Fuel Security Senior Task Force
Summary and Poll Questions
FSSTF Phase 2 Status

Gaps in Existing Mechanisms
- Modeling of uncertainties
- Compensation

What scenarios result in loss of load and what is threshold?

What is cost and incentive?
Inform stakeholder recommendation
(Are changes necessary?)

Relevant period & credible risks informed by historical data and stakeholder feedback

Relevant risks determine focused scenarios
- Supplement Phase 1

- Poll (November)
- MRC Recommendation (December)
## FSSTF Timeline

<table>
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<tr>
<th>Scenarios</th>
<th>Oct. 25 (9-4)</th>
<th>Nov. 22 (9-4)</th>
<th>Dec. 16 (1-4)</th>
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<tbody>
<tr>
<td>Present early results</td>
<td>Present final results and Summary</td>
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Vote at December 19th MRC
- Recommendation to the MRC on whether market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security
Scenario Analysis Summary: Deterministic Dispatch Simulations
324 “Phase 1” Scenarios + 56 Sensitivities based on stakeholder feedback

- Inclusion of assumptions reflective of typical conditions and more extreme assumptions intended to stress the system.
- Focus was on event impact and contributions of fuel delivery infrastructure interdependencies like firm/non-firm gas availability, onsite fuel replenishment, and pipeline disruptions. Focus was not on event probability.
- Based on assessment of a 2023 portfolio at expected reserve margin (“Announced” portfolio, 28.5%), there is no immediate threat to the reliability of the PJM RTO due to risks associated with fuel delivery infrastructure interdependencies, even in scenarios with the most conservative assumptions.
- Some scenarios with stressed portfolios at the IRM (“Escalated 1, 2, 3” 15.8%) and conservative fuel delivery infrastructure risk assumptions resulted a need for emergency procedures, including Voltage Reduction and Manual Load Shed.
- Simulation of PJM operational procedure to manage resource limitations like onsite fuel inventory (Maximum Emergency, Manual 13) showed reduction in need for escalating emergency procedures.
Arriving at the LOLE shown in each of the points in the graph below involved analyzing a large number of scenarios.
Scenario Analysis Summary:
Relevant Risk Assessment & Probabilistic Scenarios

Reported LOLE for Disruption Size

Recent Cold Snap #1 (10 days) → 1000 X
Recent Cold Snap #4 (5 days) → 1000 X
Older Cold Snap #1 (17 days) → 1000 X
Older Cold Snap #25 (6 days) → 1000 X

Random Forced Outages Scenarios
1000 X
1  X

Relevant Risks Scenarios
1  X
1  X
4  X
4  X

Disruption Timing Scenarios
14 =
9 =
21 =
10 =

Total Scenarios by Cold Snap
14000
9000
84000
40000
Scenario Analysis Summary:

Relevant Risk Assessment & Probabilistic Scenarios

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<th>Relevant Risk Scenarios</th>
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Total Scenarios: 1180000

Each of the LOLE points in the graph shown in Slide 5 summarizes the result of analyzing 1,180,000 scenarios.
Gaps in Existing Mechanisms Compensation

• Currently, there may not be sufficient incentive under the existing mechanisms for a resource to increase its fuel / energy / resource security.

• The only mechanism available for a resource that guarantees it cost-recovery of fuel availability expenses is its capacity market avoidable cost rate (ACR) and the vast majority of resources are not submitting unit specific cost data so there is no specific information on fuel availability costs.
Key Takeaways from Gap Analysis

As a result of the gaps identified:

1) It is important to study the reliability of the system under extended periods of severe weather conditions

2) Refrain from making assumptions about the potential availability improvements of certain resources under stressed system conditions

3) Consider whether any changes to the existing mechanisms are needed to incentivize desired behavior.
Potential Event Costs Derived from Historical Sources

Estimates $/MWh costs used in graph from the following sources:

- $9,000/MWh - The Brattle Group for ERCOT, "Estimating the Economically Optimal Reserve Margin in ERCOT"
- $15,000/MWh - Astrape Consulting for EISPC & NARUC, "The Economic Ramifications of Resource Adequacy"
- $97,087/MWh - Electricity Consumers Resource Council, "The Economic Impacts of the August 2003 Blackout"

Cost values ($) in graph from multiplying $/MWh cost values above by conditional value at risk (CVaR) in MWh for each portfolio, see appendix
FSSTF Phase 2 Summary

1,180,380 Scenarios
- Phase 1 (324)
- Phase 2 (1,180,056)

Analysis demonstrated there may be gaps in existing mechanisms in compensation and incentives

Cost impacts can be derived from expectations of scenarios and perceived value of loss load.
- Provided potential costs derived from historical independent sources
Potential Paths Forward

Path 1: Status Quo
PJM continue to monitor and re-visit with stakeholders if risk increases.

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

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

*All Paths include incorporation of potential NERC guidelines/standards or FERC orders if applicable
Path 1: Status Quo

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

Advantages
- Risk of event already low - No action until review indicates concerns
- Monitoring allows for additional initiatives at NERC/FERC to complete
- Includes additional stakeholder input if risk increases

Disadvantages
- Risk that a solution mechanism may not be in place before event
- Market does not drive when solution is triggered

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

Advantages
- Risk of event already low
- Monitoring allows for additional initiatives at NERC/FERC to complete
- Criteria pre-defined to trigger solution development
- Solution to be determined once trigger is met

Disadvantages
- Risk that a solution mechanism may not be in place before event
- Market does not drive when solution is triggered
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

Advantages
- Risk of event already low and impact should be minimal
- Solution already in place removes risks of timing to develop solution and implement
- Markets, Operations, or Planning pre-defined criteria can determine when solution is triggered

Disadvantages
- Potential for the solution to be triggered prematurely
### Potential Paths Forward

<table>
<thead>
<tr>
<th></th>
<th>Development of criteria to trigger further action and related solution mechanism(s) in future stakeholder process when risk increases</th>
<th>Development of criteria to trigger further action in 2020 stakeholder process</th>
<th>Development of solution mechanism(s) in future stakeholder process when criteria established by PJM &amp; stakeholder is met</th>
<th>Development of solution mechanism(s) to be triggered based on criteria in 2020 stakeholder process</th>
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<td>PJM continues to monitor risks internally</td>
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<tr>
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<td>Path 3</td>
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1. Do you think it is important for PJM to monitor fuel/energy/resource security needs? (Y, N, Maybe)

2. Do you think that existing PJM market, operational, or planning mechanisms provide sufficient incentives to ensure fuel/energy/resource security? (Y, N, Maybe)

3. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under existing conditions? (Y, N, Maybe)

4. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under expected future conditions? (Y, N, Maybe)

5. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under future conditions AND these changes should only be triggered if a PJM-determined criteria is met? (Y, N, Maybe)
6. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under future conditions AND these changes should only be triggered if a pre-determined stakeholder approved criteria is met? (Y, N, Maybe)

7. Do you think PJM should only implement changes for fuel/energy/resource security if NERC or FERC provides orders, guidelines, or standards? (Y, N, Maybe)

8. Do you think there needs to be an operational change (non-market mechanism) in place to ensure fuel/energy/resource security? (Y, N, Maybe)

9. Do you think there needs to be a change to the PJM planning criteria to ensure fuel/energy/resource security? (Y, N, Maybe)

10. Do you think there needs to be a change to market mechanism(s) in place to ensure fuel/energy/resource security? (Y, N, Maybe)
11. Do you support Path 1 as follows? (Y, N, Maybe)
   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 allowing for stakeholder feedback.

12. Do you support Path 2 as follows? (Y, N, Maybe)
   Pre-defined Criteria: *PJM and stakeholders develop criteria, but do not develop solution until criteria is met*

13. Do you support Path 3 as follows? (Y, N, Maybe)
   Solution Developed: *Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria*

14. What is your preferred path forward? (Path 1, Path 2, Path 3, Other)
Appendix
CVaR vs Disruption - Announced Retirements (28.5% ICAP Reserves)
CVaR vs Disruption – Escalated 1 Retirements
(15.8% ICAP Reserves)
CVaR vs Disruption – Escalated 2 Retirements
(15.8% ICAP Reserves)
CVaR vs Disruption – Escalated 2 Retirements (15.8% ICAP Reserves)