

ADAMS/ACCESSION NO.: ML060170638



Voltage Control for Nuclear Power Plants in PJM

NRC Public Meeting
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ENCLOSURE 8

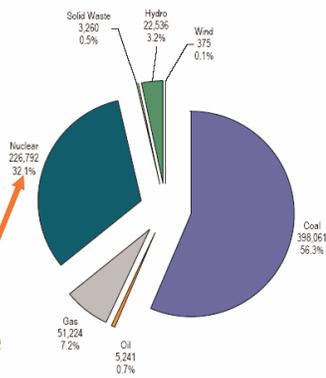


Overview of PJM

PJM Interconnection serves as the regional transmission organization (RTO) for a 164,260-square-mile area that cover all or parts of Delaware, Indiana, Illinois, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

Population – 51 million
Generating sources – 1,271, with diverse fuel types
Generating capacity – 164,597 megawatts
Peak demand – 135,000 megawatts
Annual energy delivery – 700 million megawatt-hours
Transmission lines – 56,070 miles
Members/customers – more than 390
Cumulative billing – \$28 billion since 1997

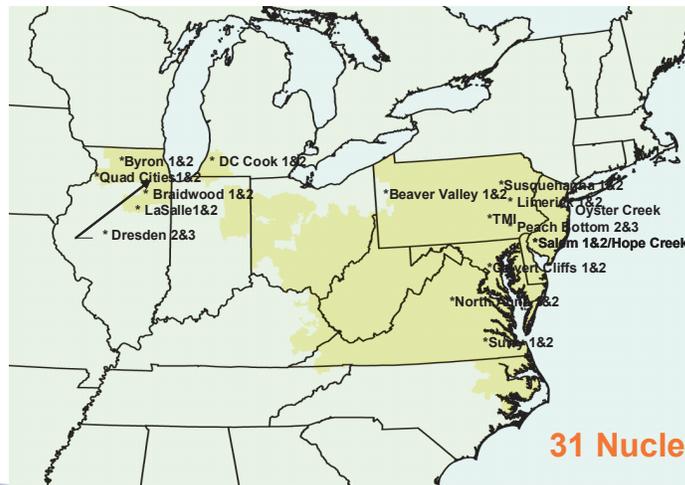
Generation By Fuel Source (GWh)



**NPPs are a key energy source
in the PJM market area**



Overview of PJM—Nuclear Plants





PJM Nuclear Owners/Operators Users Group

- Created by the owners as a feature of PJM governance (PJM staff facilitates and provides administrative support)
- Broad participation from the nuclear owners: AEP, AmerGen, Constellation, Dominion, Exelon, First Energy, PPL, and PSEG

Process

- Nuclear owners work with PJM staff and the PJM Operating Committee (transmission owners and non-nuclear generators) to establish and document requirements that address NPP concerns
- Operating requirements and procedures are documented in the PJM Manuals and become mandatory via the authority that flows from the PJM Operating Agreement, which all PJM members execute



PJM Voltage Standards and Operational Philosophy

PJM BASE LINE VOLTAGE LIMITS

PJM Base Line Voltage Limits						
Limit	500 kV	345 kV	230 kV	138 kV	115 kV	69 kV
High	550 (1.10)	362 (1.05)	242 (1.05)	145 (1.05)	121 (1.05)	72.5 (1.05)
Normal Low	500 (1.00)	328 (.95)	219 (.95)	131 (.95)	109 (.95)	65.5 (.95)
Emergency Low*	485 (.97)	317 (.92)	212 (.92)	127 (.92)	106 (.92)	63.5 (.92)
Load Dump*	475 (.95)	310 (.90)	207 (.90)	124 (.90)	103 (.90)	62 (.90)

Voltage Drop Warning*	2.5%
Voltage Drop Violation*	5-8%**
* Refer to PJM Manual for Emergen	
** The voltage drop violation percent	

The following chart details PJM's Voltage Operating Guidelines for a Post-Contingency Simulated Operation.

Exhibit 5: P.

Voltage Limit Exceeded	If post contingency simulated voltage limits are violated	Time to correct (minutes)
High Voltage	Use all effective non-cost and off-cost actions.	30 minutes
Normal Low	Use all effective non-cost actions.	Not applicable
Emergency Low	Use all effective non-cost actions, off-cost actions, and emergency procedures except load shed.	15 minutes
Load Dump Low	All of the above plus, shed load if analysis indicates the potential for a voltage collapse.	5 minutes
Voltage Drop Warning	Use all effective non-cost actions.	Not applicable
Voltage Drop Violation	All effective non-cost and off-cost actions plus, shed load if analysis indicates the potential for a voltage collapse.	15 minutes



Mitigation Protocols for NPP Voltage Limits

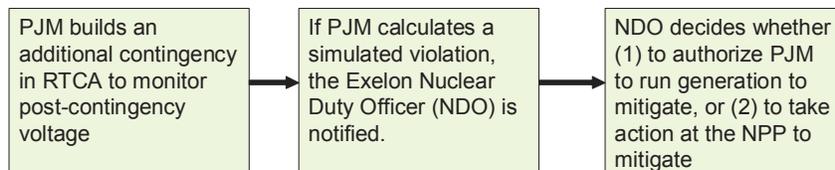
- **Communication**
 - NPP, Transmission Owner, PJM
- **Information Exchange**
 - Recognize the special needs of NPPs to have actual voltage information
- **Take Action**
 - Run generation out of economic merit order, as necessary, to prevent violation of the limit

[For details, see PJM Manual M-3, Transmission Operations, at:
<http://www.pjm.com/contributions/pjm-manuals/pdf/m03v18.pdf>,
pgs. 38-41]

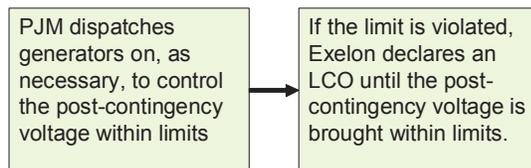


Exelon Example

Issue: Required post-contingency voltage (upon loss of the plant) at ComEd-area NPPs is more restrictive than the PJM Base Line limit.



If NDO authorizes generation,





PJM Outage Coordination Process

>30 Days From Start

- Owner requests the outage
- PJM accepts/rejects request, based on availability of required reserves, and transmission reliability

1-7 Days From Start

- Repeated transmission analysis takes place to ensure that all reliability limits are respected, given the system topology anticipated during the outage

Outage Start Day

- Owner requests to take the facility out of service
- PJM analyzes the system as it currently exists to verify that the outage can proceed without violating reliability limits
- PJM permits the facility to be switched out of service, if the analytical results are satisfactory



What are

degraded grid reliability conditions... that would warrant...the rescheduling of grid-risk-sensitive maintenance activities ? (from draft Generic Letter)

Could degraded grid reliability conditions be:

- Circuit breaker maintenance in the substation?
- Outages of adjacent transmission lines?
- Routine maintenance of protection systems?
- High load conditions?

And who decides?

- Licensee—may not be a good judge of grid risks
- TSO—will not be a good judge of NPP risks



Draft Generic Letter Open Questions from Grid Perspective

Describe your formal agreements with your transmission system operator (TSO) to promptly notify you when conditions of the surrounding grid are such that degraded voltage (i.e., below TS requirements) or LOOP could occur following a trip of the reactor unit(s). (from draft Generic Letter)

What is the NRC vision of "agreements"?

Individual bi-lateral agreements between PJM and each NPP? Tri-lateral with PJM and transmission owner?

PJM perspective:

- All PJM members (transmission owners, nuclear owners, non-nuclear owners, marketers) sign PJM Operating Agreement which binds all members to conform to requirements in the PJM Manuals
- PJM Manuals contain all operational requirements and procedures and are maintained by PJM in conjunction with the PJM committees



Describe the procedures to periodically check with the TSO to determine the grid condition and ascertain any conditions that would require a notification. If you do not have procedures, describe how you assess grid condition that would require notifications. (from draft Generic Letter)

PJM perspective: 31 nuclear units, 8 owners, 16 transmission owners

There have to be protocols in place to require the necessary notifications and a level of trust that the notifications will occur when required. Any regime other than exception reporting will quickly become a significant burden to the shift personnel at the NPPs, TSOs, and the transmission owners.



Draft Generic Letter Open Questions from Grid Perspective

Consistent with the recommendations in Section 2 of RG 1.155, you are expected to have established an agreement with your plant's TSO that identifies local power sources that could be made available to resupply your plant following a LOOP event. (from draft Generic Letter)

PJM Perspective:

PJM restoration procedures provides deference to the special needs of NPPs. The possible system configurations that might exist in the wake of a LOOP are almost impossible to predict and assess. In the PJM area, the transmission and generation sources are so densely situated that delineating particular generation and/or transmission sources for a particular NPP restoration scenario is very problematic.