” is contacted to verify and/or resolve the exception.
- If exception is verified but not resolved, SOS member is contacted to try to resolve. A general report on certification compliance will be given at the System Operator Subcommittee meetings.
- Resolution to the exception will include the submission of a mitigation plan outlining how the company will meet the training requirements. This plan must be submitted within 30 days of notification of the exception and contain the following items:
 - Scope of the exception (name(s) of operators, length of exception)
 - Initial or continuing training requirement exception
 - Dates of additional training as required
 - Expected date to fully meet training requirements
 - Contact information for operations management at company
- PJM will evaluate the details and milestones of the mitigation plan. If approved, these milestones will provide the timing of subsequent compliance checks to verify the details of plan are being carried out. If not approved, PJM will request the required additional information needed to complete the mitigation plan. If the company does not submit a mitigation plan or consistently fails to meet the deadlines outlined in the mitigation plan, the issue will be referred to escalating levels of company and PJM management for resolution.

2.3 Training Requirements for LCC System Operators

LCC System Operators are defined as System Operators who participate in the real time operations of the PJM system by operating local transmission facilities and performing other transmission-related real time duties of a Local Control Center (LCC).

2.3.1 Initial LCC System Operator Training

Minimum required:

- Effective January 1, 2006, new LCC and PJM system operators must successfully complete the following PJM sponsored training within one year of participating in PJM real time operations: Transmission 101 and Operations 101 course series, or the Standard track of the PJM Interconnection Training Program (ITP). Completion of a course is measured by receipt of a certificate of completion for the course.
- Effective January 1, 2006, all new LCC and PJM system operators must successfully complete (receive a certificate of completion for) the Standard track of the ITP or equivalent within two years of participating in real-time PJM operations. See Appendix 2 for ITP subjects.
- Note: Experienced LCC system operators only need to complete the Transmission 101 and Operations 101 courses series within one year of taking shift and participating in PJM operations. An experienced LCC system operator is defined as an individual who has two or more years of prior experience participating in real-time operations before assignment of PJM real time duties.

Strongly recommended is successful completion of the ITP Standard Track (all modules) within the first year of participating in PJM system operations. Also strongly recommended is completion of the System Dynamics Extended Training Class following completion of the ITP (see Appendix 2 for ITP topics).

Control Room Visits: Strongly recommended is within the first year LCC operators should visit the PJM control room, and PJM system operators should visit one or more LCC control rooms.

2.3.2 Annual LCC System Operator Continuing Training

Effective January 1, 2006

Beginning the first full calendar year after assuming shift responsibilities in real time PJM operations, all LCC and PJM system operators shall complete at least thirty two hours per year of Emergency Preparedness training by the following or its equivalent:

- Attendance at the annual PJM System Operator Seminar (or equivalent) complete yearly company and PJM-sponsored Emergency Preparedness activities including drills, table-top exercises, simulations, and instruction on identified training topics referenced in Appendix 1 and 2. On a rotating basis, all system operators should participate in PJM Emergency Procedures and System Restoration Drills. As part of the thirty-two hours on Emergency

Preparedness training, the following training topics are mandatory and must be completed by all LCC and PJM system operators. These topics are typically reviewed at the System Operator Seminar.

- PJM System Operator Communications Protocols
- Crew Resource Management Concepts
- PJM Transmission Operations Criteria
- PJM Emergency Procedures
- PJM System Restoration
- Individual Company System Restoration Plans

2.3.3 Determination of Equivalent Training

PJM recognizes that member companies have rigorous training programs that provide similar training identified in the PJM sponsored training courses. Additionally, there may be third party suppliers of relevant, quality training. These training courses will be considered for equivalency if they meet the criteria of the NERC Continuing Education Program (CEP) and are NERC CEH approved, and contain topics that support the PJM certification credential. Appendix 1 and 2 contain topic lists that can be used as a guide. Additionally Appendix 3 contains a System Operator task checklist that can serve as a reference to draw from when creating training content. Member courses submitted as equivalent to meeting PJM training requirements will be handled as follows:

- PJM Training will accept company training courses as equivalent if they are approved for NERC Continuing Education Hours (CEH) and identified as acceptable Emergency Operations Preparedness activities. Note: NERC Learning Activities that are ONLY approved for Professional Hours cannot be used to meet PJM Certification and Training Requirements.

2.3.4 LCC Compliance Monitoring

PJM will perform the following checks to verify compliance with the training requirements for LCC operators requiring transmission certification.

Monthly compliance will be measured on the last day of the month. Monthly checks will be made on the following requirements:

- Completion of PJM Transmission/Ops Training Series for new operators with 12 months in position.
- Completion on the Standard track of the ITP (or PJM approved equivalent) for new operators with 24 months in position.

Annual compliance will be measured on the last day of the year. Annual checks will be made on the following requirements:

- Completion of at least 32 hours of NERC approved training for the previous 12 months for all operators with at least 12 months in position.

Compliance for new operating companies will be measured on the first anniversary dates of the start of company operations in PJM. Checks will be made on the following requirements:

- First-year anniversary—Completion of the PJM Trans/Ops Training Series by all operators with at least 12 months in position.

If an exception to any of the above requirements is found:

- The Member –Training Liaison” is contacted to verify and/or resolve the exception.
- If exception is verified but not resolved, SOS member is contacted to try to resolve. A general report on certification compliance will be given at the System Operator Subcommittee meetings.
- Resolution to the exception will include the submission of a mitigation plan outlining how the company will meet the training requirements. This plan must be submitted within 30 days of notification of the exception and contain the following items:
 - Scope of the exception (name(s) of operators, length of exception)
 - Initial or continuing training requirement exception
 - Dates of additional training as required
 - Expected date to fully meet training requirements
 - Contact information for operations management at company
- PJM will evaluate the details and milestones of the mitigation plan if approved, these milestones will provide the timing of subsequent compliance checks to verify the details of plan are being carried out. If not approved, PJM will request the required additional information needed to complete the mitigation plan. If the company does not submit a mitigation plan or consistently fails to meet the deadlines outlined in the mitigation plan, the issue will be referred to escalating levels of company and PJM management for resolution.

2.4 Temporary Waiver of PJM Training Requirements

Situations lasting 3 months or longer within a calendar year may arise which can prevent a system operator from fulfilling assigned work duties and satisfying the applicable PJM Training Requirements.

In such cases, the Training Liaison must on behalf of the operator submit a letter requesting a temporary Waiver from the PJM Training Requirements with a supporting statement by the entity’s Manager of the System Operations or equivalent. The letter must provide a thorough explanation of the circumstances preventing the operator from satisfying the Training Requirements. The letter must be emailed to TrainingSupport@pjm.com

The Training Liaison will receive an acknowledgement that the email has been received within 5 business days and will also receive an email of the final determination of the request for Waiver within 10 business days.

The terms of the waiver, if granted will be suited to the specifics of the case.

The Training Liaison is required to advise TrainingSupport@pjm.com of the date when the operator resumes normal duties and can participate in training.

2.5 NERC Training Requirements

The PJM Training Requirements described above do NOT replace or supplant any NERC Training Requirements defined in NERC Standards PER-002 Operating Personnel Training or any other applicable NERC Standard.

The PJM Training Requirements are in addition to these applicable NERC standards on training and operator qualification.

PJM and Local Control Center operators are subject to the requirement for 32 hours of Emergency Operations training per year. This requirement is met or exceeded by the PJM Training Requirements discussed above. PJM monitors compliance of this requirement through the monitoring of compliance to the PJM Training Requirements.

NERC Standard PER-002 currently does not apply to Generation Operators. However, Generation Operators at Market Operations Centers in PJM still must meet the PJM Training Requirements as described above.

2.6 Training Requirements for Demand Response Resources Supplying Regulation or Synchronized Reserve

Demand Response Resources wishing to participate in PJM's Regulation or Synchronized Reserve Market must meet initial and continuing training requirements. These training requirements are as follows:

- Each Curtailment Service Provider (CSP) shall identify an individual who will serve as a Training Liaison and provide information to PJM regarding individuals who serve as agents of the CSP by contacting Demand Response (DR) customers to curtail load when advised by PJM. This process is detailed in Attachment D of this manual.
- Initial Training Requirements:
 - Each individual who serves as an agent of each CSP communicating with Demand Response (DR) customers must complete the initial training available on-line on the requirements and business rules of the Regulation and Synchronized Reserve Markets and the PJM All-Call responses within six months of being assigned these duties.
 - Upon verification of completion of this training by at least one representative at the company and that other applicable requirements are met, PJM will enable the ability of those companies to submit offer data into the Regulation and Synchronized Reserve Markets.

- Due to the limited interaction with PJM and limited impact on system reliability, PJM Certification is not required of Demand Response Resources.
- Annual Training Requirements
 - Each individual who serves as an agent of each Curtailment Service Provider (CSP) communicating with Demand Response (DR) customers must annually complete a brief refresher training available online on the requirements and business rules of the Regulation and Synchronized Reserve Markets and the PJM All-Call responses.
 - Monthly Compliance Checks will be performed to verify that operators have completed the initial and annual training requirements.

2.7 Training Requirements for Energy Storage Devices Supplying Regulation or Synchronized Reserve

Energy Storage Devices wishing to participate in PJM's Regulation or Synchronized Reserve Market must meet initial and continuing training requirements. For the purpose of these requirements, Energy Storage Devices (ESD) are equipment that are not PJM capacity resources but may participate in the PJM Synchronized Reserve or Regulation markets. These devices may include, but are not limited to: Batteries, Plug-in Hybrid Electric Vehicles (PHEV), Flywheels and Compressed Air. These training requirements are as follows:

- Each Energy Storage Device (ESD) owner shall identify an individual who will serve as a Training Liaison and provide information to PJM regarding individuals who serve as ESD operators who will interact with PJM Dispatch on Synchronized Reserve and Regulation assignments. This process is detailed in Attachment D of this manual.
- Initial Training Requirements:
 - Each individual who serves as an ESD operator must complete the initial training available on-line on the requirements and business rules of the Regulation and Synchronized Reserve Markets and the PJM All-Call responses within six months of being assigned these duties.
 - Upon verification of completion of this training by at least one representative at the company and that other applicable requirements are met, PJM will enable the ability of those companies to submit offer data into the Regulation and Synchronized Reserve Markets.
 - Due to the limited interaction with PJM and limited impact on system reliability, PJM Certification is not required of Energy Storage Devices that only participate in Ancillary Service Markets.
- Annual Training Requirements
 - Each individual who serves as an ESD operator must annually complete a brief refresher training available online on the requirements and

business rules of the Regulation and Synchronized Reserve Markets and the PJM All-Call responses.

- Monthly Compliance Checks will be performed to verify that operators have completed the initial and annual training requirements.

Section 3: PJM Sponsored Training for Members

Welcome to the *PJM Sponsored Training for Members* section of the PJM Manual for **Certification and Training Requirements**. In this section you will find the following information:

- Overview of PJM sponsored training
- Emergency Preparedness Drill and Activities
- PJM System Operator Seminar
- Interconnection Training Program
- System Dynamics
- System Restoration Workshop
- Other PJM Training Curriculum
- Online Training

3.1 Introduction

3.1.1 Training

Training of system operators and other operating personnel is essential to promoting reliable operation of the system. Formal PJM sponsored training programs for system operators and others are available on a regularly scheduled basis. Standard PJM system operator training courses include: Interconnection Training Program (ITP - basic concepts and PJM operating procedures, 4 weeks), Gen/Ops Training Series (4 days), Trans/Ops Training Series (3 days), System Restoration Workshop (2 days), System Dynamics (5days) and the annual PJM System Operator Seminar (Seminar – updates and refreshers on PJM procedures, 4 days, done 9 times or more yearly).

Key topics in PJM System Operator Training include: normal and emergency operating procedures, data reporting requirements, and other specific procedures for generation and transmission system operators. Other PJM courses for operating personnel are delivered on an “as needed” basis. Operations-related PJM sponsored training targeted to System Operators have been approved through the NERC Continuing Education Program. To verify if specific PJM courses are NERC CEH approved along with the credit hours and credit types they have been approved for, please reference the PJM website. Other PJM sponsored courses not approved through this process cannot be used to meet PJM Certification and Training Requirements.

PJM Training is free for employees and authorized representatives of PJM members, and for those from entities pursuing PJM membership. All others will be invoiced per the non-member fee noted on the respective Course page which is posted on the PJM website. Customized training is available for a fee and is subject to availability.

3.1.2 Emergency Preparedness Drill and Exercises

To be effective, drills must be organized and documented. The following are the required elements of an emergency preparedness drill or exercise upon which a PJM template and process will be developed:

- Purpose and objectives to be achieved are stated.
- Plan of action or a scenario which includes stated triggers to initiate and terminate the drill or activity.
- Measures of required performance are identified.
- A description of how the progress of the drill will be monitored.
- A description of the evaluation process that will be used to assess the achievement of drill objectives, identify problems, and develop corrective actions.
- Assignment of specific roles, and objectives to be achieved by the system operators participating in an emergency preparedness drill or exercises including their role in the evaluation process.
- Recording and documenting emergency preparedness activities and operator participation in each such activity and reporting same to PJM.
- (For information on process, see Appendix 4, Attachment B.)

The objective of the PJM Emergency Preparedness drills and exercises is to reinforce the knowledge and skills of system operators and their proficiency to detect and effectively respond to emergency conditions and events and maintain or restore the electric power system to steady state reliability.

PJM offers 4 Emergency Preparedness drill opportunities each year for its members and PJM's own operators. These drills include:

- Summer Emergency Procedure Drill – This drill simulates a capacity shortage emergency and is designed to prepare the operators for the summer operating season. The activity includes pre-drill instruction, completion of the drill itself and a post-drill debrief. The drill allows operators to practice all steps of PJM's Capacity Shortage procedures. This drill is performed in support of NERC Standards EOP-001 Emergency Operations Planning, EOP-002 Capacity and Energy Emergencies and EOP-003 Load Shedding Plans.
- Spring System Restoration Drill – This drill is conducted for the entire PJM RTO and includes PJM, LCC and MOC operators and support staff. The drill simulates a complete blackout in PJM and drills system restoration procedures. Some companies use Operator Training Simulators to complete this drill while others use it as a table-top exercise. The drill may last one or two days depending on the drill scenario. It allows companies to practice their individual restoration plans as well as coordination with neighboring companies, PJM and surrounding areas. The drill is performed in support of NERC Standards EOP-005 System Restoration Plans, EOP-006 Reliability

Coordination-System Restoration and EOP-007 Establish, Maintain and Document a Regional Blackstart Capability Plan

- Winter Emergency Procedure Drill – This drill simulates a capacity shortage emergency and is designed to prepare the operators for the winter operating season. The activity includes pre-drill instruction, completion of the drill itself and a post-drill debrief. The drill allows operators to practice all steps of PJM's Capacity Shortage procedures. This drill is performed in support of NERC Standards EOP-001 Emergency Operations Planning, EOP-002 Capacity and Energy Emergencies and EOP-003 Load Shedding Plans.
- Fall System Restoration Drills – This activity consists of a series of restoration drills focusing on particular areas of the PJM system. The affected LCC and MOC operators are brought into PJM's Operator Training Simulator to perform the drill. PJM and member operators coordinate closely in these drills. The drills allow for more focused restoration on a subset of the entire PJM system and for more realism by utilizing the PJM OTS. These annual drills focus on individual LCC restoration plans to ensure LCC and PJM operators are familiar with these plans. The drills are performed in support of NERC Standards EOP-005 System Restoration Plans, EOP-006 Reliability Coordination-System Restoration and EOP-007 Establish, Maintain and Document a Regional Blackstart Capability Plan.

3.1.3 PJM System Operator Seminar

The PJM System Operator Seminar is an annual continuing education program which is developed with input from the SOS, DTF, PJM operations and markets groups, and system operators.

The schedule for each year's Seminar program includes a set of standard reliability and markets topics, presentations on topics such as PJM and NERC system operator certification and training, and projections for future PJM markets and services. The time devoted to a particular standard Seminar topic will vary according to the identified priorities of a particular year. Standard Seminar activities that come under Emergency Preparedness Training includes the following subjects: State of PJM and Updates on Markets, Updates on PJM Operating Procedures and Tools, Refresh and exercises on PJM Emergency and System Restoration Procedures, "Lessons Learned" from Operating Events, Communications and Crew Resource Management, and Refreshers on Technical Topics.

Objectives of PJM System Operator Seminar

- Ensure operators who operate on the PJM system are familiar with current procedures, tools, operating philosophies, markets and expectations as they relate to NERC standards, normal, emergency and restoration operations.
- Refresh operators on the knowledge and skills to perform tasks related to emergency and restoration conditions.
- Provide a forum for operators to interact with their peers and enhance relationship building and operator-to-operator communications.

3.1.4 Interconnection Training Program (ITP)

This comprehensive and intensive 4-week instructor-led training program is designed for those new to system operations. Attendees must complete a self-study module on basic electricity fundamentals or equivalent prior to classroom work. The ITP is offered as a standard track (4 weeks) and a generation track (limited to the core topics required by generation operators). The ITP is typically offered twice a year by the PJM State and Member Training staff. It is typically delivered at a location near PJM's offices.

Organized in modules, ITP training is based on North American Electric Reliability Corporation (NERC) and PJM operating policies. Topics covered include AC electrical principles, electric production, transmission, interconnected operations, emergency procedures and PJM markets. See Appendix 2 for a more detailed topic list.

Objectives of the ITP

- Provide students the baseline required knowledge to perform their operations related functions in accordance with NERC standards and PJM procedures in normal, emergency and restoration conditions.

3.1.5 System Dynamics

This one-week, advanced-level course is designed to enhance the system operator's knowledge of power system dynamics. The course is designed to increase the system operator's awareness of the effects of disturbances on the interconnected power grid.

This course is targeted to experienced system operators in generation and transmission who have completed the Interconnection Training Program or equivalent. The course is also of value to operations personnel who require a detailed level of knowledge in operations-related topics. Details of the topics can be found in Appendix 2.

Objectives of System Dynamics

- Provide students with more advanced level information on power system dynamics, voltage stability, frequency fluctuations, system stability and other dynamic phenomena of power system operation in normal and emergency states.

3.1.6 Other PJM Training Curriculum

PJM makes a wide variety of additional training available to its members and own operators on a periodic basis. Please check the PJM website for the schedule and to verify which courses are approved NERC Learning Activities. The courses are as follows:

- PJM-101 – A one-day basic overview of PJM and the functions that PJM performs.
- LMP-101 – A more detailed look at Locational Marginal Price, its inputs and related concepts.

- Generation-101 – This one-day course is the first in a series of three courses designed to provide a basic level knowledge of topics critical to generation dispatch in PJM
- Generation-201 – This one-day course is the second in a series of three courses designed to provide the participant with knowledge of generation outages and generation scheduling.
- Generation-301 – This one-day course is the third in a series of three courses designed to provide the participant with knowledge of PJM's Ancillary Service Markets, reserves, and market monitoring.
- Market Settlements-301 – This advanced-level course is designed to provide details on the market settlement process and components of a typical PJM invoice.
- Operations-101 – This one-day course is designed to provide the student with an overview of PJM emergency procedures and their application, and PJM Communications protocols.
- Review of Power System Fundamentals - This four-day course presents an overview of basic electrical principles as they relate to bulk power operations.
- System Planning-201 – This course will provide a review of PJM's Regional Transmission Expansion Planning (RTEP) process. This course is designed to educate participants on the evolving economic nature of the planning process including information on the 15-year planning horizon
- System Restoration Workshop – This two-day course provides instruction on the theory of system restoration and related topics including load restoration, transmission restoration, reserves and black-start generation. A restoration simulation is also incorporated into this training.
- Transmission-101 – This two-day course is designed to provide the student with an understanding of PJM's transmission operating criteria, outage procedures and voltage control.
- Transactions-201 – This two-day course provides students with an understanding on the core topics related to conducting bilateral or spot market transactions and interchange in the PJM markets.

In addition to these regularly scheduled training courses, other training is provided on new markets, tools or other topics on an as-needed basis. See <http://www.pjm.com/training/course-catalog.aspx> for a detailed listing. Registration information for scheduled upcoming training events can be found at <http://www.pjm.com/training/training-events.aspx>.

3.1.7 Online Training

PJM has an extensive array of online training available publicly, free-of-charge on its website. See <http://www.pjm.com/training/course-catalog/online-courses.aspx> for details.



System operators can earn NERC CEH credit by successfully completing online training and associated quizzes that are offered through the PJM Learning Management System (LMS). See Appendix 4 for LMS details and related forms to provide needed documentation for the LMS and its use for the tracking of operator training completion.

Section 4: PJM Operator Training

Welcome to the *PJM Operator Training* section of the ***PJM Manual for Certification and Training Requirements***. In this section you will find the following information:

- Systematic Approach to Training
- PJM Master Coordinator training and qualification requirements
- PJM Generation Dispatcher training and qualification requirements
- PJM Power Director training and qualification requirements
- PJM Reliability Engineer training and qualification requirements
- PJM Shift Supervisor training and qualification requirements
- Description and objectives of continuing training program for PJM system operators
- Process for ensuring proficiency following extended absence

4.1 Overview

To ensure continued reliable and economic operations, PJM is committed to providing their operators high quality training. PJM has well defined training programs for initial qualification training for their system operators as well as continuing training. PJM system operators have a training week built into their shift schedule allowing for 8 weeks of dedicated training time per year.

While the general requirements for each operating position are presented below, the specific training plan is customized for each operator based on that operator's needs, experience, abilities and background. PJM may supplement its training program with additional training provided by universities, vendors or internal staff as required.

4.2 Systematic Approach to Training

PJM Trainers have been trained in utilization of the Systematic Approach to Training (SAT). The SAT approach is used for initial and continuing training of the PJM operators. Described below is the process that is followed for each phase of the –ADDIE process” which is utilized in training development.

Note 1: PJM's SAT approach is based on the Department of Energy's –Training Program Handbook: A Systematic Approach to Training” (DOE-HDBK-1078-94).

Note 2: Definition of the ADDIE Process – Systematic Approach to Training including five distinct, yet interrelated phases as follows:

Analysis – This phase identifies the training requirements and may include a needs analysis, job analysis and task analysis.

Design – The design phase uses the information collected during the analysis phase to provide a –blueprint” for developing training programs and includes development of training objectives.

Development – This phase incorporates the results of the design activities. The output of this phase is the training material.

Implementation – Implementation involves taking the results of the development phase into the training setting and conducting the training.

Evaluation – This phase involves periodic review of training material and a method for collecting feedback from trainees and supervisors on the effectiveness of the training.

4.2.1 Analysis Phase

PJM has performed a comprehensive Job and Task analysis for each operating position within the PJM control room. This analysis includes the following components for each identified task: Conditions of the task, Duration of the task, Frequency task is performed, Criticality of the task, Standards for Completion of the task, Detailed steps of the task, Skills/Knowledge required to perform the task and the Tools used to complete the task. This Job and Task analysis was used to identify all reliability-related tasks in compliance with NERC Standard PER-005, Requirement 1.1.

This Job and Task analysis is updated at least annually or more frequently as required based on changes to operator tasks in accordance with NERC Standard PER-005, Requirement 1.1.1.

In addition, PJM employs the use of a standardized ADDIE template for training analysis (Training needs analysis and task analysis) when developing training for continuing education or just in time training (PJM DOC 509111).

4.2.2 Design Phase

Section 4 of this Manual M-40 describes the training plan for PJM operator initial and continuing training that resulted from this design phase. This plan is reviewed and updated on at least an annual basis based on feedback from operators and operations management.

PJM identifies a yearly training plan for operator continuing training based on NERC required training, training needs identified by operations management, refresher training and training on new tools, processes and procedures.

This yearly plan is further refined and detailed prior to each of the 8 continuing education training cycles to identify any required changes or updates to the planned cycle training.

Objectives are defined for the training plan and the individual training topics.

4.2.3 Development Phase

The output of this phase is the actual training material. For PJM operator training, this includes the following:

Initial Training:

- OJT Training Materials and documentation
- Online training presentations
- Position Qualification checklists
- OTS Practice session documentation
- Written/OTS Qualification test documentation

Continuing Training:

- Online training presentations
- Classroom training material
- OTS scenario documentation
- Training quizzes
- Student evaluations

4.2.4 Implementation Phase

PJM makes use of a Learning Management System to maintain all records of training completion by operators. In addition to the training records maintained in the LMS, PJM maintains completed OJT training material, completed OTS practice session sheets and completed Qualification checklists. All of these are evidence of completion of the Implementation Phase of the ADDIE process.

4.2.5 Evaluation Phase

PJM utilizes several methods to obtain feedback on training programs to continuously improve the effectiveness of these programs.

These evaluation methods include:

- Trainee performance on quizzes
- Trainee critiques of training
- Instructor observations and critiques

This feedback is analyzed and summarized. A training summary report is prepared at the conclusion of each continuing training cycle and provided to operations management.

4.3 Master Coordinator Initial Training and Qualification Requirements

A candidate for the position of Master Coordinator at PJM will receive 12 weeks of training to complete position related training.

In addition to the Master Coordinator qualification testing, a trainee will be given up to an additional 12 weeks of preparation time to pass the NERC Reliability Coordinator certification test. NERC Certification must be obtained within 24 weeks of hire in order to meet the requirements of the Master Coordinator position and work the position without direct supervision. If a trainee already is NERC certified at the Balancing and Interchange level, this certification will meet the NERC certification requirements of Master Coordinator. Note that Reliability Coordinator NERC Certification would be required prior to becoming a Power Director.

PJM Generation Certification is required within 1 year of hire date or prior to beginning training for a Generation Dispatcher (whichever is sooner). PJM Training requirements for Generation operators as outlined in Section 2 must also be satisfied.

Training for the Master Coordinator position is accomplished through on-line training modules, one-on-one training with PJM instructors, self-study and on-the-job training (OJT). During the training period, the Trainee is assigned to an on-shift OJT Instructor who will work with the Trainee and guide them in acquiring the knowledge and skills required for the position. The Master Coordinator, to whom the Trainee is assigned, shall complete an Observation Assessment Record (OAR) and submit a weekly progress report on the Trainee for the respective week, including identifying areas of weakness, which the Trainer will review with the Trainee and arrange for remediation as appropriate.

The Candidate will receive a Master Coordinator Training Manual, with reference material that the Trainee will be required to review. Included in the Manual will be a Shift Check list, to inform the Trainee of the various tasks that he will be required to perform on each of the three shifts he will be working. There is also a sign-off sheet in the Training Manual, listing the tasks that the Trainee must learn how to perform and understand when and why it is required. The on-shift Master Coordinator to which the Trainee is assigned assesses the Trainee's mastery of the tasks and when acceptable signs the check sheet for the task(s).

Midway through the training period, the trainee will be required to take a quiz, to assess the Trainee's progress. By this time, the Trainee should:

- Know the different operating levels of a generator
- Understand PJM reserves
- Be familiar with Emergency Procedures and his role.
- Understand the scheduling process

The Trainer will review the Trainee's quiz performance and recommend any remediation which may be indicated.

Upon completion of training, the Trainee will be required to take a 50 question test, minimum passing score of 80% (85% if retest), to verify knowledge on:

- Load Forecasting
- Reserves
- Regulation
- Data inputs and tools
- Understand why there are different Load Curve shapes
- Understand cost vs. price
- Understand no load and operating rate for generators
- Economic Dispatch
- Cost capping
- Understand the various on/off reasons in Dispatch Management Tool

After successfully completing the written test the Trainee will be required to perform a skill test, demonstrating his ability to perform all the duties of the Master Coordinator.

Completion of PJM Classroom Courses

Per the PJM Training requirements described above, the Master Coordinators will be required to complete the GEN/OPS classes within 1 year of assuming shift duties. They will also be required to complete the ITP within 2 years of assuming shift duties. Additional time will be added to the candidates training schedule to complete these courses within the training time if scheduling allows.

Training Objectives for the Master Coordinator Position

1. Become familiar with the purpose, organization and functions of the PJM RTO.
2. Learn and demonstrate mastery of the knowledge and skills required of a PJM Master Coordinator.
3. Learn and demonstrate mastery of the job task routines performed by the Master Coordinator for all three shifts: day, evening and night, and in all three operating states: normal, emergency and restoration.
4. Become familiar with the function of the Dispatch Department in scheduling and real-time operation of the PJM RTO system, and functions performed by the Master Coordinator.
5. Become familiar with the member companies participating in real time operations, the characteristics of their system and generating facilities.
6. Become familiar with the duties and responsibilities of the other PJM Dispatch positions and related PJM operations support staff.
7. Develop a mastery of all applicable NERC and Regional Reliability Standards.
8. Become familiar with all applicable regulatory requirements.

9. Develop a mastery of applicable PJM operating procedures as defined in the PJM Manuals and Operating Memos.

Knowledge and Skills required for the Master Coordinator Position

- Basic understanding of PJM Energy and Ancillary Service Markets
- Understanding of concepts of Unit Commitment and Economic Dispatch
- Understanding of applicable NERC and Regional Reliability Organization (RRO) Standards
- Understanding of applicable regulatory requirements
- Ability to utilize various PJM tools in support of required tasks including Enhanced Energy Scheduler (EES), Dispatcher Management Tool (DMT), eDART, eDATA, SmartLog, Resource Scheduling and Commitment (RSC), Security Constrained Economic Dispatch (SCED), Interchange Distribution Calculator (IDC) and OATI tagging system.
- Understanding of generation scheduling procedures
- Understanding of generation outage scheduling rules, systems and procedures.
- Ability to recognize impacts to load forecasting
- Ability to perform load forecasting within required error bandwidths
- Understanding of Automatic Generation Control concepts
- Understanding of PJM, RFC, SERC and NERC Reserve requirements
- Ability to schedule generation to meet next day's load forecast, net interchange and reserve requirements
- Knowledge of PJM Emergency Procedures and associated reporting

Non-technical Competencies required for the Master Coordinator Position

- Initiative
- Productivity
- Time Management
- Communication Skills
- Customer Focus
- Problem Solving
- Teamwork
- Decision Making
- Adaptability/Dependability

4.4 Generation Dispatcher Initial Training and Qualification Requirements

Readiness for Generation Dispatcher Training

Although some operators are hired directly as Generation Dispatcher, the majority of operators is hired as Master Coordinators and will progress up to Generation Dispatcher.

To begin training for the position of Generation Dispatcher within PJM dispatch, the candidate must have earned both NERC Certification (RC or BI) and PJM Certification (Generation), and have successfully passed a Master Coordinator to Generation Dispatcher pre-test with a minimum score of 80%. The purpose of the pre-test is to determine if the candidate has gained the minimum knowledge required to begin training for the Generation Dispatcher Position. Failure to pass pre-test will require a two week period before candidate can re-test.

Skills and knowledge required to pass the pre-test include:

- Area Control Error (ACE) components
- NERC Resource and Demand Balancing Standards
- Generation impact on PJM Reactive Transfer Limits
- NERC, RFC, SERC and PJM Reserve requirements
- Emergency Procedures
- NERC Interchange Scheduling and Coordination Standards
- UDS, DMT, EES, and Spin/Reg applications
- Communication Protocols
- PI and VGR Displays
- PJM Manuals

Generation Dispatcher Training

Upon successful completion of the pre-test, the candidate then will receive a Generation Dispatcher Training Manual, with reference material that the candidate must review and understand.

Training is for a period of 12 weeks and consists of on-line training, self-study, one-on-one training, OTS simulations, video training review and on-the-job training (OJT) as outlined in the Generation Dispatcher Initial Training Manual. The first and second week will include review of both PJM on line training along with relevant system operations video material. During the training period, the Trainee is assigned to an on-shift OJT Instructor who will work with the Trainee and guide them in acquiring the knowledge and skills required for the position. The GD, to whom the Trainee is assigned, shall complete an Observation Assessment Record (OAR) and review any deficiencies with the trainee. Each week will be broken down by a position sign off of tasks and functions that should be reviewed and understood by that week to be signed by system operator giving the on-the-job training. Included in the training manual is a Generation Training Sign-Off which is an additional sign-

off form to include meeting with a subject matter expert on various applications, review of operational topics with a Supervising Dispatcher, and review with a member of the System Operator Training Department. These sign offs will also be time dependent to be completed by a designated date in the training cycle.

Completion of PJM Classroom Courses

If not completed during their time as Master Coordinator, the GEN/OPS classes should be completed prior to assuming shift as a Generation Dispatcher if possible and are required to be completed within one year of assuming shift duties.

If not completed during their time as Master Coordinator, the ITP classes must be completed within 2 years of initially taking shift as either Master Coordinator or Generation Dispatcher (if hired into PJM as a Generation Dispatcher)

Job Qualification

By week twelve of training, and after having attained all Generation sign-offs on materials review and subject matter expert tutorials on application tools, trainee will complete a 50 question written test, minimum passing score of 80% (85% if retest). Note that written test will not be given until all sign-offs are completed.

Upon successfully completing the written test, the trainee will be given at least 2 sessions of simulator practice in preparation for the Simulator test. Additional simulator practice time will be made available if requested by the trainee, based on instructor availability.

The final phase of the Generation Dispatcher training will be a 5 hour simulation, testing the Trainee on the knowledge, understanding and ability to perform the tasks of the Generation Dispatcher during normal and emergency conditions. The minimum passing score for the simulator test is 80% (85% retest). The score will be the average score of at least four evaluators including at least two Shift Supervisors, and at least two simulator operators/system operations trainers. System Operator Training Dept. maintains a list of qualified OTS test evaluators for each operating position.

Retest Written and Simulator Procedure:

If the initial written test score is less than 80% a second test will be given after one week of reviewing problem areas from first test. The second test will be different from the first and also consist of 50 questions with a required score of 85% to pass.

If the initial simulator test score is less than 80% a second simulator test will be given after two weeks of reviewing problem areas from the first test. The trainee will be given coaching on the areas needed for improvement and additional training focusing on these areas. The second simulation will be the same time length (5 hours) as first simulation but with different events. The second test will require a score of 85% to pass and will be scored by the same evaluators from original test, if possible.

If an individual is not successful after two test administrations, they will not be eligible to take any exam for a period of six months. Upon failing the qualifying test a second time the individual will be returned to their previous job classification or to a position that management selects for a minimum of six months until they are eligible for re-testing. During this period of ineligibility the individual will be responsible to complete all requirements prior to any administration of the qualifying test. In conjunction with the six month period of

ineligibility, the individual must have satisfactory performance evaluations to be eligible for retesting.

Training Objectives for the Generation Dispatcher Position:

1. Learn and demonstrate mastery of the knowledge and skills required of a PJM Generation Dispatcher.
2. Learn and demonstrate mastery of the job task routines performed by the Generation Dispatcher in all three operating states: normal, emergency and restoration.
3. Develop a mastery of all applicable NERC and Regional Reliability Standards and their application to the Generation Dispatcher position.
4. Understanding and demonstrate the ability to balance generation with demand factoring in all variables including load, interchange, frequency, generation movements, weather and emergency conditions.
5. Become familiar with all applicable regulatory requirements.
6. Develop a mastery of applicable PJM operating procedures as defined in the PJM Manuals and Operating Memos.

Skills and knowledge for the Generation Dispatcher position include:

- Understanding of applicable NERC and Regional Reliability Organization (RRO) Standards
- Understanding of applicable regulatory requirements
- NERC, RFC, SERC and PJM Reserve requirements
- Generation Control
- Time Error
- Emergency Procedures
- Security Constrained Economic Dispatch (SCED) operation
- Combustion Turbine Parameters
- Dispatch Management Tool Operation (including logging)
- Energy Management System (EMS)
- EMS Alarm Recognition
- Various methods of Generation Control
- System Reserves and Instantaneous Reserve Check
- Economic Dispatch/ Economic Decisions
- ACE and Frequency deviations (what they indicate)
- PJM Manuals

- Business rules for Generation
- Understand impact of generation on Reactive Transfer limits
- Shared Reserves activation

Non-technical Competencies required for the Generation Dispatcher Position

- Initiative
- Productivity
- Time Management
- Communication Skills
- Coaching Skills
- Results Driven
- Strategy Development
- Dealing with and managing change
- Customer Focus
- Problem Solving
- Teamwork
- Decision Making
- Adaptability/Dependability

4.5 Power Director Initial Training and Qualification Requirements

Readiness for Power Director Training

Most Power Directors progress to this position from the Generation Dispatcher position.

Candidates hired directly into the Power Director position must obtain their NERC Certification (RC) prior to assuming shift duties. They also must obtain PJM Certification (Generation and Transmission) prior to assuming shift duties.

To begin training from the position of Generation Dispatcher to the Power Director at PJM, the candidate must be both NERC (RC) and PJM (Generation and Transmission) certified. The candidate will also be required to have successfully passed the Power Director pre-test. The purpose of the pre-test is to determine if the candidate has gained the minimum knowledge required to begin training for the Power Director Position.

Skills and knowledge required to pass the pre-test include:

- Mastery of all applicable NERC and Regional Reliability Standards relating to operations including Reliability Coordination
- PJM Emergency Procedures
- Voltage control concepts and procedures

- Reactive Transfer Limits
- Interchange impacts on transmission control
- Contingency control and operating criteria
- Communication protocols
- Voltage drop analysis and prevention
- Interpreting EMS and trend data
- SCED (transmission constraint control)
- EMS One Lines
- EMS Alarm Classifications

Power Director Training

The candidate then will receive a Power Director Training Manual, with reference material that they will be required to review and understand.

Training is for a period of 19 weeks and consists of on-line training, self-study, one-on-one training, OTS simulations, video training review and on-the-job training (OJT) as described in the Power Director Initial Training Manual. During the training period, the Trainee is assigned to an on-shift OJT Instructor who will work with the Trainee and guide them in acquiring the knowledge and skills required for the position. The PD, to whom the Trainee is assigned, shall complete an Observation Assessment Record (OAR) and review any deficiencies with the trainee.

Completion of PJM Classroom Courses

If not already accomplished, the trainee is required to successfully complete the Standard track of the PJM Interconnection Training Program (ITP). The System Dynamics course is required to be completed within 2 years of Power Director qualification. The time spent in these courses will not be deducted from the 19 weeks training.

Job Qualification

By week five of training, the trainee will complete a 50 question written test, minimum passing score of 80% (85% if retest). Note that written test will not be given until all sign-offs are completed.

By week nineteen of the training, in addition to the written PD test, the trainee must successfully complete a Master Dispatcher written test focusing on the transmission area specifics of the member transmission zones. Minimum passing score on this test is 80% (85% if retest).

Within the training period there will be at least 3 sessions of simulator practice in preparation for the simulator test. Additional simulation practice time will be made available if requested by the trainee based on instructor availability.

The final phase of the Power Director training is a simulator practical exam.

The simulation test is of four hours duration where the trainee is tested on their operating knowledge and their responses to a variety of system conditions, events and emergencies.

The minimum passing score for the simulator test is 80% (85% retest). The score will be the average score of at least four evaluators including at least two Shift Supervisors, and at least two simulator operators/system operations trainers. System Operator Training Dept. maintains a list of qualified OTS test evaluators for each operating position.

Retest Written and Simulator Procedure:

If the initial written test score is less than 80% a second test will be given after one week of reviewing problem areas from first test. The second test will be different from the first and also consist of 50 questions with a required score of 85% to pass. The same retest process applies for the region specific written test.

If the initial simulator test score is less than 80%, a second simulator test will be given after two weeks of reviewing problem areas from the first test. The trainee will be given coaching on the areas needed for improvement and additional training focusing on these areas. The second simulation will be the same time length (5 hours) as first simulation but with different events. The second test will require a score of 85% to pass will be scored by the same evaluators from original test, if possible.

If an individual is not successful after two test administrations, they will not be eligible to take any exam for a period of six months. Upon failing the qualifying test a second time the individual will be returned to their previous job classification or to a position that management selects for a minimum of six months until they are eligible for re-testing. During this period of ineligibility the individual will be responsible to complete all requirements prior to any administration of the qualifying test. In conjunction with the six month period of ineligibility, the individual must have satisfactory performance evaluations to be eligible for retesting.

Training Objectives for the Power Director Position:

1. Learn and demonstrate mastery of the knowledge and skills required of a PJM Power Director.
2. Learn and demonstrate mastery of the job task routines performed by the Power Director in all three operating states: normal, emergency and restoration.
3. Develop a mastery of all applicable NERC and Regional Reliability Standards and their application to the Power Director position.
4. Understanding and demonstrate the ability to maintain transmission reliability factoring in all variables including load, interchange, generation movements, weather, transmission maintenance, voltage and emergency conditions.
5. Understand and demonstrate the ability to maintain voltages within acceptable limits factoring in all variables including load, interchange, generation movements, maintenance outages and emergency conditions.
6. Demonstrate the ability to utilize all network analysis advanced applications to monitor and control the power system within all reliability limits.
7. Learn and demonstrate mastery of the transmission area specifics of the applicable transmission zones.

8. Learn and demonstrate mastery of the specific operating procedures and considerations of the applicable transmission zones.
9. Gain experience in operating the specific applicable transmission zones through On-The-Job Training and simulation training.
10. Become familiar with all applicable regulatory requirements.
11. Develop a mastery of applicable PJM operating procedures as defined in the PJM Manuals and Operating Memos.

Skills and knowledge for the Power Director position include:

- Understanding of applicable NERC and Regional Reliability Organization (RRO) Standards with primary focus on EOP, Emergency Preparedness and Operations, IRO, Interconnection Reliability Operations and Coordination, TOP, Transmission Operations and VAR, Voltage and Reactive
- Understanding of applicable regulatory requirements
- NERC, RFC, SERC and PJM Reserve requirements
- PJM Emergency Procedures
- Reactive Power and Voltage Control concepts
- Surge Impedance Loading and its impact on voltage
- Contingency overload identification and correction techniques
- Interchange impacts on transmission flows
- PJM reliability limits including thermal limits, voltage limits, reactive transfer limits and stability limits
- TERM application for changing of thermal limits
- Security Constrained Economic Dispatch (SCED) operation
- System Restoration techniques, strategies and procedures
- Combustion Turbine Parameters
- Dispatch Management Tool Operation (including logging)
- Energy Management System (EMS) and all network analysis applications
- EMS Alarm Recognition
- ACE and Frequency deviations (what they indicate)
- PJM Manuals
- Understand impact of generation on Reactive Transfer limits
- Shared Reserves
- One-line diagrams symbols and colors

- eDART use for transmission outages and reactive capability adjustments
- Reactive Reserve Check process
- Transmission area specific operating procedures
- Transmission area specific operating considerations and problem areas

Non-technical Competencies required for the Power Director Position:

- Initiative
- Productivity
- Time Management
- Communication Skills
- Coaching Skills
- Results Driven
- Strategy Development
- Dealing with and managing change
- Customer Focus
- Problem Solving
- Teamwork
- Decision Making
- Adaptability/Dependability
- Conflict Management

A *Master Dispatcher* is an operator that can perform the tasks associated with Generation Dispatcher, Power Director – East and Power Director – West. They are familiar with the specific transmission systems of all areas of the RTO. Ideally, the Master Dispatchers are rotated between the GD and PD positions frequently to maintain proficiency in these tasks.

4.6 Reliability Engineer Initial Training and Qualification Requirements

Most Reliability Engineers are hired directly into this position though many come from the Power Director candidate pool.

Candidates hired directly into the Reliability Engineer position must obtain their NERC Certification (RC) prior to assuming shift duties. They also must obtain PJM Certifications (Generation and Transmission) prior to assuming shift duties.

Reliability Engineer Training

The candidate will receive a Weekly Training Schedule listing reference material that they will be required to review and understand.

Training is for a period of 14 weeks and consists of on-line training, self-study, one-on-one training, OTS simulations, video training review and on-the-job training (OJT) as described in the Weekly Training Schedule. The Trainee will be assigned to an RE OJT Instructor who is responsible for completion of Observation and Assessment Records (OAR) sign-offs, and weekly updates to the Training Department. The Trainee will take a weekly self assessment quiz on the material covered.

Completion of PJM Classroom Courses

If not already accomplished, the trainee is required to successfully complete the Standard track of the PJM Interconnection Training Program (ITP) prior to taking shift and the System Dynamics course within two years of taking shift. The time spent in these courses will not be deducted from the 14 weeks training.

Job Qualification

By week fourteen of training, and after having attained all Reliability Engineer OAR sign-offs, and completed review of all training materials assigned, the trainee will complete a 50 question written test, minimum passing score of 80% (85% if retest). Note that written test will not be given until all sign-offs are completed.

The final phase of the Reliability Engineer training is a simulator test. The simulator test is of 3 hours duration where the trainee is tested on their operating knowledge and their responses to a variety of system conditions, events and emergencies. The minimum passing score for the simulator test is 80% (85% retest). The score will be the average score of at least four evaluators including the OPD Supervisor and at least three simulator operators/system operations trainers.

Retest Written and Simulator Procedure:

If the initial written test score is less than 80% a second test will be given after one week of reviewing problem areas from first test. The second test will be different from the first and also consist of 50 questions with a required score of 85% to pass. The same retest process applies for the region specific written test.

If the initial simulator test score is less than 80%, a second simulator test will be given after two weeks of reviewing problem areas from the first test. The trainee will be given coaching on the areas needed for improvement and additional training focusing on these areas. The second simulator test will be the same time length but with different events. The second test will require a score of 85% to pass will be scored by the same evaluators from original test, if possible.

If an individual is not successful after two test administrations, they will not be eligible to take any exam for a period of six months. Upon failing the qualifying test a second time the individual will be returned to their previous job classification or to a position that management selects for a minimum of six months until they are eligible for re-testing. During this period of ineligibility the individual will be responsible to complete all requirements prior to any administration of the qualifying test. In conjunction with the six month period of ineligibility, the individual must have satisfactory performance evaluations to be eligible for retesting.

Training Objectives for the Reliability Engineer Position:

1. Learn and demonstrate mastery of the knowledge and skills required of a PJM Reliability Engineer.
2. Learn and demonstrate mastery of the job task routines performed by the Reliability Engineer in all three operating states: normal, emergency and restoration.
3. Develop a mastery of all applicable NERC and Regional Reliability Standards and their application to the Reliability Engineer position.
4. Understanding and demonstrate the ability to maintain transmission reliability factoring in all variables including load, interchange, generation movements, weather, transmission maintenance, voltage and emergency conditions.
5. Understand and demonstrate the ability to maintain voltages within acceptable limits factoring in all variables including load, interchange, generation movements, maintenance outages and emergency conditions.
6. Demonstrate the ability to utilize all network analysis advanced applications to monitor and control the power system within all reliability limits.
7. Demonstrate the ability to process outage data and interpret outage study results
8. Proper understanding of remedial actions to be taken in the event that an equipment outage causes operational issues.
9. Become familiar with all applicable regulatory requirements.
10. Develop a mastery of applicable PJM operating procedures as defined in the PJM Manuals and Operating Memos.

Skills and knowledge for the Reliability Engineer position include:

- Understanding of applicable NERC and Regional Reliability Standards with primary focus on EOP, Emergency Preparedness and Operations, IRO, Interconnection Reliability Operations and Coordination, TOP, Transmission Operations and VAR, Voltage and Reactive
- Understanding of applicable regulatory requirements
- NERC, RFC, SERC and PJM Reserve requirements
- PJM Emergency Procedures
- Reactive Power and Voltage Control concepts
- Surge Impedance Loading and its impact on voltage
- Contingency overload identification and correction techniques
- Interchange impacts on transmission flows
- Use of the Interchange Distribution Calculator (IDC) program to control transactions for system reliability
- PJM reliability limits including thermal limits, voltage limits, reactive transfer limits and stability limits

- TERM application for changing of thermal limits
- Security Constrained Economic Dispatch (SCED) operation
- System Restoration techniques, strategies and procedures
- Combustion Turbine Parameters
- Dispatch Management Tool Operation (including logging)
- Energy Management System (EMS) and all network analysis applications
- EMS Alarm Recognition
- ACE and Frequency deviations (what they indicate)
- PJM Manuals
- Understand impact of generation on Reactive Transfer limits
- One-line diagrams symbols and colors
- eDART use for transmission outages and reactive capability adjustments
- Market to Market duties
- Reliability Coordinator Information System (RCIS) posting procedures and requirements
- System Data Exchange (SDX) files for sharing of transmission and generation outages across RTO borders
- Voltage Stability Analysis (VSA) tool

Non-technical Competencies required for the Reliability Engineer Position:

- Initiative
- Productivity
- Time Management
- Communication Skills
- Coaching Skills
- Results Driven
- Strategy Development
- Dealing with and managing change
- Customer Focus
- Problem Solving
- Teamwork
- Decision Making
- Adaptability/Dependability

- Conflict Management

4.7 Shift Supervisor Initial Training and Qualification Program

Most Shift Supervisor candidates come up through the Dispatcher ranks and thus are familiar with the tasks and responsibilities of all of the Dispatch positions. These candidates that have operating experience in the positions of Master Coordinator, Generation Dispatcher and Power Dispatcher will not be required to re-train or re-qualify in these positions.

Candidates hired directly into the Shift Supervisor position without any real-time Dispatch experience will be required to go through the training and qualification programs for Master Coordinator, Generation Dispatcher and Power Dispatcher.

Candidates with experience at some of the real-time Dispatch positions will be required to go through the training and qualification programs for those operating positions which they do not have experience.

Required Certifications

Shift Supervisors are required to have NERC RC Certification, PJM Generation Certification and PJM Transmission Certification prior to assuming on-shift duties.

Completion of PJM Classroom Courses

Shift Supervisors are required to have completed the ITP prior to taking shift and the System Dynamics course within one year of taking shift (if not already completed).

Shift Supervisor Training

Training for the Shift Supervisor will consist of 6 weeks of OJT training. A limited number of reliability-related tasks have been identified specific to the Shift Supervisor.

Shift Supervisors are expected to complete all of the training offered as part of PJM's Continuing Training Program. Additional training will focus on the development of the leadership and management skills of the Shift Supervisors. Management/Leadership courses offered by Human Resources are recommended training for new Shift Supervisors.

These courses include:

1. Harassment, Americans with Disabilities Act (ADA) Laws, Family and Medical Leave Act (FMLA) Laws and Employment Laws. This training will be completed via on-line training modules and tracked in the Human Resources Learning Management System.
 - This training should be completed within 6 months of hire date.
2. SAP User Training – This 2 hour training session is delivered by PJM's Finance Dept and is designed to give new managers and supervisors the basics of using the SAP accounting system including time entry and approval, expense approval and requisitioning. This training is offered quarterly.
 - The supervisor should attend the first available course upon hire.

3. Performance Management Training – This training will be sponsored by Human Resources annually. This in-person training class will explain PJM's Performance Management process, teach methods of delivering feedback and getting optimal team performance.
 - This training should be completed prior to the next milestone in the Performance Management process (i.e. year-end review, mid-year review)
4. New Reporting Relationship (NRR) Meeting – This one day meeting facilitated by Human Resources will help the Shift Supervisor identify issues that his/her new team feels are important and allow the team to get to better know their new supervisor.
 - This meeting should occur within a few months of the supervisor taking shift.
5. Emerge – Maximizing Your Impact Workshop – This one-day class focuses on how to transition from being an individual contributor to a management position.
 - This training should occur within a few months of the supervisor taking shift.
6. Center for Creative Leadership – Foundations of Leadership - This 3-day vendor-delivered class focuses on identifying the Shift Supervisor's individual strengths and areas for improvement. The course presents fundamental conflict management and influencing skills and culminates with a one-on-one feedback session designed to allow for individual development plan creation.
 - This training should occur within the first six months of the supervisor taking shift.
7. Managing Conflict for Managers – This course can be offered in-house or through an external consultant. It expands upon the concepts presented in the Foundations for Leadership course dealing with conflict management and teamwork.
 - This training should occur within the first 2 years of the supervisor taking shift.
8. Communication and Influencing Skills – This four-day advanced level training teaches communication techniques and styles and advanced influencing skills.
 - This training should occur within the first 2 years of the supervisor taking shift.

Job Qualification

Readiness for taking shift will be determined by the OJT instructor and Dispatch management based on the successful completion of the tasks identified in the Job Task Analysis.

Training Objectives for the Shift Supervisor Position:

1. Demonstrate leadership in the control room and accept overall responsibility for maintaining reliability on the PJM system.
2. Learn and demonstrate mastery of the job task routines performed within the control room in all three operating states: normal, emergency and restoration.
3. Maintain a mastery of all NERC, RFC, SERC and other regulatory standards and their application within PJM.
4. Understand and demonstrate the ability to maintain transmission reliability factoring in all variables including load, interchange, generation movements, weather, transmission and generation maintenance, voltage and emergency conditions.
5. Demonstrate the ability to utilize all network analysis advanced applications to monitor and control the power system within all reliability limits.

Skills and knowledge for the Shift Supervisor position include:

- Mastery of all NERC, RFC, SERC and other regulatory standards and requirements
- PJM Emergency procedures
- PJM Transmission operations and constraint control procedures
- SCED application mastery
- PJM reliability limits including thermal limits, voltage limits, reactive transfer limits and stability limits
- System Restoration techniques, strategies and procedures
- Energy Management System (EMS) and all network analysis applications
- All auxiliary tools used in operations including Dispatcher Management Tool (DMT), Interchange Distribution Calculator (IDC), SmartLogs, eDART, Reliability Coordinator Information System (RCIS), System Data eXchange (SDX), Voltage Stability Analysis (VSA) and Transient Stability Analysis (TSA).
- Coordination with neighboring areas

Non-technical Competencies required for the Shift Supervisor position include:

- Interpersonal & Team Skills
- Communication Skills
- Ability to Maintain Focus
- Adaptable & Agile
- Abstract Thinking Ability

- Analysis, Problem Solving and Decision Making
- Accountability/Ownership
- Honesty/Integrity/Credibility
- Advocacy/Persuasiveness
- Organization, Anticipation
- The Capacity to Learn Quickly
- Efficient and Proactive

4.8 PJM System Operator Continuing Training Program

To ensure continued reliable and economic operations, PJM is committed to providing their operators high quality training. PJM has well defined continuing training programs for their system operators. PJM system operators have a training week built into their shift schedule allowing for 8 weeks of dedicated training time per year. All PJM System Operators are required to obtain, at a minimum, 32 hours of Emergency Operations training per year in accordance with NERC PER-002 and PJM Training Standards (as described in Section 2).

PJM Continuing Training Program is broken into eight 6-week training “cycles”. These training cycles correspond to the training week for each operator team as identified on the shift schedule. PJM System Operator Training Department prepares training activities for each of these 8 training cycles. Activities include PJM-developed computer based training, simulation training, instructor-led training, daily operations review and other training activities.

Daily Review Team Process

PJM operators on their training week participate daily in the Daily Review Team Process (DRT). The DRT process promotes continuous improvement in operations. A review of the previous day(s) operations is performed by examining and analyzing operating data including log reports, ACE performance, transmission constraint control performance and uneconomic unit operations.

Objectives of the Daily Review Team are:

- Gain knowledge and understanding of how reliably and economically PJM dispatched the system on the previous day
- DRT is designed to give near-term feedback (and provide immediate remedial training if necessary) to dispatch.
- Provide a better understanding of problems encountered by both markets and operations, communicate these problems to help resolve, and provide a learning experience to all departments involved to avoid future repeating issues.
- To identify tool/data issues to improve reliability and efficiency.
- To recognize good operating days/events and capture these for future performance enhancements.

Operator Training Simulator

PJM operates and maintains a full-scale, full-fidelity Operator Training Simulator (OTS). The OTS is designed to replicate the response of the real-time power system in a similar operating environment to the PJM control room. The OTS allows PJM operators to build their experience base quicker by allowing them to see and operate in conditions that may be unusual or unexpected on the real time power system. PJM has been utilizing OTS based training in its training programs since 1998. Simulator training is recognized by NERC as an important component in any initial or continuing training program for system operators.

PJM utilizes its OTS in the following manner:

- Continuing team training on normal and emergency operations during PJM system operator's training weeks.
- Initial job qualification testing
- Training and development of new operator tools
- System Restoration drills and training

Teams are evaluated on their performance in the OTS in the following areas: Shift Turnover Process, Generation Control, Transmission Control, Proper Use of Applications, and Crew Resource Management skills (including Situational Awareness, Teamwork, Decision-making, Communications and Assertiveness).

Annual Training

In support of NERC and Regional Standards, PJM operators will receive training *annually* in the following topical areas:

- NERC/Regional Standards
- System Restoration
- Emergency Procedures and Operations
- System Protection
- Backup Control Center Evacuation Drills and Procedures
- Control of IROL facilities
- Cyber Security

Training Objectives for Continuing System Operator Training:

1. Provide training on updates on procedures, markets or tools in a timely manner to all PJM system operators.
2. Build the PJM system operator's level of experience through participation in OTS team training scenarios on normal, emergency and restoration operations.
3. Evaluate PJM system operator performance through OTS training scenarios and real time daily operations review and provide training on these areas of deficiency.
4. Provide refresher training on topics of critical importance to reliability including emergency preparedness, emergency operations and system restoration.

5. Facilitate the delivery of 4 PJM Emergency Preparedness drills per year.
6. Accurately track successful completions of all delivered training in PJM Learning Management System and identify areas for follow-up training.

Training plan and general assumptions of the PJM System Operator Continuing Training Program include:

- All System Operators will be required to complete all training offered (regardless of their operating position). This is to enhance the concept of cross-training of operators and help facilitate the job qualification and rotation process.
- Each operator will have the responsibility for ensuring completion of the required training modules by the due dates assigned. The Shift Supervisors will monitor the progress of their teams. Reports showing the operators status of completion of assigned training are available through the PJM Learning Management System.
- Operators on their training week will participate daily in the Daily Review Team process. This process examines the prior day(s) operation looking for any issues, concerns or training needs. Issues found are referred to the Dispatch Analysis Team for a more detailed review and follow-up.
- PJM Operators will be scheduled to attend applicable and relevant member training programs that are offered through the PJM Training Curriculum.
- These classes have been identified by Dispatch and Training. (i.e. GEN 101, GEN 201, GEN 301, OPS 101, LMP 101, MS 301)
- Training team will participate in the bi-annual PJM wide Emergency Procedure and System Restoration Drills when they are scheduled.
- There will be formal team OTS training scenarios scheduled throughout the training year. The simulations will be evaluated and debriefed in accordance with Crew Resource Management principles.
- Topics for the simulations will be selected based on the needs and desires of dispatch with input from System Operator Training.
- Each training week will include one evacuation drill to be scheduled at the Shift Supervisor's discretion.
- Each training week will include computer based training.
- The majority of this training will be self-study through the use of online presentations.
- There will be a quiz developed for each required training topic by the PJM System Operator Training Department.
- Completion of required training topics and quizzes will be tracking in the PJM's Learning Management System (LMS)

- System Operator Training will provide each Shift Supervisor a status report on their team's progress of the required training.
- Topics for the computer based training include:
 - Updates or changes to operating procedures, markets, or tools
 - Review of emergency preparedness topics
 - Review of power system fundamentals
 - Topics identified through performance evaluations as required improvement areas
- System Operator Training Department will apply to NERC for Continuing Education Hour (CEH) credit for any training delivered to PJM operators including OTS simulations, computer-based training, instructor-led training and any other training activities.
- Each training week will include one day of training at the Shift Supervisors discretion based on needs of each team. Friday will be an open day and used as needed.
- This training will be led and coordinated by the individual Shift Supervisors.
- Examples of this type of training include:
 - Operations Lessons Learned – review of recent operating events/decisions
 - Review of logs and use of PI to analyze noteworthy system events
 - Periodic review of taped conversations
 - 3-part communications
 - Effective communications
 - Professional conversations
 - Team members to present material to other team members
 - Develop specialty and enhance teamwork
 - Dispatcher web-site review and enhancements/ideas
 - System Restoration Lessons learned
 - Company visits
 - LCC or field
 - NERC/PJM Certification Review
 - Effective Logging
 - Position pre-tests
 - Shift Takeover

- Personal Training
- PC Skills
- Technical Writing
- Project Work

Skills and knowledge taught in the PJM Continuing Training include:

- Mastery of all NERC and Regional Standards
- NERC, RFC, SERC and PJM Reserve requirements
- Applicable regulatory requirements
- PJM Emergency Procedures
- Reactive Power and Voltage Control concepts
- Contingency overload identification and correction techniques
- Interchange impacts on transmission flows
- PJM reliability limits including thermal limits, voltage limits, reactive transfer limits and stability limits
- SCED Application
- System Restoration techniques, strategies and procedures
- Dispatch Management Tool Operation (including logging)
- Energy Management System (EMS) and all network analysis applications
- EMS Alarm Recognition
- ACE and Frequency deviations (what they indicate)
- PJM Manuals
- Understand impact of generation on Reactive Transfer limits
- Shared Reserves
- One-line diagrams symbols and colors
- Reactive Reserve Check process
- Reliability Engineer specific duties
- Operating Procedures and Operating Memos

Non-technical Competencies drilled in the PJM Continuing Training program:

- Initiative
- Productivity
- Time Management
- Communication Skills

- Coaching Skills
- Results Driven
- Strategy Development
- Dealing with and managing change
- Customer Focus
- Problem Solving
- Teamwork
- Decision Making
- Adaptability/Dependability
- Conflict Management

4.9 Process for Ensuring Proficiency Following Extended Absence

4.9.1 Purpose

Ensure PJM System Operator proficiency following an extended period where the operator has not worked shift duties due to illness, military service, project assignment or other extended leave situations.

4.9.2 Illness, Military Service or Other Extended Leave Situations

This process will apply to all PJM System Operators, Reliability Engineers and Shift Supervisors who have not worked their shift position for a consecutive period of three months (90 days) or more due to reasons of illness, military service or other extended leave situations.

4.9.3 Process for Operators who have not worked shift for a consecutive period of 3-6 months

Upon clearance to return to work, these operators must:

- Successfully complete all online training and classroom training (if possible) assigned to them in the Learning Management System (LMS) during their absence
- Read and acknowledge understanding of all new or revised Operating Memos assigned to the operators in the LMS during their absence
- Complete 2 days of On-The-Job Training for each month of absence with a qualified OJT Instructor

Upon completion of the above, the operator shall

Be interviewed and evaluated by their OJT Instructor and their Shift Supervisor to determine their readiness to resume shift duties.

4.9.4 Process for Operators who have not worked shift for a consecutive period of 6 months or longer

Upon clearance to return to work, these operators must:

- Successfully complete all online training and classroom training (if possible) assigned to them in the LMS during their absence
- Read and acknowledge understanding of all new and revised Operating Memos assigned to the operators in the LMS during their absence
- Complete a minimum of 2 days of On-The-Job Training for each month of absence with a qualified OJT Instructor
- Complete all requirements of a new candidate qualifying into the operating position including;
 - Completion of all OJT sign-offs

- Completion of required online training modules

Upon completion of the above, the operator shall:

- Be interviewed and evaluated by their OJT Instructor and their Shift Supervisor to determine their readiness to resume shift duties.
- Successfully complete all position qualification requirements outlined in Manual M-40 including:
 - Passing of written qualification test
 - Passing of OTS qualification test
 - Currency of required NERC and PJM Certifications

4.9.5 Project Work or Other Temporary Special Assignments

This process will apply to all PJM System Operators, Reliability Engineers and Shift Supervisors who have been taken out of the normal shift rotation to participate in projects or other special assignments on a temporary basis.

These operators are expected to:

- complete all training assignments during this period
- be available to fill shifts as required during this period

These operators will still be considered “active” operators. They will be offered up to 2 days of OJT per month of their assignment, if needed, prior to their return to full shift rotation.

Appendix 1: NERC Recommended Operator Training Topics

Letter from Mark Fidrych, Chairman, NERC Operating Committee, March 2, 2004

Recommended Operator Training topics

NORTH AMERICAN ELECTRIC RELIABILITY COUNCIL

Princeton Forrestal Village, 116-390 Village Boulevard, Princeton, New Jersey 08540-5731

March 2, 2004

TO: OPERATING COMMITTEE

Recommended Operator Training Topics

The Operating Committee's Personnel Subcommittee has developed a list of training topics that address the requirements of Recommendation #6 in Recommendation 6: All reliability coordinators, control areas, and transmission operators shall provide at least five days per year of training and drills in system emergencies, using realistic simulations, for each staff person with responsibility for the real-time operation or reliability monitoring of the bulk electric system. This system emergency training is in addition to other training requirements. Five days of system emergency training and drills are to be completed prior to June 30, 2004, with credit given for documented training already completed since July 1, 2003. Training documents, including curriculum, training methods, and individual training records, are to be available for verification during reliability readiness audits."

I have had a number of queries asking what kinds of training would fulfill this objective. In general, the recommendation requires five days of training to prepare operators for credible emergencies, for example, multiple contingencies, control center failure, voltage collapse, etc. The five days should include realistic simulations and drills, but could also include training in the principles and procedures needed for effectively recognizing and responding to emergencies. The bottom line is we need operators who are prepared to recognize and respond to emergencies. To achieve this goal, we must provide our system operators with hands-on training that is effectively provided by system simulations and drills, along with general study of the principles of interconnected systems operations that relate to recognizing and responding to system emergencies. The Personnel Subcommittee has developed a list of topics (See Attachment) that we believe fits Requirement 6. The subcommittee originally developed this list as a guide of suggested training courses for potential Continuing Education Providers. Therefore, this list is not all-inclusive. You may easily develop a course that is not listed below but still meets the recommendation.

If you have additional questions as to what type of training would be appropriate to meet the requirements of this recommendation, please contact me at 970-461-7240, or NERC's Training Manager John Theotonio at 609-452-8060.

Sincerely, Mark Fidrych
Chairman, NERC Operating Committee

Recommended Operating Training Topics

A. Recognition and Response to System Emergencies

1. Emergency drills and responses
2. Communication tools, protocols, coordination
3. Operating from backup control centers
4. System operations during unstudied situations
5. System Protection
6. Geomagnetic disturbances weather impacts on system operations
7. System Monitoring – voltage, equipment loading
8. Real-time contingency analysis
9. Offline system analysis tools
10. Monitoring backup plans
11. Sabotage, physical, and cyber threats and responses

B. Operating Policies Related to Emergency Operations

1. NERC standards that deal with emergency operations (e.g. Policy 5, “Emergency Operations”)
2. Regional reliability operating policies
3. Sub-regional policies and procedures
4. ISO/RTO policies and procedures

C. Power System Restoration Philosophy and Practices

1. Blackstart
2. Interconnection of islands – building islands
3. Load shedding – automatic (underfrequency and undervoltage) and manual
4. Load restoration philosophies

D. Interconnected Power System Operations

1. Operations coordination
2. Special protections systems
3. Special operating guides
4. Voltage and reactive control, including responding to eminent voltage collapse
5. Understanding the concepts of Interconnection Reliability Operating Limits versus System Operating Limits
6. DC tie operations and procedures during system emergencies
7. Thermal and dynamic limits
8. Unscheduled flow mitigation – congestion management
9. Local and regional line loading procedures
10. Radial load and generation operations and procedures
11. Tie line operations
12. E-tagging and Interchange Scheduling
13. Generating unit operating characteristics and limits, especially regarding reactive capabilities and the relationship between real and reactive output

E. Technologies and Tools

1. Forecasting tools
2. Power system study tools
3. IDC

F. Market Operations as They Relate to Emergency Operations

1. Market rules
2. LMP
3. Transmission rights
4. OASIS
5. Tariffs
6. Fuel management
7. Real-time, hour-ahead and day-ahead tools

Appendix 2: Training Topics From PJM Curriculum

Note: Courses listed represent the principle part of the PJM Curriculum targeted toward System Operators. These courses are NERC CEH approved learning activities. Please reference current course information on PJM website to verify actual number of CEH hours and hour categories each course is good for.

PJM Interconnection Training Program for System Operators (ITP)

Standard Track: 18 days of classroom instruction - all Modules modules

Generation Track: 11 days of classroom instruction, Modules FE, FS, FC, GU, GC, LS, EM, RE, SR

Module FE: Fundamentals of Electricity Refresh
Module FS: Introduction to the PJM System
Module FC: Fundamentals of Communication
Module GU: Generating Units
Module GC: Generation Control
Module LS: Load Scheduling
Module EM PJM Markets & Service
Module TF: Trans/Substation Facilities
Module TO: Transmission Ops
Module RA: Relay Applications
Module RE: Responding to Emergencies
Module SR: System Restoration

Power System Dynamics

Time: Five days of classroom instruction

Lesson 1 Review of Power System Flows and Limits
Lesson 2 Overview of System Dynamics
Lesson 3 Frequency Problems & Control
Lesson 4 Effect of Power Plants
Lesson 5 Islanded System Operation
Lesson 6 Voltage Deviations: High Voltage
Lesson 7 Voltage Deviations: Low Voltage
Lesson 8 Voltage Collapse
Lesson 9 PJM Methodology for Controlling Voltage
Lesson 10 Power System Oscillations I: Characteristics of Oscillations
Lesson 11 Power System Oscillations II: Causes and Effects of Oscillations
Lesson 11 Case Studies
Lesson 12 PJM Stability Criteria
Lesson 13 Other Dynamic Phenomenon
Lesson 14 Global Examples and Case Histories

Generation 101

Time: One day of classroom instruction

Basics of Generation Plants

How PJM Dispatches and Controls Generation, and Orient to PJM Control Room

LMP Overview

Orient to PJM website and eDATA

Generation 201

Time: One day of classroom instruction

Generation Outages and eDART

Overview of Two Settlements

PJM Day-Ahead Scheduling Process

Generation Check-out

Generation 301

Time: One day of classroom instruction

Ancillary Services

Overview of PJM Operating Reserve Settlements

Overview of PJM Market Monitoring

Orient to PJM System Operator Certification Program

Transmission 101

Time: Two days of classroom instruction

Introduction to the PJM Organization

How PJM Operates and Dispatches

Overview of Markets, LMP, Two Settlements

Orient to PJM Website

Transmission Operations Criteria

Transmission Outages and e-DART

Orient to PJM System Operator Certification Program

Operations 101

Time: One day of classroom instruction

Reserves - Scheduling, Reporting and Loading

Capacity Shortage Procedures

Supplementary Status Report

Light Load Procedures

Transmission and Voltage Emergencies

Weather/Environmental Emergencies

Sabotage/Terrorism Emergencies

Communication Protocols and All-Call

System Restoration Workshop

Time: 12 hours of classroom instruction, 4 hours simulations

Intro to Restoration

Types and causes of blackouts

Determining system status

Elements of system restoration

Considerations of a system restoration plan

System restoration at PJM
Simulations

Review of Power System Fundamentals
Time: four days of classroom instruction
Basic electrical theory - DC circuits
Alternating current principles
Impedance principles
AC power principles
Transformer theory
AC real and reactive power flow

Appendix 3: Check List for New System Operators at LCCs and MOCs

Check List for New System Operators at LCCs and MOCs

The following is a generic checklist of system operator tasks that are performed by LCC and MOC system operators separately or jointly, as compiled by a PJM Job Analysis Committee.

This checklist is a set of suggested competencies to guide the training of new generation and transmission system operators.

The checklist is meant to serve companies as a help reference to draw from for their initial in-house training of new operators before they take shift.

T001. Analyze weather to determine impact on: load forecast
T002. Analyze weather to determine impact on: transmission outages
T003. Analyze weather to determine impact on: generation availability
T004. Submit demand bid via PJM eMkt tool
T005. Interpret the results (e.g., times, fuel schedules, operating limits) of the day ahead schedule
T006. Schedule the generation that is called for in the day ahead schedule
T007. Respond to the deviations between the day ahead demand bid, with the PJM load forecast by scheduling additional generation
T008. Respond to request to cost cap unit
T009. Take requests from field personnel for generation outages
T010. Coordinate planning of generation outages with engineering, field personnel, transmission companies, and PJM if applicable (eDART)
T011. Analyze any hydro unit or other unit fuel, regulatory, (e.g., lake level restrictions) or environmental issues affecting plant availability or bidding strategy
T012. Evaluate scheduling strategy for generating units
T013. Analyze and compile unit price and/or cost offers
T014. Analyze and input unit operating parameters into eMkt (e.g., costs, availability, limits)
T015. Submit generation offers and/or self-scheduled units via PJM eMkt tool by published deadline
T016. Analyze regulation requirement and availability
T017. Submit regulation offers via PJM eMkt tool by published deadlines
T018. Submit synchronous reserve offers via PJM eMkt tool by published deadlines
T019. Submit Day Ahead Scheduling Reserve offers via PJM eMkt tool by published deadlines
T020. Respond to request to operate unit different from day ahead schedule
T021. Analyze differences in forecasted load and actual
T022. Analyze and prepare generation switching and tagging procedures to block equipment
T023. Monitor PJM real-time dispatch signal
T024. Interpret calculated bus Locational Marginal Price (LMP's)
T025. Compare unit performance to real-time dispatch signal
T026. Evaluate unit fuel status/availability
T027. Monitor and respond to plant alarms/limits
T028. Monitor regulation resource performance/availability
T029. Support reactive testing of units
T030. Evaluate performance of computer systems (e.g., EMS, GMS, SCADA, Security Analysis Program)
T031. Verify the integrity of data links, and quality of data
T032. Monitor and respond to PJM All-Call

T033. Monitor Area Control Error (ACE)
T034. Monitor frequency
T035. Evaluate Area Control Error (ACE)
T036. Evaluate frequency
T037. Monitor scheduled and actual interchange
T038. Coordinate start-up of units
T039. Perform start-up of units (locally) in response to directive
T040. Coordinate adjustments to unit output
T041. Adjust unit output (locally) in response to directive
T042. Coordinate unit reactive output
T043. Maintain generator voltage schedule
T044. Maintain transmission voltage schedule
T045. Report changes in Generator Reactive Capability via eDART
T046. Report changes in Automatic Voltage Regulator (AVR) status via eDART
T047. Report changes in Generator Governor status via eDART
T048. Adjust unit reactive output (locally) in response to directive
T049. Coordinate the shutdown of units
T050. Perform shutdown of units (locally)
T051. Start-up units which can include SCADA or other electronic applications/software
T052. Control unit output which can include SCADA or other electronic applications/software
T053. Adjust reactive output which can include SCADA or other electronic applications/software
T054. Shut down units which can include SCADA or other electronic applications/software
T055. Operate telecommunications equipment (e.g., phone systems, radio system, satellite phone)
T056. Operate computer systems (e.g., EMS, SCADA, PC's)
T057. Update limits for min, max, emergency min, max emergency, and any incremental loading schedule
T058. Initiate emergency procedures
T059. Respond to emergency procedures
T060. Verify and confirm daily capacity numbers via GEN Checkout
T061. Validate and report Instantaneous Reserve Check (IRC) data
T062. Validate and report Reactive Reserve Check (RRC) data
T063. Report real-time unit limits to PJM via eMkt
T064. Report to management and key personnel important system information/developments while observing communication protocols
T065. Report required system information/developments to governmental agencies
T066. Report unit availability/outage status both orally and electronically
T067. Document system events and conditions via written/electronic logs and/or reports
T068. Coordinate requests from field personnel for transmission/substation outages
T069. Model system outages in security analysis program and analyze results
T070. Coordinate planning of transmission outages with engineering, field personnel, neighboring companies, and PJM if applicable (eDART)
T071. Coordinate real-time operations with neighboring systems as needed
T072. Analyze and prepare transmission switching and tagging procedures to block equipment
T073. Determine if actual flows are within established limits, and initiate corrective action if necessary
T074. Determine if actual voltages are within established limits, and initiate corrective action if necessary
T075. Determine if reactive transfer interface flows and other IROL's are within established limits, and initiate corrective action if necessary
T076. Determine if simulated post-contingency flows are within established operating criteria, and initiate corrective action if necessary

T077. Determine if simulated post-contingency voltages are within established operating criteria, and initiate corrective action if necessary
T078. Respond to Post-Contingency Local Load Relief Warning (PCLLRW)
T079. Initiate Post-Contingency Local Load Relief Warning (PCLLRW)
T080. Monitor and respond to substation equipment, line alarms, and dispatch personnel if needed
T081. Monitor weather and ensure that proper temperature set is reflected in limits
T082. Analyze and respond to relay action and other system disturbances if necessary
T083. Perform routine switching on transmission system via SCADA
T084. Perform emergency switching on transmission system via SCADA
T085. Coordinate the switching and tagging of equipment with field personnel
T086. Direct the switching and tagging of equipment with field personnel
T087. Issue clearance on equipment blocked for work
T088. Switch capacitors and reactors for voltage control and system security
T089. Perform adjustments to system equipment (e.g., PARS, LTC's)
T090. Perform manual load shedding
T091. Perform voltage reduction
T092. Report line and equipment availability/outage status both orally and electronically
T093. Coordinate and verify PJM interchange schedules with source and sink
T094. Coordinate and verify PJM purchases and sales
T095. Utilize PJM tools (e.g., EES, eSchedules, Oasis) to set up valid schedules or adjust existing schedule
T096. Procure valid NERC tags for all schedules
T097. Enforce schedule limits (e.g., ramp, time constraints)
T098. Monitor system TLR's that could affect interchange
T099. Initiate Transmission Loading Relief (TLR's) in response to transmission constraints
T100. Monitor PJM and Reliability Coordinator Information System (RCIS) websites for constraints and other data that could affect interchange
T101. Update the Reliability Coordinator Information System (RCIS) as appropriate
T102. Implement back-up control center recovery plan
T103. Test and operate from back-up control center
T104. Implement NERC Emergency Alert Levels (e.g., EEA, TEA, SEA)
T105. Respond to NERC Emergency Alert Levels (e.g., EEA, TEA, SEA)
T106. Monitor access to control room
T107. Register Demand Response resources into PJM market system
T108. Implement Demand Response actions in response to real-time dispatch signals
T109. Implement Demand Response actions in response to emergency conditions
T110. Submit Demand Response offers by published deadlines
T111. Fulfill Demand Response requirements for settlements data
T112. Utilize three-part communications in real time operational messages.
T113. Ensure proper information transfer during shift turnover
T114. Monitor zonal system costs
T115. Monitor regional system loads
T116. Monitor PJM ramps via Enhanced Energy System (EES)
T117. Report any schedule changes to PJM complying with established time constraints
T118. Notify parties involved of changes, cuts, or restoration of transactions
T119. Issue or respond to request for 100% synchronized reserves
T120. Issue or respond to Heavy Load Voltage Schedule
T121. Respond to PJM issued Alerts, Warnings, and Actions.
T122. Conduct all procedures related to capacity shortages
T123. Conduct all procedures related to light load conditions

T124. Conduct all procedures related to conservative operations (e.g., solar magnetic disturbances (SMDs), contingencies, actuals, thermal, reactive)
T125. Conduct all procedures related to severe weather
T126. Monitor and report suspected or actual physical or cyber attacks
T127. Compile and submit Supplemental Status Report (SSR)
T128. Ascertain system status after disturbance
T129. Determine method of restoration process
T130. Disseminate information on system status
T131. Isolate any damaged equipment for prioritization and repair
T132. Implement restoration procedures
T133. Direct the operation of blackstart generating units
T134. Perform start-up of blackstart generating units
T135. Facilitate restoration of station light and power to critical facilities
T136. Coordinate and direct sources of cranking power to generating stations
T137. Coordinate load pick up to maintain frequency and voltage within parameters during system restoration
T138. Maintain adequate synchronous and dynamic reserves so islands can withstand largest energy contingency
T139. Observe minimum source requirements to safely energize the EHV transmission system
T140. Coordinate the synchronization of islands
T141. Coordinate the synchronization of islands to neighboring systems
T142. Coordinate frequency and tie-line control with interconnected systems
T143. Transfer system control back to PJM when at proper stage of restoration process
T144. Coordinate outages of Telemetry and Communication equipment (i.e., Phones, RTUs, Datalinks) with PJM
T145. Report changes in transmission equipment ratings to PJM
T146. Demonstrate knowledge of System dynamics
T147. Demonstrate knowledge of thermal, voltage, and stability limits
T148. Demonstrate knowledge of equipment and schemes used for system protection
T149. Demonstrated knowledge of dynamics of power flow and methods of controlling
T150. Demonstrate knowledge of reactive requirements and methods of voltage control
T151. Demonstrate knowledge of safe switching practices and proper blocking of equipment
T152. Demonstrate knowledge of operating criteria for alleviating actual and contingency violations
T153. Demonstrate knowledge of computer and communications systems used in power system operations
T154. Demonstrate knowledge of control Areas and the requirement of power supply and demand balance
T155. Demonstrate knowledge of the various equipment and devices found on the transmission system and in substations; their purpose, function, operation, capability and limitations
T156. Demonstrate knowledge of the types of generating stations, along with equipment found at each type; their purpose, function, operation, capability and limitations
T157. Demonstrate knowledge of the operation of the market systems: regulation
T158. Demonstrate knowledge of the operation of the market systems: two settlement
T159. Demonstrate knowledge of the operation of the market systems: RPM
T160. Demonstrate knowledge of the operation of the market systems: operating reserve
T161. Demonstrate knowledge of the operation of the market systems: dispatch rate and LMP
T162. Demonstrate knowledge of the operation of the market systems: future developing markets
T163. Demonstrate knowledge of member obligations under the PJM Operating Agreement
T164. Demonstrate knowledge of guidelines and procedures found in PJM manuals
T165. Demonstrate industry knowledge related to NERC, SERC, RFC Standards



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Appendix 3: Check List for New System Operators at LCC's and MOC's

T166. Demonstrate industry knowledge related to obligations and implications of Codes of Conduct
T167. Demonstrate industry knowledge related to the role of FERC in the industry
T168. Demonstrate Industry knowledge related to the role of other agencies such as state PUC/BPA's

Appendix 4: Continuing Education Hour (CEH) Tracking Process

Overview

System Operators involved in the operation of the PJM RTO are subject to the PJM certification and training requirements documented in Sections 1 and 2 of this manual. Part of these requirements involves the tracking of approved training which can then be used to maintain an operator's certification and comply with the annual training requirements.

This document discusses what approved Continuing Education Hour (CEH) training can be used to fulfill the above requirements, describes the process for documenting the successful completion of such training by individual system operators, outlines the role of the designated company Training Liaison and uses of the web based PJM Learning Management System (LMS). The Attachments contain the various forms that can be used to support the process.

Approved CEH Training

All training used to meet PJM training or certification renewal requirements must be approved through the NERC Continuing Education Program (CEP) for NERC CEH's and identified as acceptable Emergency Operations Preparedness activities. NERC Learning Activities that are ONLY approved for Professional Hours cannot be used in meeting PJM Certification and Training Requirements.

Third party, vendor supplied training that has been approved for NERC CEHs and identified as acceptable Emergency Operation Preparedness activities or deemed supportive to the duties of a System Operator working within the PJM RTO, may also be used to meet the PJM training and re-certification requirements. (See Attachment A for the form to submit NERC CEH approved training to PJM.)

Training sponsored by the PJM State and Member Training Department designed for System Operators is NERC CEH approved. This includes the Annual PJM System Operator Seminar, the Gen/Ops and Trans/Ops training series, the Interconnection Training Program (ITP), System Dynamics, System Restoration Workshop as well as many training modules available through the LMS. PJM State and Member Training Department performs all administrative tasks associated with this training, including applying to NERC for approval, issuing NERC CEH's, documenting and tracking these CEH's for individual System Operators in the PJM LMS.

PJM sponsored Emergency Procedure Drills and System Restoration Drills, conducted in the spring and fall can also earn NERC CEH's for system operators that participate in them. Since for most of these drills, the participants do not come to PJM but participate from their home work location, a company Training Liaison is designated to facilitate various training administrative tasks and interface with the PJM State and Member Training Department. (See Attachment B for documentation form and further details on PJM System Restoration and Emergency Procedures Drills)

Training Liaison

The company Training Liaison will serve as the representative for PJM related to PJM sponsored training activities that are not directly facilitated by on-site PJM State and Member Training Department personnel. The role of the Liaison includes verification of attendance and participation in the training, successful completion of any assessments and evaluations as required by the CEH approval process. Where on-site proctored training assessments are

required, the Training Liaison will serve in this role, maintaining a secure environment in connection with administering the assessment. This role and standard is also to be carried out for company or vendor supplied training used to meet the PJM training and re-certification requirements. For audit purposes, all source data (attendance sign in sheets, assessment, etc) for company and vendor supplied training, as well as PJM Drill documentation should be maintained for at least sixty months.

The Training Liaison will notify PJM State and Member Training before having someone else assume this role, or if additional personnel are added to serve as alternates. (See Attachments D for Initial Training Liaison and E– For additional Liaisons or reporting changes of Liaison.) The Training Liaison will ensure that any data for new System Operators, or changes to existing System Operators are kept up to date. (See Attachment C)

The Training Liaison will provide the information associated with this role to PJM Member Training department via email sent to: TrainingSupport@pjm.com. Forms to facilitate this communication are found in the Attachments. Links to electronic versions are on the PJM website at <http://www.pjm.com/training/member-training-liaison.aspx>. Completed forms (or equivalent data based on the forms) should be sent at least monthly.

Additional duties of the Training Liaison include; Monitoring the training and certification status of their system operators in connection with PJM training and certification requirements. Ensuring that company system operators are informed of their training obligations and have been informed of upcoming relevant training opportunities. The Training Liaison will be granted supervisory access to the PJM LMS for their company to facilitate these activities.

Learning Management System

PJM employs an online Learning Management System to track all NERC CEH approved training used to measure compliance with the PJM training and certification requirements.

All NERC CEHs that are awarded through PJM Member training programs will be entered into the LMS by PJM State and Member Training. Additionally the LMS serves as the portal for launching online training and assessments that are available to Members for NERC CEH credit. Successful completion of online content will be automatically populated in the LMS.

PJM State and Member Training will also enter other NERC CEH approved training into the LMS when properly submitted as described above utilizing the appropriated forms found in the attachments. The Member Company will be responsible for the accuracy and validity of all operator and training data submitted to PJM.

The LMS will allow individual system operators to view their own training history. Designated company Training Liaisons will be able to run reports and monitor training progress for their company's operators. If desired, the Training Liaison can enter and track other training that has not gone through the NERC approval process into the LMS through the "External Training" feature. While training entered here can be included in certain reports, it will be separate from the NERC CEH training and NOT count toward meeting the PJM certification and training requirements.



NERC CEH Approved Training Activity Submission

Training Liaison Documentation Form

Note: Approved Training submitted through this form may be used toward meeting the PJM Training Requirements.

This form will NOT need to be completed for PJM-sponsored training (Spring Seminar, ITP, etc.).

Name of PJM Designated Training Liaison:

Date

Name of Member Company:

Market Operations Center (MOC) ☐

PJM ☐

Local Control Center (LCC) ☐

NERC Approved CE Provider Information:

Company				Co. NERC ID		Contact Name	
Address				Phone		Contact Title	
City				Fax		Contact email	
State		Zip		Co. Website		Contact Phone	

NERC Approved CE Activity (Course) Information:

NERC Activity ID:							
Total CEH Hours		Std's Hrs		Sim Hrs		EOP Hrs	
Activity Title							
Activity Description							
Type: (Check all that apply)	☐ Classroom		☐ OJT Training		☐ Operator Training Simulation		
	☐ Workshop/Seminar		☐ Self-study		☐ Computer-based (CBT)		
	☐ Conference		☐ Internet-based		☐ Other:		
☐ Multiple Deliveries (List separate dates/locations)				☐ This learning activity is open to public			

Sponsorship Affidavit:

The Submitting PJM Training Liaison, on behalf of the sponsor(s), agrees to:

- Ensure that all training activities approved for use in meeting PJM Training and Certification requirements are delivered and adhere to NERC CE Program requirements
- Maintain accurate records of all participants' attendance and individuals who successfully earned a certificate of completion.
- Within 30 days following the completion of the program, submit to PJM information for any operators awarded CEH's..
- Ensure the training activity is delivered according to plan, attendance is monitored and accurately recorded, evaluation is performed and results accurately recorded and retained.
- Maintain participants' attendance, evaluation, and CE Hours awarded for five years.
- Uphold the standards for high quality continuing education activities.

Check box to indicate agreement ☐

Please complete, save, and e-mail to TrainingSupport@pjm.com



Please complete, save, and e-mail to TrainingSupport@pjm.com



PJM Drill Participation Submission Form

Training Liaison Documentation Form for CEH Credits

Name of PJM Designated Training Liaison:

Scheduled Date of Drill:

Name of Member Company:

Type of Drill

Market Operations Center (MOC) ☐

PJM ☐

Local Control Center (LCC) ☐

Pre-Drill Activity Description

Pre-Drill activities consist of, at a minimum, a refresher training session that covers pertinent sections of the PJM Manuals along with a follow up quiz. For the Emergency Procedures drill, Section 2 of the M13 Emergency Operations Manual is required. For the System Restoration Drill, material from the M36 System Restoration Manual is required. PJM produced training materials available on line may also be utilized. PJM will provide a quiz to be administered at the conclusion of the PJM refresh session. Other activities should include a review of internal procedures and documentation. Pre-Drill activities should occur prior to the day of the drill. Those participating in the actual drill should participate in the Pre-Drill Activities. Additionally, others who will not be participating in the actual drill may participate in and receive credit for the Pre-Drill Refresher Training Activities.

Where possible, the PJM designated Training Liaison should serve as the lead of the Pre-Drill Activities. If necessary, the presentation of the materials may be delegated to other qualified operating personnel; however, the Training Liaison will be personally responsible for carrying out the following duties:

- Verifying complete attendance at the Pre-Drill Activities
- Serve as proxy for administration of the post-refresh session quiz
- Collect and grade quizzes, identifying those who met the passing criteria of 75% correct.
- Provide documentation of training participation by completing and forwarding this form to PJM.
- Retain documentation of participant's refresh training and drill participation.

Pre-Drill Activity Documentation

Please provide a brief description of how the Pre-Drill Activities were handled.

Please complete, save, and e-mail to TrainingSupport@pjm.com



Please note any issues or comments on the Pre-Drill Activities.

Drill and Post-Drill Debrief Session Description

Both the Emergency Procedures Drill and the System Restoration Drill consist of two components: the actual drill and a Post-Drill Debrief Session, which serves as the assessment portion of the training. Only operators that participate in both of these components may receive CEH credit.

The debrief should include discussions on: what worked well, a critique of drill communications, a review of the completed reports, any lessons learned or areas of confusion, and any deficiencies found in internal procedures.

For the Emergency Procedures Drill, issues raised during the drill or debrief should be documented on the "Debrief and Issues Log" provided with the Drill Scenario documentation and faxed to PJM at the end of the drill. This information will be used in the end of drill debrief conference call lead by PJM.

For the System Restoration Drill, the following questions taken from PJM's Crew Resource Management training may serve as a guide to the discussions:

What were the tough decisions?

- For each situation assessment:
 - What was your initial assessment of the situation?
 - What specific cues did you use in your assessment?
 - What cues or factors were missed? Why?
 - What made the assessment difficult?
 - What assumptions did you have to make? Why?
 - What was your greatest uncertainty?
 - How did you expect the situation to develop?
 - What impact did time have on your assessment?

- For each course of action:
 - What was your intent in choosing that course of action?
 - How did your intention change over time? Why?
 - What other options did you consider?
 - Why did you not choose them?
- Summary at the end:
 - What are some important lessons learned?
 - How might a novice (or expert) misdiagnose this event?

What would have made this a more challenging scenario?

Please complete, save, and e-mail to TrainingSupport@pjm.com



Drill and Post-Drill Debrief Session Documentation

Please provide a brief description of how the Post-Drill Activities were handled.

Please note any issues or comments on the Drill or Post-Drill Activities.

Drill CEH Award Explanation

All CEHs will be categorized as Emergency Operations Preparedness (EOP). The criteria for awarding CEHs will be as follows:

For the Pre-Drill Activities of both the Emergency Procedures Drill and the System Restoration Drill, PJM will award up to 2.0 CEHs. To receive the full 2.0 CEHs the Pre-Drill Activities must include **BOTH** a refresh session on information from the applicable PJM manuals including a passing score on the quiz provided by PJM, **AND** a review of pertinent company procedures and documentation. The Member Company Training Liaison will provide a method of assessment for internal company procedures. This method should be noted in the Pre-Drill Activity Documentation box on this form. If the only refresh activity completed is the review of PJM manuals with a passing score on the PJM provided quiz, 1.0 CEH will be granted.

For the Emergency Procedures Drill, 2.0 CEHs will be awarded to operators who participate in both the complete actual drill AND Post-Drill Debrief Session. If only one or the other element is participated in, NO CEHs will be awarded.

For the System Restoration Drill, the number of CEHs that will be awarded will depend on the specific plan and length of the drill (one-day or two-day drill). This information will be documented in the information sent to members prior to the drill. Operators are required to participate in both the actual drill AND Post-Drill Debrief Session to receive CEHs.

Please complete, save, and e-mail to TrainingSupport@pjm.com



Drill CEH Documentation

Please complete the table below for those who participated in the Pre-Drill, Drill and Post-Drill Debrief Sessions.

Name	NERC Certification Number (if applicable)	Credited Hours Pre-Drill Activities (Note: Max Hours =2.0)	Credited Hours for Drill and Post-Drill Debrief Session	Total Credited Training Hours (All hours are considered EOP)

The PJM designated Training Liaison will be responsible for documenting participation in the Pre-Drill Activities, the Drill, and Post-Drill Debrief session by accurately completing [this](#) form and forwarding it to TrainingSupport@pjm.com

Please complete, save, and e-mail to TrainingSupport@pjm.com



System Operator Change Submission Form

Type of Change*:

☐ Add a New Operator

☐ Operator has previous PJM training records

☐ Operator has PJM Certification

☐ Update an Existing Operator

Type of Update:

☐ Job Title

☐ Certification Information

☐ Other:

☐ Effective Date

☐ E-mail Address

☐ Delete an Operator

☐ Operator is moving to an organization where his/her PJM training will continue

Name of organization (if known):

Operator Information:

General Information*:

First Name		Last Name	
E-mail		Company	

Job Title*:

This selection must match the type of PJM Certification this operator is or will be **REQUIRED** to obtain.

- If the operator is **REQUIRED** to obtain a Generation Certificate, select "Generation"
- If the operator is **REQUIRED** to obtain a Transmission Certificate, select "Transmission"
- If the operator is **REQUIRED** to obtain BOTH a Generation AND Transmission Certificate, select "Gen/Trans"

If the person being added is **NOT REQUIRED** to be certified for your company to be compliant with PJM Certification and Training requirements outlined in PJM Manual 40, select the Job Title "Other". This would include those who may have or chose to pursue a PJM Certificate, even though their real-time job duties **DO NOT REQUIRE** certification.

☐ **Generation** ☐ **Transmission** ☐ **Gen/Trans** ☐ **Other**

Effective Date*:

Date the operator began real-time operations on the PJM system with current company:

Prior Experience:

☐ The above named system operator has completed two or more years of prior experience as a system operator prior to the submission of this form (company records are available upon request, detailing the dates and employers of this work experience). Based on prior experience, waive the second PJM Initial Training Requirement, Completion of the Interconnection Training Program (ITP).

The operator first began real time system operations as a system operator on the PJM RTO or elsewhere on:

Certification Information:

Certification Type (NERC/PJM)	Certification Number	Date Issued	Date Expires

Comments:

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Submitted By:

Date:

Phone:

*Field is required

Please complete, save, and e-mail to TrainingSupport@pjm.com



Initial Identification of Member Company Training Liaison for Entities Starting to Perform Dispatch Functions within the PJM RTO

Note: This form only needs to be completed if Company performs real-time operational functions involving capacity resource generation or transmission resources in the PJM RTO.

Training and Certification Requirements for Local Control Centers (LCC), Market Operation Centers (MOC) and PJM System Operators

System Operators working within the PJM RTO are required to have the daily operations related knowledge and skills needed to implement procedures for normal, emergency, and restoration conditions. All system operators must understand and be able to implement these procedures as presented in the PJM Manuals to ensure reliable operation of the PJM RTO. In addition, system operators must understand basic operating concepts in order to perform the referenced tasks.

The specific certification, initial, and continuing training requirements are listed in the PJM Manual M40, Certification and Training Requirements, Sections 1 and 2. The role of the Training Liaison is described in Appendix 4. Additional website references include the PJM System Operator Certification Program webpage (<http://www.pjm.com/training/certification/sys-op-cert.aspx>) and the Member Training Liaison webpage (<http://www.pjm.com/training/member-training-liaison.aspx>).

Please fill in the information below, save document, then attach it to an email and send to the PJM Member Training Department at TrainingSupport@pjm.com.

Company Name		Check if PJM Member	☐
Address			
Please describe facilities for which your operators will provide real-time operational support (for example, name(s) and location(s) of PJM capacity resource generating unit(s))			
Start date of operational support and interaction with PJM for these facilities			
If these facilities are owned by another PJM Member for whom you are providing operational dispatch services, please provide name of other PJM Member.			

	Company Training Liaison	Alternate Training Liaison
Name		
Title		
e-mail Address		
Desk Phone		
Mobile Phone		

Please complete, save, and e-mail to TrainingSupport@pjm.com

Training Liaison Change Submission

Training Liaison Documentation Form

Type of Change:

Adding an Alternate Training Liaison ☐	
	- Please check if the new Training Liaison will be the new primary contact for PJM Member Training Department ☐ - Please check if the new Training Liaison already has existing training records in the PJM LMS ☐
Updating Information on an existing Training Liaison ☐	
	(Please provide details of change in Comments box below)
Deleting a Training Liaison ☐	

Training Liaison Info:

First Name	
Last Name	
Company	
Phone	
Email Address	

Comments

Submitting Training Liaison Info:

First Name	
Last Name	
Phone	

Please complete, save, and e-mail to TrainingSupport@pjm.com

Revision History

Revision 09 (1/1/2010):

- 1) Added NERC Certification requirement for Transmission Owner Local Control Center operators.

Revision 08 (10/01/2009):

- 1) Added language for Small Generation Plant Operator Certification Exemptions to Section 1.
- 2) Made changes to Master Dispatcher training in Section 4

Revision 07 (08/01/2009):

- Modified Certification requirement for LCC operators to require certification prior to operator taking shift as of 7/1/2010.
- Added description of Systematic Approach to Training (SAT) method utilized by PJM to Section 4.
- Annual Review of Manual

Revision 06 (04/24/2009):

- Section 4: Added process for ensuring operator competency following an extended absence.

Revision 05 (02/12/2009):

- Section 4: Revised requirements for PJM Certification for PJM operators. Added section on Shift Supervisor Training Plan.
- Section 1: Revised some PJM Certification requirements – changed term of certification to 3 years from 5 years, changed required CEH credit to renew, added provisions for certifying and within 1 year for LCC and MOC operators.
- General grammatical changes and clarification made throughout the document.

Revision 04 (11/05/2008):

Revised requirements for PJM PD completion of PJM classroom courses in Section 4. Updated Training Liaison Forms in Appendix 4. Minor clarifications and grammatical updates. Removed option for PJM-approved CEH credit.

Annual review of manual.

Revision 03 (01/25/2008):

Separated the Power Director and Reliability Engineer Training descriptions in Section 4. Added references to formal OJT training to MC, GD, PD and RE positions. Changed "Power Dispatcher" title to "Power Director".

Revision 02(09/10/2007):

Minor clarifications to the PJM Master Coordinator Initial Training and Qualification Requirements in Section 4

Revision 01 (07/13/2007)

Added section on Master Dispatcher Training program for PJM operators. Added annual requirement for training on company specific System Restoration plans for LCC operators per NERC Standard EOP-005

Revision 00 (05/16/2007)

This is the original issuance of the PJM Manual for **Certification and Training Requirements**