Fuel Security Senior Task Force Summary

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Agenda

- Background history on fuel security initiative at PJM
- Phase 2 Summary
- Task force recommendation and vote

Background: A History of Fuel Security at PJM

2015 – 2017	• PJM produces a series of reports on the impact of the changing landscape of the electrical power industry, culminating in a report evaluating the changing resource mix in PJM
Apr. 2018	• PJM releases a brief outlining its intent to perform further analysis on the topic of fuel security and its proposed approach to the process
Nov. / Dec. 2018	• PJM releases the results of its analysis and simulations and presents the data to its stakeholders, identifying some potential risks and vulnerabilities associated with fuel security
Feb. / Mar. 2019	• Problem Statement & Issue Charge presented to and approved by PJM stakeholders, identifying fuel security as an important component of reliability and resilience
Apr. 2019 - Present	• The PJM Fuel Security Senior Task Force is formed to identify and evaluate options and provide recommendations back to the larger PJM stakeholder body

Background: Three Phases of PJM Fuel Security

Phase I

- Stress the system to identify potential system vulnerabilities that result in inability to ensure that peak demands can be met

Phase II

- Work through the PJM stakeholder process to identify if market, operational, or planning changes are needed to address fuel security

Phase III

- Work with federal and state agencies alongside other industry sectors to address any specific security concerns, such as physical and cybersecurity risks

Background: Phase I Scenarios Analyzed - 2018

Dispatch	Retirement	Winter Load	Non-Firm Gas	Refueling	Pipeline Disruption (med. impact)	Pipeline Disruption (high impact)	Forced Outages
Economic	Announced	Typical 50/50 134,976 MW	62.5% Avail.	Moderate	Looped 1	Looped 1	Five-Year Avg.
Max. Emergency	Escalated 1	Extreme 95/5 147,721 MW	0% Avail.	Limited	Looped 2	Looped 2	Modeled Outages
	Escalated 2				Single 1	Single 1	
					Single 2	Single 2	

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combinations

Background: Phase I Conclusions

There is NO immediate threat to the reliability of the PJM RTO.

- PJM is reliable in the announced retirements and escalated retirements cases under all typical winter load scenarios.
- PJM is reliable in the announced retirements cases under all extreme winter load scenarios.

- Scenarios to identify points at which an assumption or combination of assumptions begin to impact the ability to reliably serve customers.
- The stressed scenarios resulted in a loss of load under extreme but plausible conditions.

Contributing factors:

- The level of retirements and replacements
- The level of non-firm gas availability
- The ability to replenish oil supplies
- The location, magnitude and duration of pipeline disruption
- Pipeline configuration

Phase 2 Objectives

Step 1 2019

- Education
- Additional analysis
- Key work activities #1- #4*
- Deliverable #1: 12/19/19 MRC

Deliverable #1: *A recommendation to the MRC on whether market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security*.

Step 2 2020

- Pending recommendation from Step 1
- Timing determined at 12/19/19 MRC
- Key work activities #5 - #9
- Deliverable #2- #3
- Solution development

Deliverable #2: *A recommendation to the MRC on proposed market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security*.

Deliverable #3: Revisions to governing documents

*Key work activities #1-4 provided in Appendix A

Phase 2 Work Streams

Work stream 1:
Risk Assessment

Work stream 2:
Scenario Analysis

Work stream 3:
Gap Analysis

Determine Path Forward

Work Stream 1: Risk Assessment

Identified Risks (86 identified)

- Reviewed historical data and solicited input from stakeholders and area experts to list Risks to the PJM system (Pipeline disruptions, Cold snaps, Heat Waves, etc.)

Narrow to Relevant Risks (19 identified for winter period)

- Analyzed the Risks identified and developed a list of risks within the Fuel/Energy/Resource Security scope and the identified Relevant Period (Pipeline disruptions, Cold snaps, Solar and Wind Intermittency, Fuel Availability)

Collect Data on Study Risks

- Collect data on the frequency of occurrence, generation impact, locational nature, and other factors necessary to model the Study Risks and their affect of Fuel/Energy/Resource Security

Define Relevant Scenarios

- Combine the Relevant Risks into event scenarios and identify any significant gaps from Phase 1 scenarios

Evaluate Relevant Scenarios (Work Stream 2)

- Identify Relevant Scenarios for simulation to determine impact on the PJM system

Work Stream 2: Scenario Analysis

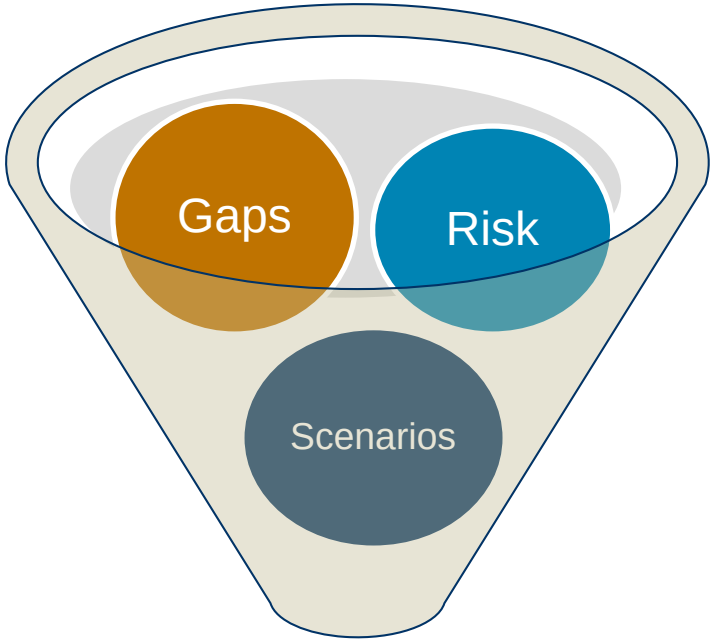
Approach	Winter Load	Phase 2 Relevant Risks	Scenario Results
Phase 1 & Phase 1 Sensitivities based on Stakeholder Feedback **(56 scenarios)**	Typical • 50/50 peak (134,976 MW) • 2011/12 load profile Extreme Winter • 95/5 peak (147,721 MW) • 2017/18 load profile 14 day study period	Modeled sensitivities for fuel delivery risks: oil refueling, non-firm gas availability, pipeline disruptions	• Portfolios at expected reserve margin shows no immediate threat to reliability • Some scenarios with *stressed* portfolios and conservative fuel delivery infrastructure assumptions resulted in emergency procedures, including Voltage Reduction and Manual Load Shed.
Historical Relevant Risk Events (Work stream 1) **(1.18 million scenarios per portfolio)**	Load shapes consistent with selected cold snaps	Relevant Risk Forced Outages Rates from cold snap scaled to portfolio	• Over 1 million simulations conducted for relevant period and filtered credible risks • Loss of load expectations (LOLE) determined for different levels of disruptions • Cost impacts provided from expectations of scenarios and perceived value of loss load using independent sources. • Impact dependent on assumed probability of disruption
		Sensitivities for discrete occurrences of risks outside of historical forced outage dataset	

Work Stream 3: Gaps Analysis

- Existing Mechanism Assessment
  - Determined if any gaps in uncertainties/risks, procurement period, compensation, and incentives
- Results
  - There may not be sufficient compensation and incentives with existing mechanisms for a resource to increase its fuel/energy/resource security.
    - Measured using penalties and lost revenue for not performing
  - Expected cost varies based on assumption of scenario occurrence
  - Demonstrated value of lost load using historical independent sources

Capacity Performance (CP)	Energy Market (DA and RT)	Contingency Reserves – Current and Proposed
Regulation	Maximum Generation Emergency Procedure	"Resource Limited" Unit Dispatch
Voltage Reduction	Gas Contingency Procedures	Gas/Electric Coordination
Transmission Planning Solution	Restoration Plan (Black Start Services)	Emergency Operating Procedures

FSSTF Phase 2 Summary



4,720,380 Scenarios

- Phase 1 (324)
- Phase 2 (4,720,056)

- Analysis demonstrated there may be gaps in existing mechanisms in compensation and incentives
- Loss of load scenarios exists for unlikely but plausible events
- No Immediate threat

Multiple Potential Paths Forward

Cost impacts

- Dependent on expectations of scenarios and perceived value of loss load.

Potential Paths Forward

Path 1: Status Quo

PJM continue to monitor and re-visit with stakeholders if risk increases.

- Included in a stakeholder work plan
- Guidelines provided to stakeholders with opportunity to provide feedback

Non-binding poll results:
Yes: 74%
No: 26%
Maybe 0%

Path 2: Pre-defined Criteria

PJM and stakeholders develop criteria, but do not develop solution until criteria is met

- *Criteria to be developed in 2020*

Non-binding poll results:
Yes: 24%
No: 47%
Maybe 30%

Path 3: Solution developed

Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria

- *Criteria and solution mechanism to be developed in 2020*

Non-binding poll results:
Yes: 19%
No: 65%
Maybe 17%

*All Paths include incorporation of potential NERC guidelines/standards or FERC orders if applicable

Appendix A
Key Work Activities #1-4

Status: Key Work Activities

KWA	Description	Status
1	Provide education, at a minimum, on the following: a. Fuel security study recently completed by PJM. b. Work other ISO/RTOs are doing relative to fuel/energy/resource security. c. PJM mechanisms and products from both the supply side and demand side that contribute to fuel/energy/resource security. d. NERC Assessments that may support this initiative. e. The primary risks to fuel/energy/resource security in PJM and the impact and likelihood of such risks.	• Reviewed Phase 1 • ISO-NE and MISO provided status • Mechanisms identified • NERC provided status • Risks identified • Relevant period identified 
2	Quantify the risk of occurrence of selected scenarios that might present a risk of fuel/energy/resource insecurity.	• Risks identified 

Status: Key Work Activities (cont.)

KWA	Description	Status
3	Determine what it means from a PJM system and/or resource level to be fuel/energy/resource secure. This determination should include all aspects of fuel supply characteristics, resource type characteristics, location of the fuel supply, roles of demand response and demand side management, location and characteristics of non-fuel generation (e.g., renewable and energy storage resources), and other alternative options that can ensure fuel/energy/resource security in the coming years.	• Reviewed impact of existing mechanisms • Identified Gaps in Incentive and Compensation 
4	Determine whether there is a quantifiable and/or locational requirement for fuel/energy/resource security in PJM.	• Risk assessment incorporated locational aspect • Scenarios results demonstrated a locational aspect quantifiable requirement. 

Appendix B
FSSTF Non-Binding Poll Results

FSSTF Poll

- Poll participation
  - Voting members – 69
  - Affiliate members – 134
  - State Commission – 1
  - TOTAL = 204 votes

FSSTF Poll Results

1. Do you think it is important for PJM to monitor fuel/energy/resource security needs?
    - Yes – 94%
    - No – 6%
    - Maybe – 0%
2. Do you think that existing PJM market, operational, or planning mechanisms provide sufficient incentives to ensure fuel/energy/resource security?
    - Yes – 51%
    - No – 35%
    - Maybe – 13%

FSSTF Poll Results

3. Do you think that market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security?
   - Yes – 35%
   - No – 48%
   - Maybe – 17%

4. Do you think PJM should implement changes for fuel/energy/resource security ONLY if NERC or FERC provides orders, guidelines, or standards?
   - Yes – 16%
   - No – 54%
   - Maybe – 30%

FSSTF Poll Results

5. Do you support Path 1 as follows? Status Quo: PJM continue to monitor and re-visit with stakeholders if risk increases. Include as part of stakeholder work plan with guidelines for study provided and allow stakeholder feedback.
   - Yes – 74%
   - No – 26%
   - Maybe – 0%

6. If you think that market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security, beyond status quo, do you support: Path 2: Pre-defined Criteria: PJM and stakeholders develop criteria, but do not develop solution until criteria is met
   - Yes – 24%
   - No – 47%
   - Maybe – 30%

FSSTF Poll Results

7. If you think that market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security, beyond status quo, do you support: Path 3: Solution Developed: Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria
   - Yes – 19%
   - No – 65%
   - Maybe – 17%

8. If you think that market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security, beyond status quo, do you support something other than the identified paths? Please use the comments box to define this alternative.
   - See comments

FSSTF Poll Results

9. Please rank the Paths in priority order. (Path 1, Path 2, Path 3)
   - Path 1 as priority 1 – 134 votes
   - Path 2 as priority 1 – 32 votes
   - Path 3 as priority 1 – 38 votes
   - Or, by order:
     - Order #1 – 1,2,3 – 134 votes
     - Order #2 – 3,2,1 – 38 votes
     - Order #3 – 2,1,3 – 16 votes
     - Order #4 – 3,1,2 – 16 votes