What the Processing Industry Must Learn from the February 2021 Texas Power Outages

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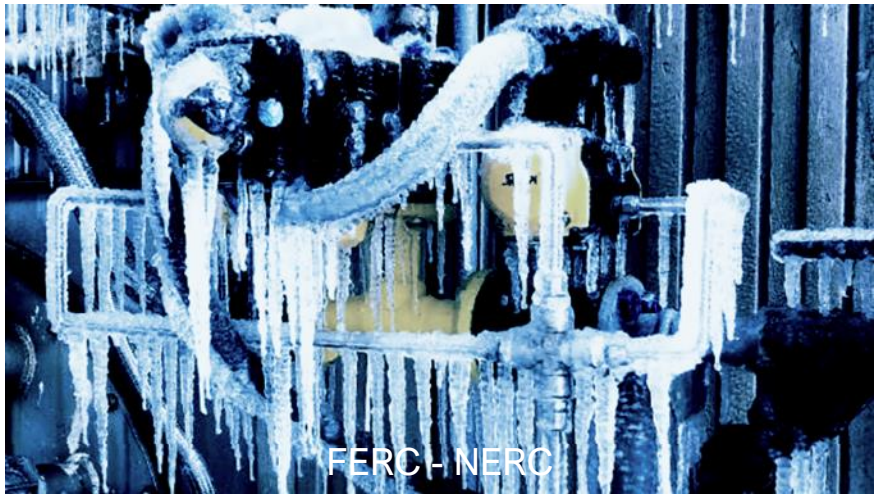
Joe Raedle, Getty Images


FERC – NERC

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February 2021 Winter Storm

- Brought extremely low temperatures to many parts of North America
- Caused record high winter-time electrical demand in Texas
- Also caused significant disruption to electrical generation capacity
- Resulted in outage of nearly 30% of Texas' generation capacity – nearly 50% unavailable in total
- Continuous power outages for 3 days from February 15th to 18th
- Disrupted electricity supply to over 4.5 million people

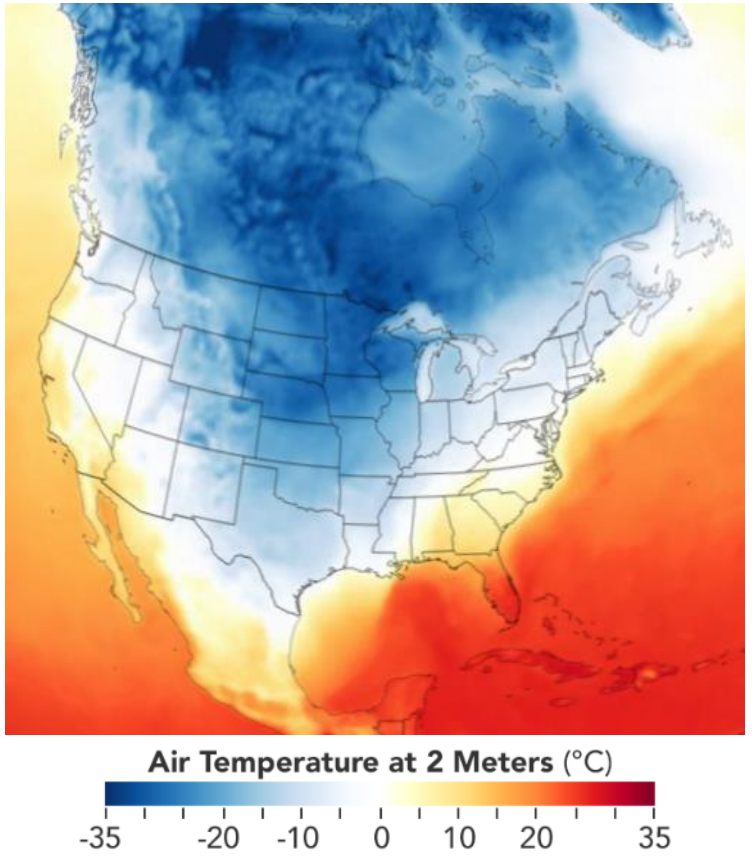


Image source: NASA

Impacts of the February 2021 Power Outages

Estimated 215 fatalities

Estimated USD$80 to $130 billion

4 minutes and 37 seconds from probable total system collapse

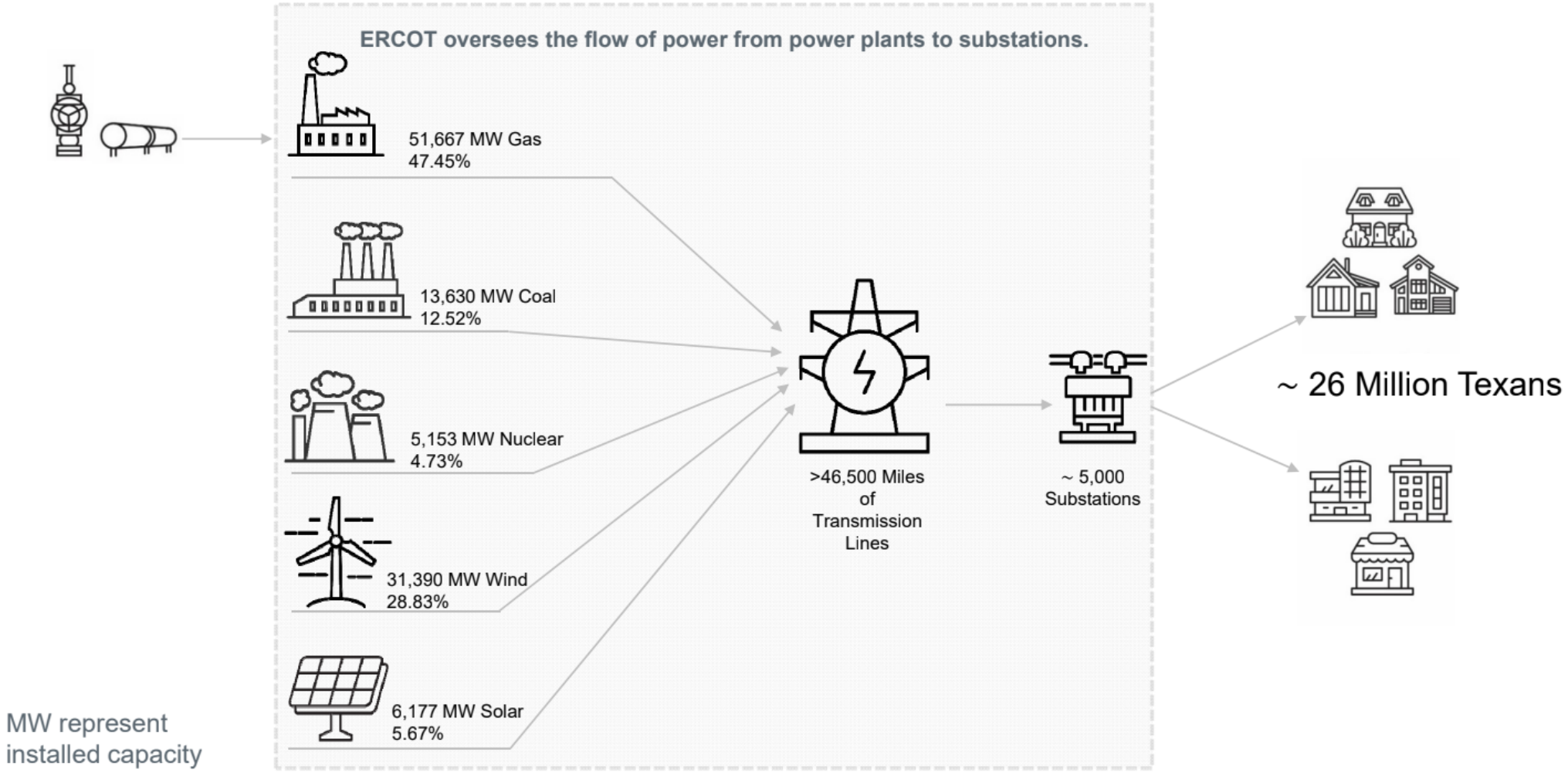
Overview

- How the electric system works
- Why power cuts were necessary
- Process safety lessons from the event



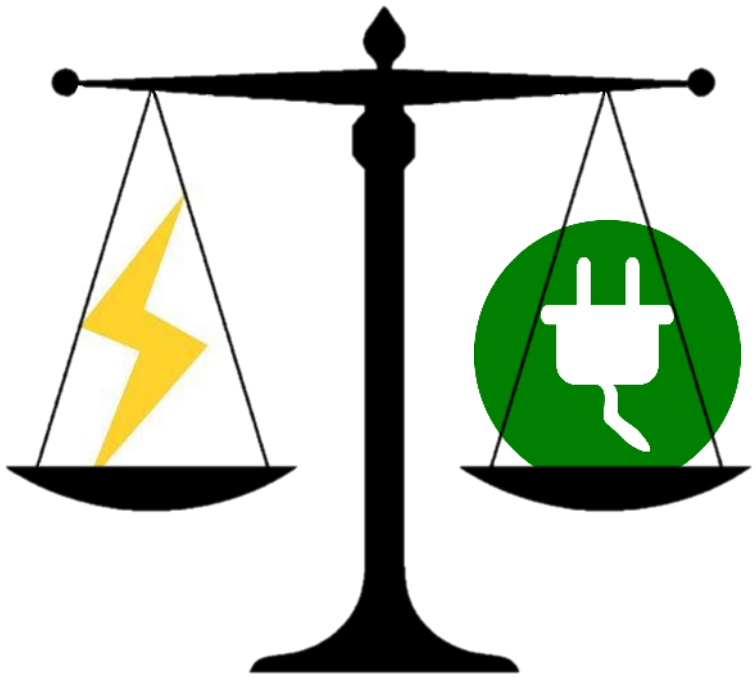

The Electric "Grid"

Generation → Transmission → Distribution → Load



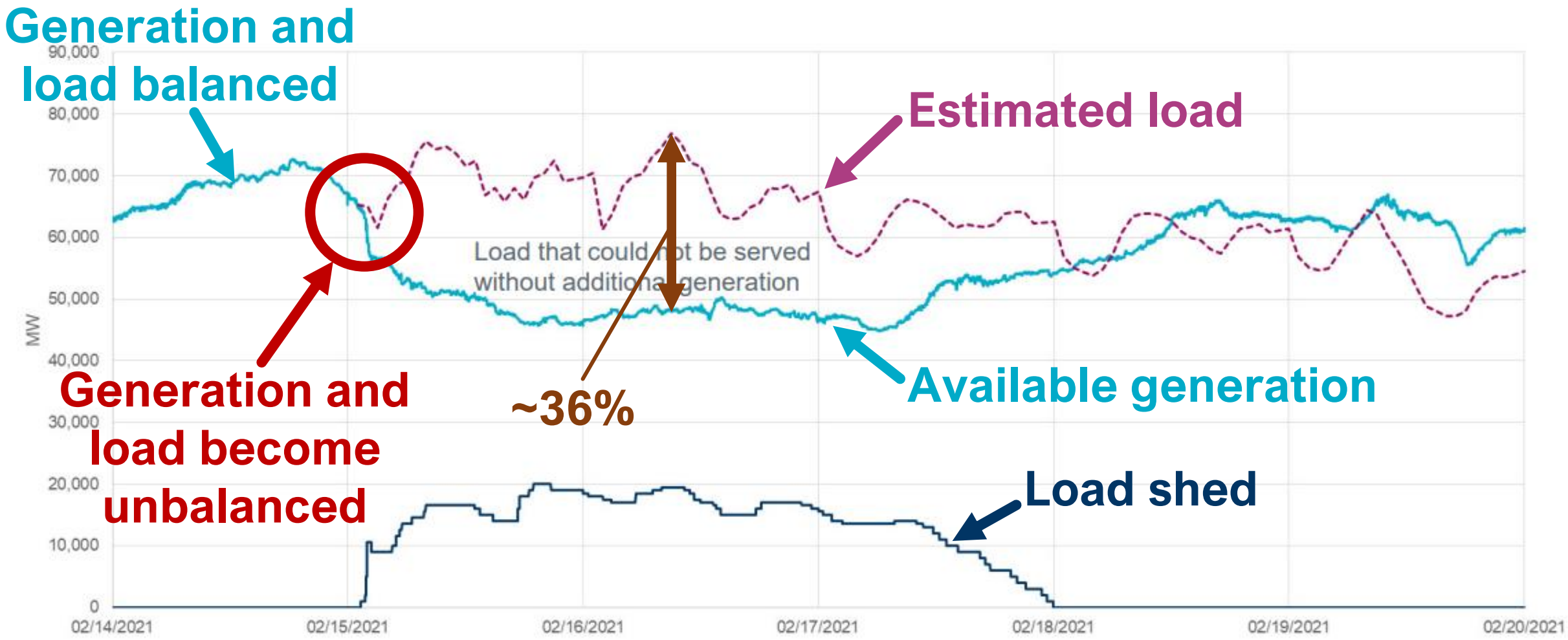
Source: ERCOT (annotations added)

Generation Must be Balanced with Load



- System operates at 60 Hz by balancing generation and load
- More load than generation results in underfrequency, which damages equipment
- Underfrequency can be managed by:
  - Increasing generation (preferred)
  - Shedding load

Load Shedding Required



Source: ERCOT (annotations added)

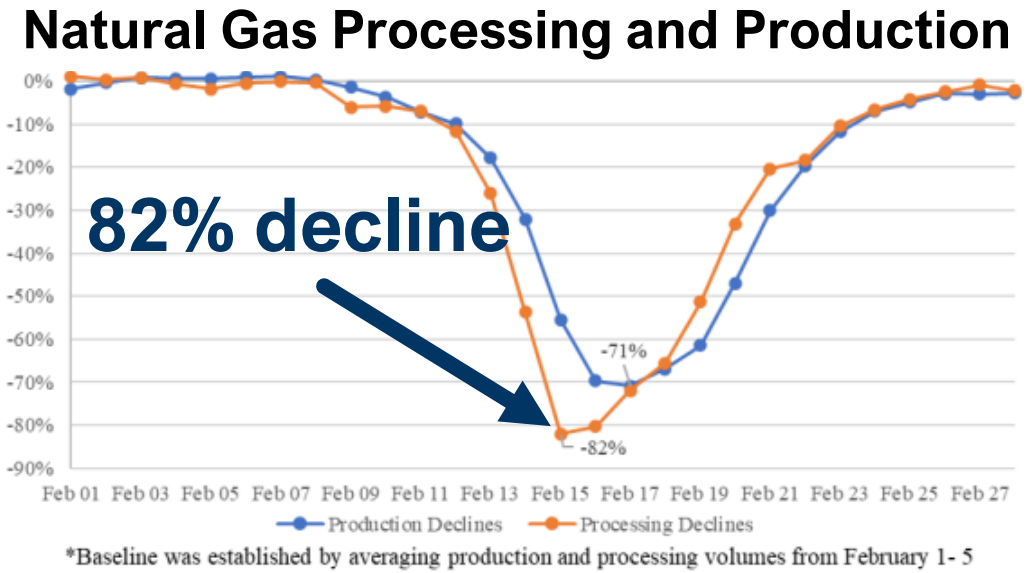
Plan and Prepare for Extreme Situations

- Load-shedding plans created in advance
- Identified critical circuits not to be disconnected
- Need clear authority and lines of communication established in advance
- Load shedding plans did not cover the full amount required to be shed

RBPSM elements: **Emergency Management**, **Training**, **Stakeholder Outreach**, **Conduct of Operations**

Understand and Manage Common-Cause Impacts

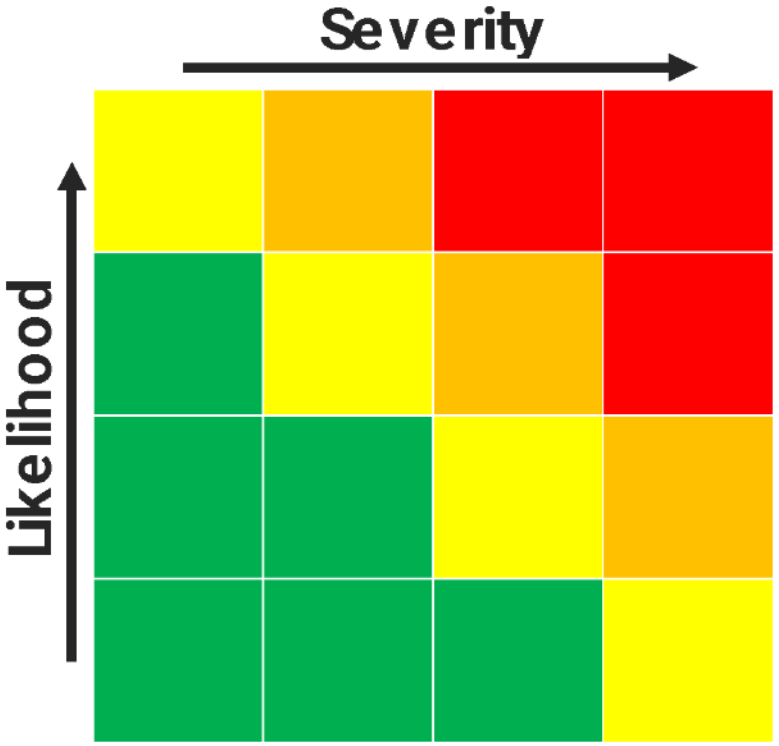
- Electric heating demand rose rapidly as electric heat pumps switched to resistive heating
- Cold weather caused outages of all generation types
- Insufficient fuel for natural gas-fired generators and backup equipment due to cold weather effects



Source: ERCOT (annotation added)

RBPSM elements: **Process Knowledge Management**, **Emergency Management**, **Hazard Identification & Risk Analysis**

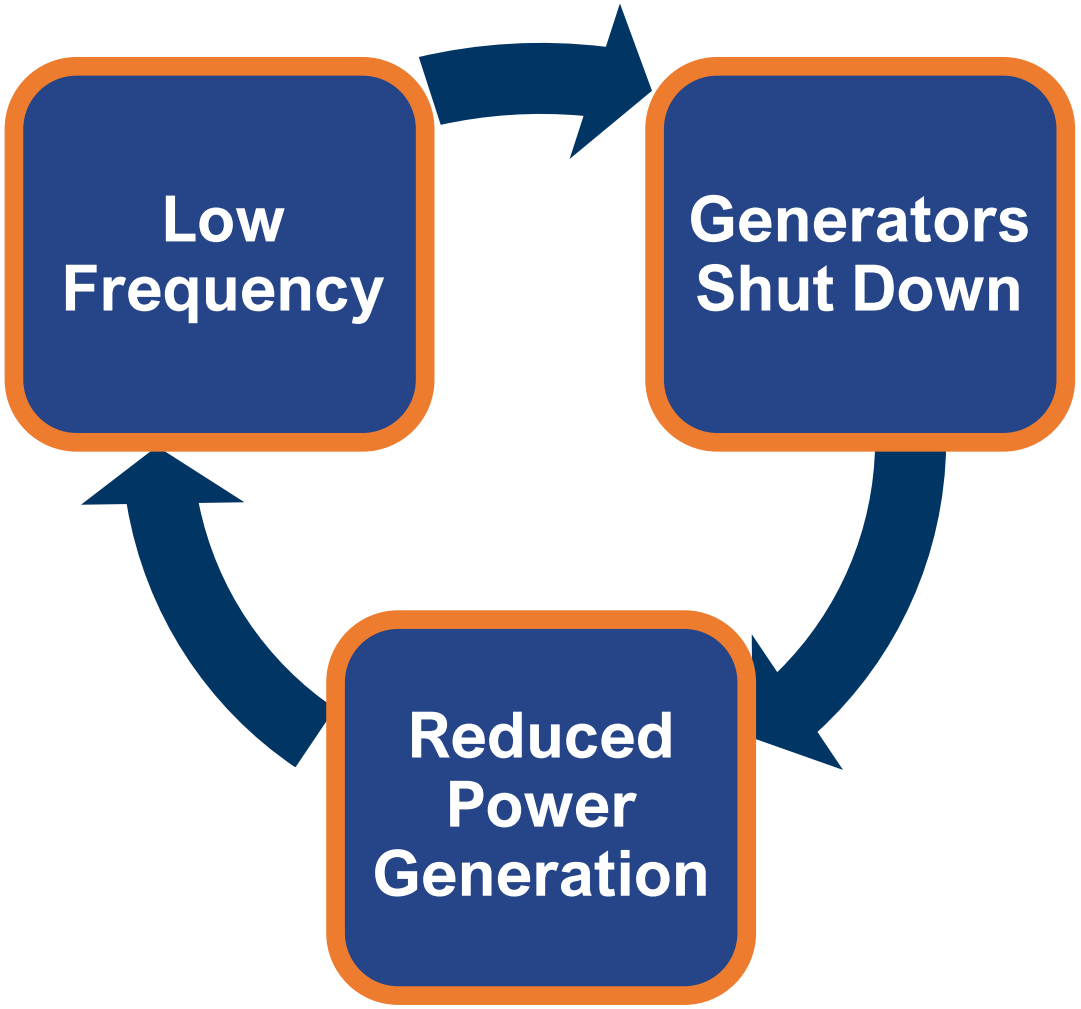
Forecast a Range of Severity and Likelihood Values



- Operators made 50/50 and 90/10 forecasts of peak winter loads
- Estimated peak load: 14% above 90/10 forecast, 33% above 50/50 forecast
- Range of forecasts give a better indication of possible scenarios
- However, these forecasts can still underestimate the risk

RBPSM element: **Hazard Identification and Risk Analysis**

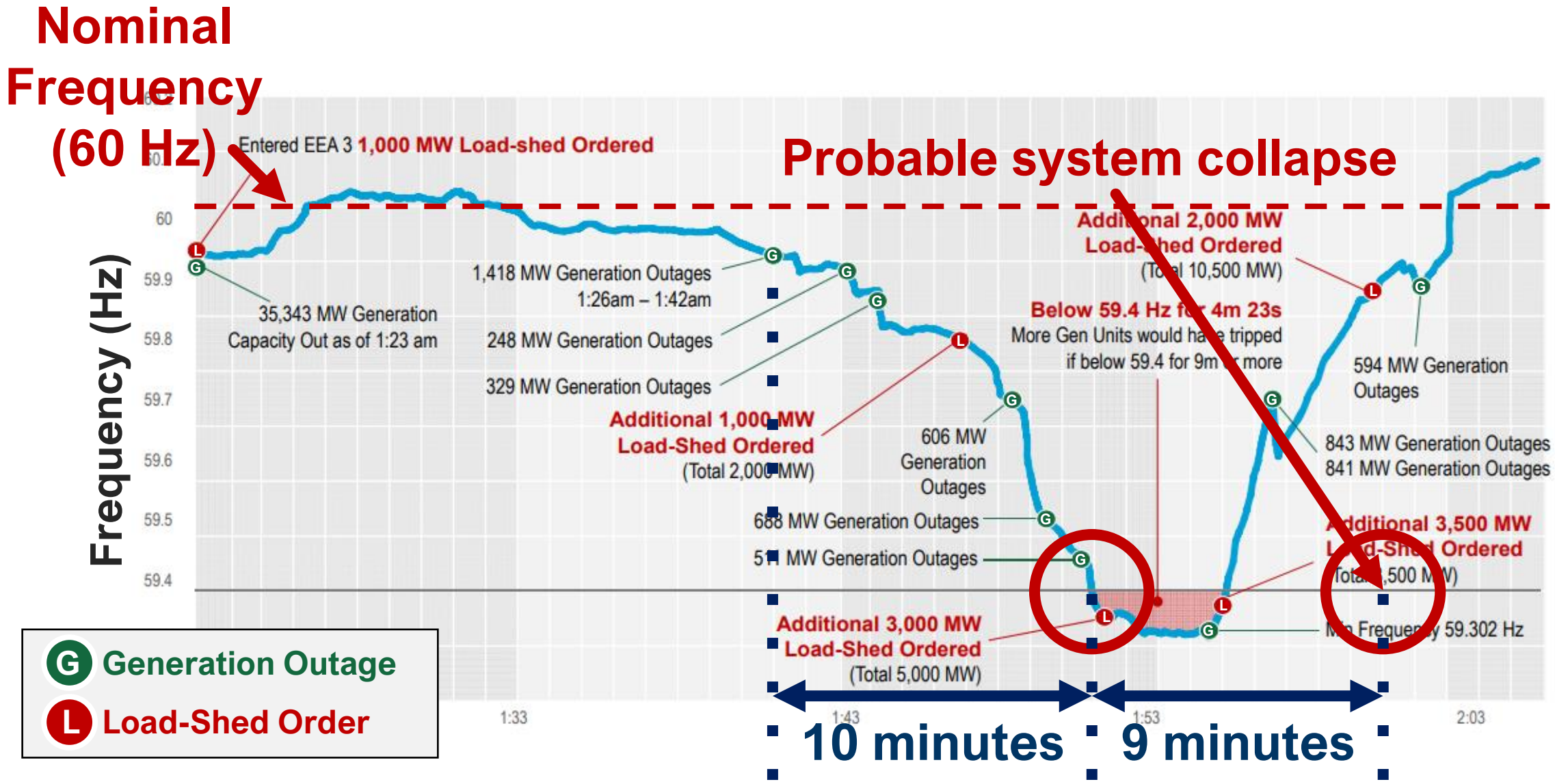
Manage Potential Cascading Failures



- Generators shut down to protect equipment when frequency is too low
- Low frequency can lead to cascading failure of entire system (“black start”)
- ERCOT and operators understood this risk and took action to prevent this scenario

RBPSM elements: **Hazard Identification & Risk Analysis, Incident Investigation**

Potential Cascading Failure



Source: ERCOT (annotations added)

Investigate the Worst Credible Potential Scenario

- Black start would have taken much longer to recover from
- Consider what else could have happened, were there worse consequences that were avoided?
- Include the potentially worse case in investigations and future planning

RBPSM elements: **Incident Investigation**, **Hazard Identification and Risk Analysis**

Respond to Warning Signs

Recent cold weather events before 2021:

- 2011: Nearly 15,000MW unavailable, Nearly 7,000MW firm load shed
  - 26 recommendations issued
- 2014: Nearly 10,000MW unavailable, Less than 300 MW firm load shed
  - 10 recommendations issued
- 2018: Nearly 16,000MW unavailable, Voluntary load management emergency measures only – near miss
  - 13 recommendations issued

RBPSM elements: **Incident Investigation**

Identify Potential Hazards Associated With Backup Systems

- 29 fatalities related to emergency heat sources (fires, carbon monoxide poisoning)
- Need to understand and manage hazards associated with backup systems
- Need to predict what people might do in urgent and uncertain situations

RBPSM elements: **Emergency Management**, **Hazard Identification & Risk Analysis**, **Process Knowledge Management**

Plan for Weather and Climate Risks

- “100 year storm” means a 1% chance every year
- Storm frequency can change
- Planning, construction and training must be completed in advance

“Projects that do not include consideration of climate in their scope may seem to be less costly for initial procurement. However, projects with no scope for incorporating climate risk are likely to incur much higher costs associated with renewing non-resilient designs over the life of the system.”

Engineers Canada, *National guideline on sustainable development and environmental stewardship for professional engineers*

RBPSM elements: **Hazard Identification and Risk Management, Process Safety Culture**

Conclusions

- Forecast a range of potential scenarios of varying likelihood and potential severity
- Understand potential common cause failures and potential cascading failures
- Ensure adequate redundancy between normal systems and backup/emergency systems
- Know which backup systems might be used in an emergency and understand the associated hazards
- Investigate the worst credible potential scenario, not just the scenario that occurred, and make it so it can’t happen again
- Investment now will prevent larger costs in the future

Thank You

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