Transmission ITP

Introduction

PJM State & Member Training Dept.

Objectives

Students will be able to:

- Define PJM's role as a Regional Transmission Organization (RTO)
- Describe the relationship between PJM and its Member Companies
- Identify the PJM Training and Certification requirements for Transmission Owner Operators

Course Schedule

Daily Schedules

- 0800 Start Time
  - Open Discussion Format
    - Please use microphones provided on table so everyone can hear your questions and comments
- Lunch and Breaks
  - Schedule
  - Locations
- End of Class Day
  - Turn in badges daily

Logistics

- Housekeeping
  - Evacuation procedure
  - Restrooms
  - Break/smoking locations
- Productivity
  - Phones on vibrate
  - Wireless printer available
    - Email document to pjmctc1@hpeprint.com
  - Quiet area (near wireless printer)

NERC CEH

- To earn NERC CEHs, you MUST:
  - Scan your badge/sign in at the start of each session
  - Attend all presentations and complete all activities
- Rules for quizzes
  - 75% or higher is required
  - Re-testing is available
- Rules for Simulations:
  - You must participate in the full Simulation activity
  - You must complete and sign the accompanying Activity Sheet
  - Simulation facilitator must sign off on your Activity Sheet

Transmission ITP

- The goal of this program is to provide you with the knowledge you need to successfully execute any of the shared tasks on the Transmission Owner Operator Task List
- This task list is mandated by NERC (PER-005) and also serves as the basis for the PJM Certification Exam content outline
- The task list is continuously evaluated by the PJM Dispatcher Training Subcommittee (DTS)

What is an RTO?

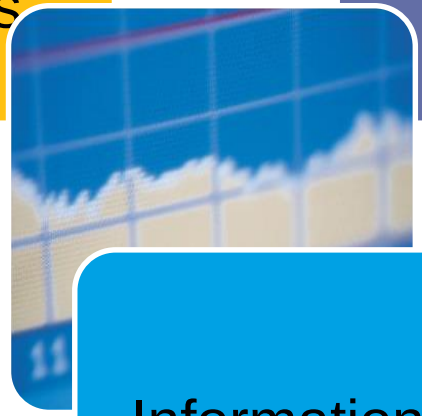
Elements of A Regional Transmission Organization

Independent Governance

Wholesale Electric Markets

Regional Reliability

Market Monitoring



Information Resource

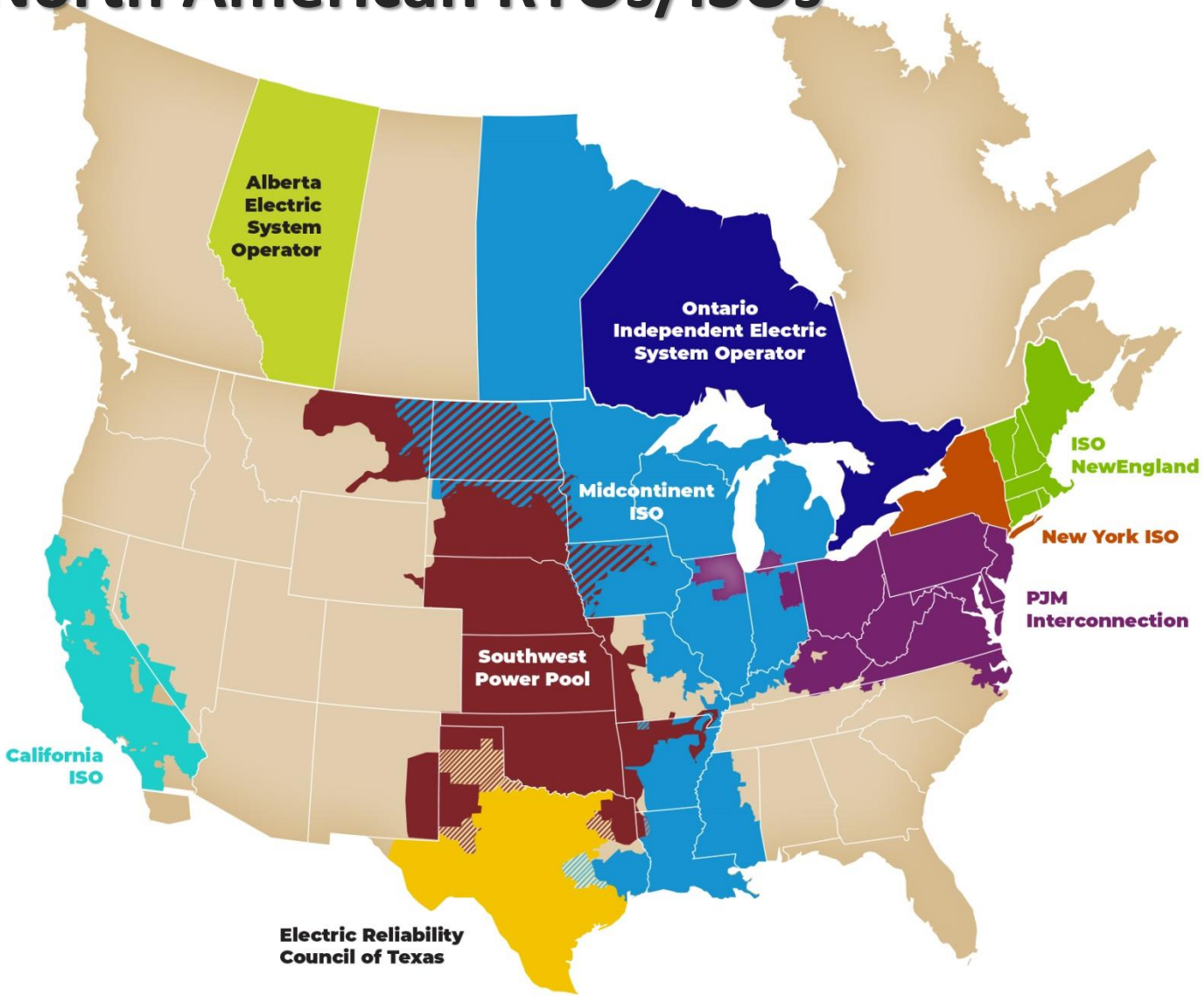
Transmission Planning

PJM as an RTO

Functions

- Administer tariff
- Administer regional wholesale electric markets
- Provide independent market
- Provide for comprehensive regional transmission expansion planning
- Manage congestions
- Supply ancillary services
- Operator OASIS
- Plan and coordinate transmission additions and upgrades

Nine Major North American RTOs/ISOs



How is PJM Different From Other Utility Companies?

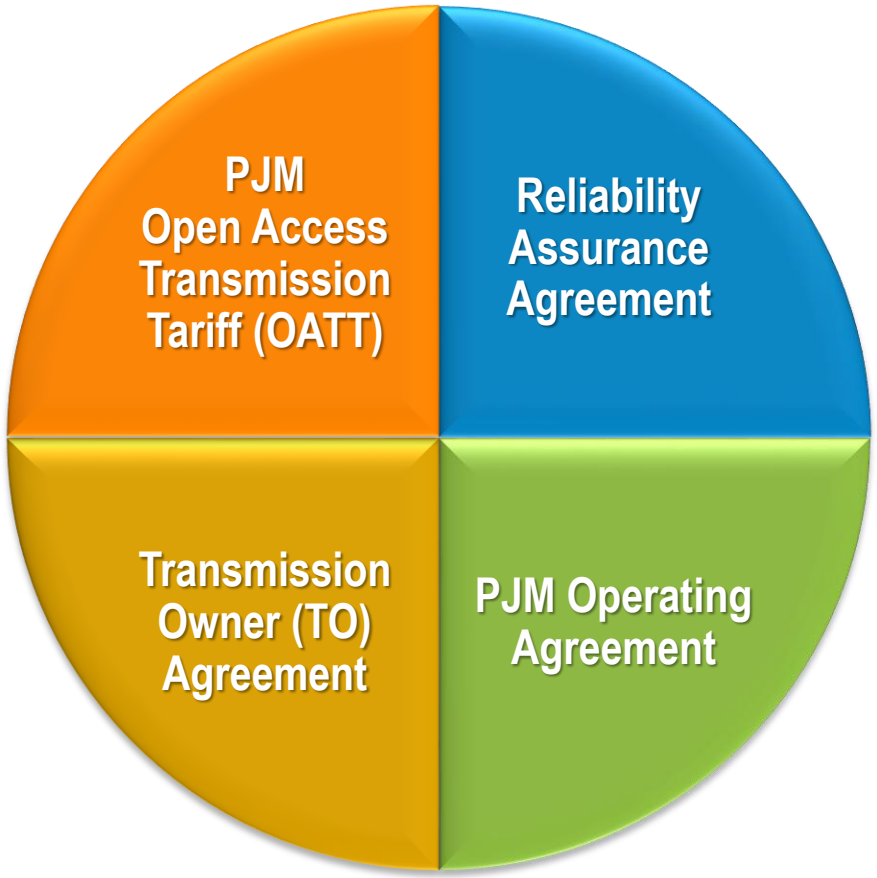
PJM Does:

- Direct operation of the transmission system
- Remain profit-neutral
- Maintain independence from PJM members
- Coordinate maintenance of grid facilities

PJM Does *NOT:*

- Own any transmission or generation assets
- Function as a publicly-traded company
- Take ownership of the system's energy
- Perform maintenance on generators or transmission systems (e.g. repair power lines)
- Serve or direct any end-use customers (retail)

PJM Authority Provided by Contract

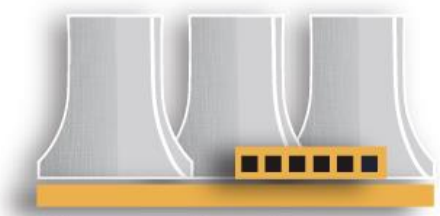


PJM Organization and Committee Structure

Independence and Governance Process

Independent Board of Managers — **Market Monitor**

Members Committee

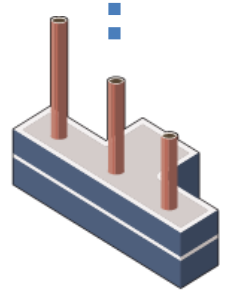


Generation Owners

Transmission Owners

Competitive Retail Companies & Trading Companies

Utility Electric Distributor & Retail Business

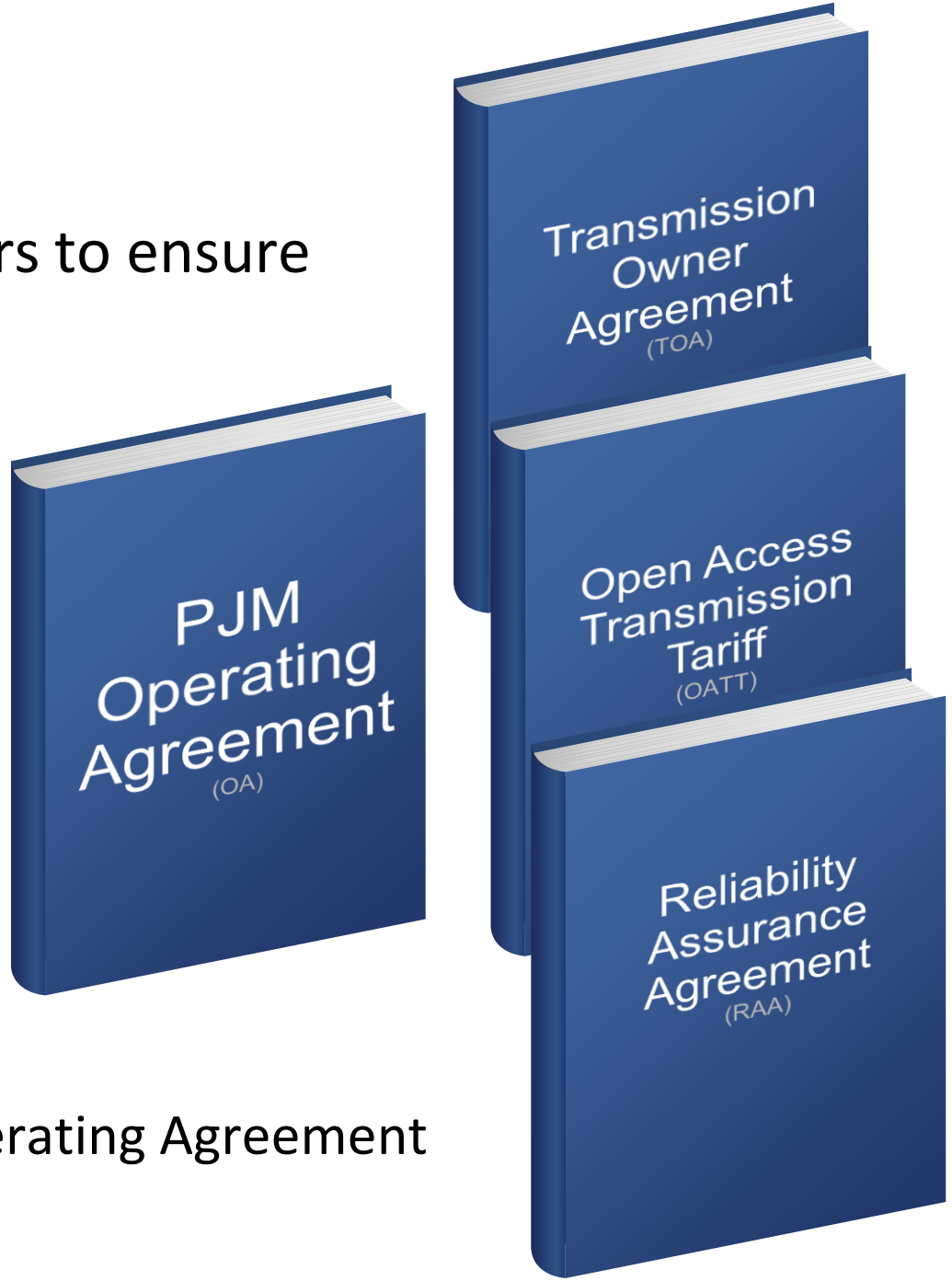


Wholesale End Use Customers (Industrial)

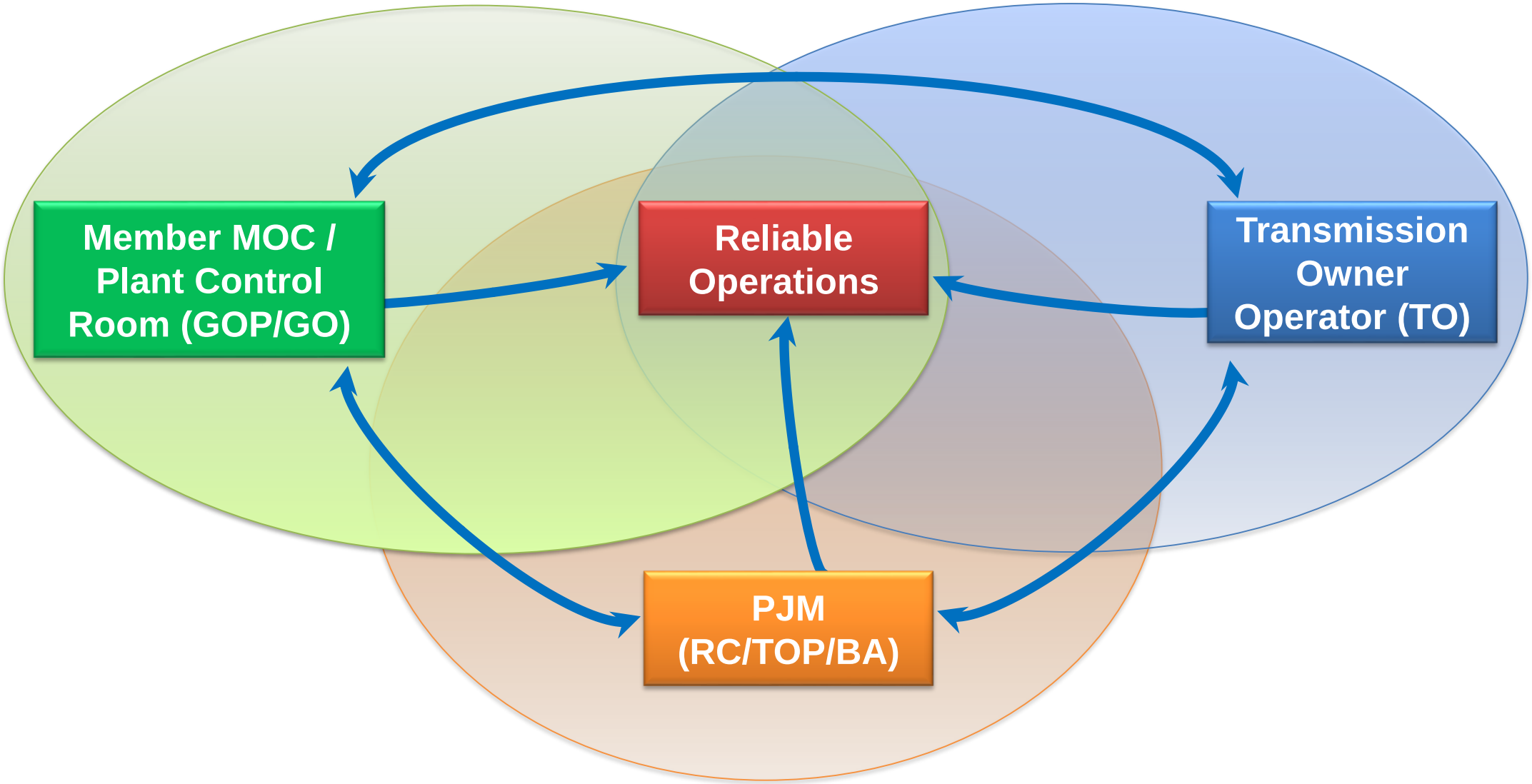
- Independent Board of Managers
- Stakeholder process – provide balanced stakeholder input
- Established process for discussion of market evolution

Working Together….

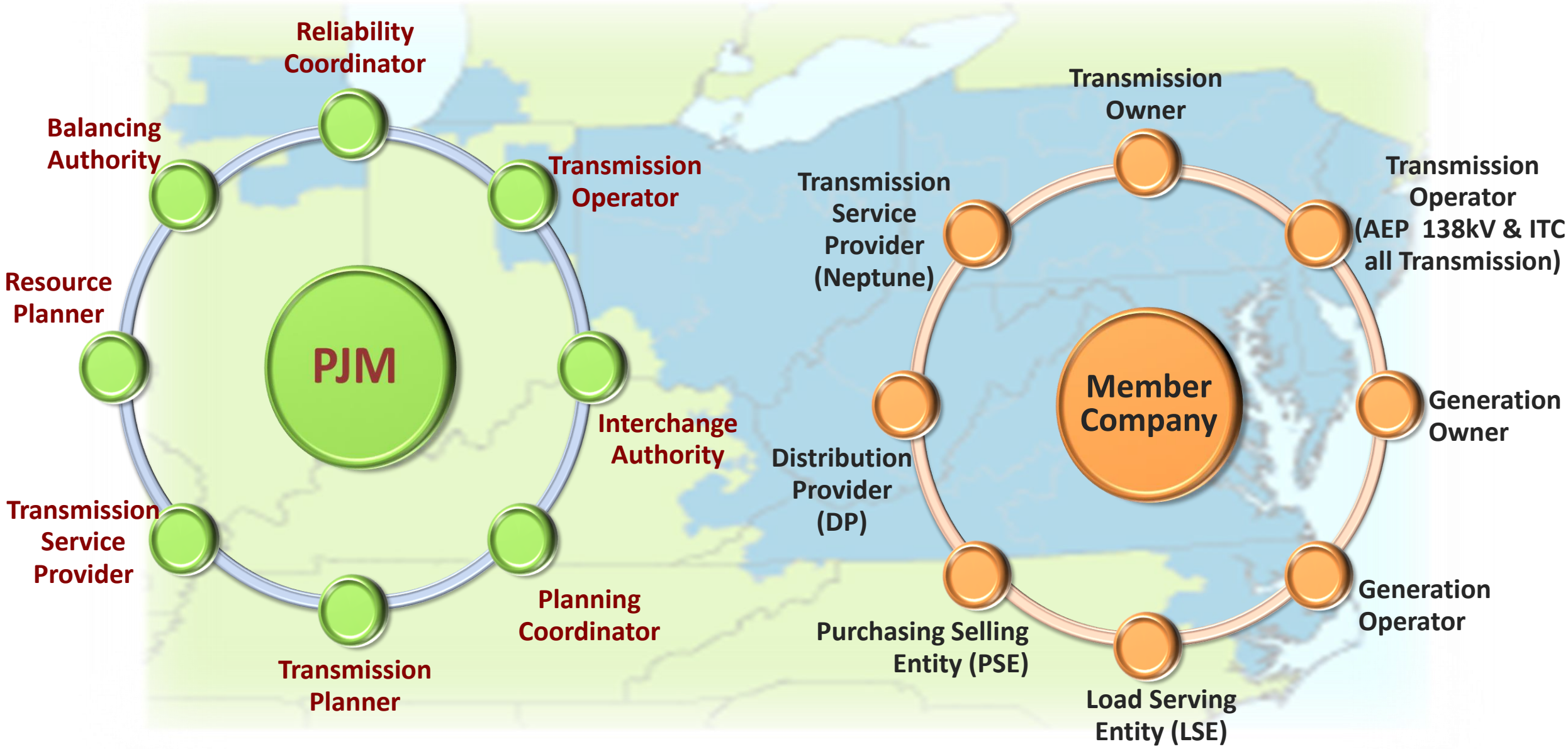
- Agreements are developed with stakeholders to ensure reliability of the electric power grid
- Stakeholders include:
  - Members
  - ISOs/RTOs
  - FERC
  - NERC
- ***PJM Operating Agreement***
  - Governs operation of PJM
  - Defines roles & responsibilities
  - PJM Membership requires signing of PJM Operating Agreement



Interaction among Members & PJM



NERC Functional Model



NERC Functional Model – Transmission Operator

- Definition
  - The functional entity that ensures the Real-time operating reliability of the transmission assets within a Transmission Operator Area
- Tasks
  - Monitor and provide telemetry (as needed) for all reliability-related parameters within the reliability area
  - Monitor the status of, and deploy, facilities classed as transmission assets, which may include the transmission lines connecting a generating plant to the transmission system, associated protective relaying systems and Special Protection Systems
  - Develop system limitations such as System Operating Limits and Total Transfer Capabilities, and operate within those limits

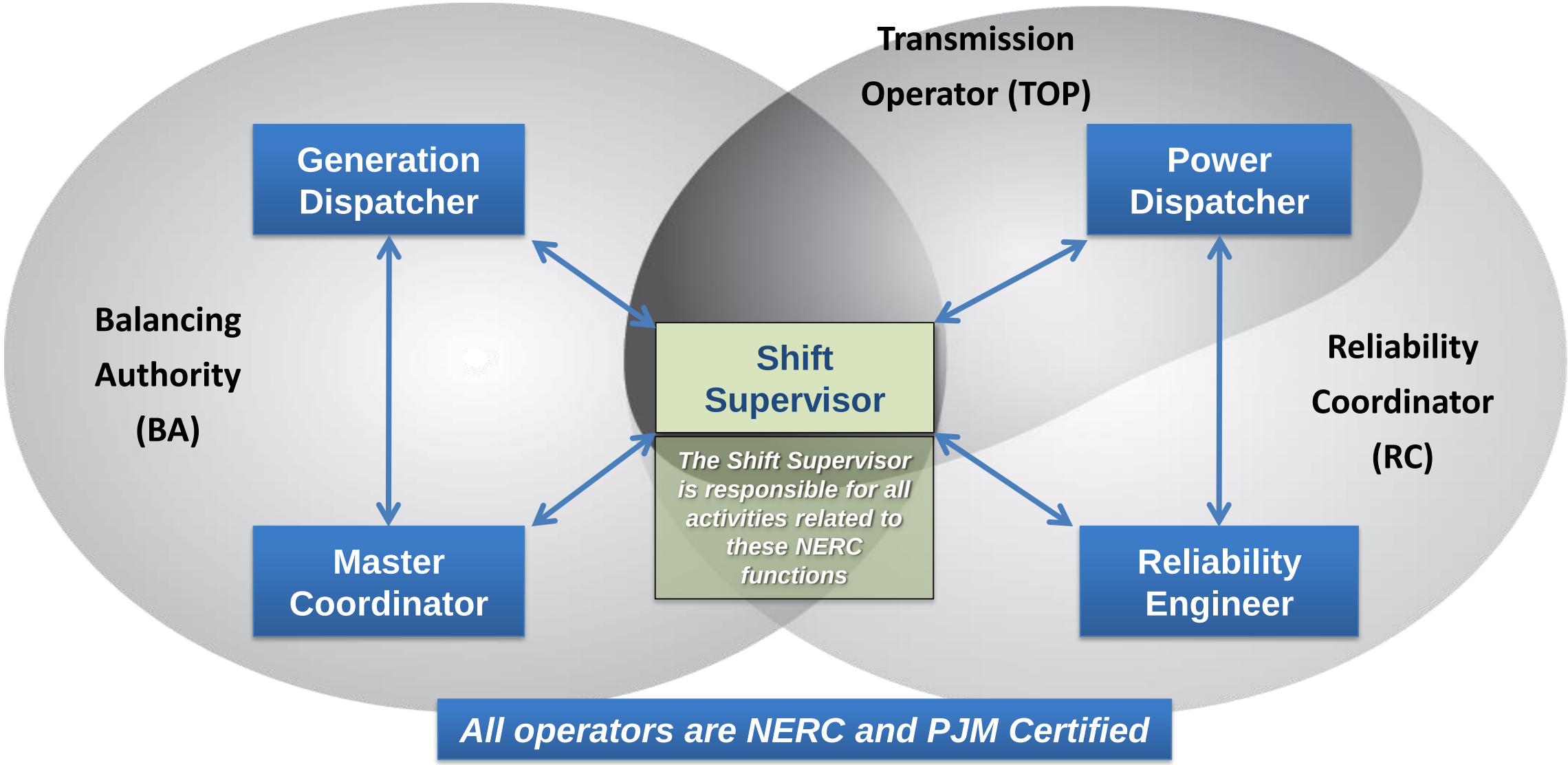
NERC Functional Model – Transmission Operator

- Tasks *(cont.)*
  - Develop and implement emergency procedures
  - Develop and implement system restoration plans
  - Operate within established Interconnection Reliability Operating Limits
  - Perform reliability analysis (actual and contingency) for the Transmission Operator Area
  - Adjust flow control devices within the transmission area to maintain reliability
  - Deploy reactive resources to maintain transmission voltage within defined limits

NERC Functional Model – Transmission Owner

- Definition
  - Owns and provides for the maintenance of transmission facilities
- Tasks
  - Develop interconnection agreements
  - Establish ratings of transmission facilities
  - Authorize maintenance of transmission facilities rights-of-way
  - Design and install owned facilities classified as transmission and obtain associated rights-of-way
  - Design and authorize maintenance of transmission protective relaying systems and Special Protection Systems

PJM Control Room Positions and NERC Responsibilities



All operators are NERC and PJM Certified

Valley Forge Control Room

Milford Control Room

PJM and Transmission Owners – TO/TOP Matrix

- PJM has the responsibility for planning and directing the operation of PJM Transmission Facilities in accordance with applicable NERC, RF, SERC and PJM standards

- Requirements for Transmission Owners to assure compliance by both the TO and PJM in the role as the TOP, RC and BA
  - Various agreements
  - PJM Manuals
  - **PJM TO/TOP Matrix**

PJM and Transmission Owners – TO/TOP Matrix

- PJM, as the TOP, is involved in all transmission operating decisions
  - Pre-existing procedures can be executed by the TO, but PJM approves any deviations
  - New procedures do not proceed without approval from PJM as the TOP
- All TOP requirements are performed by PJM
  - Tasks can be ***assigned*** to the TOs, but only via an agreement and with *PJM still holding the responsibility*
- PJM has enough knowledge and information, so that it can execute the TOP requirements without information from the TO

PJM and Transmission Owners – TO/TOP Matrix

- Those requirements cover all of the following areas:

Security	Training	Staff Certification	Responsibility and Authority	Transmission Operations
Emergency Operations	Operations Planning	Real-time Monitoring (Meters	Plans for Loss of the Primary Control Center	System Restoration
Outage Coordination	Capacity and Energy Emergency Plan	Nuclear Power Interaction	Communications Facilities	Operator Voice Communications
Ratings Coordination	Modeling	Voltage Control	Protection Coordination	Sabotage Reporting

Purpose and Use of the TO/TOP Matrix

- Clarify the assignment of tasks based on the unique relationship between PJM and its Member TOs
  - Relationship is outlined in OA, OATT and PJM Manuals
- Does not create any new obligations for PJM or its members
  - Simply a cross-reference to indicate where the assignment of various reliability tasks is documented

PJM/Transmission Owners NERC Standards Compliance Matrix, as approved by the TOAAC

All of the requirements in the Matrix come directly from reliability standards or the PJM manuals. No new requirements are included, however, in some cases the manuals contain additional detail not included in the standard

Example – TO/TOP Matrix

Category	T O P	Purpose	Scheduled generator and transmission outages that may affect the reliability of interconnected operations must be planned and coordinated among Balancing Authorities, Transmission Operators, and Reliability Coordinators.
Standard Number	TOP-003-1		
Requirement Number	R1		
Approved BOT/FERC Standards	Generator Operators and Transmission Operators shall provide planned outage information.		
A/S	S		
Assigned or Shared TO Tasks	1. The Member TO must submit transmission outage information to PJM based on the procedures in PJM Manual 3 2. PJM shall inform Member TOs and external TOs of planned transmission and generation outage information.		
PJM Tasks	PJM shall inform Member TOs and external TOs of planned transmission and generation outage information		
Audit Questions	Do you submit transmission outage information based on the procedures in PJM Manual 3?		
Evidence of Compliance	Show examples that you provide outage information based on the procedures in PJM Manual 3 (eDART Tickets; PJM day ahead email; and day-ahead discussion with PJM Reliability Engineer).		
Reference Documents	PJM OA; 11.3-Member Responsibilities, Schedule 1, 1.7.15 Corrective Action M-3 Transmission Operations; Section 5-Index and Operating Procedures for PJM RTO Operation M-10 Pre-Scheduling Operations; Section 2.2-Planned Outages M-37 Reliability Coordination, Section 1.1-Policy Statements M-38, Operations Planning; Section 3-Next Day Reliability Analysis		

Example – TO/TOP Matrix

Category	EOP	Purpose	Ensure plans, Facilities and personnel are prepared to enable System restoration from Blackstart Resources to assure reliability is maintained during restoration and priority is placed on restoring the Interconnection.
Standard Number	EOP-005-2		
Requirement Number	R4		
Approved BOT/FERC Standards	Each Transmission Operator shall update its restoration plan within 90 calendar days after identifying any unplanned permanent System modifications, or prior to implementing a planned BES modification, that would change the implementation of its restoration plan.		
A/S	A		
Assigned or Shared TO Tasks	Each Member TO shall update its restoration plan within 90 calendar days after identifying any unplanned permanent System modifications, or prior to implementing a planned BES modification, that would change the implementation of its restoration		
PJM Tasks	N/A		
Audit Questions	1. Did you need to update your restoration plan more than annually? 2. Did you update your restoration plan within 90 calendar days after identifying any unplanned permanent System modifications, or prior to implementing a planned BES modification, that would change the implementation of its restoration plan?		
Evidence of Compliance	1. Exhibit dated documents showing identification of any unplanned permanent system changes or a planned BES modification that would change the implementation of its restoration plan. 2. Exhibit the revision log of your restoration plan and note the applicable revisions.		
Reference Documents	M-36 System Restoration, Attachment G: Coordination of Restoration Plan with PJM Internal and External Neighboring Entities - PJM Approval Process for TO Restoration Plans		

Transmission Owner Operator Responsibilities

Awareness

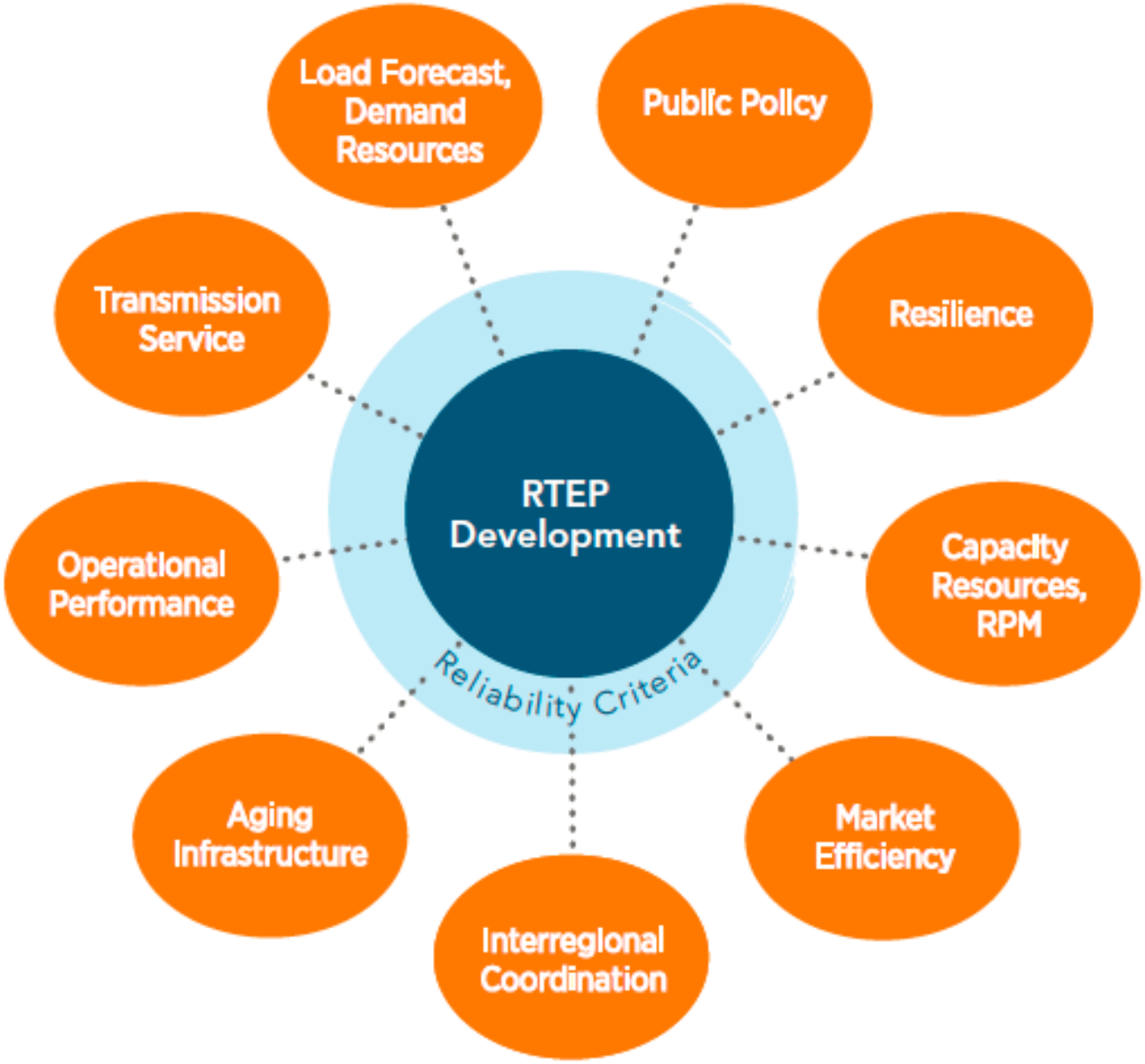
- Member TO company operators need to maintain an awareness of the delineation of responsibilities and assignment of tasks within PJM TO/TOP Matrix

Regional Transmission Expansion Planning (RTEP)

Regional Planning Objectives

- Identifies transmission system enhancements
- 15 year outlook to identify reliability standards violations
- Test the transmission system against mandatory national standards and PJM regional standards
- Reliability and economic efficiency drivers

RTEP Development Drivers



Regional Planning
• 15-Year Outlook

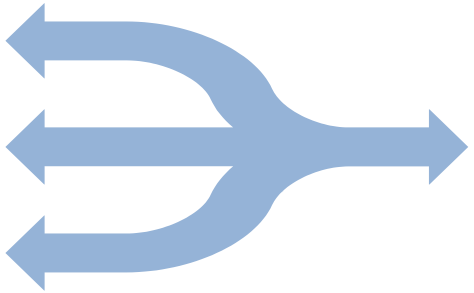
3

Projects Cover a Range of Power System Elements

New lines and transformers

Existing line re-conductoring

Bus reconfigurations



increase power flow capability

New reactive devices like shunt capacitors and SVCs

provide voltage support and improve generating unit stability

New substation equipment like circuit breakers, switches and wave traps

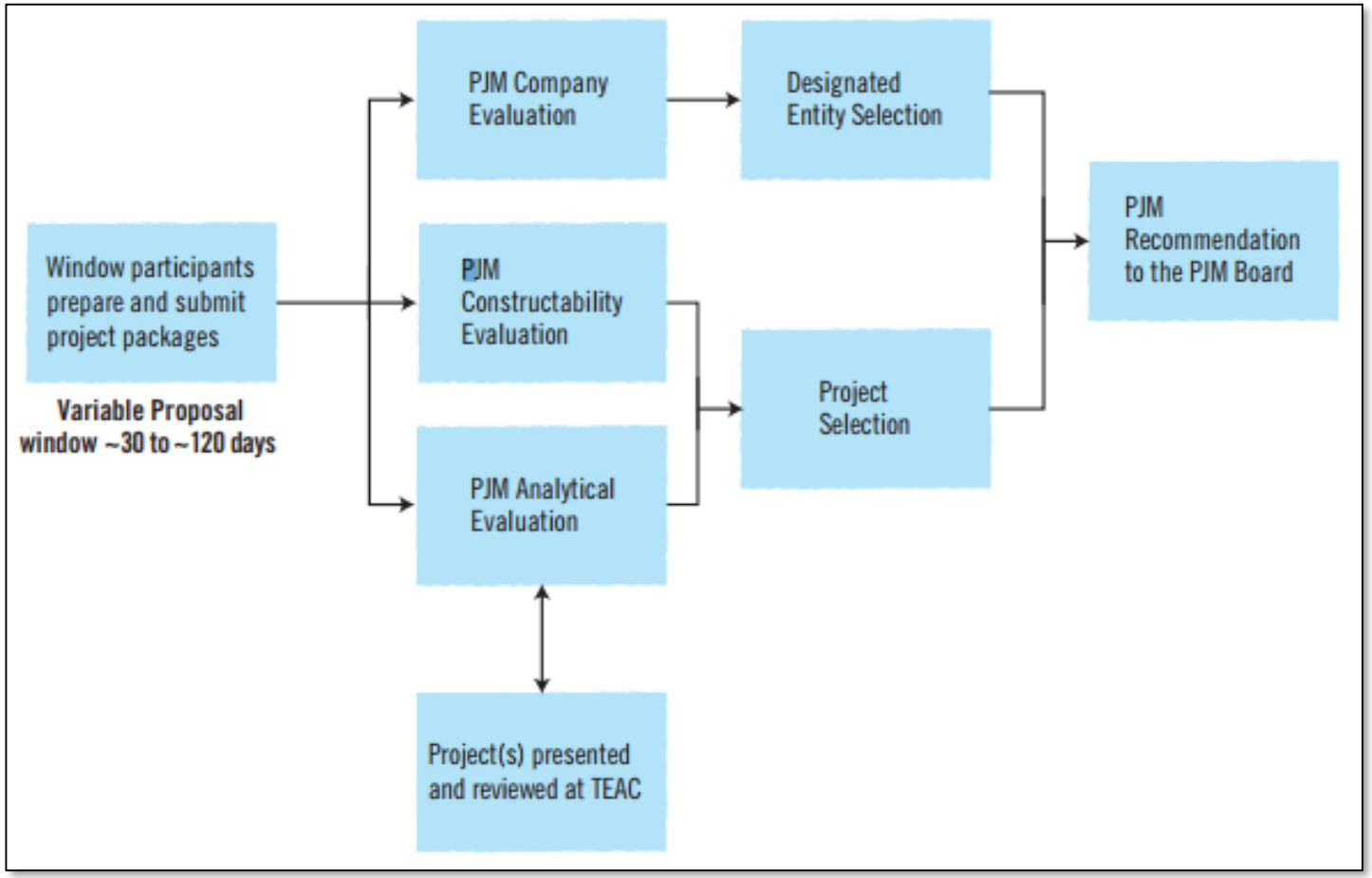
help protect transmission lines

Comprehensive Analysis

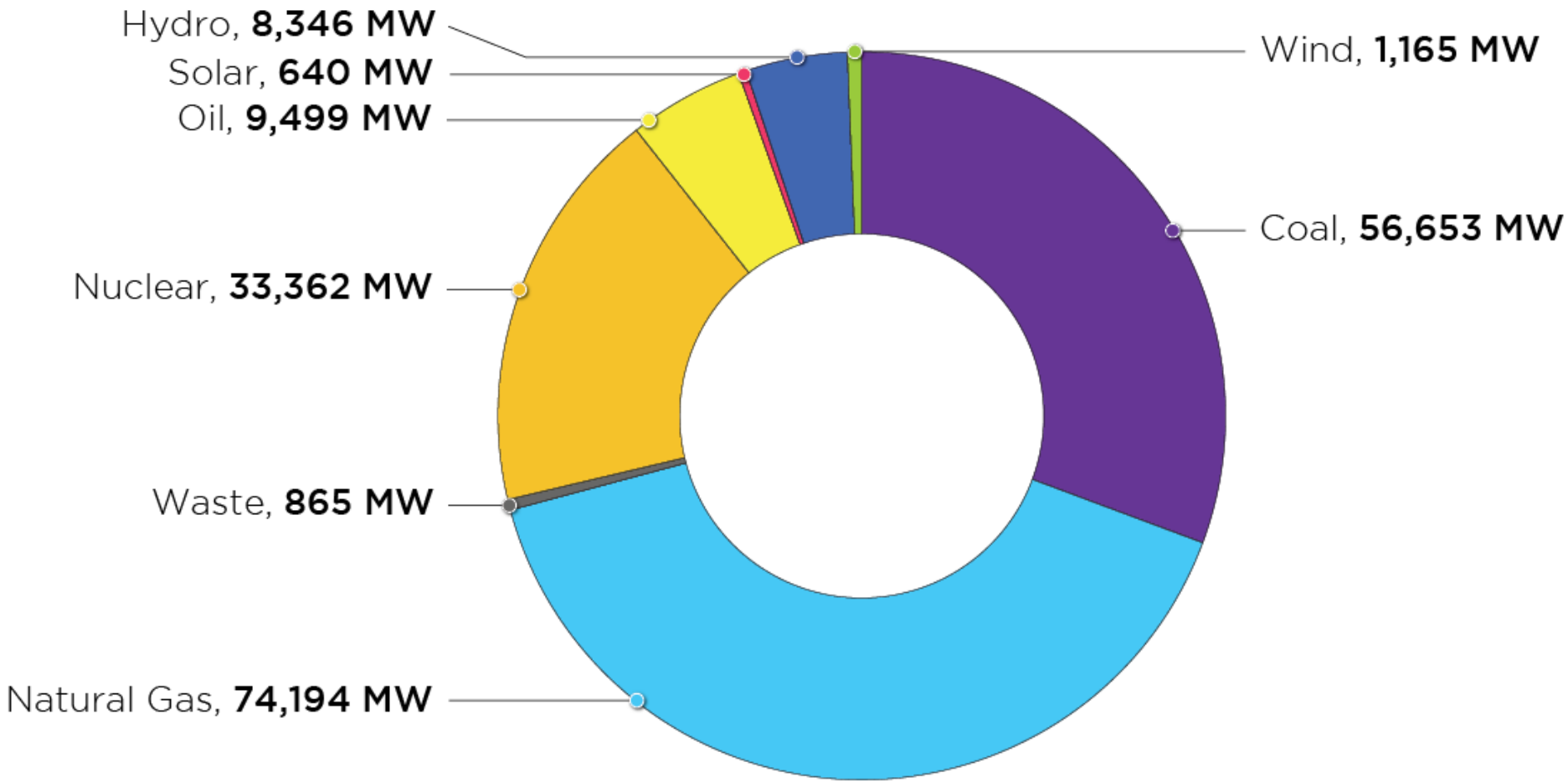
- PJM power flow analysis incorporates:
  - Latest load forecast
  - Generating resources
  - Transmission topology
  - Demand resources
  - Known transactions with adjoining systems
- Regional planning analysis addresses:
  - Reliability
  - Market efficiency
  - Public policy initiatives by states

RTEP Process Windows

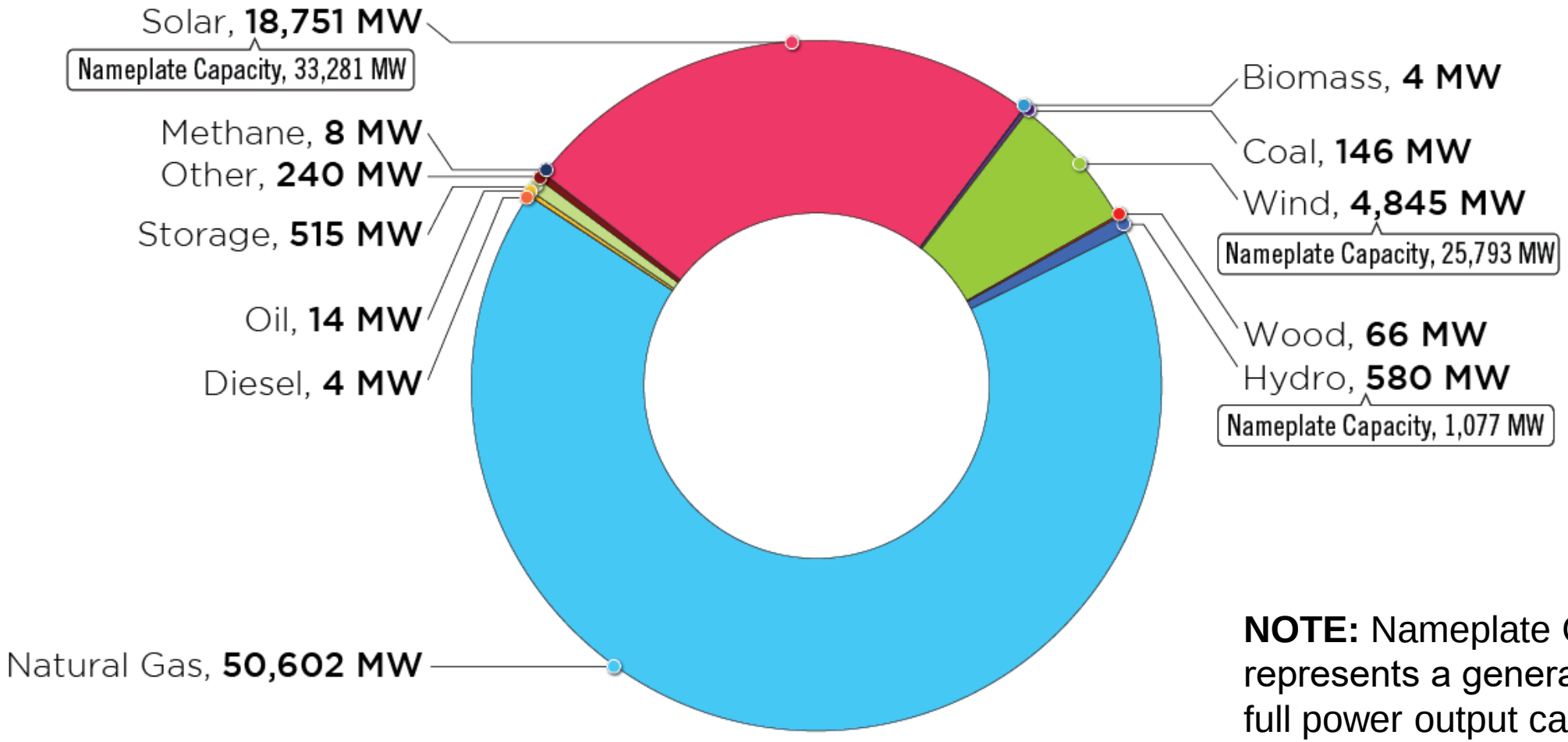
During each window PJM seeks transmission proposals to address one or more identified needs – reliability, market efficiency, operational performance and public policy.



PJM Existing Installed Capacity Mix RPM Eligibility Capacity (December 31, 2018)



PJM Queued Generation Fuel Mix- Requested Capacity Interconnection Rights (December 31, 2018)



NOTE: Nameplate Capacity represents a generator's rated full power output capability.

Accessing the PJM RTEP Report

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- Services & Requests
- RTEP Upgrades & Status
- Competitive Planning Process
- RTEP Development
- Resource Adequacy Planning
- Planning Criteria
- Design, Engineering & Construction
- Interregional Planning

Home ▸ Planning

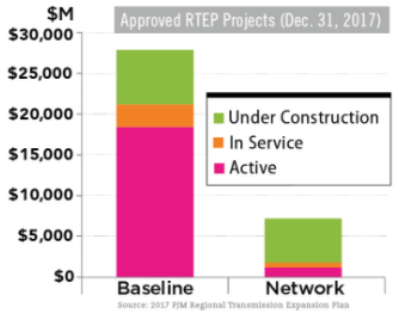
Planning

RTEP Planning Year 2022

Transmission Under Construction

36.1 billion
As of 4.10.2018

TEAC White Paper PDF



Regional Transmission Expansion Plan
Load Forecast Reports
Transmission Projects & Cost Allocation

Tools

Planning Center: Queue Point | Gen Model
Submit a Competitive Planning Process Proposal

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- Filings & Orders
- Manuals
- Compliance
- Reports & Notices
- Regional Transmission Expansion Plan (RTEP)
  - 2016 Regional Transmission Expansion Plan Report
  - 2015 Regional Transmission Expansion Plan Report
  - 2014 Regional Transmission Expansion Plan Report
  - 2013 Regional Transmission Expansion Plan Report
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Regional Transmission Expansion Plan (RTEP)

PJM's Regional Transmission Expansion Plan identifies transmission system additions and improvements needed to keep electricity flowing to the millions of people throughout PJM's region. PJM's annual RTEP Report describes transmission study input data, processes and results, as well as PJM Board-approved transmission upgrades and process changes during the previous year. Periodically, PJM publishes white papers that present study input parameters and address transmission planning topics of current stakeholder interest.

Book 1: RTEP In Review

Book 1 provides an executive summary of reliability, market efficiency and operational performance studies. Results from a number of these studies drove RTEP proposal windows which are also summarized. Book 1 goes on to discuss generation fleet changes driven by plant deactivation and new natural gas plant interconnection. RTEP process enhancements completed or initiated in 2017 are also presented.

Book 1 PDF (9MB)

Book 2: Inputs and Process

Book 2 focuses on input parameters (e.g., load forecasts, generation and topology) and study methodologies (e.g., deliverability) used to conduct PJM's 2017 RTEP process cycle of studies. Book 2 also describes NERC and regional planning criteria.

Book 2 PDF (9MB)

Book 3: Studies and Results

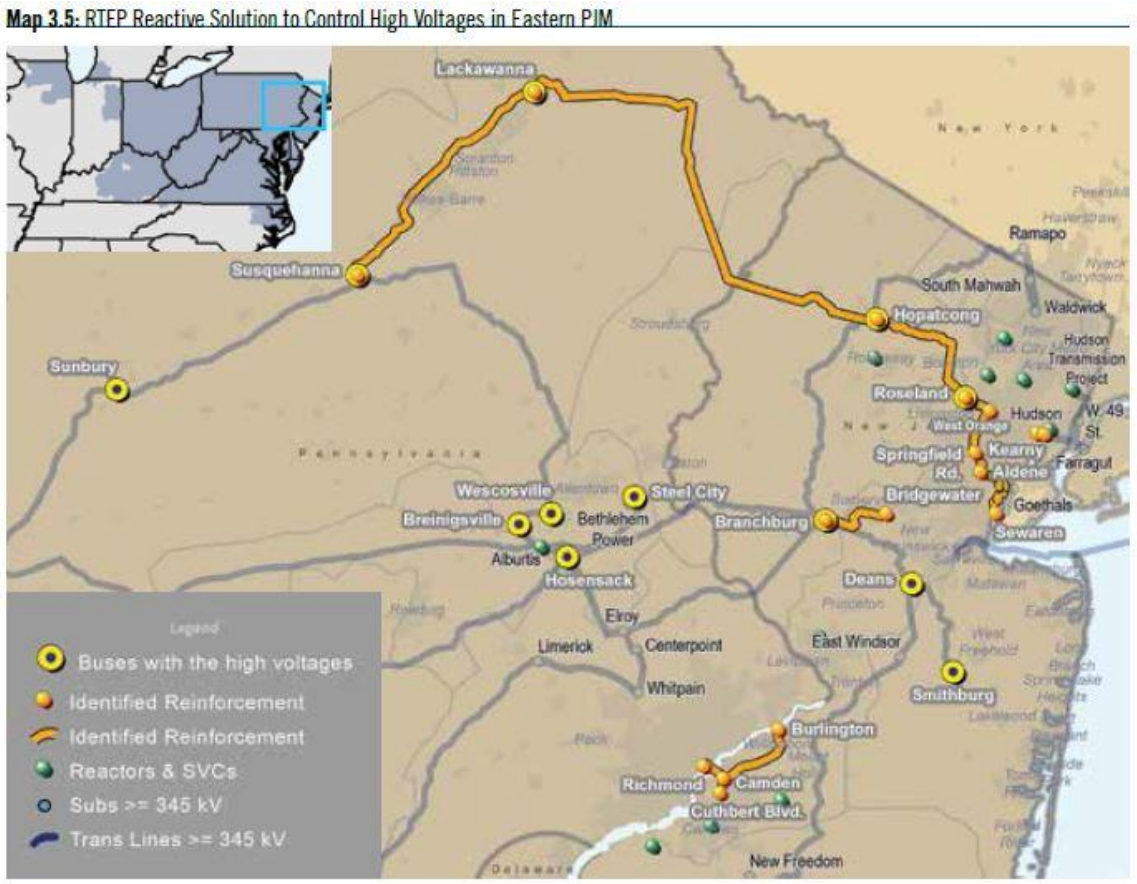
Book 3 presents specific results from studies conducted throughout 2017 including baseline reliability, market efficiency, operational performance, transmission owner criteria analyses as well as scenario and interregional studies. Book 3 also summarizes RTEP window activity during 2017. Subregional summaries are also provided.

Book 3 PDF (30MB)

Book 1 - 3

Book 1 - 3 PDF (45MB)

Example RTEP Project



- High System Voltages
  - Eastern PJM
    - RTEP solutions
      - Shunt reactors to be installed at:
        - Roseland – 350 MVAR
        - Bergen – 100 MVAR
        - Essex – 150 MVAR
        - Bayonne – 100 MVAR
        - Lackawanna – 200 MVAR
      - Variable reactive devices at:
        - Bergen & Bayway – 200 MVAR

Training and Certification Requirements

Member Transmission Owner Operator Requirements

Initial Training Requirements

- PJM Transmission ITP Course
  - Training is linked to each shared task on the Transmission Owner Task List
  - PJM provides training on all shared tasks; member companies provide training on company-specific tasks
- Task Verification
  - Each operator must be verified as having the capability to perform each task at least one time (PER-005)
  - Verify within 6 months for new or changed tasks

Member Transmission Owner Operator Requirements

Certification Requirements

- PJM Transmission Certification
  - Certificate good for 3 years
  - May be renewed in 2 ways:
    - Re-test before the prior certificate expires
    - Over the 3 year period, accrue 140 CE hours (of which 30 must be simulation related)
- NERC Certification
  - 3 acceptable versions
    - Transmission (TO)
    - Balancing, Interchange and Transmission (BT)
    - Reliability Coordinator (RC)
  - Certificate good for 3 years
  - May only be renewed by CE hours (140/160/200, respectively)

Member Transmission Owner Operator Requirements

Continuing Training Requirements

- Each operator must complete:
  - **32 hours** of emergency operations related training annually
  - Training related to tasks identified as requiring annual training (DIF analysis)

- How can you meet these requirements?
  - PJM-provided training (in-person, online via LMS)
  - Company-provided training
  - Third-party, NERC-approved providers

Questions?

PJM Client Management & Services

Telephone: (610) 666-8980

Toll Free Telephone: (866) 400-8980

Website: www.pjm.com

The Member Community is PJM's self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services