PJM Manual 39:

Nuclear Plant Interface Coordination

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Prepared By
Operations Planning Division

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Approval

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Michael Zhang, Manager Generation

Current Revision

Revision 23 (03/07/2025):

- Attachment C: Plant Specific NPIRs Revisions History: NPIR Revision Update

~~**Administrative Change (Michael Zhang Approved on 07/03/2024):**~~

- ~~Updated manual ownership to Michael Zhang~~
- ~~Attachment C: Plant Specific NPIRs Revisions History: Asset Owner name and NPIR revision updates~~

~~**Revision 22 (10/24/2022):**~~

- ~~Periodic Review~~
- ~~Updated references to Manual 03 Section 5 to Manual 03B throughout the manual~~
- ~~Sect 1.1 Reworded explanation of Nuclear Plant Interface Requirements (NPIRs)~~
- ~~Sect 1.2 and 2.4.2 Added reference to eDART's Nuclear Voltage Limit feature~~
- ~~Sect 2.4 Clarifying language on communication of off-cost and redispatch~~
- ~~Sect 3.1 Added language addressing company name changes~~
- ~~Sect 3.2 Updated reference to Manual 13 Attachment L to Manual 13 Attachment J and added Attachment K reference~~
- ~~Sect 3.5 Updated reference to Nuclear Generator Owner User Group to Nuclear Generator Owners/Operators Forum~~
  - ~~NPIR Revision as part of periodic review process no longer applicable~~
- ~~Attachment A.6 Added definition of Off-cost to Key Transmission Terms~~
- ~~Attachment A.8 Added Reference to COM-002~~
- ~~Appendix 1 Updated NERC information~~
- ~~Attachment C: Plant Specific NPIRs Revisions History: Asset Owner name and NPIR revision updates~~
- ~~Corrected typographical errors and capitalization in multiple sections~~

Introduction

Welcome to the PJM Manual for ***Nuclear Plant Interface Coordination***. 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 PJM for the operation, planning, and accounting requirements of PJM RTO and the PJM Energy Market. The manuals are grouped under the following categories:

- Transmission
- PJM Energy Market
- PJM Regional Transmission Planning Process
- Reserve
- Accounting and Billing
- PJM Administrative
- Miscellaneous

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

About This Manual

The PJM Manual for ***Nuclear Plant Interface Coordination*** focuses on how PJM and the PJM Members are expected to coordinate operations with the Nuclear Plant Generator Operator (NPGO) to ensure the Nuclear Plant Interface Requirements (NPIRs) are addressed and implemented while maintaining Bulk Electric System reliability.

The PJM Manual for ***Nuclear Plant Interface Coordination*** consists of four sections.

The sections are as follows:

- Section 1: Nuclear Plant Interface Requirements (NPIRs)
- Section 2: Operating to the NPIRs
- Section 3: Other NPIR Issues
- Section 4: NUC-001 Requirements Not Addressed by Manual 39

Note:
When 'NPIR' or 'NPIRs' is used in this manual, it means Nuclear Plant Interface Requirements.

PJM shall work with NPGO and the appropriate PJM Committees to periodically review and update this manual and its attachments.

Note:
1: PJM and the PJM Member Nuclear Plant Generator Operators ("NPGO") and Transmission Entities ("TE"), as defined in NUC-001 (including amendments to NUC-001), covered by the NUC-001 requirements agree that Manual 39, as approved and implemented, represents an agreement, or one of the agreements, among the applicable NUC-001 covered entities that reflects the mutually agreed upon NPIRs and documents how the NPGOs and Transmission Entities shall address and implement the NPIRs. By approving and publishing Manual 39 on the PJM website, PJM acknowledges its agreement and intention to be bound by the Manual 39 requirements except as otherwise required under the PJM Tariff or any other FERC approved agreement, or any law, regulation or NERC Reliability Standard. Through the Operating Agreement (Section 11.3.2) the NPGOs and applicable TEs are required to comply with all approved and published PJM Manuals, including Manual 39 when approved and published on the PJM website except as otherwise required under the PJM Tariff or any other FERC approved agreement, or any law, regulation, or NERC Reliability Standard.

2: All capitalized terms incorporate the definitions given to those terms in the "NERC Glossary of Terms", unless otherwise specifically stated.

3: The names of responsible entities, organizational relationships and responsibilities related to the NPIRs are contained within PJM Manual 39, Attachment B – Plant Specific NPIRs.

4: Manual 39 was developed to capture in one document an overall statement of the requirements and procedures applicable to the NPGOs and relevant TEs in PJM for the purpose of satisfying NPIRs; however, because most of the requirements and procedures preceded FERC adoption of NUC-001, PJM Manual 39 contains cross-references to other manuals where requirements and procedures in compliance with NUC-001 are set forth.

Intended Audience

The Intended Audiences for the PJM Manual for ***Nuclear Plant Interface Coordination*** are:

- *PJM Nuclear Power Plant Operators and Support Staff (also referred to as the Nuclear Plant Generator Operators)* — Conduct safe nuclear plant operations and interface with transmission system operators.

- *Transmission Owners (TOs) and Generation Owners/Operators* — Conduct reliable operations of the Bulk Electric System and communicate with applicable nuclear power plant operators. Unless noted otherwise Transmission Owners listed in Manual 39 are the Transmission Owner of the substation where the nuclear plant interconnects.
- *PJM System Operators* — Conduct reliable operations of the Bulk Electric System.
- *PJM and TO Planners* – Plan for the reliable operations of the Bulk Electric System, including safe nuclear plant operations consistent with NPIRs.

References

The references to other documents that provide background or additional detail directly related to the PJM Manual for ***Nuclear Plant Interface Coordination*** are:

- PJM Manual for Control Center and Data Exchange Requirements (Manual 1)
- PJM Manual for Transmission Operations (Manual 3)
- PJM Manual for Transmission Operating Procedures (CEII) (Manual 3B)
- PJM Manual for Energy Management Systems (EMS) Model Updates and Quality Assurance (QA) (Manual 3A)
- PJM Manual for Emergency Operations (Manual 13)
- PJM Manual for Generation & Transmission Interconnection Process (Manual 14A)
- PJM Manual for PJM Regional Transmission Planning Process (Manual 14B)
- PJM Manual for Definitions & Acronyms (Manual 35).
- PJM Manual for System Restoration (Manual 36)
- PJM Manual for Reliability Coordination (Manual 37)
- PJM Manual for Operations Planning (Manual 38)
- PJM Manual for Certification and Training Requirements (Manual 40)

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
- An approval page that lists the required approvals and the revision history
- This introduction

- Sections containing the specific guidelines, requirements, or procedures including PJM actions and participant actions
- Attachments that include additional supporting documents, forms, or tables in this PJM Manual.

Section 1: Nuclear Plant Interface Requirements (NPIR)

Welcome to the Nuclear Plant Interface Requirements section of the PJM Manual for **Nuclear Plant Interface Coordination.**

This section of the manual addresses Nuclear Plant Interface Requirements.

1.1 Background

PJM and its member companies have a responsibility to ensure the safe, reliable operation of the bulk power transmission system while facilitating a fair and open energy market. The nuclear plant owners and operators have the responsibility to safely operate their facilities in compliance with all of the rules and requirements in order to protect the health and safety of the public. The licensee is accountable to the Nuclear Regulatory Commission (NRC) and personnel face possible criminal penalties for violations of the requirements of the nuclear facility license and the associated documents, including the technical specifications.

Of particular importance to both nuclear plant operations and transmission operations are those Nuclear Plant Licensing Requirements (NPLRs) included in the design basis of the nuclear plant and statutorily mandated, for:

1. Off-site power supply to enable safe shutdown of the nuclear plant during an electric system or plant event; and
2. Avoiding preventable challenges to nuclear safety as a result of an electric system disturbance, transient, or condition.

Nuclear Plant Interface Requirements (NPIRs) are requirements based on the NPLRs and Bulk Electric System requirements that have been mutually agreed to by the Nuclear Plant Generator Operator and the applicable Transmission Entities[1] to satisfy the requirements of NERC Reliability Standard NUC-001. Manual 39 serves as the basis to document the requirements of NUC-001. The Transmission Entities are required to incorporate the NPIRs into their systems and processes, and to operate the transmission system to meet the NPIRs. Planning enhancements shall be coordinated between Transmission Entities and NPGO, consistent with the PJM Manuals for PJM Region Transmission Planning Process (Manual 14B) and Generation and Transmission Interconnection Process (Manual 14A). Planning enhancements may result in either revising the NPIRs or initiating mitigation protocols to ensure the continued

[1] Transmission Entities – As originally defined by NERC Reliability Standard NUC-001-1 titled "Nuclear Plant Interface Coordination", effective April 1, 2010. Transmission Entities identified in PJM manuals which contain requirement and procedures to support NUC-001 typically include applicable Reliability Coordinators, Transmission Operators, Transmission Owners and Generator Operators (non-nuclear).

compliance with the plant NPIR limits if the NPIR limits are more restrictive than PJM Transmission System standard baseline voltage limits contained within PJM Transmission Operations Manual (M03), Section 3: Voltage and Stability Operating Guidelines.

In order to implement the appropriate limits for planning and operations, the plant specific NPIRs must be known to the applicable Transmission Entities (e.g., applicable Reliability Coordinators, Transmission Operators, Transmission Owners, Transmission Planners, Transmission Service Providers, Planning Authorities, Distribution Providers, Load-serving Entities, Generator Owners, Generator Operators, and Balancing Authorities). Further, the Reliability Coordinator, Transmission Operator, Transmission Owner and the Balancing Authority must conduct operations of the electric system that ensures that the NPIRs are met at all times. In cases where the NPIRs cannot be maintained within the specified limits, the nuclear plant must be immediately notified so that it can take action as necessary. If compliance with the NPIRs is dependent on the performance of other neighboring Transmission Planners, Transmission Operators, Reliability Coordinators or Balancing Authorities, the request must be submitted to those entities by the NPGO.

In the absence of separate bilateral or multi-lateral agreements between the NPGO, the transmission owner(s), PJM, and any applicable neighboring Reliability Coordinators (as discussed in Section 3.7), operational aspects of the NPIRs are to be performed in accordance with the requirements of the PJM agreements, manuals, and agreements with neighboring Reliability Coordinators, as applicable. Many of the requirements contained in NERC Reliability Standard NUC-001 are addressed in the PJM agreements and manuals. The remaining requirements of NUC-001 are addressed in separate agreements between the NPGOs and other applicable Transmission Entities. Contents of Plant Specific Nuclear Plant Interface Requirements (NPIRs) are documented in template format consistent with Attachment B. Due to the critical nature of the information, PJM, applicable Transmission Entities and the NPGO maintain a current revision of the NPIRs but they are not published publicly.

1.2 Implementation of the NPIRs

The NPGO is responsible for developing the NPIRs based on requirements from its licensing documentation and design basis and Bulk Electric System requirements. Proposed NPIRs are to be transmitted to the Transmission Entities and PJM with the proposed requirements that the TEs and PJM will be expected to operate to. PJM and TO Real-time communication requirements are documented in PJM Transmission Operating Procedures Manual 03B (CEII). PJM Day-ahead analysis and communication requirements are documented in PJM Operations Planning Manual 38 (M38) Attachment B: Transmission Reliability Analysis Procedure and PJM Reliability Coordination Manual 37 (M37) Attachment A: PJM Reliability Plan.

PJM Actions

PJM is responsible for the following activities:

- Receipt of proposed NPIRs as submitted by the NPGO and acknowledge receipt of the NPIRs back to the nuclear licensee. (NERC Reliability Standard NUC-001, R1)
- Incorporation of the mutually agreed NPIRs into the PJM operating requirements, including: (NERC Reliability Standard NUC-001, R4.1)
    - Obtaining the necessary data from the NPGO or other entities that are necessary to support calculation and monitoring of the NPIRs in real time operations (PJM Manual for Energy Management Systems (EMS) Model Updates and Quality Assurance (Manual 3A)).
    - Inclusion into the operating reliability analyses (See Manual M-38, Operations Planning)
    - Incorporation of the NPIRs into the PJM operating limits that are monitored by the PJM real time operating tools. (See Manual M-03, Transmission System Operations, Attachment C: Requesting Voltage Limit Exceptions to the PJM Base-Line Voltage Limits and Section 3.4.2 referencing eDART's Nuclear Voltage Limit feature).
    - Assisting the Nuclear Plant Generator Operator in coordinating with the other members and external entities to ensure that the NPIRs are included in their operating plans.
    - Operate the electric system to meet the NPIRs (NERC Reliability Standard NUC-001, R4.2)
    - Notify the Nuclear Plant Generator Operators through the TOs (in accordance with M03), when the ability to assess the operation of the electric system affecting NPIRs is lost. (NERC Reliability Standard NUC-001, R4.3)
- Incorporation of the NPIRs into the PJM planning analysis process. The frequency of planning analyses will be that which is required in the PJM RTEP process. (Manual 14B – Generation and Transmission Expansion Planning, NERC Reliability Standard NUC-001, R3, R9.2.3)
- The results of the planning analyses are made available to all participants, including the NPGOs, according to the RTEP process. (NERC Reliability Standard NUC-001, R3)
- If the planning analysis results identify the need for transmission reinforcements in the future in order to maintain compliance with the NPIRs, then PJM shall contact the NPGO to determine whether a change to the NPIRs could be implemented to reduce or eliminate the need for transmission reinforcements or whether the appropriate reinforcements are required to be constructed in a timely manner to ensure that the transmission system will be able to operate within the limits of the NPIRs at all times (NERC Reliability Standard NUC-001, R3).
- The Nuclear Generator Owner will be responsible for costs of reinforcements resulting from more limiting plant limitations.

NPGO Actions

PJM NPGOs are responsible for performing the following activities:

- Developing the NPIRs based on licensing documentation and design basis and Bulk Electric System requirements.
- Providing proposed NPIRs in writing to the applicable TEs (i.e. Transmission Owners, Balancing Authorities, Transmission Operators, Transmission Planners, Transmission Service Providers, Reliability Coordinators, Distribution Providers, Load Serving Entities, Planning Authorities, Generator Owners, and Generator Operators). (NERC Reliability Standard NUC-001, R1)
- Verifying that the NPIR transmittals have been received by all applicable Transmission Entities. (NERC Reliability Standard NUC-001, R1)
- Identifying the parameters, limits, configurations, and operating scenarios that comprise the NPIRs and, as applicable, procedures for providing any specific data not provided within the agreement. (NERC Reliability Standard NUC-001, R9.2.1)
- Establishing the ownership demarcation of the electrical facilities, so that the boundaries of operational control and the associated responsibility for maintenance are clear. (NERC Reliability Standard NUC-001, R9.3.1)
- Specifying analyses and the frequency of such analyses necessary to support the NPIRs (NERC Reliability Standard NUC-001, R9.2.3).
- NPGO shall operate per Manual 39, which was developed to satisfy the requirements of NUC-001. (NERC Reliability Standard NUC-001, R5).
- NPGO shall establish agreements with other Transmission Entities to address requirements of NERC Reliability Standard NUC-001 that are not addressed within this manual and are identified in Section 4: NUC-001 Requirements Not Addressed by Manual 39.

Transmission Owner (TO) Actions

PJM Transmission Owner(s) is responsible for the following activities:

- Acknowledge receipt of the NPIRs as submitted by the NPGO. (NERC Reliability Standard NUC-001, R1)
- Establishing the ownership demarcation of the electrical facilities, so that the boundaries of operational control and the associated responsibility for maintenance are clear. (NERC Reliability Standard NUC-001, R9.3.1)
- Incorporation of the NPIRs into the TO operating requirements, including:
    - Obtaining the necessary data from the NPGO or other entities that are necessary to support calculation and monitoring of the NPIRs in real time operations.
    - Inclusion into the operating reliability analyses. (NERC Reliability Standard NUC-001, R4.1)

- Incorporation of the NPIRs into the operating limits that are monitored by the real time operating tools and operate to those limits. (NERC Reliability Standard NUC-001, R4.2)
- Upon direction/consultation from/with PJM, inform the Nuclear Plant Generator Operator when the ability to assess the operation of the electric system affecting NPIRs is lost. (NERC Reliability Standard NUC-001, R4.3)

Section 2: Operating to the NPIRs

Welcome to the *Operating to the NPIRs* section of the PJM Manual for ***Nuclear Plant Interface Coordination***. In this section, you will find the following information:

- Outage Coordination
- Real Time Operations
- Notification for Loss of Calculation Capability
- Notification and Mitigation Protocols for NPIR voltage limits
- Emergency Operations
- System Restoration
- Remedial Action Scheme and Under Frequency Load Shedding/Under Voltage Load Shedding Scheme Coordination

2.1 Outage Coordination

PJM is responsible for coordinating and approving requests for outages of generation and transmission facilities, as necessary, for the reliable operation of the PJM RTO. PJM will coordinate outages which affect the NPIRs with the NPGO and the applicable TEs. Coordination for outages, including testing and calibration of equipment related to the NPIRs, will be in accordance with M-38, Operations Planning, Section 2 and Attachment B: Transmission Reliability Analysis Procedure. [NERC Reliability Standard NUC-001, R6 and R9.3.3]

The Transmission Owner, whose asset connects to the same substation where the nuclear plant interconnects, or results in an off-site station light and power source to be outaged or single-sourced, or results in a loss of power flow to the nuclear plant or off-site source, and is performing the work is responsible to submit and coordinate planned outages consistent with timing requirements identified in the plant specific NPIRs.

2.2 Real Time Operations

PJM and the applicable Transmission Owners will monitor the NPIR limits in real time, in accordance with PJM Transmission Operations Manual 03 and PJM Operating Procedures Manual 03B (CEII). PJM and the Transmission Entities will take action in real time, to ensure that the NPIRs are not violated. [NERC Reliability Standard NUC-001, R4.2, R5]

2.3 Notification for Loss of Calculation Capability

The continuous calculation and monitoring of post-contingency voltages for nuclear power plants (for the loss of the nuclear unit) is an important requirement to ensure that adequate

voltage is always available for the operation of the nuclear safety systems. Given this requirement, the nuclear power plant(s) shall be notified in cases where the transmission monitoring capability (at PJM and the Transmission Owner) becomes unavailable and the ability to calculate the post-contingency voltages is lost. [There may be situations where the calculations are only being performed at PJM. In this case, loss of the PJM capability shall trigger the notification to the nuclear power plant(s).] The notification will go via the All-Call from PJM to the Transmission Owner(s) who will then communicate with the applicable nuclear power plant(s) consistent with PJM Transmission Operating Procedures Manual 03B (CEII) [NERC Reliability Standard NUC-001, R4.3]. Such notification shall occur within 30 minutes of the loss of EMS capability [NERC Reliability Standard NUC-001, R9.3.4]

2.4 Notification and Mitigation Protocols for NPIR Voltage Limits

The maintenance of acceptable actual and post-contingency voltages at the substations of nuclear power plants is critical to assuring that the nuclear safety systems will work properly if required. In order to provide this assurance, the nuclear power plant operators must be notified whenever actual or post-contingency voltages are determined to be below acceptable limits. This requirement applies to all contingencies involving the tripping of the nuclear plant generator or any transmission facility as the contingent element. The notification is required even if the voltage limits are the same as the PJM standard baseline voltage limits. [NERC Reliability Standard NUC-001, R4.3]

Generally, nuclear plants have voltage limits that are more restrictive than the PJM standard baseline voltage limits. In the case where standard PJM voltage limits, as defined by the Transmission Owner (TO), are more restrictive, PJM will direct redispatch without consultation of nuclear plants after all non-cost measures are implemented; however, PJM will still notify the NPGO of the violation to the limit. [NERC Reliability Standard NUC-001, R4.2] In the case where NPIR voltage limits are more restrictive than standard PJM voltage limits, all costs required to mitigate the violations will be borne by the generation owner.

PJM's EMS models and operates to the most restrictive substation voltage limit for both actual and N-1 contingency basis. PJM will initiate notification to nuclear plants if the PJM EMS results indicate nuclear substation voltage violations. This notification should occur within 15 minutes for voltage contingency violations and immediately for actual voltage violations. To the extent practical, PJM shall direct operations such that the violation is remedied within 30 minutes. [NERC Reliability Standard NUC-001, R9.3.4]

2.4.1 Communication

All communication of future and current operations between PJM and the nuclear plant related to the NPIR voltage limits should be through the Transmission Owner (TO). If there is any confusion about a communication, the plant can talk directly with PJM, however, the Transmission Owner should be apprised of the discussion. If direct discussions are needed between PJM and a nuclear plant the preferred method would be a 3-way call among all parties

(i.e., inclusion of TO). If off-cost operations are required based on a more restrictive NPIR voltage limit, the nuclear plant or their representative (e.g., Nuclear Duty Officer) may consult with the related Market Operations Center (MOC), as defined within the PJM Operating Agreement Section1.3.12, and evaluate whether an alternative such as operating at a reduced output would alleviate the voltage violation and is more cost effective. PJM will provide the approximate nuclear plant reduction, if applicable. (NERC Reliability Standard NUC-001, R9.4.1)

All communication of imminent or actual real-time operations should be through the Transmission Owner (TO) of the substation where the nuclear plant interconnects.

All communication regarding outage planning should be facilitated by the asset owner submitting the planned outage.

Attachment A, entitled Nuclear Plant Communications Protocol, provides additional background materials and defines roles and responsibilities to ensure appropriate communications between NPGO and Transmission Entities. PJM Control Center Requirements Manual (M01) Section 4: Voice Communications details 3-part communication requirements.

2.4.2 Information Exchange

Normally, PJM does not provide information relative to transmission operation to any individual market participant without providing that information to all. However, in this unique condition where the public health and safety requirement is to have a reliable source for safe unit shutdown and/or accident mitigation; it is imperative that specific information be provided to a nuclear plant (this information should not be provided to their marketing members). If PJM observes voltage violations or anticipates voltage violations (pre or post-contingency) at any nuclear stations, PJM is permitted to provide the nuclear plant with the actual voltage at that location, the post-contingency voltage at that location (if appropriate) and limiting contingency causing the violation. The operation for more restrictive NPIR limits at these nuclear stations should not be posted or provided to the Market via Data Viewer, once off-cost operations are initiated. PJM Transmission Operations Manual 03 and PJM Transmission Operating Procedures Manual 03B (CEII) contains the defined procedures to analyze and communicate plant specific NPIR or PJM limit violations to the NPGO.

PJM Action

- PJM shall notify the nuclear plant, through the Transmission Owner, of calculated post contingency voltage violation of the Nuclear Plant Generator Operator requirements (Transmission Owner or more limiting voltage limits defined in the NPIRs).
- PJM shall notify the nuclear plant, through the Transmission Owner, of violations to actual voltage limits (Transmission Owner or more limiting voltage limits defined in the NPIRs). Actions taken to mitigate violations of more restrictive NPIR limits must be agreed upon by the nuclear plant and logged by PJM.
- All non-cost actions should be implemented prior to MW adjustments.

- All costs required to mitigate violations of more restrictive NPIR voltage limits will be borne by the generation owner.
  - Controlling actions must be cost-capped, if applicable.
  - LMP shall not be used to control the voltage at these locations.
  - TLR shall not be used to control the voltage at these locations.
- PJM shall notify the nuclear plant, through the Transmission Owner, when the voltage level is restored within limits (and stable).
- PJM shall attempt to control more restrictive NPIR voltage limitations within 30 minutes.
- PJM will continue to monitor the appropriate voltage limits based on changes provided.

Transmission Owner Action

- Transmission Owner shall independently monitor for Nuclear Plant actual and contingency voltage violations as reflected on the Transmission System.
- Transmission Owner will communicate notifications from PJM to the nuclear plant (Transmission Owner or more limiting NPIR voltage limit violations).
- Transmission Owners will monitor the appropriate voltage limits based on changes to more limiting NPIR voltage limits as provided by the Nuclear Plant Operator.

NPGO Action

- Nuclear plant will notify PJM when different (new or default) temporary or permanent voltage limits shall be used based on various plant service loading conditions. Revised Nuclear Voltage Limits (permanent or temporary) will be communicated through eDART's Nuclear Voltage Limit feature or PJM Manual for Transmission Operations (M03), Attachment C: Requesting Voltage Limit Exceptions to the PJM Base-Line Voltage Limits.
- Determine internal plant options, and if appropriate, provide revised NPIR voltage limits.
- Coordinate with MOC to evaluate PJM provided redispatch option (no cost or unit information will be provided).
- Provide PJM with decision to redispatch – if applicable.
- Provide PJM with decision that nuclear plant will closely monitor plant activities and will take action within the plant if conditions change and inform PJM not to implement off-cost.
- Provide PJM with clear direction if they do not want PJM to perform redispatch.

Note:
PJM's goal is to resolve all security violations (i.e., N-1 contingency) within 30 minutes, however; inherent communication delays related to off-cost agreement for NPIR voltage limits may not permit this goal to be achieved.

2.5 Emergency Operations

Emergency operations are conducted in accordance with PJM Manual, M-13, Emergency Operations. Any situation or operation that either impacts or could impact the continuing ability to comply with the NPIRs must be communicated to the nuclear plant, as provided for in the manual. The process for communicating is explained in Attachment A, Nuclear Communications Protocol. [NERC Reliability Standard NUC-001, R9.4.1 and R9.4.2)]

2.6 System Restoration

System restoration is conducted in accordance with PJM Manual, M-36. PJM and the Transmission Owner will provide the Nuclear Plant Generator Operator provisions for coordination during an off-normal or emergency event affecting NPIRs, including timely information explaining the event, an estimate of when the system will be returned to a normal state, and the actual time the system is returned to normal. (NERC Reliability Standard NUC-001, R9.3.5 and R9.4.2).

Offsite power should be restored as soon as possible to nuclear units, both to units that had been operating and to those units that were already offline prior to the system disturbance, without regard to using these units for restoring customer load. There is a heightened urgency if the nuclear plant has lost both offsite and onsite AC power (NERC Reliability Standard NUC-001, R9.3.5).

Safe shutdown loading shall be considered in the following manner in the plant specific NPIRs:

- *For the purpose of determining the TO/TOP zonal blackstart requirement for critical load, as defined in PJM Manual 36, the minimum required load capability of an offsite power source, in order to maintain the unit(s) in safe shutdown and to allow the transition to cool down using the main condenser, are xx.x MVA* at yy.y% power factor for Unit 1 and xx.x MVA at yy.y% power factor for Unit 2 The load capability also allows transition from natural circulation. Providing offsite power for Plant XXX is a restoration priority. The target restoration time of four hours is to be a drilled upon goal - however it is not a requirement since restoration times will be dependent on the nature of the LOOP event.*

2.7 Remedial Action Schemes and Under Frequency Load Shedding/ Under Voltage Load Shedding Coordination

Any transmission system Remedial Action Schemes (RAS) and any programs that reduce or shed load based on underfrequency or undervoltage conditions, such as Under Frequency Load Shedding or Under Voltage Load Shedding (UFLS/UVLS) schemes that affect the nuclear plant, shall be coordinated with the nuclear plant and identified in the plant interface agreements with the Transmission Owners. Transmission Owners shall communicate any changes to such

schemes to the NPGO to facilitate the process to update the interface agreements as required (NERC Reliability Standard NUC-001, R9.3.7).

Section 3: Other NPIR Issues

Welcome to the *Other NPIR Issues* section of the PJM Manual for **Nuclear Plant Interface Coordination**. In this section, you will find the following information:

- Changes to the NPIRs
- Reporting and Investigation of Unplanned Events
- Training
- Dispute Resolution
- Periodic Review of Manual
- Nuclear Plant Deactivations and Retirements
- Coordination Functions Between Reliability Coordinators

3.1 Changes to the NPIRs

The NPGO shall inform PJM and the other applicable Transmission Entities whenever there is a proposed change to the NPIRs. Similarly, PJM and the Transmission Entities shall inform the NPGO whenever there is an actual or proposed change to the transmission system that can impact the ability of the electric system to meet the NPIRs. All such changes need to be communicated as soon as known, as monitoring systems and operator training may need to be updated to support the change. It is important that there be a clear understanding between the NPGO, PJM, and the other applicable Transmission Entities as to when the change becomes effective, so that there be no discontinuity or confusion in compliance requirements. [NERC Reliability Standard NUC-001, R7, R8]

Revisions to nuclear plant specific NPIRs may require actions to be implemented by one or more parties prior to formal incorporation of the NPIRs into Manual 39. In general, the milestone date(s) for the implementation / required actions by one or more parties should be documented in formal correspondence between the parties.

PJM stakeholder / committee approval of nuclear plant specific NPIR revisions is not required; however, PJM will post notification of changes to M39 Attachment C Plant Specific NPIR Revision History as informational updates on the respective PJM stakeholder meeting agendas. The effective date of revised plant specific NPIRs may be prior to the effective date of the version of Manual 39 that includes the revised NPIRs.

Editorial changes such as name changes to applicable Transmission Entities or to the NPGO listed in the NPIRs do not necessitate an immediate revision to the NPIRs and may be incorporated into the next revision to the NPIRs and/or Agreements (including Manual 39).

PJM Actions

- Receive proposed changes to the plant specific NPIRs from the NPGO.
- Identify changes that may impact the ability of the electric system to meet the NPIRs and communicate that information to the Transmission Entities and the NPGO.
- Incorporate NPIR changes into monitoring systems, planning criteria, analysis techniques, operator training materials, etc. to ensure that the modified NPIRs will be properly considered in real time operations and planning studies.
- Inform the NPGO of actual or proposed changes to electric system design (e.g., protective relay setpoints), configuration, operations, limits, or capabilities that may impact the ability of the electric system to meet the NPIRs. (NERC Reliability Standard NUC-001, R7)

NPGO Action

- Provide a redline version of the proposed NPIR, including proposed changes to nuclear plant design, configuration, operations, limits, protection systems, or capabilities that may impact the ability of the electric system to meet the NPIRs. The NPIRs shall be provided in writing to the TEs (i.e. Transmission Owner(s), Balancing Authorities, Transmission Operators, Transmission Planners, Planning Authorities, Transmission Service Providers, Reliability Coordinators, Distribution Providers, Load Serving Entities, Generation Owners and Generation Operators) as applicable.
- Communicate with PJM, other members, and external entities, to explain and clarify the proposed changes to the NPIRs and its incorporation into the operations of PJM and the other members.
- Once all parties concur with NPIR revisions, provide both redline (including all changes from the previous version) and clean versions of the updated NPIRs that include an effective date.

Transmission Owner Actions

- Receive proposed changes to the NPIRs from the NPGO.
- Incorporate NPIR changes into monitoring systems, analysis techniques, operator training materials, etc. to ensure that the modified NPIRs will be properly considered in real time operations.
- Inform the NPGO of actual or proposed changes to electric system design (e.g., protective relay setpoints), configuration, operations, limits, or capabilities that may impact the ability of the electric system to meet the NPIRs (NERC Reliability Standard NUC-001, R7).

3.2 Reporting and Investigation of Unplanned Events

PJM, Transmission Owners and the NPGO shall coordinate investigations of causes of unplanned events affecting the NPIRs and develop solutions to minimize future risk of such events. Unplanned events that impact the NPIRs may be reported to governmental agencies as required. If such events meet the reporting criteria to DOE and NERC EOP-004 requirements

the event may result in several responsible entities submitting a report for the same event. Additional guidance on reporting requirements is provided in PJM Manual for Emergency Operations (M-13), Attachment J: Disturbance Reporting—US Department of Energy (Electric Emergency Incident and Disturbance Report). [NERC Reliability Standard NUC-001, R9.4.4] The event may also be investigated according to the PJM Event Investigation Process, which is included in PJM Manual M-13, Emergency Operations, Attachment K, “Event Analysis Process”. [NERC Reliability Standard NUC-001, R9.4.3]

3.3 Training

Specific training on this manual is included in the curriculum for the PJM System Operators (PJM Dispatch, PJM Transmission Owners and Market Operations Centers). Specific training for the member operators will be conducted as part of the PJM Initial Training Program and refreshed on a periodic basis at the annual PJM Spring Operator Seminar. PJM System Operator training requirements are defined within PJM Manual for Certification and Training Requirements (Manual 40). [NERC Reliability Standard NUC-001, R9.4.5]

3.4 Dispute Resolution

Should the execution of the requirements of this process, which are embodied in the PJM agreements and manuals, result in a dispute between any interested parties, the PJM Dispute Resolution Procedures (Schedule 5 of the PJM Operating Agreement) shall be used.

3.5 Periodic Review of Manual

PJM will lead a periodic review of this manual sponsored by the System Operations Subcommittee, with support from the Nuclear Generator Owners/Operators Forum (NGOF), with a periodicity not to exceed every 3 years. PJM will add revised NPIRs in Attachment B and update revision history in Attachment C.

3.6 Nuclear Plant Deactivations and Retirements

Once a nuclear generating unit is permanently shut down the unit will no longer be part of the Bulk Electric System as a generating resource and NERC Standard NUC-001 will no longer be mandatory and enforceable to the NPGO, PJM, or the associated Transmission Entities. The process for changes to NERC Registration are dependent on how the GO is registered with NERC and the specific requests from the applicable NERC Region, however, there are critical considerations during the transition from permanent shutdown through decommissioning that should be evaluated and coordinated with PJM and any other associated NUC-001 Transmission Entities. Early coordination with PJM is encouraged to ensure transition to decommissioning status adequately addresses the nuclear plant’s decommissioning needs.

Critical considerations that may affect the date the PJM NPGO revises its NERC registration and terminates the associated NPIRs will be unique to each nuclear generating unit but should include an evaluation of the following at a minimum:

- Date of nuclear generating unit final shutdown and generator output breakers opened.
- Date fuel is offloaded from the reactor.
- Station Blackout (SBO) Agreement termination.
- NRC notifications and implementation of Permanent Defueled Technical Specifications (PDTS).
- Electrical configuration post shutdown and permanent (physical) separation from the grid as a generating unit.
- Restoration Plan considerations/revisions (may need to be coordinated with the TO).
- Design Changes with potential to affect the BES.
- Potential revisions to existing Agreements or generation of new Agreements to support power supply as a retail customer.

PJM NPGOs are responsible for performing the following activities:

- Notifying PJM of the impending permanent shutdown and decommissioning activities related to registration changes, the NPIRs, and M39.
- Notifying PJM of the proposed timeline for the permanent shutdown, NERC registration changes, termination of the NPIRs, and inclusion as an applicable nuclear plant listed in M39 Attachment C.

3.7 Coordination Functions Between Reliability Coordinators

In certain cases, the PJM member NPGOs may identify an applicable Transmission Entity (TO/TOP/GO) that is not a member of PJM but may be a member of another Reliability Coordinator (e.g., Midcontinent Independent System Operator (MISO)). Examples may include configurations where the nuclear generating unit is physically located within PJM on the “border” near the neighboring Reliability Coordinator and one or more of the offsite power lines supporting the NPIRs are owned by a TO that is not a member of PJM (a “non-member”); the remote end of a transmission line supplying an offsite power line for the NPGO is owned and/or operated by a non-member TO/TOP; or a dedicated non-nuclear generating unit supporting the NPIRs as a Station Blackout (SBO) resource is owned and/or operated by a non-member GO/GOP.

PJM and the NPGO shall coordinate with the non-member Transmission Entity and the other Reliability Coordinator as necessary to ensure that all provisions that support the interactions between Reliability Coordinators are addressed in agreements between the Reliability Coordinators.

Coordination between the Reliability Coordinators may include the following provisions:

- References to necessary operating guides or procedures, as appropriate, to meet the applicable NPIRs.
- Coordination on weather emergencies
- ICCP links to facilitate real-time data transmittal associated with the non-member Transmission Entity owned facilities (including ICCP link failure protocol)

Section 4: NUC-001 Requirements Not Addressed by M39

Welcome to the *NUC-001 Requirements Not Addressed by M39* section of the PJM Manual for **Nuclear Plant Interface Coordination**. In this section, you will find the following information:

- Additional NPGO Requirements

4.1 Additional Nuclear Plant Generator Operator Requirements

In order to fully comply with NERC Reliability Standard NUC-001, the PJM NPGO shall establish one or more agreements with applicable Transmission Entities to address requirements of NERC Reliability Standard NUC-001 and the NPIRs that are not explicitly addressed within the body of this manual.

Attachment B of M39 contains the complete set of NPIRs for each nuclear plant as defined in NUC-001. For the requirements not handled in the body of M39, separate agreements will need to be established between NPGOs and the other applicable Transmission Entities. PJM Manual 39 applies to the subset of NPGO NPIRs and NERC Reliability Standard NUC-001 requirements applicable as a result of PJM's function as a Transmission Operator (TOP), Reliability Coordinator (RC), and Planning Authority (PA). The applicable requirements are identified in each nuclear plant NPIRs (Attachment B of M39) and further detailed within the body of this manual.

Given PJM's function as a TOP, RC and PA for the NPGO, some of the NUC-001 requirements do not apply to PJM. Specifically, the following NUC-001 Requirements do not apply to PJM as a TOP, RC or PA:

NUC-001 Requirement	Description	Reason not Applicable to PJM
R5.	Per the Agreements developed in accordance with this standard, the Nuclear Plant Generator Operator shall operate the nuclear plant to meet the NPIRs.	This requirement is specific to the Nuclear Plant Generator Operator and does not apply to PJM.
R7.	Per the Agreements developed in accordance with this standard, the Nuclear Plant Generator Operator shall inform the applicable	This requirement is specific to the Nuclear Plant Generator Operator and does not apply to PJM.

NUC-001 Requirement	Description	Reason not Applicable to PJM
	Transmission Entities of actual or proposed changes to nuclear plant design (e.g., protective relay setpoints), configuration, operations, limits, or capabilities that may impact the ability of the electric system to meet the NPIRs.	
R9.3.6.	Coordination of physical and cyber security protection at the nuclear plant interface to ensure each asset is covered under at least one entity's plan.	This requirement is the responsibility of the asset owners and PJM does not own any of the applicable assets. This requirement is specific to the Nuclear Plant Generator Owner and applicable Transmission Owner, and is therefore not applicable to PJM.

PJM Actions

- PJM shall provide support to NPGO to assist in identifying applicable Transmission Entities that the NPGO may have to establish agreements with to comply with NUC-001.

NPGO Action

- NPGO shall establish necessary agreements with applicable Transmission Entities to ensure compliance with NUC-001.

Transmission Owner Actions

- Transmission Owner shall provide support to NPGO to assist in identifying other entities that the NPGO may have to establish agreements with to comply with NUC-001.
- Transmission Owner shall work with NPGO to establish agreements necessary to comply with NUC-001.

Attachment A: Nuclear Plant Communications Protocol

A.1 Purpose

PJM and its member companies have a responsibility to ensure the safe, reliable operation of the bulk power transmission system while facilitating a fair and open energy market. The nuclear plant owners and operators have the responsibility to safely operate their facilities in compliance with all of the rules and requirements in order to protect the health and safety of the public. The proper execution of these responsibilities by the respective set of parties can have very significant impact on the others. The collective requirements are not mutually exclusive but support the business needs of nuclear and transmission as they both strive to maintain operational excellence.

It is imperative that the nuclear plant owners and operators, the transmission owning members of PJM, and PJM work seamlessly together to carry out these significant responsibilities. A key aspect of that mutual effort to achieve operational excellence is to provide accurate and timely communications among the parties so that all operations are conducted safely and reliably.

Given that the respective regulatory obligations and lexicons are different, the purpose of this document is to provide explanatory information for both the nuclear and transmission businesses to enable the seamless cooperation and communication that we all seek. Also, each business needs to understand the key phrases and terms that each other use to signify critical events that require open and immediate response from the other. Understanding and properly using the key phrases will ensure that each business supports the other in the proper execution of their respective responsibilities and obligations.

This document provides examples of significant events that require implementation of this protocol document in order to ensure safe and reliable operation of both the transmission system and nuclear generation facilities.

A.2 Nuclear Safety

The Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974, "empowers the NRC to establish by rule or order, and to enforce, such standards to govern these uses as the Commission may deem necessary or desirable in order to protect health and safety and minimize danger to life or property."[2]

"The nuclear industry is strictly regulated because radioactive materials are potentially hazardous. Radioactive materials give off radiation, which can be hazardous to people exposed

[2] NRC Website

to it in significant amounts. The amount of harm depends on the type and amount of radioactive material, the distance between the source of the radiation and a person, and the length of time a person is exposed to the radiation. If radioactive materials are properly handled and regulated, they do not pose a significant risk to the public or to workers.[3]

A.3 Grid Reliability

Bulk-power systems are fundamentally different from other large infrastructure systems, such as air-traffic control centers, natural-gas pipelines, and long-distance telephone networks. Electric systems have two unique characteristics:

- The need for continuous and near instantaneous balancing of generation and load, consistent with transmission-network constraints. This requires metering, computing, telecommunications, and control equipment to monitor loads, generation, and the voltages and flows throughout the transmission system, and to adjust generation output to match load. Generation must follow load in near real time because it is difficult and expensive to store electricity.
- The transmission network is primarily passive. Unlike natural gas pipelines, transmission grids have few "control valves" or "booster pumps" to regulate electrical flows; control actions are limited primarily to adjusting generation output and to opening and closing switches to add or remove transmission lines from service.

These two unique characteristics lead to four reliability consequences with practical implications that dominate power system design and operations. The consequences are:

- Every action can affect all other activities on the grid. Specifically, changes in the locations and amounts of power generated and consumed, and in the configuration of the transmission grid can affect flows throughout the system. Therefore, the operations of all bulk-power participants must be coordinated.
- Cascading problems that increase in severity are a real problem. Failure of a single element can, if not managed properly, cause the subsequent rapid failure of many additional elements, disrupting the entire transmission system.
- The need to be ready for the next contingency, more than current conditions, dominates the design and operation of bulk-power systems. It is usually not the present flow through a line or transformer that limits allowable power transfers, but rather the flow that would occur if another element fails.
- Because electricity flows at nearly the speed of light, maintaining reliability often requires that actions be taken instantaneously (within fractions of a second), which requires computing, communication, and control actions that are automatic.[4]

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[3] NRC Website NUREG/BR-0164, Rev. 9 June 2012

[4] Hirst, Eric. Electric Reliability—Potential Problems and Possible Solutions. May 2000 , page 4.

A.4 Operating Philosophy

A.4.1 Nuclear Safety

Nuclear Risk Management

Nuclear power plants assess risk based on a plant risk model, usually a computer model, at various plant operating conditions. The objective of risk management is to control risk increases from maintenance activities on Maintenance Rule[5] (10CFR50.65) structure systems and components (SSCs). While the plant may experience an increase in instantaneous risk during scheduled activities, the overall plant risk will decrease as a result of the activities. Preventative and corrective maintenance and modifications control the aging process, renew equipment and correct deficiencies in the equipment. The equipment reliability is improved as a result of the activities.

The risk program will protect systems and equipment vital to the safe shutdown of the nuclear units. Performing work on maintenance rule equipment for any reason - corrective or preventative maintenance, surveillance testing, etc. - removes the equipment from its normal alignment. The additional risk involved with these evolutions must be assessed. The results of the assessment must then be used to manage the risk based on the magnitude and duration of the risk impact, the nature of the activity and other factors.

Nuclear Safety Significant

A condition or potential condition which can lead to operation in a degraded mode, with regard to safety systems, which may exceed the Limiting Conditions for Operation (LCO) as defined by the nuclear plant specific Technical Specifications. Events declared as "Nuclear Safety Significant" by the nuclear plant operators are with the intent to minimize the consequences of undue risk to the public health and safety. In these scenarios, requests for information that may ordinarily be understood as market sensitive due to Code of Conduct concerns should be granted as the nuclear safety concerns are paramount.

A.4.2 Transmission

The Bulk Electric System is planned, maintained and operated such that it can withstand the loss or outage of any single element, such as a transmission line, transformer, or generation plant or contingency without causing the remaining elements of the system to become overloaded or to cause cascading outages.

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[5] Maintenance Rule equipment generally includes any equipment that could cause a plant trip and may include switchyard equipment and other non-safety related equipment. The purpose of the Maintenance Rule is to monitor and analyze important plant equipment to ensure that the overall maintenance program related to this equipment is effective.

The philosophy is contained in the purpose statement from NERC Reliability Standard TOP-004, Transmission Operations:

"To ensure that the transmission system is operated so that instability, uncontrolled separation, or cascading outages will not occur as a result of the most severe single Contingency and specified multiple Contingencies."

To ensure that the N-1 operating philosophy is not violated, PJM and the other control area operators of North America use analytical tools which simulate the loss of each element (a contingency) and calculate that the remaining system will be secure from the thermal (conductor or equipment heating), voltage (magnitude and stability) and stability (transient and dynamic) perspectives. (In PJM's case, the analysis is on-line, running approximately every minute.) If the security analysis program identifies a contingency or actual violation, PJM's operators will initiate any number of actions, including re-dispatch of generation, reconfiguring the transmission system (e.g. opening lines, removing equipment from service, etc.), invoking emergency procedures, or interrupting load or combinations of the above. Normally, the consequences of not responding correctly or timely enough is to cause protective devices on the equipment to operate taking the equipment out of service. However, such events can also lead to catastrophic equipment failure from overheating, or induce a cascading outage which can interrupt large numbers of customers, etc.

A.5 Roles and Responsibilities

A.5.1 Nuclear Plant Operations

Operate in compliance with the license

The nuclear plant must operate in accordance with the provisions of its license. It is accountable to the NRC and personnel may face criminal penalties for violations of the requirements of the license and the associated documents, including the technical specifications.

Any request for a nuclear plant to deviate from any regulatory requirement must allow time for the plant owner, the Transmission Owner, and PJM to approach the NRC with the appropriate analysis to justify the request. It is simply not possible for the nuclear plant to honor such requests in real time. Also, such a request will only be considered when the electrical system emergency is such that there is significant risk of widespread outages impacting large numbers of consumers. Therefore, it is imperative that PJM, through the Transmission Owner and the applicable market operations center, fully inform the nuclear plant of any impending system problems or emergencies that could require unusual operations by the nuclear plant.

Inform Market Operations Center (MOC) and/or Local Control Center (LCC) of impending plant status changes or regulatory circumstances that could impact power production

Nuclear plant generation is a very significant portion of the PJM generating assets. As such, any changes to the ability of the nuclear plants to provide energy will likely have significant impacts

to PJM's generation schedule and will be difficult to replace in a short period of time. Therefore, it is very important that any condition of the nuclear plant's operational capability be communicated to the MOC, the associated LCC, and to PJM so that analysis can be conducted to assess any system impacts and to develop contingency plans. Following notification, through established communication channels with the associated LCC and PJM as detailed in Section 2.4.1, of a grid-side event that impacts the NPIRs, the nuclear plant shall in turn communicate through the established communication channels, any resultant limiting conditions experienced at the plant, such as but not limited to offsite power no longer being considered operable, or initiation of shutdown sequence to comply with a Technical Specification requirement. This is intended to ensure PJM and LCC awareness of impacts to the plant as they operate the system to meet the NPIRs.

Coordinate maintenance outages with MOC and/or LCC

Normally, the nuclear plant outages are planned far in advance. However, there can be situations where transmission work needs to be done during the window of the nuclear plant outage. Such coordination is important to ensuring that the minimum amount of outage time is needed to accomplish the necessary maintenance for the nuclear plants and the transmission facilities.

Respond to transmission system operator requests

Requests from the transmission system operators will come into the nuclear plant from the MOC or the LCC. In some circumstances, the various parties may be convened by PJM on a conference call. All requests need to be complied with on a timely basis after consideration of consequences to nuclear safety, personnel safety, and equipment protection. If there are questions or doubts in the nuclear plant operators' minds, the request should be questioned with the requestor and elevated as necessary to assure that there is understanding of the situation and the request.

A.5.2 Affiliated Power Marketer Operations Center (MOC)

Inform PJM of nuclear plant conditions that could impact the continued power production of the nuclear plant.

If there are conditions that have the potential to result in a nuclear plant reducing generation or going off-line, the LCC and PJM need to know as soon as possible. If the situation is regulatory-related, that is important information that needs to be conveyed.

Submit bidding information for applicable nuclear plants.

The MOC needs to understand the business implications of any nuclear and transmission system situation that could impact the nuclear plant operations so that it can accurately reflect the impact into the market. The MOC shall interface with PJM regarding maintenance outage requests and other potential reliability issues.

If the situation will require the nuclear plant to taken off-line, the MOC shall process the appropriate outage request for approval by PJM.

A.5.3 Transmission Owner Local Control Center (LCC)

The LCC shall inform the nuclear plant operations staff of system events or conditions that could impact the continued safe operation of the nuclear plant.

The LCC is a critical link in the communications chain from PJM to the nuclear plant and back. The LCC also has the clearest picture of the local situation in the vicinity of the nuclear plant and can be an important facilitator in the discussions between PJM, the MOC, and the nuclear plants.

A.5.4 PJM Control Center

Operate the transmission system in accordance with NERC Reliability Standards, regional reliability council requirements, PJM agreements, and PJM manuals.

PJM is responsible for the safe and reliable operation of the transmission facilities on behalf of the PJM Transmission Owners. PJM is accountable to FERC, NERC, the Regional Entities, the PJM members, and the various state regulatory bodies who have oversight responsibility for PJM's activities.

In an emergency situation, PJM has the authority to direct any necessary action to be taken to preserve the reliability of the system. Normally, PJM will work directly with the LCCs to accomplish these actions, but there may be situations where PJM will need to gather the nuclear plant operators, LCCs, MOCs together to explain a request for coordinated action by all parties.

PJM shall inform the LCC and MOC of system conditions and events that need to be communicated to nuclear plant operations.

Timely information is the key for permitting the proper response to any operating situation. Regarding the nuclear plants, it is important to convey the details behind the event, so that the need for understanding that is ingrained in the nuclear business can be satisfied.

It is incumbent upon PJM to keep timely and accurate information flowing to all of the operating entities during the course of transmission system events. Effective concerted action can only be accomplished when the all of the operating entities completely understand the situation and their role in implementing the solution. In order to facilitate rapid communications to the nuclear plant, the Code of Conduct should be bypassed when conditions are such that the nuclear plant needs to have immediate information on the transmission system.

Facilitate communications among nuclear plant operations, MOC, and LLC as necessary to ensure that nuclear plant and transmission system event information is transferred and understood by the respective operational entities.

Ensuring that all entities understand the situation and are clear in their role in the response is the key to successfully mitigating any negative impacts. Since the level of understanding of the transmission system may be an issue, PJM must strive to get the right parties together and take the time to explain what is happening and what response PJM seeks.

A.6 Implementation of the Protocol

A.6.1 Event Initiation and Identification

Normal Communications

Communications between and among the nuclear plants, MOCs, LCCs, and PJM should be in accordance with accepted professional practices. There is a need to be able to clearly direct and communicate instructions in a timely manner to ensure safe and reliable operations. Nothing in this protocol supersedes the need for professional behavior by all of the parties.

Special Situations

There will be special situations where the need to communicate rapidly and clearly will be heightened. The need for clear, accurate communications will be even more important due to the impact either to nuclear safety or transmission system reliability or both. All parties need to be prepared to understand the language used and the implications associated with the situation. Listed below are the special terms to which all parties need to be especially attentive. (The following is not intended to be an all-inclusive list, but is meant to identify many of the situations that operators can be expected to face.)

KEY NUCLEAR TERMS

Limiting condition for operation (LCO)

The section of Technical Specifications that identifies the lowest functional capability or performance level of equipment required for safe operation of the facility. Failure to resolve the LCO within the established timeframe will result in a controlled shutdown of the plant. Nuclear Power Plants are required to follow the actions of the LCO unless prior NRC approval is obtained.

Implication: If the LCO time period ends without satisfactory resolution of the problem, the nuclear plant is required to immediately implement a safe shutdown of the plant. Immediate replacement of the energy of the plant will be necessary. During the course of any LCO event, the transmission system operators should be planning for the potential loss of that plant's energy at the end of the LCO time limit. [Bear in mind that multiple unit sites can have differing requirements and an LCO may apply to one or all units at the site.]

Safety limit

A restriction or range placed upon important process variables that are necessary to reasonably protect the integrity of the physical barriers that guard against the uncontrolled release of radioactivity. The nuclear plant cannot violate these limits under any circumstances.

Implication: When the nuclear plant communicates that it is up against a safety limit that is the end of any discussion about providing any additional output (MW or MVAR).

Safety related

The managerial controls, administrative documents, operating procedures, systems, structures, and components that have been designed to mitigate the consequences of postulated accidents that could cause undue risk to public health and safety.

Implication: When the nuclear plant reports degradation of safety related equipment (nuclear safety system unavailability, diesel generator unavailability, off site power loss, etc.), a serious situation exists which the nuclear plant is required to immediately resolve or face near-term shutdown. Any assistance that can be immediately rendered should be dispatched. Plans should be developed to replace the plant's energy.

SCRAM

The sudden shutting down of a nuclear reactor, usually by rapid insertion of control rods, either automatically or manually by the reactor operator. (May also be called a reactor trip)

Implication*:* A SCRAM is an unplanned manual or automatic trip of a Nuclear Plant. In many cases the initiating event of a SCRAM may not be known. In these situations the Transmission system operators should be supportive to the nuclear plant information request, as the nuclear plant operators may need expeditious answers to questions from regulator or plant oversight safety review committees.

Reactor Shutdown

A decrease in the rate of fission (and heat production) in a reactor.

Implication: A nuclear plant is never completely out of service, unless it is decommissioned. A nuclear plant in shutdown mode still is required to have its safety systems and off site power sources in service and maintain them in service throughout any outage.

Technical Specifications

Part of an NRC license authorizing the operation of a nuclear production or utilization facility. A Technical Specification establishes requirements for items such as safety limits, limiting safety system settings, limiting control settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls.

Implication: Technical specifications are non-negotiable, mandatory requirements that the nuclear plant must comply with as part of its license to operate. Requesting that the nuclear plant provide a variance to a technical specification is simply not an option.

Notice of Enforcement Discretion (NOED)

Term used when the nuclear facility goes to the NRC to request an extension of an LCO to prevent plant shutdown when the LCO limit is reached. NRC can grant extension of LCO time if the nuclear facility can demonstrate that they know precisely the problem (i.e. they are not troubleshooting) and a clear time estimate to fix the problem is available.

Implication: In order to provide this discretion to the nuclear plant, the NRC may require detailed information from the transmission operators that would provide the justification for granting this discretion. These requests should be immediately elevated to management for a response.

KEY TRANSMISSION TERMS

First Contingency Violation

The transmission system is operated so that the single loss of any facility (line, generator, etc.) will not result in violation of any operating limit. The single loss is called the first contingency. The transmission operators have software that simulates the first contingency individually for a number of facilities on the system.

Implication: The operators are required to correct any first contingency violation that will violate the emergency ratings on any facility within a period of time (normally within 30 minutes). If the operators ask the nuclear plant to take action as the result of the first contingency violation, the action should be implemented unless the action will jeopardize nuclear safety, personnel safety, or equipment protection.

Actual Overload/Voltage Violation

The transmission operators receive telemetered data from a large number of facilities and are monitoring actual thermal overloads (excessive flow) and actual voltages. Violations are alarmed and require immediate action from the operators to prevent equipment damage.

Implication: Actual overloads need to be mitigated quickly (minutes). Requests to the nuclear plant should be accommodated unless nuclear safety, personnel safety, or equipment protection would be jeopardized. Such requests may include changing voltage regulator modes to either increase or decrease VAR output.

Voltage Collapse/Instability

Stability or collapse conditions are serious situations for the transmission system because they can result in significant loss of load in an instant. Stability problems occur in two scenarios:

Transient instability—Instability caused by a sudden outage of equipment. Normally, these situations are analyzed ahead of time but may arise when equipment is removed from service for maintenance in certain combinations or patterns. Dynamic instability—Instability caused by the interaction of various system elements, characterized by oscillating flows or voltages.

Voltage collapse can occur when there are insufficient reactive resources (capacitors, generator VARs, etc.) in an area leading to local blackout or a cascading outage, which is an outage that spreads to large areas of the system (e.g. the Northeast Blackout of August 14, 2003).

Implication: All of these situations are serious situations that require quick action by the transmission operators. Transmission operators will attempt to mitigate these conditions as quickly as possible. The transmission operators may ask for additional VAR output from the nuclear plant in these scenarios.

These requests need to be implemented immediately to avoid system collapse and blackout.

Off-cost Generation Dispatch

Out of merit dispatch operation that may necessitate the need for expensive resources to come online or economic resources to decrease their output to relieve a transmission constraint. PJM Manual M-3, Transmission Operations and PJM Manual M-3B, Transmission Operating Procedures (CEII) should be consulted for additional guidance on notification and mitigation protocols for NPIR voltage limits.

Implication: Nuclear plants may have voltage limits that are more restrictive than standard PJM voltage limits. In the case where standard PJM voltage limits are more restrictive, PJM will direct redispatch without consultation of nuclear plants after all non-cost measures are implemented; however, PJM will still notify the Nuclear Owner of the violation to the limit. Off-cost generation will set Locational Marginal Prices (LMP). In the case where nuclear plant voltage limits are more restrictive than standard PJM voltage limits, all costs required to mitigate the violations will be borne by the Generation Owner.

A.7 Emergency Procedures

Emergency procedures are a set of steps that are implemented by transmission system operators to avoid loss of load associated with a lack of capacity (capacity emergency) or loss of transmission elements. The procedures are a sequence of escalating measures, generally starting with alerts and warnings, progressing to voluntary curtailments, voltage reductions, and ultimately mandatory load shedding. Issuance of NERC EEAs (Energy Emergency Alerts) can also be a part of emergency procedures, indicating an impending capacity or transmission emergency.

Another type of emergency procedure is a Minimum Generation Emergency. In this scenario, demand is forecast to be lower than the level of economically dispatchable generation. Demand

and generation must match in real time, so PJM will issue a Minimum Generation event, and call for reducible generation to reduce output. There may be times when the call for reducible generation will fall upon the nuclear plants.

Emergency procedures can also be implemented for other situations. Responses to security threats, solar magnetic disturbances (SMDs), or local reliability issues are examples of other problems that can cause PJM to invoke emergency procedures. PJM Manual M-13, Emergency Procedures should be consulted for complete descriptions of emergency procedure scenarios and guidance as to the associated PJM response.

Implication: Invoking emergency procedures means that a capacity emergency or other reliability problem is anticipated or imminent. The last stages of the emergency procedures can result in load shedding. These situations are very serious situations and ***require the full support of all of the parties.***

A.8 Communication of the Event

Dissemination

The receiver of the initial message concerning a special situation needs to quickly disseminate the message among their shift team, particularly to the shift supervision. Consistent with NERC standard COM-002[6], Operating Personnel Communications Protocols, 3-part communication is necessary to verify that the received message is correct and any requested action is accurately heard and recorded. Any questions regarding the message or requested action should be immediately raised with the requester. Reference to this protocol may be necessary. Accurate logging is important to assure that actions that were requested for later investigation. (Inevitably, these special situations are of such a magnitude that post-event investigations are the norm in both the nuclear and transmission businesses.)

PJM operators may be required to report some of these events to the Department of Energy, FERC, NERC, or other entities. Similarly, nuclear plant operators may be required to report to the NRC or other regulatory bodies. All organizations should be mindful of these reporting responsibilities and be supportive to ensure that all reporting obligations are carried out within the mandated times.

Transmission Operators, including PJM and the PJM Transmission Owners are required to abide by a Code of Conduct as required by FERC Order 889. Normally, the Code of Conduct prohibits the disclosure of transmission information by PJM or the LCCs to market entities outside of the OASIS system.

[6] NERC Standard COM-002

There will be situations where the Code of Conduct should be bypassed, because the potential nuclear safety implications take precedence. Examples of applicable situations are: (1) actual or imminent transmission system degradation or failure that could impact the nuclear plant and its off-site power sources; (2) ongoing or forecasted system conditions that may result in emergency procedures, outages, or blackout; (3) transmission stability issues that could impact the nuclear plant and its off-site power sources. If PJM or the LCCs choose to disclose this information to the market entities, PJM will be required to follow-up that information with a posting on the PJM OASIS.

Elevation

Shift personnel should not carry the full burden of managing these events. It is important to elevate the event to management. Management may decide to further communicate the event within the respective organization. PJM will normally implement conference calls with the System Operators Subcommittee to coordinate information and response to special situations. PJM may also implement additional communications with neighboring systems as necessary to assure coordinated action.

Monitoring

Vigilance is necessary to ensure that any continuing surveillance or action is being properly implemented. Periodic reviews of the situation are required, both within the shift personnel and management. Shift turnovers are particularly important as a means to make sure that accurate information is both available and being acted upon in these events.

Close Out

Once the situation has been resolved, communications are needed to close out the event and to clearly indicate to the operating entities to resume normal operations.

Appendix 1 – Regulatory Background

US Nuclear Regulatory Commission (NRC)

The U.S. Nuclear Regulatory Commission (NRC) was formed in 1975 to regulate the various commercial and institutional uses of nuclear energy, including nuclear power plants. The agency succeeded the Atomic Energy Commission, which previously had responsibility for both developing and regulating nuclear activities. It is the NRC's job to protect people and the environment from radiation hazards through regulation of the various commercial and institutional uses of nuclear material, including nuclear power plants in the United States. The mission is accomplished through (1) establishment of standards, regulations and requirements governing licensed activities: (2) licensing of nuclear facilities and the possession, use and disposal of nuclear materials: and (3) inspection of facilities and users to ensure compliance with these requirements.[7]

Nuclear Plant Licensing Summary

The licenses for nuclear power plants are issued for a 40-year period. Licenses for nuclear power plants can be amended and updated as the result of operating experiences at that plant or at other plants. When necessary, the NRC can impose new regulations or require changes in operating procedures or equipment to improve the safety of nuclear power plant operations.

In addition to licensing the facility, the NRC also licenses the individuals who operate the controls of the reactor. Licenses fall into two categories -- reactor operator and senior reactor operator. The second category is necessary for supervisory positions. Before operator licenses are issued, individuals must complete an extensive training program conducted by the utility and pass license examinations administered by NRC examiners. Once licensed, the operators continue to receive training and are periodically tested to show they remain qualified to operate the plant.

Key Licensing Documents

The application for a nuclear plant license contains many parts which form the basis for the enforcement program that follows once the application is approved and the plant goes into service. Key documents include:

Updated Final Safety Analysis Report (UFSAR).

Each application for a license to operate a facility shall include a final safety analysis report. The final safety analysis report shall include information that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole.[8]

The Final Safety Analysis report contains information on the plants Transient Stability Studies that are required to show, for transmission configurations with various bus and line faults, the system remains stable and satisfactory recovery voltages are maintained, resulting in uninterrupted supply to the offsite power system. The acceptance criteria are based on the reliability requirements of the applicable NERC regional reliability council along with any plant specific stability requirements listed in their FSAR or design basis documents.

In order for the nuclear power plants to be able to support their design basis, the transmission system minimum allowable voltages have been determined and provided to PJM. PJM uses these plant specific voltage requirements to ensure under all contingency cases and as part of the PJM planning process; these voltage limits are not violated. The plant specific voltage requirements are usually contained in design basis calculations or plant Technical

[7] NRC Website

[8] 10CFR 50.34

Specifications. The FSAR provides the design basis criteria in which the plant voltage limits need to support.

Technical Specifications

Each license authorizing operation of a production or utilization facility of a type described in §50.21 or §50.22 will include technical specifications. The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to §50.34. The Commission may include such additional technical specifications as the Commission finds appropriate. Technical specifications will include items in the following categories:

- Safety limits, limiting safety system settings, and limiting control settings.
- Limiting conditions for operation (LCO) – Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.
- Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.
- Design features
- Administrative controls
- Decommissioning
- Initial notification
- Written Reports[9]

Enforcement

Violations are identified through inspections and investigations. All violations are subject to civil enforcement action and may also be subject to criminal prosecution. Unlike the burden of proof standard for criminal actions (beyond a reasonable doubt), the NRC uses the Administrative Procedures Act standard in enforcement proceedings (preponderance of evidence, i.e., information that is of greater weight or credibility or is more likely correct than not). After an apparent violation is identified, it is assessed in accordance with the Commission's Enforcement Policy.[10]

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[9] 10CFR 50.36 (33 FR 18612, Dec. 17, 1968, as amended at 48 FR 33860, July 26, 1983; 51 FR 40308, Nov. 6, 1986; 53 FR 19249, May 27, 1988; 60 FR 36959, July 19, 1995; 61 FR 39299, July 29, 1996)

[10] NRC Website, Enforcement Program Overview

1. The Commission may obtain an injunction or other court order to prevent a violation of the provisions of -- (1) The Atomic Energy Act of 1954, as amended; (2) Title II of the Energy Reorganization Act of 1974, as amended; or (3) A regulation or order issued pursuant to those Acts.
2. The Commission may obtain a court order for the payment of a civil penalty imposed under Section 234 of the Atomic Energy Act: (1) For violations of -- (i) Sections 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Atomic Energy Act of 1954, as amended; (ii) Section 206 of the Energy Reorganization Act; (iii) Any rule, regulation, or order issued pursuant to the sections specified in paragraph (b)(1)(i) of this section; (iv) Any term, condition, or limitation of any license issued under the sections specified in paragraph (b)(1)(i) of this section. (2) For any violation for which a license may be revoked under section 186 of the Atomic Energy Act of 1954, as amended.[11]

Federal Energy Regulatory Commission (FERC)

The Commission is a five-member independent regulatory agency, which succeeded to the regulatory responsibilities of the Federal Power Commission in 1977. The Commission's responsibilities include the licensing of non-federal hydroelectric facilities, the certification of natural gas pipelines, regulating the rates of natural gas pipelines and pipelines transporting crude oil and oil products, regulating the rates and other aspects of electric utility activities, protects the reliability of the high voltage interstate transmission system through mandatory reliability standards, monitors and investigates energy markets and enforces FERC regulatory requirements through imposition of civil penalties and other means.

Since 1935, the Commission has regulated certain electric utility activities under the Federal Power Act (FPA). Under FPA Sections 205 and 206, the Commission oversees the rates, terms and conditions of sales for resale of electric energy and transmission service in interstate commerce by public utilities. The Commission must ensure that those rates, terms and conditions are just and reasonable, and not unduly discriminatory or preferential. Under FPA Section 203, the Commission reviews mergers and other asset transfers involving public utilities. The utilities regulated under FPA sections 203, 205 and 206 are primarily investor-owned utilities; government-owned utilities (such as the Tennessee Valley Authority [TVA], the federal power marketing agencies, and municipal utilities) and most cooperatively-owned utilities are not subject to the Commission's regulation, with certain exceptions.[12]

Open Access Order (Order No. 888)

FERC issued Order 888 in April 1996, requiring investor-owned utilities to file tariffs for open-access transmission. The Order also encouraged utilities to form and join independent system operators (ISOs) to operate transmission grids and be independent of all commercial interests.

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[11] 10CFR50.110 Violations (57 FR 55075, Nov. 24, 1992)

[12] See, generally, FERC Website, About FERC (2015) http://www.ferc.gov/about/about.asp.

Today, these systems are used to transport power over longer distances, often across several utility systems. Both the number and complexity of these wholesale power transactions have grown dramatically in recent years, stimulated by the creation of more than 700 FERC-approved power marketers.[13]

Code of Conduct and OASIS (Order No. 889)

FERC issued Order 889 in April 1996, requiring each transmission service provider to provide an Open Access Same-time Information System (OASIS), where transmission customers could view availability and product information to enable them to make informed purchase decisions. In addition, the Order required transmission service providers and others who possess transmission information to establish a Code of Conduct which would ensure that transmission information was not made available to affiliated marketing organizations of vertically integrated utilities and other power marketers in a preferential manner. Such information was only to be made available via OASIS or other suitable electronic means.

FERC Interpretive Orders on 888/889

FERC issued Interpretive Orders on 888/889 on February 16, 2006 and May 18,2006.

The Order on February 16, 2006 clarified that Transmission Providers may communicate with affiliated nuclear power plants regarding certain matters related to the safety and reliability of the transmission system on the nuclear power plants, in order to comply with the requirements of the Nuclear Regulatory Commission.

The Order on May 18, 2006 clarified that, in the event of a grid disturbance, a Transmission Provider may communicate to affiliated nuclear power plant specific information about transmission system conditions on a real-time basis.

RTO Order (Order No. 2000)

FERC issued Order 2000 in December 1999, setting forth requirements for the formation of Regional Transmission Organizations (RTO) which FERC indicated were the key to advancing competitive wholesale markets and eliminating anticompetitive behaviors by vertically integrated utilities. The RTO characteristics and functions are as follows:

Minimum Characteristics:

1. Independence
2. Scope and Regional Configuration
3. Operational Authority
4. Short-term Reliability

[13] Hirst, Eric. Electric Reliability—Potential Problems and Possible Solutions. May 2000 , page 6

5. Minimum Functions:
6. Tariff Administration and Design
7. Congestion Management
8. Parallel Path Flow
9. Ancillary Services
10. OASIS and Total Transmission Capability (TTC) and Available Transmission Capability (ATC)
11. Market Monitoring
12. Planning and Expansion
13. Interregional Coordination

PJM was granted RTO status by FERC in July 2001.

North American Electric Reliability Corporation (NERC)

The North American Electric Reliability Corporation's (NERC) is a not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains and certifies industry personnel. NERC is the Electric Reliability Organization (ERO) for North America, subject to oversight by the Federal Energy Regulatory Commission and governmental authorities in Canada.[14]

Planning and Operating Standards

NERC Reliability Standards are developed using an industry-driven, ANSI-accredited process that ensures the process is open to all persons who are directly and materially affected by the reliability of the North American bulk power system; transparent to the public; demonstrates the consensus for each standard; fairly balances the interests of all stakeholders; provides for reasonable notice and opportunity for comment; and enables the development of standards in a timely manner.

NERC Reliability Standards define the reliability requirements for planning and operating the North American bulk power system and are developed using a results-based approach that focuses on performance, risk management, and entity capabilities. The Reliability Functional Model defines the functions that need to be performed to ensure the Bulk Electric System operates reliably and is the foundation upon which the Reliability Standards are based.

The Standards Committee (SC) oversees and prioritizes NERC's standards development activities. The Standards Committee also coordinates NERC's development of Reliability

[14] NERC Website

Standards with the North American Energy Standards Board's (NAESB) wholesale electric business practices. Standards drafting teams, which are made up of industry volunteers and supported by NERC staff, work collaboratively to develop requirements using results-based principles that focus on three areas: measurable performance, risk mitigation strategies and entity capabilities.

Compliance and Enforcement Function

NERC's compliance efforts are comprised of key activities:

1. **Compliance Monitoring** is the process used to assess, investigate, evaluate and audit in order to measure compliance with NERC Reliability Standards. Standards are developed, adopted, and approved through the Reliability Standards Development program and placed into effect pursuant to FERC orders or to applicable authorities in other North American jurisdictions. This statutory responsibility is set forth in section 215(e) of the Federal Power Act as well as 18 C.F.R. §39.7.
2. **Compliance Enforcement** is the process by which NERC issues sanctions and ensures mitigation of confirmed violations of mandatory NERC Reliability Standards. As part of these efforts, NERC can also issue directives to immediately address and deter new or further violation(s), irrespective of the presence or status (i.e. confirmed or alleged) of a violation. Sanctioning of confirmed violations is determined pursuant to the NERC Sanction Guidelines and is based heavily upon the Violation Risk Factors and Violation Severity Levels of the standards requirements violated and the violations' duration. Entities found in violation of any standard must submit a mitigation plan for approval by NERC and, once approved, must execute this plan as submitted.
3. **Regional Entity Compliance Monitoring and Enforcement Programs** NERC relies on the Regional Entities to enforce the NERC Reliability Standards with bulk power system owners, operators, and users through approved regional delegation agreements. Regional Entities are responsible for monitoring compliance of the registered entities within their regional boundaries, assuring mitigation of all violations of approved Reliability Standards and assessing penalties and sanctions for failure to comply.
4. Regional hearing process are available to resolve contested violations or penalties or sanctions. If resolution cannot be achieved at the regional level, NERC maintains and appeal process to hear disputes.
5. Registered entities or other relevant industry stakeholders can report any perceived inconsistency in the methods, practices, or tools of two or more Regional Entities through the Consistency Reporting Tool located on the ERO Enterprise Program Alignment Process page.

Regional Entities

NERC relies on the Regional Entities to enforce the NERC Reliability Standards with bulk power system owners, operators, and users through approved delegation agreements. Regional Entities are responsible for monitoring compliance of the registered entities within their regional

boundaries, assuring mitigation of all violations of approved reliability standards and assessing penalties and sanctions for failure to comply. The PJM members are contained within two REs: Reliability*First Corporation* and SERC Reliability Corporation.

State Regulatory Commissions

State regulatory commissions exert broad powers over jurisdictional utilities and are involved with most activities of utilities as it relates to providing reliable and cost-effective service to distribution customers. Transmission is not normally state jurisdictional; it is regulated by FERC. Similarly, nuclear power generation is not normally state jurisdictional; it is regulated by the NRC. However, to varying degrees, PJM members are vertically integrated and hence, subject to state regulatory oversight in many areas, including transmission and nuclear power generation.

The following is an explanation of the Pennsylvania state regulatory process, which is typical of state regulatory regimes:

Regulation

In order to provide the most economical, efficient and practical service to a community, the state grants a utility the sole right to provide its service within a specified geographical area. Experience and past history have determined that the construction of facilities by more than one utility company in the same location would be extremely costly and disruptive to community life and property. In exchange for the geographic monopoly, the utility accepts regulation by state government to assure that rates are fair and service safe and adequate for customers who cannot choose a different company.

Commission Role

The PUC is responsible for ensuring safe, adequate service for consumers at fair and reasonable rates. The Commission is required to make decisions that allow utilities to meet all prudent expenses including the cost of borrowing money for expansion to provide service. The PUC does not exist solely for the benefit of any one group, but must balance the concerns of all the parties. The Office of Trial Staff, which has experts in economics, engineering, law and financial accounting, represents the public at large by reviewing the company records and rate requests and presenting its view on what is in the public interest.

Utility Role

Regulated utilities must meet all reasonable requests for service by customers within their designated territories. To provide adequate service, it is recognized that the company must obtain a return on its investment sufficient to attract investors. If a company must expand its capacity to provide increased or improve service, it must borrow money, persuade investors to make money available, or seek a rate increase from the PUC.

Ratepayer Role

Ratepayers must pay for the service they use, which includes a share of the cost of utility company expenses, such as salaries, equipment, maintenance and taxes. While the ratemaking process is complex, consumers have the right to be informed about the process; to receive an explanation of their utility bills; to have their complaints resolved in a prompt and fair manner; and to receive continuous utility service if payment responsibilities are met.[15]

PJM Agreements

PJM and member roles and responsibilities are defined in the main agreements that PJM members must execute as a condition of membership— the Amended and Restated Operating Agreement of PJM Interconnection, L.L.C. (Operating Agreement), Consolidated Transmission Owners Agreement, and PJM Open Access Transmission Tariff (PJM Tariff). Following are excerpts from the agreements which outline major roles for each party:

Operating Agreement

PJM Duties and Responsibilities

Generally, the duties and responsibilities of the Office of the Interconnection are lin section 10.4 of the Operating Agreement.

Member Roles and Responsibilities[16]

Generally, the roles and responsibilities of PJM's members are in section 11.3 of the Operating Agreement.

Transmission Owners Agreement

Generally, Article 4 and Article 6 of Transmission Owners Agreement contain the commitments and obligations of the parties to the Transmission Owners Agreement.

PJM Tariff

Roles and responsibilities of PJM and its members are specified throughout the PJM Tariff.

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[15] "An Overview of the Ratemaking Process", PA PUC Annual Report, 2001-2002, Page 6.

[16] PJM Operating Agreement, Section 11.3

Attachment B: Plant Specific NPIRs

This attachment provides a Plant Specific NPIR template.

Unit: _____ Operating Company: _____

Transmission Zone(s): _____

Requirement Categories:

1. **Operational requirements** (e.g. minimum and maximum voltage, voltage drop or stability limits, configuration or topology limitations, post-accident load requirements, environmental limitations, etc. that are required to be respected in real time operations.) The requirements should contain associated communications requirements to ensure that the nuclear licensee is properly informed about the ability of the Transmission Entities to comply with the requirements.
2. **Planning Requirements** (e.g. minimum and maximum voltage, voltage drop or stability limits, configuration or topology limitations, post-accident load requirements, environmental limitations, etc. that are required to be respected in planning studies and analysis.)
3. **Design Criteria**
4. **Restoration Requirements** (e.g. Minimum service level requirements to enable restoration of nuclear plant generation, minimum restoration times for the restoration of service to the nuclear plant station service busses, etc.)
5. **Equipment Maintenance Requirements** (e.g., equipment performance requirements, notification and/or communication requirements to inform the plant of degraded equipment function or capability, etc.)
6. **Communication Requirements** (e.g. Emergency Procedures, Conservative Operations, Emergent Grid Issues, Periodic Operations/Planning Study Results, Periodic Restoration/Emergency Procedure Drill Results, RTEP upgrades impacting Nuclear Stations.)

Note:
1: Maintenance will be addressed between Nuclear Owner and Transmission Owner or designee.

2: Attachment B is completed for each nuclear unit on the PJM RTO footprint. Since the completed template may include Critical Infrastructure information it is maintained by PJM Operations Planning Division but not published as part of the manual.

Attachment C: Plant Specific NPIRs Revision History

Asset Owner	Plant Name	App Date	Revision Number
Constellation Energy Generation, LLC – Constellation Nuclear	Calvert Cliffs Nuclear Power Plant 1	2/7/20254/ 14/2020	54
Constellation Energy Generation, LLC – Constellation Nuclear	Calvert Cliffs Nuclear Power Plant 2	2/7/20254/ 14/2020	54
Constellation Energy Generation – Constellation Nuclear	Braidwood Station 1	9/1/2015	3
Constellation Energy Generation – Constellation Nuclear	Braidwood Station 2	9/1/2015	3
Constellation Energy Generation – Constellation Nuclear	Byron Station 1	3/28/2019	6
Constellation Energy Generation – Constellation Nuclear	Byron Station 2	3/28/2019	6
Constellation Energy Generation – Constellation Nuclear	Dresden Station 2	4/28/2023	1110
Constellation Energy Generation – Constellation Nuclear	Dresden Station 3	4/28/2023	1110
Constellation Energy Generation – Constellation Nuclear	LaSalle Station 1	8/23/ 202412/7/ 2016	43
Constellation Energy Generation – Constellation Nuclear	LaSalle Station 2	8/23/ 202412/7/ 2016	43

Asset Owner	Plant Name	App Date	Revision Number
Constellation Energy Generation – Constellation Nuclear	Limerick Generating Station 1	8/23/ 20244/14/ 2018	43
Constellation Energy Generation – Constellation Nuclear	Limerick Generating Station 2	8/23/ 20244/14/ 2018	43
Constellation Energy Generation – Constellation Nuclear	Peach Bottom Atomic Power Station 2	12/20/2023	98
Constellation Energy Generation – Constellation Nuclear	Peach Bottom Atomic Power Station 3	12/20/23	98
Constellation Energy Generation – Constellation Nuclear	Quad Cities Nuclear Power Station 1	1/11/2024	76
Constellation Energy Generation – Constellation Nuclear	Quad Cities Nuclear Power Station 2	1/11/2024	76
Vistra Operations Company LLCEnergy Harbor Nuclear Corp	Beaver Valley 1	5/28/2021	4
Vistra Operations Company LLCEnergy Harbor Nuclear Corp	Beaver Valley 2	5/28/2021	4
Vistra Operations Company LLCEnergy Harbor Nuclear Corp	Davis Besse	5/28/2021	6
Vistra Operations Company LLCEnergy Harbor Nuclear Corp	Perry	5/28/2021	5
Indiana Michigan Power Co	Donald C Cook 1	11/7/ 20247/13/ 2016	32

Asset Owner	Plant Name	App Date	Revision Number
Indiana Michigan Power Co	Donald C Cook 2	11/7/ 2024~~7/13/ 2016~~	3~~2~~
Susquehanna Nuclear LLC	Susquehanna 1	12/22/2014	2
Susquehanna Nuclear LLC	Susquehanna 2	12/22/2014	2
PSEG Nuclear LLC	PSEG Hope Creek Generating Station 1	5/1/2015	1
PSEG Nuclear LLC	PSEG Salem Generating Station 1	5/1/2015	1
PSEG Nuclear LLC	PSEG Salem Generating Station 2	5/1/2015	1
Virginia Electric & Power Co	North Anna 1	12/1/2018	4
Virginia Electric & Power Co	North Anna 2	12/1/2018	4
Virginia Electric & Power Co	Surry 1	2/26/ 2025~~12/1/ 2018~~	5~~4~~
Virginia Electric & Power Co	Surry 2	2/26/ 2025~~12/1/ 2018~~	5~~4~~

Revision History

Administrative Change (Michael Zhang Approved on 07/03/2024):

- Updated manual ownership to Michael Zhang
- Attachment C: Plant Specific NPIRs Revisions History: Asset Owner name and NPIR revision updates

Revision 22 (10/24/2022):

- Periodic Review
- Updated references to Manual 03 Section 5 to Manual 03B throughout the manual
- Sect 1.1 Reworded explanation of Nuclear Plant Interface Requirements (NPIRs)
- Sect 1.2 and 2.4.2 Added reference to eDART's Nuclear Voltage Limit feature
- Sect 2.4 Clarifying language on communication of off-cost and redispatch
- Sect 3.1 Added language addressing company name changes
- Sect 3.2 Updated reference to Manual 13 Attachment L to Manual 13 Attachment J and added Attachment K reference
- Sect 3.5 Updated reference to Nuclear Generator Owner User Group to Nuclear Generator Owners/Operators Forum
    - NPIR Revision as part of periodic review process no longer applicable
- Attachment A.6 Added definition of Off-cost to Key Transmission Terms
- Attachment A.8 Added Reference to COM-002
- Appendix 1 Updated NERC information
- Attachment C: Plant Specific NPIRs Revisions History: Asset Owner name and NPIR revision updates
- Corrected typographical errors and capitalization in multiple sections

Revision 21 (06/22/2020):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 20 (10/15/2019):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 19 (07/26/2019):

- Section 2.7: Added section to address the need for coordination between the Transmission Owner and the Nuclear Plant Generator Operator regarding Remedial Action Schemes

and Under Frequency Load Shedding/Under Voltage Load Shedding schemes and their identification in plant interface agreements.

- Section 3.6: Added section to address the process by which the NPIRs will be discontinued after a nuclear plant deactivates and retires.
- Section 3.7: Added section to address the coordination between Reliability Coordinators when a non-PJM member is identified by an Nuclear Plant Generator Operator as a Transmission Entity.
- Attachment B: Attachment title updated and note section updated
- Attachment C: NPIR revision update
- Periodic Review to address:
  - Three-year Nuclear Generators Owners Users Group (NGOUG) review per Section 3.5
  - Language clarification in Section 1.1

Revision 18 (04/01/2019):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 17 (12/05/2018):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 16 (07/11/2018):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 15 (01/15/2018):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 14 (07/01/2017):

- Section 3.1: Clarified language to ensure all changes made to Nuclear Plant Interface Requirements (NPIR) are clearly highlighted with drivers communicated
- Attachment A, Section 5: Added clarification to reinforce that NPGO notifies PJM and associated LCC of conditions at nuclear plant impacted by grid-side event
- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 13 (12/23/2016):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Administrative Change (11/18/2016):

- Section 2.1 – removed struck out language and footnote (Production System) as this change was inadvertently not made during the periodic review.

Revision 12 (01/01/2016):

- Updates to align with NUC-001-3 (effective 01/01/2016) – Grammatical corrections; edits to be consistent with NERC documentation.
- Section 2.6: System Restoration – updated to include safe shutdown loading requirement for plant specific Nuclear Plant Interface Requirements (NPIRs) developed and endorsed by the Nuclear Generation Owners User Group (NGOUG).
- Attachment A; Appendix 1: Regulatory Background – Removed Operating Agreement (OA) and Transmission Owners Agreement (TOA) text; replaced with appropriate references to OA, TOA, and Open Access Transmission Tariff (OATT)
- Periodic Review

Revision 11 (12/07/2015):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 10 (07/15/2015):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 09 (04/15/2015):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 08 (10/1/2014):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 07 (9/25/2013):

- Attachment C: Plant Specific NPIRs Revision History: NPIR revision update

Revision 06 (03/01/2013):

- 3 year review was performed for M39, including NPIR attachments, in accordance with NUC-001-2 R9.1.3
- Introduction: Note added to page 1, that NPIR means Nuclear Plant Interface Requirements
- Introduction: Note 1: revised to read NUC-001
- Section 1.1: ***Background*** now references when NUC-001 was implemented
- Section 1.1: Added Footnote 1 which was inadvertently deleted in a prior revision.
- Section 1.2: Revised to apply to TEs not just TOs. Clarified that PJM notifies the TOs and not the NPGOs (in accordance with M03) when the ability to monitor the operation of the Bulk Electric System in accordance with the NPIRs is lost.
- Section 2.4.2: ***NPGO Action:*** - - -will notify PJM and ***not*** the Transmission Owner when voltage limits are revised
- Section 2.6: Minor edits.

- Section 3.1 Revised to apply to TEs not just TOs.
- Section 3.5: Added clarifying phrase, as part of 3-year review that revisions to NPIRs are made only if required.
- Attachment A and the associated Appendix 1: Updated several paragraphs and references.
- Changed template for Attachment B, Note 1: to read Nuclear Plant Generator Operator (NPGO)
- Attachment C: Plant Specific NPIRs Revision History: NPIR revision updates.

Revision 05 (11/01/2012):

- Section 3: Other NPIR Issues / Section 3.1: Added clarifying text to address sequencing of M39 revision approval with respect to effective dates of plant specific NPIR revisions.
- Attachment C: Plant Specific NPIRs Revision History: NPIR revision updates.

Revision 04 (07/01/2012):

- Introduction / About this Manual / Note 1: Added Operating Agreement section number reference.
- Section 4.1: Additional Nuclear Plant Generator Operator Requirements: Expanded section to include NUC-001 requirements that are not applicable to PJM.
- Attachment C: Plant Specific NPIRs Revision History: NPIR revision updates.

Revision 03 (06/01/2011):

- Changed manager ownership to Generation Department based on reorganization.
- Attachment B: Added Perry and Davis Besse NPIR as part of ATSI Integration into PJM
- Attachment C: Updated Perry and Davis Besse NPIR revision.

Revision 02 (09/07/2010):

- Section 1.1: Background – updated reference to manuals.
- Section 2.1: Outage Coordination – updated maintenance notification requirements for facilities impact Nuclear Plant or off-site station light and power source.
- Attachment B: Updated Peach Bottom NPIR to reflect new Cooper 230kV substation between Nottingham and Graceton.
- Attachment C: Updated Peach Bottom NPIR revision.

Revision 01 (4/1/2010):

- Section 2.1: Outage Coordination – modified language to clarify outage coordination process.
- Section 2.3: Notification for Loss of Calculation Capability – added 30 minute timeframe to notify Nuclear Station of loss of EMS.

- Section 2.4.1: Communications – modified language to clarify real-time communication process.
- Section 2.6: System Restoration – highlighted urgency if the nuclear plant has lost both offsite and onsite AC power.
- Attachment B: Added individual Plant Specific NPIR for all nuclear plants with PJM RTO footprint. Plant Specific NPIR are not posted due to the confidential nature of subject matter.
- Attachment C: Plant Specific NPIR Revision History – updated to include approval date for plant specific Nuclear Plant Interface Requirements.

Revision 00 (10/01/2009):

New manual to address NUC-001 standard