RELIABILITY FIRST

Agenda
Board of Directors

December 7, 2023 11:00 am – 2:15 pm (ET)

Market Square Conference Center
Concourse Level
801 Pennsylvania Ave. NW
Washington, DC 20004

Room: Forum A, B, C
Attire: Business

Closed Agenda

Board of Directors – Executive Session – Location: Boardroom B 8:00 am

Gas Market 101 8:00 am
Presenter: Michael Oberleitner, Fuel Commodity Specialist, Dominion Energy
Reference: Presentation

The Interregional Transfer Capability Study 8:40 am
Presenter: Jim Uhrin

Confidential Security Update 9:00 am
Presenter: Marcus Noel
Reference: Presentation

Confidential Executive Session 9:10 am
Presenter: Antonio Smyth, Chair

Open Agenda

1. Call to Order and Appoint Secretary to Record Minutes 11:00 am
Presenter: Antonio Smyth, Chair

2. Antitrust Statement 11:00 am
Presenter: Niki Schaefer, Vice President and General Counsel
Reference: Antitrust Compliance Guidelines

3. Chair Remarks 11:05 am
Presenter: Antonio Smyth, Chair

4. Consent Items 11:10 am
Presenter: Antonio Smyth, Chair
Reference:
a) Draft Minutes from August 24, 2023 Board of Directors meeting
b) Resolution for Election of Officers (No. 2023-5)
c) Resolution for Special Election (No. 2023-6)
d) Proposed 2024 Board Meeting Dates
Action: Approve Consent Items

5. Keynote Speaker 11:15 am
Presenter: Manny Cancel, Senior Vice President and Chief Executive Officer of the E-ISAC
Reference: Bio

6 President's Report 11:30 am
Presenter: Tim Gallagher, President and CEO

7. Lead Independent Director Report Out 11:50 am
Presenter: Pat Cass, Lead Independent Director

8. Lunch 12:00 pm

9. Update on FERC Activities 12:30 pm
Presenter: Eric Vanderberg, Deputy Director, Office of Electric Reliability
Description: Mr. Vanderberg will provide an update on the activities of the Office of Electric Reliability as well as FERC's interactions with ReliabilityFirst.
Reference: Presentation
Action: Information and Discussion

10. Winter Storm Elliott Inquiry Report 1:00 pm
Presenter: Heather Polzin, Attorney Advisor and Reliability Coordinator for the Office of Enforcement, and David Huff, Electrical Engineer, Office of Electric Reliability, FERC
Description: Ms. Polzin and Mr. Huff will discuss highlights and key findings from the joint FERC, NERC and Regional Entity Inquiry into Winter Storm Elliott.
Reference: Presentation
Action: Information and Discussion

11. Committee Reports 1:20 pm

Compensation Committee • Lesley Evancho

Compliance Committee • Joanna Burkey

Finance and Audit Committee • Patrick Cass

Nominating & Governance Committee • Courtney Geduldig

12. Comments from Stakeholders 2:10 pm

13. Adjourn 2:15 pm

Roster • Board of Directors

Antonio Smyth, Chair • AEP (S • 2023)
Nelson Peeler, Vice Chair • Duke Energy (T • 2024)
Patrick Cass • Lead Independent (2023)
Steve Ambrose • DTE Energy (M-LSE • 2025)
Joanna Burkey • Independent (2025)
Lesley Evancho • Independent (2025)
Tim Gallagher • ReliabilityFirst
Courtney Geduldig • Independent (2024)
Scott Hipkins • FirstEnergy Services Company (T • 2024)
Jason Marshall • Wabash Valley Power Association (S-LSE • 2023)
Ken Seiler • PJM (RTO • 2024)
Rachel Snead • Dominion Resources Services, Inc. (S • 2024)
Jennifer Sterling • Exelon Corporation (L-LSE • 2025)
Joe Trentacosta • Southern Maryland Electric Cooperative, Inc. (AL • 2025)
Simon Whitelocke • ITC Holdings Corporation (AL • 2024)

a) Draft Minutes from August 24, 2023 Board of Directors meeting

RELIABILITY FIRST

DRAFT Minutes
Board of Directors

August 24, 2023

ReliabilityFirst Corporation
3 Summit Park Drive, Suite 600 • Cleveland, OH 44131

Closed Session

Executive Session – The ReliabilityFirst (RF) Board of Directors met in executive session at 8:00 am (ET) and discussed confidential matters concerning the corporation. Presentations included an update on the status of the transfer capability studies being performed by the ERO pursuant to the Fiscal Responsibility Act of 2023, and a confidential security update from Marcus Noel, RF's Chief Security Officer.

Open Session

Call to Order – Chair Antonio Smyth called to order a duly noticed open meeting of the Board of Directors (Board) on August 24, 2023, at 9:16 am (ET). A quorum was present, consisting of the following members of the Board: Chair Antonio Smyth, Vice Chair Nelson Peeler; Steve Ambrose; Joanna Burkey (virtual); Patrick Cass; Scott Etnoyer; Lesley Evancho; Tim Gallagher; Courtney Geduldig (virtual); Jason Marshall; Ken Seiler; Rachel Snead; Jennifer Sterling; Joe Trentacosta; and Simon Whitelocke.

A list of others present during the Board meeting is set forth in Attachment A.

Appoint Secretary to Record Minutes – Chair Smyth designated Niki Schaefer, RF's Vice President and General Counsel, as the secretary to record the meeting minutes.

Antitrust Statement – Ms. Schaefer advised all present that this meeting is subject to, and all attendees must adhere to, RF's Antitrust Compliance Guidelines.

Remarks and Reports – Chair Smyth welcomed everyone to the third quarter Board meeting. Mr. Gallagher provided the President's report, and began by noting that all six Regions' budgets have been submitted to NERC. He then discussed the anniversary of the 2003 blackout, and emphasized the diligent work taking place every day across the ERO Enterprise and the industry to reduce the likelihood of a similar event happening in the future. Mr. Gallagher also discussed emerging reliability risks facing the electric grid, including the rapidly changing generation resource mix and increasing electrification and demand. He discussed RF's state outreach efforts to legislatures and public utility commissions, which include serving as a technical resource on reliability risks related to the changing resource mix. Mr. Gallagher stated that it is also important to effectively address known reliability risks, such as facility ratings issues and misoperations, to ensure the ability to address future challenges.

Mr. Gallagher also provided updates on the NERC Board of Trustees Compliance Committee, the recent ERO Enterprise town hall, and RF's new entity awards program where RF's Vice President of Entity Engagement & Corporate Services Diane Holder recognizes exemplary work at entities. Examples of characteristics that can earn an entity an award in this program include transparency, audit readiness and continuous improvement, and positive observations.

Consent Items – Chair Smyth introduced the following consent agenda items for approval:
Agenda Item 4(a): Draft Minutes from the April 27, 2023 Board Meeting
Agenda Item 4(b): Draft Minutes from the June 29, 2023 Board Meeting
Agenda Item 4(c): Standards Committee Member approval
Agenda Item 4(d): Resolution 2023-3 to Approve the Annual Meeting

Upon a motion duly made and seconded, the Board approved the consent agenda items.

Keynote Speaker – Chair Smyth introduced David Kennedy, Founder and CEO of Binary Defense, a Managed Security Service Provider (MSSP), and TrustedSec, an Information Security consulting firm. Mr. Kennedy provided a brief history of his background and the current cyber security landscape. He discussed Artificial Intelligence (AI), and how generative AI has resulted in a 420% increase in business email compromises from bad actors. Mr. Kennedy then discussed various security risks, including threats from China and breaches involving multi-factor authentication and push technology. Mr. Kennedy emphasized the importance of reducing the amount of time it takes to detect a threat, and shared how the capabilities of adverse nation states and criminal organizations are advancing rapidly.

There were questions from the Board regarding threat detection, the use of AI, and how to grade the security of the electric industry's critical infrastructure. In response, Mr. Kennedy discussed the legacy equipment and the types of critical infrastructure in the electric industry. He advised that it is important to minimize the attack surface as much as possible, and to closely monitor systems adjacent to the attack surface.

Guest Speaker – Chair Smyth introduced Mike Doran, Deputy COO of American Water, the largest publicly-traded U.S. water and wastewater utility company. Mr. Doran provided background on the company, which began in military operations. He discussed how the water sector is working to address issues with aging infrastructure. Mr. Doran also explained that smaller communities tend to have less sophisticated compliance and security programs in place, and are seeking ways to minimize their vulnerability through various dam and reservoir projects. He closed with a brief discussion on per-and polyfluoroalkyl substances (PFAS), and initiatives to keep them out of the water system. There was a question on terrorist threats and threats related to the supply chain. Mr. Doran responded that rigorous testing and monitoring of public water sources is important to ensure its safety.

Resource Adequacy – Chair Smyth introduced Scott Wright, Executive Director of Resource Planning at MISO. Mr. Wright discussed factors driving generation portfolio changes and the resulting resource adequacy concerns. He stated that enhanced reliability risk evaluation and management tools are needed to manage uncertainties arising from more extreme weather events. Mr. Wright also emphasized the importance of visibility, and how resource adequacy assessments across planning horizons help provide visibility into gaps between future resource adequacy requirements and accredited capacity. He discussed the importance of accreditation, and that how resources are counted is more critical as excess reserve margins decline. Mr. Wright then discussed MISO's planning processes, and there was discussion with the Board on resource retirements and load growth in the MISO footprint.

Chair Smyth then introduced Emmanuel Bernabeu, Sr. Director of Applied Innovation & Analytics at PJM. Mr. Bernabeu discussed four major trends related to resource adequacy: 1) the increase of renewables, 2) increased electrification and load growth, 3) policy changes driving resource retirements, and 4) evolving risks (including extreme weather risks and gas-electric interdependencies, as seen during Winter Storm Elliott). He also discussed the importance of essential reliability services (which are critical for balancing and system stability) and how to ensure their sufficiency. The Board had a discussion regarding load forecasting, and Mr. Bernabeu discussed what constitutes a healthy load margin. He concluded his presentation by giving an overview of initiatives at PJM to address resource adequacy concerns, including continued queue improvements, long-term scenario analysis efforts, and gas-electric coordination efforts.

STANDING UPDATES

Financial Update – Beth Dowdell, Senior Director Corporate Services, provided a financial update, beginning with a report on the 2023 second quarter financials. She reported that RF was 1.9% under budget, and discussed key budget variances. She noted that RF's investment income is performing well, and that meeting and travel expenses are down. Ms. Dowdell provided year-end projections, predicting that RF will be 1.4% over budget at year-end due to increases in employee salaries and in rent and utilities. She discussed the employee salary adjustments approved by the Board earlier in the year and noted that the management team is being cost-conscious with overall spending considering those adjustments. She also gave an update on employee benefits and training, and the plan to be mindful and strategic with that spending. Finally, Ms. Dowdell covered the 2024 Business Plan and Budget, and provided information on where NERC and all the Regions landed with their 2024 budget and assessment amounts.

Security Update: Marcus Noel, RF's Chief Security Officer, provided a security update to the Board and began by discussing commonly exploited vulnerabilities highlighted in a recent Cybersecurity and Infrastructure Security Agency (CISA) joint cybersecurity advisory report. He explained that the report describes malicious cyber actors focusing on older systems and unpatched internet. The report also includes remediation and mitigation guidance, and stresses the importance of good backups and incident response.

Mr. Noel then discussed the status of RF's security projects and the security project roadmap for 2023. He reported that during the second quarter, the Security Department focused on remediating vulnerabilities identified during recent penetration testing, and enhancing RF's logging, monitoring, and alert systems. He also discussed projects scheduled for the rest of 2024. Mr. Gallager noted that several security projects involve shared resources across the ERO Enterprise, which helps to manage costs.

Outreach and Regulatory Update – Brian Thiry, RF's Director of Entity Engagement and External Affairs, provided an update to the Board on RF's outreach efforts. He discussed recent work on the communication strategic plan, which maps out strategic communication efforts through the year. Mr. Thiry highlighted some of these communication efforts, such as outreach on RF's regional risk assessment, monthly Tech Talk webinars on various reliability and security topics, and workshops (such as the upcoming annual fall workshop). He also spoke to how RF's communications align with the risks highlighted in the NERC Risk Report. Mr. Thiry then discussed RF's state outreach efforts, where RF serves as a resource for state policymakers on key reliability risks. Activities in this area have included meetings with state legislatures and public utility commissions, providing testimony to state legislatures, a state outreach-focused webinar, and a monthly state outreach newsletter for policymakers. He discussed the coordination, communication and collaboration that is taking place across the ERO Enterprise regarding state outreach, and how RF is staying up to date on federal and state policies and regulatory developments (such as state renewable portfolio standards) that can affect reliability.

Committee Reports

a) Compensation Committee – Compensation Committee Chair Lesley Evancho reported that the Committee discussed RF's succession planning methodology, changes to the succession planning timeline and process, and reviewed the succession plan. There was also a staffing and demographics update, including diversity and retention metrics. Ms. Evancho reported that the Committee is redefining the diversity strategy to be more future focused. The Committee also discussed the progress of the corporate goals, and reviewed RF's medical benefits and their level of competitiveness. The Committee voted to add two holidays to the RF calendar (Juneteenth and Veteran's Day) to be more in line with the rest of the ERO Enterprise, and approved minor changes to the Committee's charter. Finally, the Committee discussed Tim Gallagher's annual review process and timeline, and discussed the annual review further during executive session.

b) Compliance Committee – Compliance Committee Chair Joanna Burkey reported that the Committee heard remarks from NERC Senior Vice President and Chief Engineer Mark Lauby on various topics, including NERC's standards development efforts, cold weather preparedness efforts, and activities related to the reliability of inverter-based resources. The Committee then received a presentation from Jim Kubrak on inverter-based resources, their associated risks, and the ERO activities in that space to reduce those risks. The Committee also received a physical security update from Johnny Gest on physical security risks and efforts underway to enhance physical security at Bulk Electric System facilities. The Committee discussed and approved revisions to its charter, which include expanding the Committee's scope to focus more broadly on risks to the grid (not just compliance-

related risks), and to have oversight of the RF technical and advisory stakeholder committees that currently report to the Nominating and Governance Committee. In closed session the Committee discussed confidential monitoring and enforcement matters, and it was apparent that these matters are each complex in their own ways and require careful thought and purposeful interaction with entities.

c) Finance and Audit Committee – Finance and Audit Committee Chair Pat Cass reported that the Committee received a financial update (similar to the financial update provided to the full Board), and reviewed the final 2022 Actual Cost to Budget Comparison report provided to NERC. The Committee also received an update on the status of RF's working capital and investments, and reviewed financial policies (making no changes to those policies). The Committee reviewed and approved changes to its charter. In closed session, the Committee approved the engagement of RSM as RF's independent auditor for 2023. The Committee also discussed seeking proposals for independent auditor services for 2024.

d) Nominating and Governance Committee – Nominating and Governance Committee Vice Chair Rachel Snead reported that the Committee reviewed the 2023 Timetable of Key Events and endorsed a resolution to hold the next Annual Meeting of Members on December 7, 2023 in Washington, DC. The Committee also reviewed and approved changes to its charter, which will transfer oversight of the RF technical and advisory stakeholder committees to the Compliance Committee while also adding new responsibilities to review potential director conflicts and appoint members to the hearing body when needed. The Committee then reviewed the Procedure for Electing Directors in preparation for upcoming elections later this year. During closed session, the Committee reviewed the results of the individual director surveys, and recommended that incumbent At-Large Director Scott Etnoyer and incumbent Independent Director Patrick Cass serve another term. Upon a motion duly made and seconded, the Board nominated Mr. Etnoyer and Mr. Cass for election as At-Large Director and Independent Director, respectively.

Committee Charters – Chair Smyth requested a motion to approve the changes to the four Committee Charters. These Committee Charter changes were discussed in detail and endorsed by the respective Committees during their Committee meetings. Upon a motion duly made and seconded, the Board approved the changes to the Committee Charters.

Stakeholder Comments - Chair Smyth provided an opportunity for stakeholders to comment, and no stakeholders did so.

Next Meeting – Chair Smyth noted that the next meeting of the Board of Directors will occur in Washington, DC on December 7, 2023

Adjourn – Chair Smyth adjourned the meeting at 12:54 (ET).

As approved on this seventh day of December, 2023 by the Board of Directors,

Niki Schaefer
Vice President, General Counsel & Corporate Secretary

ATTACHMENT A

Others Present During the Board of Directors Meeting

Carol Baskey • ReliabilityFirst
Steve Belle • Dominion Energy
Emanuel Bernabeu • PJM
Jeff Craigo • ReliabilityFirst
Mike Doran • American Water
Beth Dowdell • ReliabilityFirst
Chelsey Eppich • ReliabilityFirst
Vinit Gupta • ITC
Doug Hohlbaugh • FirstEnergy
Diane Holder • ReliabilityFirst
Erik Johnson • ReliabilityFirst
Rhonda Jones • Invenergy
David Kennedy • TrustedSec
Marcus Noel • ReliabilityFirst
Nicholas Poluch • Talen
Niki Schaefer • ReliabilityFirst
Kristen Senk • ReliabilityFirst
Brian Thiry • ReliabilityFirst
Matt Thomas • ReliabilityFirst
Jody Tortora • ReliabilityFirst
Jim Uhrin • ReliabilityFirst
Bobbie Welch • MISO – virtual
Scott Wright • MISO - virtual

b) Resolution for Election of Officers (No. 2023-5)

RELIABILITY FIRST

RESOLUTION NO. 2023-5

Resolution for Election of Officers

WHEREAS, Section 9.1 of the Bylaws states that the officers of the Corporation shall include a President, one or more Vice Presidents, a Secretary, a Treasurer and any other officers as may be elected or appointed in accordance with the Bylaws;

WHEREAS, Section 9.2 of the Bylaws states that the officers of the Corporation shall be elected annually by the Board of Directors at the annual meeting of the Board of Directors;

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors elects, pursuant to Section 9.2 of the Bylaws,

Tim Gallagher as President & CEO;
Jeff Craigo as Senior Vice President, Reliability and Risk;
Diane Holder as Vice President, Entity Engagement & Corporate Services;
Niki Schaefer as Vice President, General Counsel & Corporate Secretary;
Marcus Noel as Vice President and Chief Security Officer; and
Beth Dowdell as Treasurer.

FINALLY RESOLVED, that each elected officer shall continue to serve as officer of the Corporation in his or her respective elected capacity at the pleasure of the Board of Directors and hold office until his or her successor has been duly elected and qualified, or upon his or her earlier resignation or removal.

As adopted on this 7th day of December, 2023 by the Board of Directors,

Niki Schaefer
Vice President, General Counsel & Corporate Secretary

c) Resolution for Special Election (No. 2023-6)

RELIABILITY FIRST

RESOLUTION NO. 2023-06

Resolution for
Special Industry Sector Director Election

WHEREAS, the Corporation's Bylaws provide that the Corporation's Industry Sectors may elect sector directors prior to the Annual Meeting of Members;

WHEREAS, Small LSE Sector Director, Jason Marshall, will resign from the Board following the 2023 Annual Meeting and the process to solicit nominees for his position will occur immediately following the meeting to hold a noticed election in February of the following year.

NOW, THEREFORE, BE IT RESOLVED, that a Small LSE Sector director election shall be conducted prior to the 2024 Annual Meeting of Members at a special telephonic meeting to be held on February 9, 2024, at 10:00 a.m., Eastern Time;

FURTHER RESOLVED, that the close of business on January 9, 2024 is designated as the record date for the determination of the Regular Members in the Small LSE Industry Sector entitled to receive notice of, and to vote in, the election;

FURTHER RESOLVED, that the nominees submitted by members of the Small LSE Sector on or prior to January 9, 2024 be submitted to the Small LSE Sector for election to the Board of Directors, for a term expiring as provided in the Bylaws or until their successor is duly elected;

FURTHER RESOLVED, that the authorized officers, each acting alone or together with the other, are hereby authorized and directed to solicit and transmit a notice and proxy to each Regular Member entitled to receive notice of, and to vote in, the election;

FURTHER RESOLVED, that Niki Schaefer of the Corporation is hereby appointed and authorized to tabulate proxies on behalf of the Corporation and to act as inspector of election in connection with the Small LSE Sector Director election;

FURTHER RESOLVED, that the President or the Corporate Secretary, or such other officer of the Corporation as may be appointed by them, shall preside at the special meeting;

FURTHER RESOLVED, that all actions heretofore taken by the authorized officers of the Corporation in connection with the subject matter of any of the foregoing resolutions be, and they hereby are, approved, confirmed and ratified in all respects; and

FINALLY RESOLVED, that the appropriate officers of the Corporation be and they hereby are authorized and directed to take all actions and execute all such documents as they deem necessary or appropriate to effectuate the foregoing resolutions.

As adopted on this 7th day of December, 2023 by the Board of Directors,

Niki Schaefer
Vice President, General Counsel & Corporate Secretary

d) Proposed 2024 Board Meeting Dates

RELIABILITY FIRST

ReliabilityFirst Proposed Meeting Dates for 2024

(all dates are Wednesday-Thursday)

Request for approval of the following dates for the 2024 ReliabilityFirst Board Directors and Committee meetings.

1st and 2nd Quarter	**May 1-2**
3rd Quarter	**August 21-22**
4th Quarter and Annual Meeting of Members	**December 4-5**

Bio - Manny Cancel

Manny Cancel
Senior Vice President, Chief Executive Officer of the E-ISAC

Manny Cancel assumed the role as NERC senior vice president and chief executive officer of the Electricity Information Sharing and Analysis Center (E-ISAC) in January 2020. He is responsible for the management and oversight of the E-ISAC and leading security operations and information sharing, threat intelligence and analysis, and stakeholder engagement initiatives designed to protect critical electricity infrastructure in North America.

Mr. Cancel also serves as the E-ISAC's key representative to important constituencies, such as the Electricity Subsector Coordinating Council (ESCC), government partners, and key industry groups and leads the E-ISAC's strategic planning initiatives.

Prior to joining NERC, Mr. Cancel served as Con Edison's chief information officer (CIO) leading all aspects of information technology, including cyber security initiatives. In this capacity, he also supported various industry initiatives, serving as chair of the sector's Cyber Mutual Assistance Program and supporting the Member Executive Committee (MEC), an advisory group formed out of the ESCC that provides guidance to the E-ISAC. Prior to assuming the role of CIO at Con Edison, Mr. Cancel held various roles over his 39-year career, including leadership roles in operations, customer service, audit, and information technology.

Mr. Cancel earned a bachelor's degree in Business Administration from Baruch College and a master's degree in Business Administration from the Johnson School at Cornell University.

Update on FERC Activities

Eric Vandenberg, Deputy Director, Office of Electric Reliability

December 7, 2023

The views expressed in this presentation are my own and do not represent those of the Commission or any individual Commissioner.

Major FERC Reliability Activities – Summer/Fall 2023

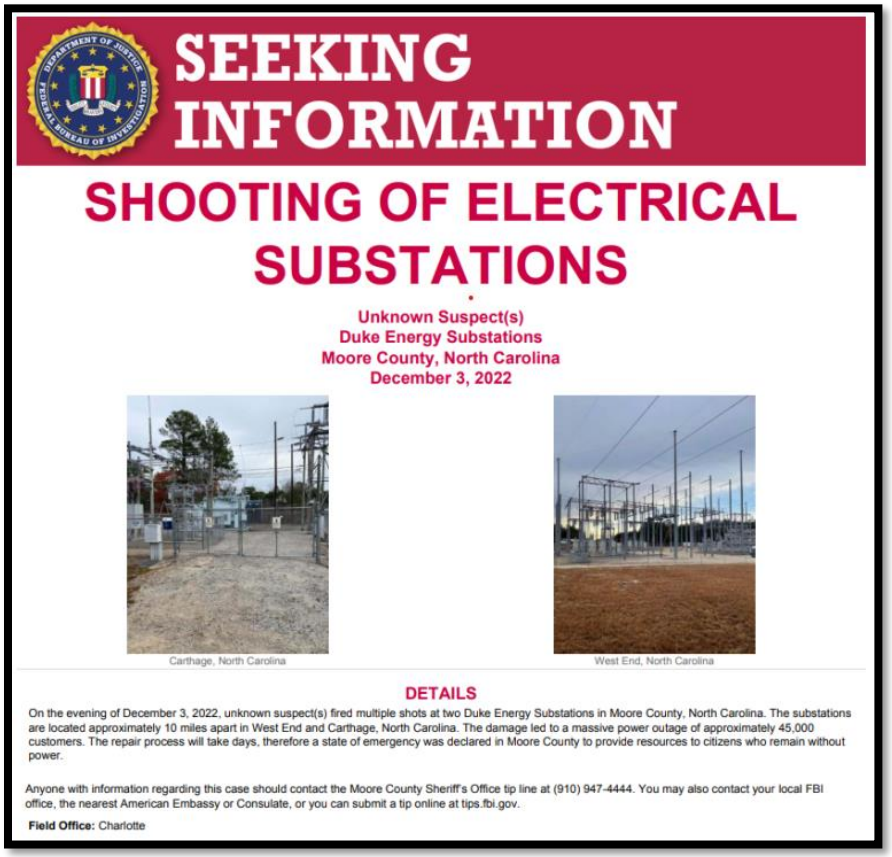
- IBR Registration Order
- Final Rule directing reliability standards for IBRs:
  - Tranche 1 (performance, monitoring) – Nov 1, 2024
  - Tranche 2 (data collection) – Nov 1, 2025
  - Tranche 3 (modeling) – Nov 1, 2026
- Final Report on Winter Storm Elliot Inquiry
- Technical Conferences
  - Physical Security Tech Conference (held Aug 10)
  - Annual Reliability Tech Conference including discussion of EPA draft carbon rules(November 9)

Key Priorities for OER

- Cyber and Physical Security
  - Supply Chain Compromise
  - Protections for Low Impact Assets
  - Physical Security
- Resource transition
  - Inverter Based Resources
  - Resource/Energy Adequacy
  - Priority System Attributes (e.g., quick start, ramping)
- Extreme Weather
  - Asset Hardening (e.g., generator freeze protection)
  - System Planning and Design

Key Priority: Physical Security

- FERC/NERC held joint technical conference on August 10
- Comments due September 20
- Increasing indication that malicious actors are learning from each other



SEEKING INFORMATION

SHOOTING OF ELECTRICAL SUBSTATIONS

Unknown Suspect(s)
Duke Energy Substations
Moore County, North Carolina
December 3, 2022

Carthage, North Carolina

West End, North Carolina

DETAILS

On the evening of December 3, 2022, unknown suspect(s) fired multiple shots at two Duke Energy Substations in Moore County, North Carolina. The substations are located approximately 10 miles apart in West End and Carthage, North Carolina. The damage led to a massive power outage of approximately 45,000 customers. The repair process will take days, therefore a state of emergency was declared in Moore County to provide resources to citizens who remain without power.

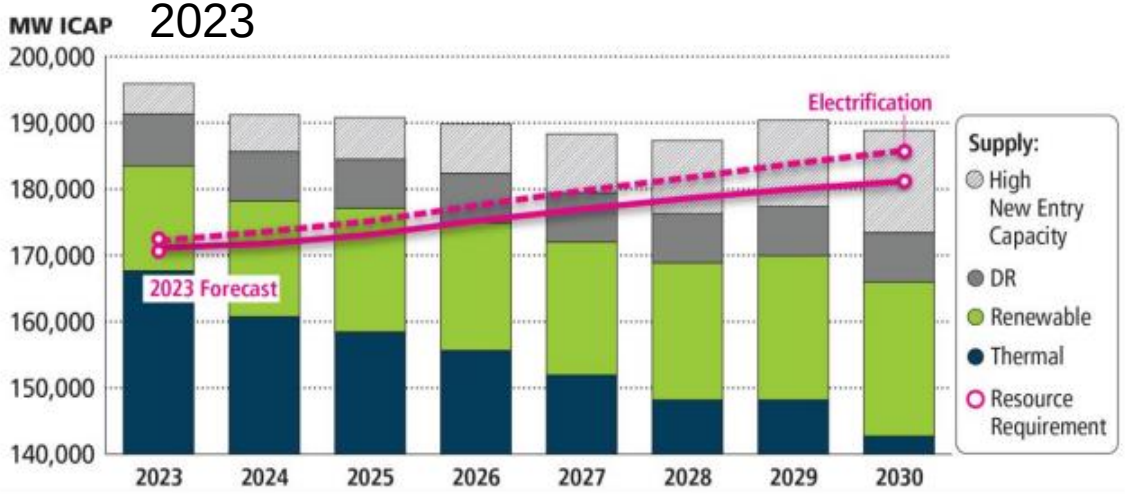
Anyone with information regarding this case should contact the Moore County Sheriff's Office tip line at (910) 947-4444. You may also contact your local FBI office, the nearest American Embassy or Consulate, or you can submit a tip online at tips.fbi.gov.

Field Office: Charlotte

Key Priority: Resource/Energy Adequacy

- Resource adequacy studies showing RA risk increasing through 2030 and beyond
  - Retirements
  - New resources with lower capacity value
  - Interconnection backlog
  - Load growth

Energy Transition in PJM: 4R Report, 2023



"The amount of generation retirements appears to be more certain than the timely arrival of replacement generation resources, given that the quantity of retirements is codified in various policy objectives, while the impacts to the pace of new entry of the Inflation Reduction Act, post-pandemic supply chain issues, and other externalities are still not fully understood."

Key Priority: Priority System Attributes

- Studies show clear future need for flexibility
  - PJM Study estimates 2035 net load ramps up to 70 GW
  - MISO proposed 6 attributes; potential gaps by 2039
  - FERC directed RTOs to file flex reports (AD21-10) – continuing to evaluate

Perspective: Return to ERO Enterprise

- Significant maturation of processes across ERO Enterprise since 2013
- More opportunities for agility, efficiency at all levels

Winter Storm Elliott

Inquiry into Bulk-Power System Operations During December 2022 Winter Storm Elliott

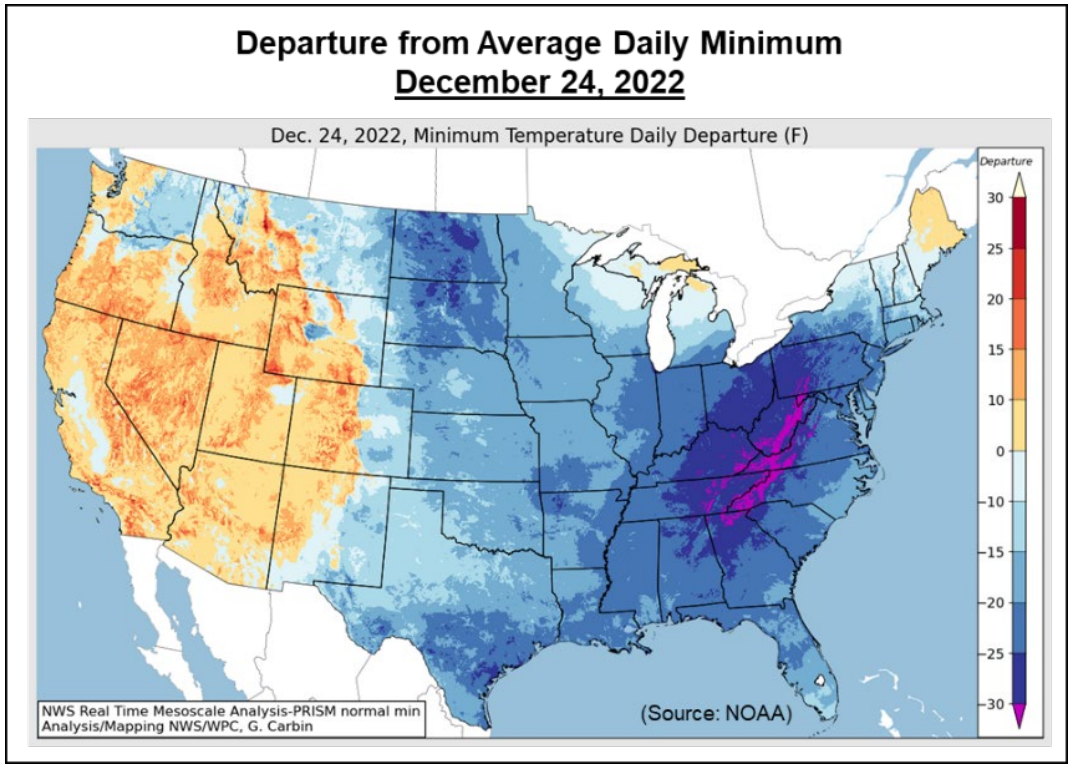
FERC, NERC and Regional Entity Joint Staff Report

October 2023

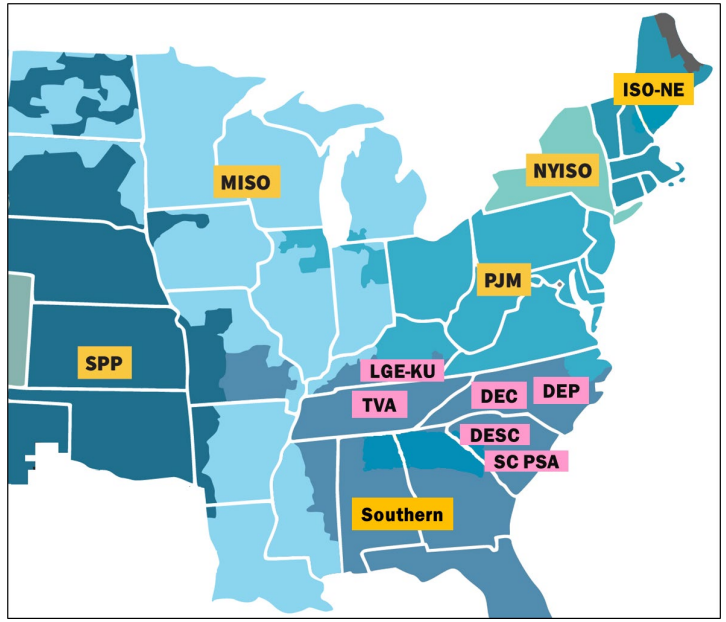
This report was prepared by the staff of the Federal Energy Regulatory Commission in consultation with staff from the North American Electric Reliability Corporation and its Regional Entities. This report does not necessarily reflect the views of the Commission.

Winter Storm Elliott's Effects on Grid Reliability

- **Unprecedented unplanned electric generation outages of 90,500 MW,** which occurred during winter peak electricity demands (i.e., winter peak loads)
- Including generation already on outage, **18 percent** of the U.S. portion of the anticipated resources in the Eastern Interconnection were unavailable at the worst point
- Several Balancing Authorities (BAs) in the Eastern U.S. declared Energy Emergencies, and to maintain electric grid reliability, some in the southeastern U.S. ordered firm load shed at different times, in total exceeding **5,400 MW** during the extreme cold weather
- **Largest ever** controlled firm load shed recorded in the history of the Eastern Interconnection



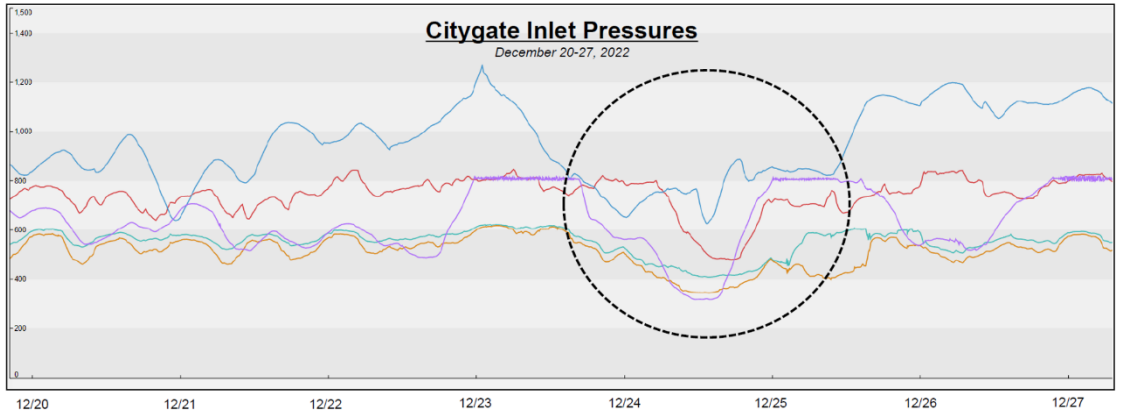
BA Operators Order Firm Load Shed and Internal Gas System Emergency Declared



- **Tennessee Valley Authority (TVA) BA:** nearly eight hours total and at worst point, 3,000 MW
- **Duke** Energy Carolinas (**DEC**) and Duke Energy Progress (**DEP**) **BAs:** approximately three hours total and at worst points totaled over 1,900 MW
- **Louisville Gas and Electric – Kentucky Utilities (LGE-KU) BA:** approximately four hours total and at their worst point, over 300 MW
- **Dominion Energy South Carolina (DESC)** and **South Carolina Public Service Administration/Santee Cooper (SC PSA) BAs:** at worst point totaling 94 MW (DESC) and 86 MW (Santee Cooper), for 9 and 17 minutes, respectively

PJM, Southern, MISO, SPP, and ISO-NE BAs also declared Energy Emergencies, but conditions improved, sparing them from the need to order firm load shed.

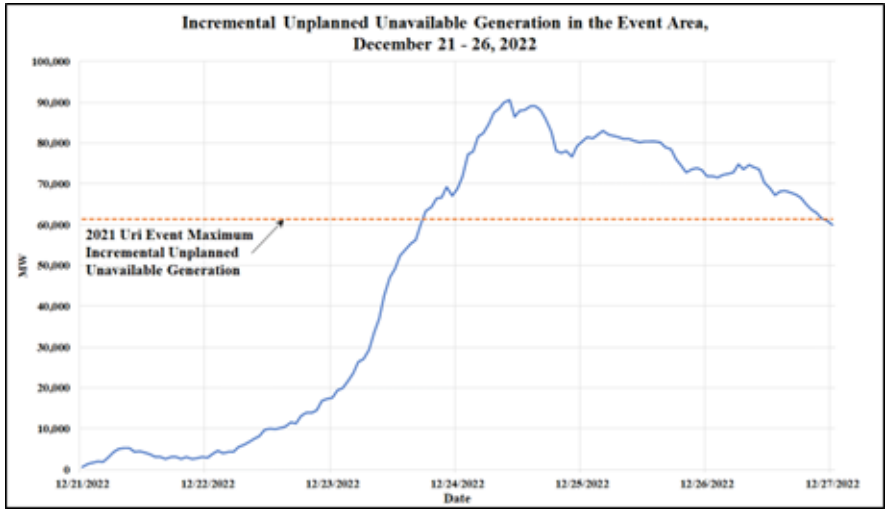
- **Consolidated Edison (NY) Gas Operations** – On December 24, 2022, experienced reliability-threatening delivery pressure decreases across all the interstate pipelines that served its citygate, which were not improving, and declared an internal Gas System Emergency

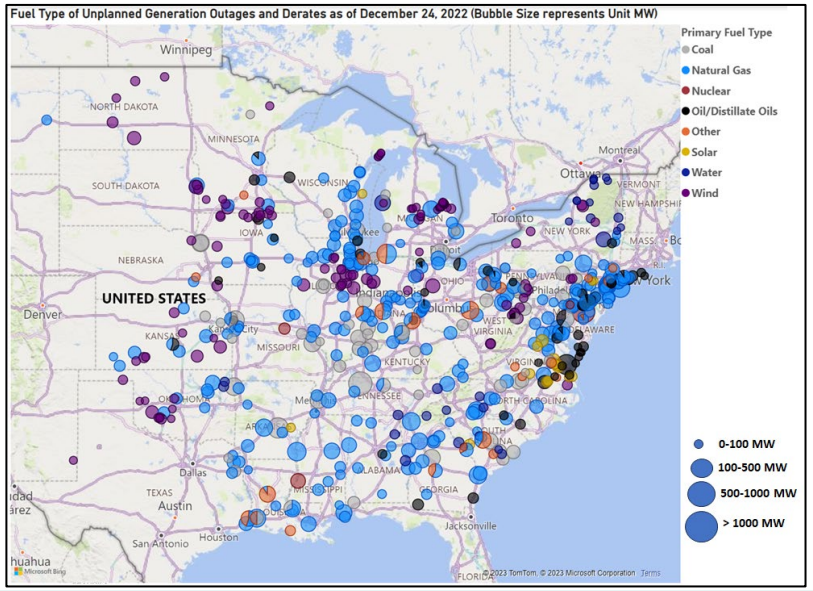


Electric Generation Outages Rapidly Escalated

- The Event is the FIFTH in the past 11 years in which unplanned cold weather-related generation outages jeopardized bulk-power system reliability:
  - 2011 – 29,700 MW
  - 2014 – 19,500 MW
  - 2018 – 15,800 MW
  - 2021 – 61,300 MW
  - 2022 – 90,500 MW

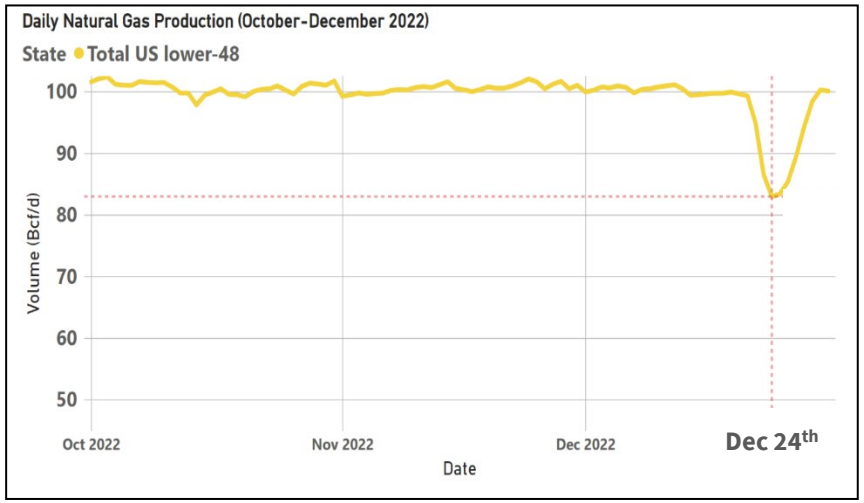
The 90,500 MW of incremental coincident unplanned outages during Winter Storm Elliott represented 13% of the U.S. portion of the anticipated resources in the Eastern Interconnection and approximately 150% of unplanned generation outages seen in Winter Storm URI

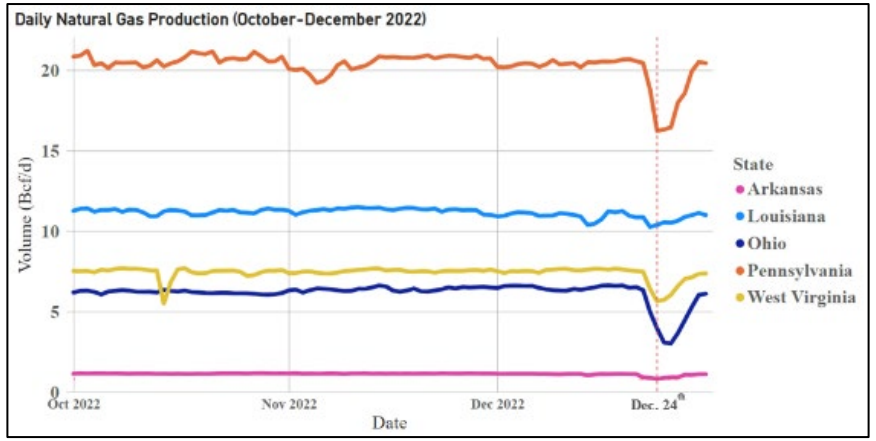


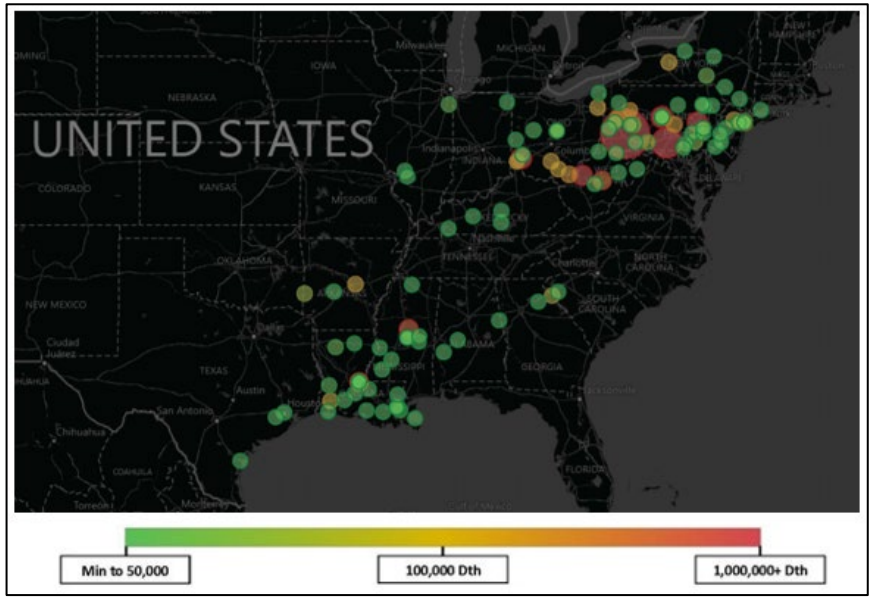


Natural Gas Production Rapidly Declined

- "Dry natural gas production in the Lower 48 states dropped to a low of 82.5 Bcf on December 24, a **16 percent** decrease (16.1 Bcf/d) from December 21…" (EIA)
- Gas production experienced the greatest declines in the Marcellus and Utica Shale formations, where it dropped by **23-54 percent** during the Event. (S&P)
  - "In 2022, the Appalachia region in the Northeast produced more natural gas than any other U.S. region, accounting for 29% of U.S. gross natural gas withdrawals (or 34.6 Bcf/d)." (EIA)





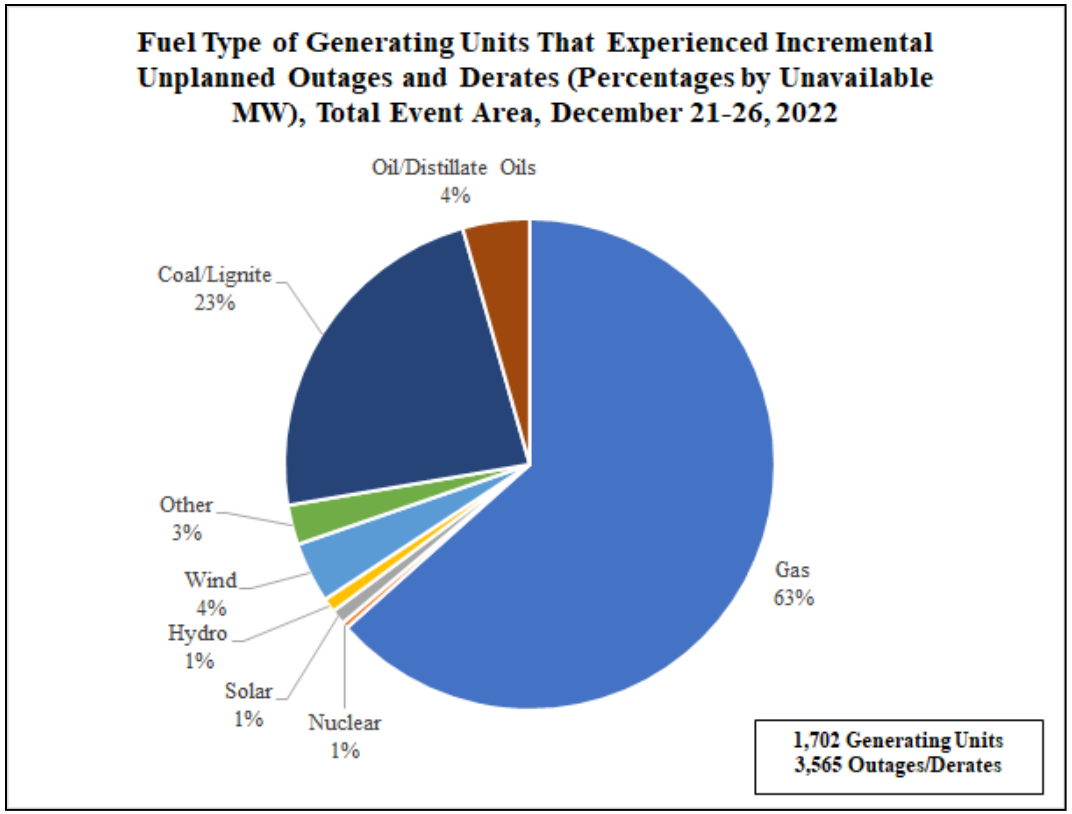


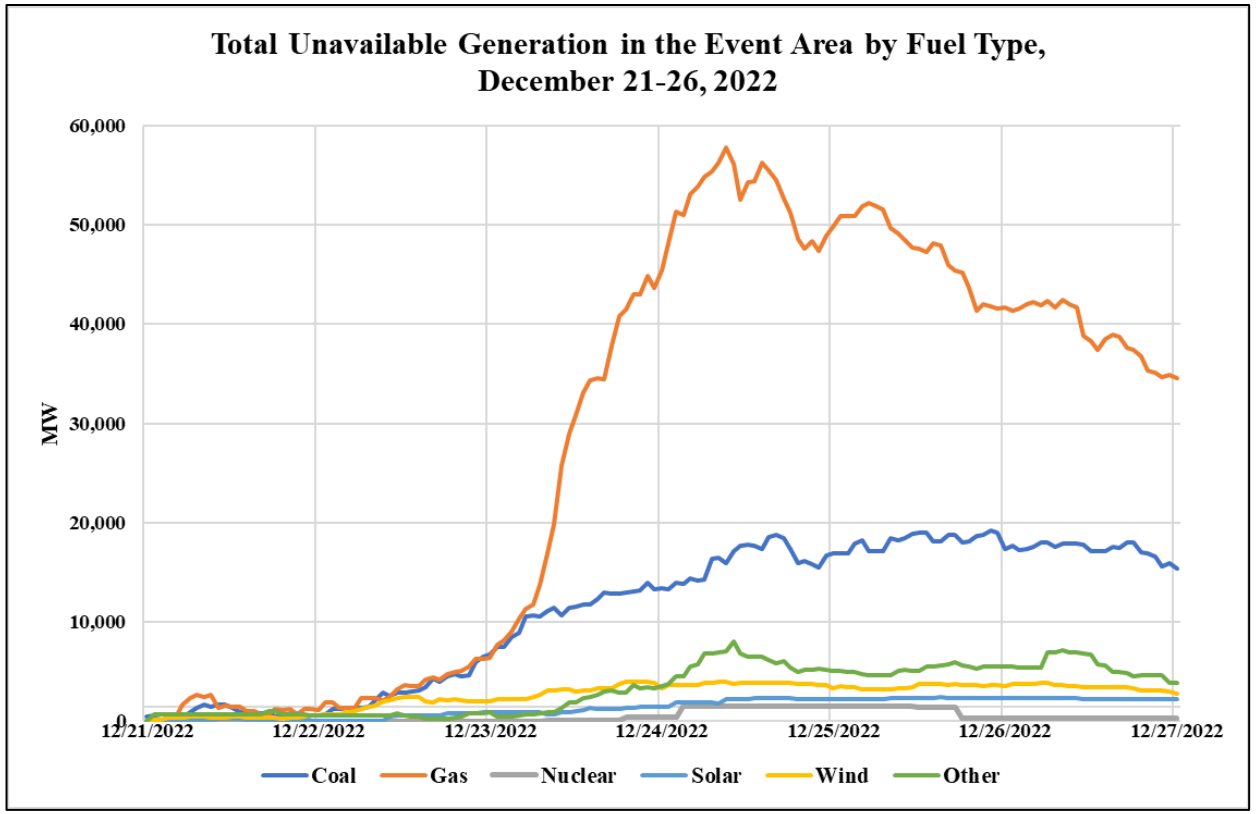
Similarities to Past Extreme Cold Weather Events

	2011 Event	2014 Event	2018 Event	2021 Event	2022 Event
Significant levels of incremental unplanned electric generating unit losses with top causes found to be mechanical/electrical, freezing, and fuel issues.	✓	✓	✓	✓	✓
Significant natural gas production decreases occurred, with some areas of the country more severely affected.	✓			✓	✓
Short-range forecasts of peak electricity demands were less than actual demands for some BAs in event area.	✓		✓	✓	✓
Significant natural gas LDC outages or near miss	✓				✓

Electric Generation Outages During Extreme Cold Weather

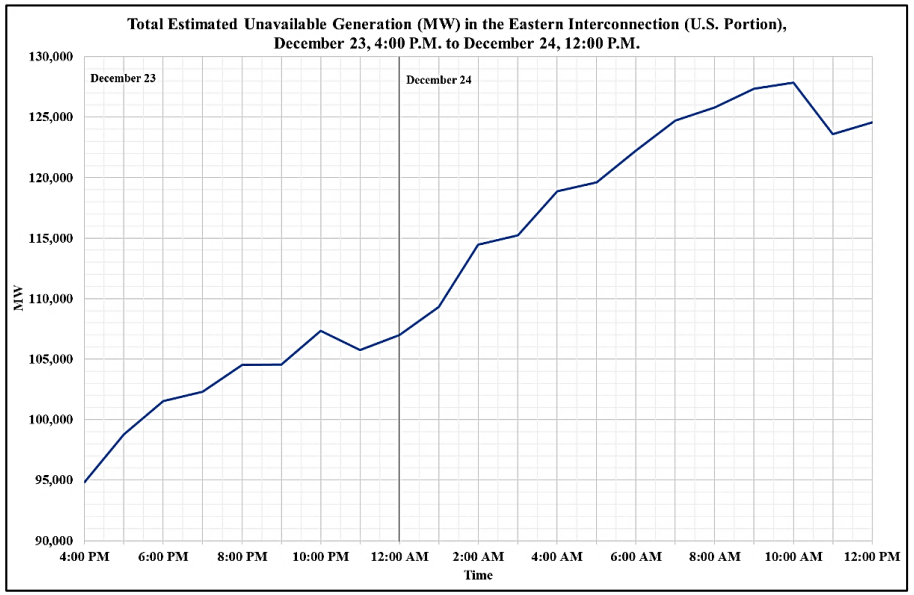
- **1,702** individual generating units experienced **3,565** outages, derates, or failures to start, of which **825** units were natural gas-fired generators.

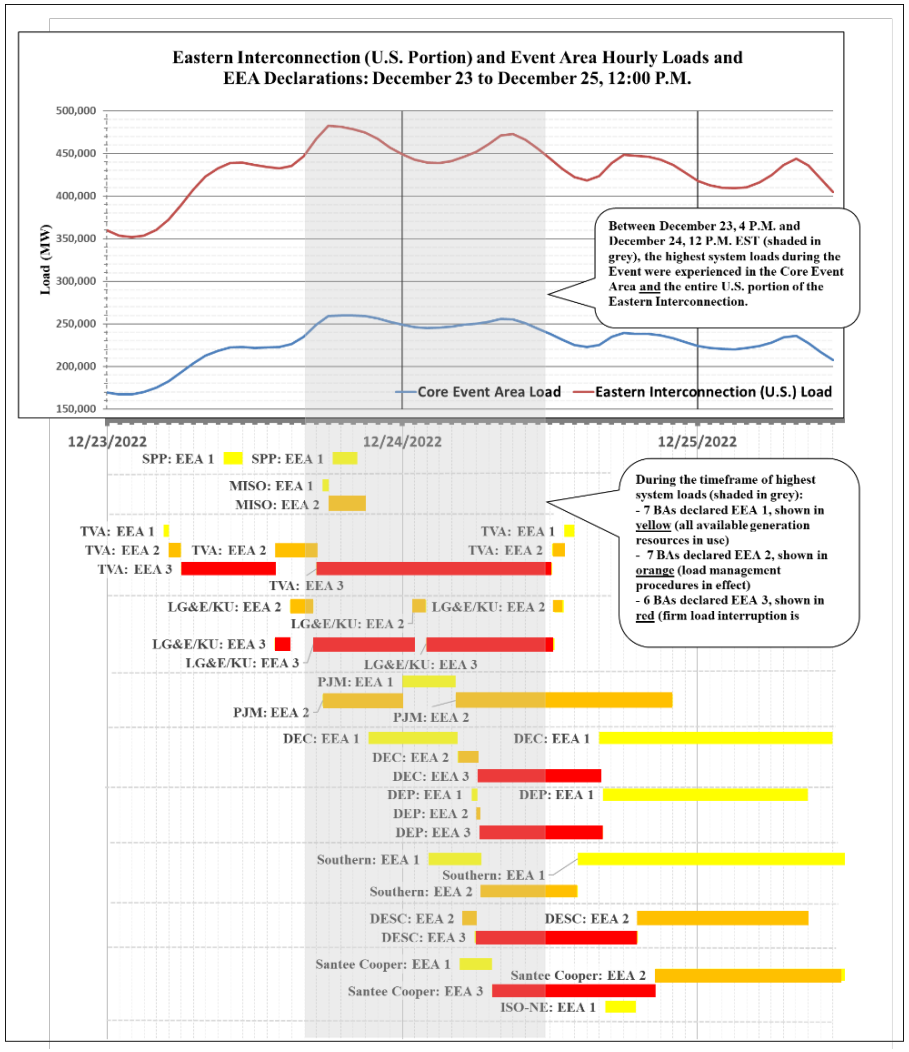




Generation Outages Led to Decreased Reserves During Winter Peak Load Conditions, Leading to Energy Emergencies

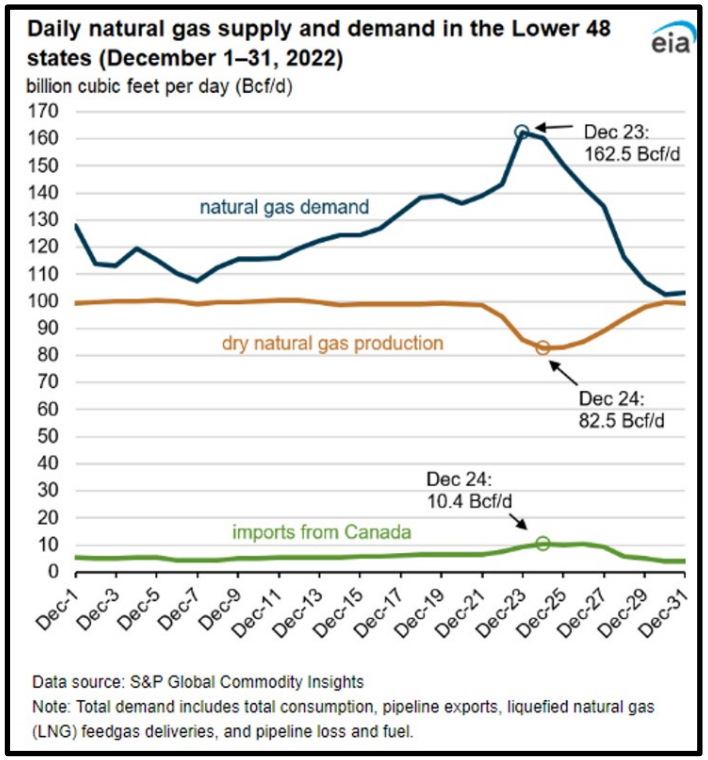
- At worst point, **over 127,000 MW** of generation was unavailable by 10:00 a.m. on December 24
- Widespread and simultaneous energy emergency conditions greatly reduced the BAs' ability to obtain power from neighboring entities

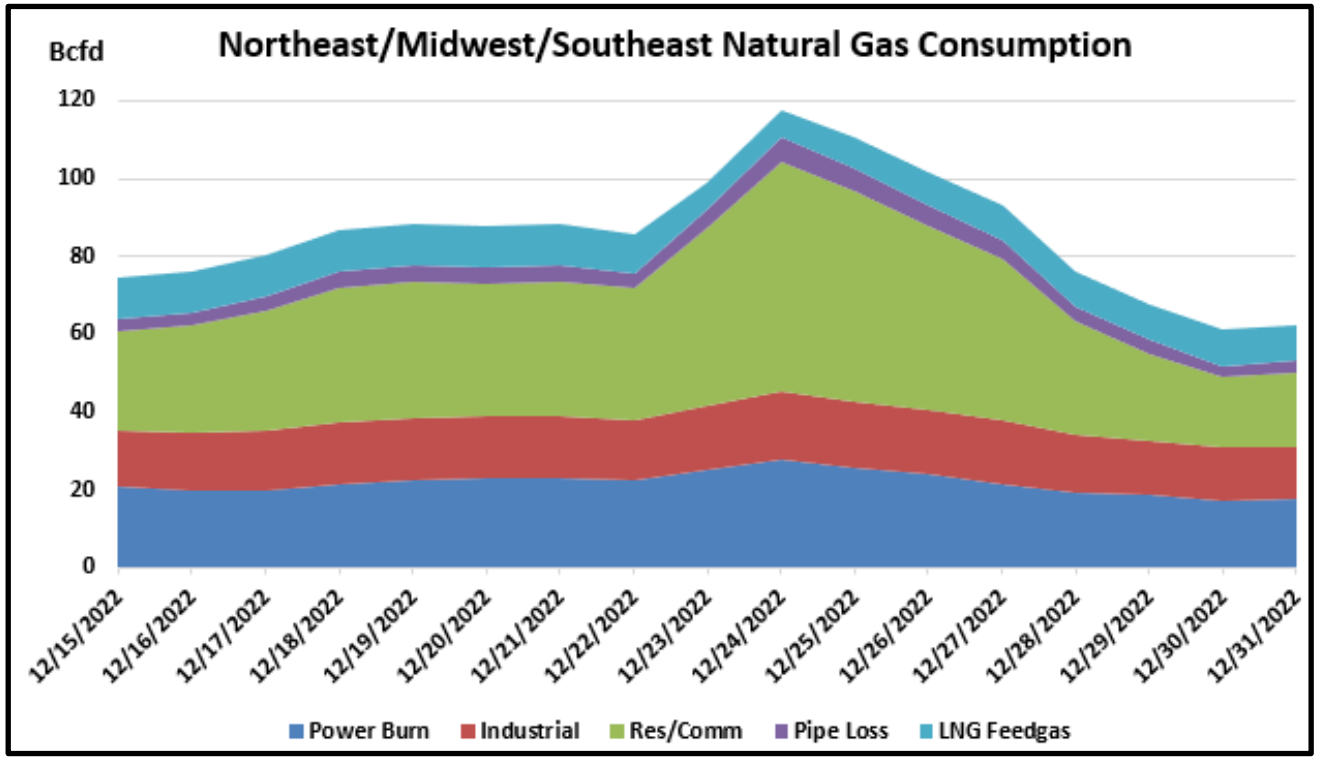




Gas Production and Consumption During Winter Storm Elliott

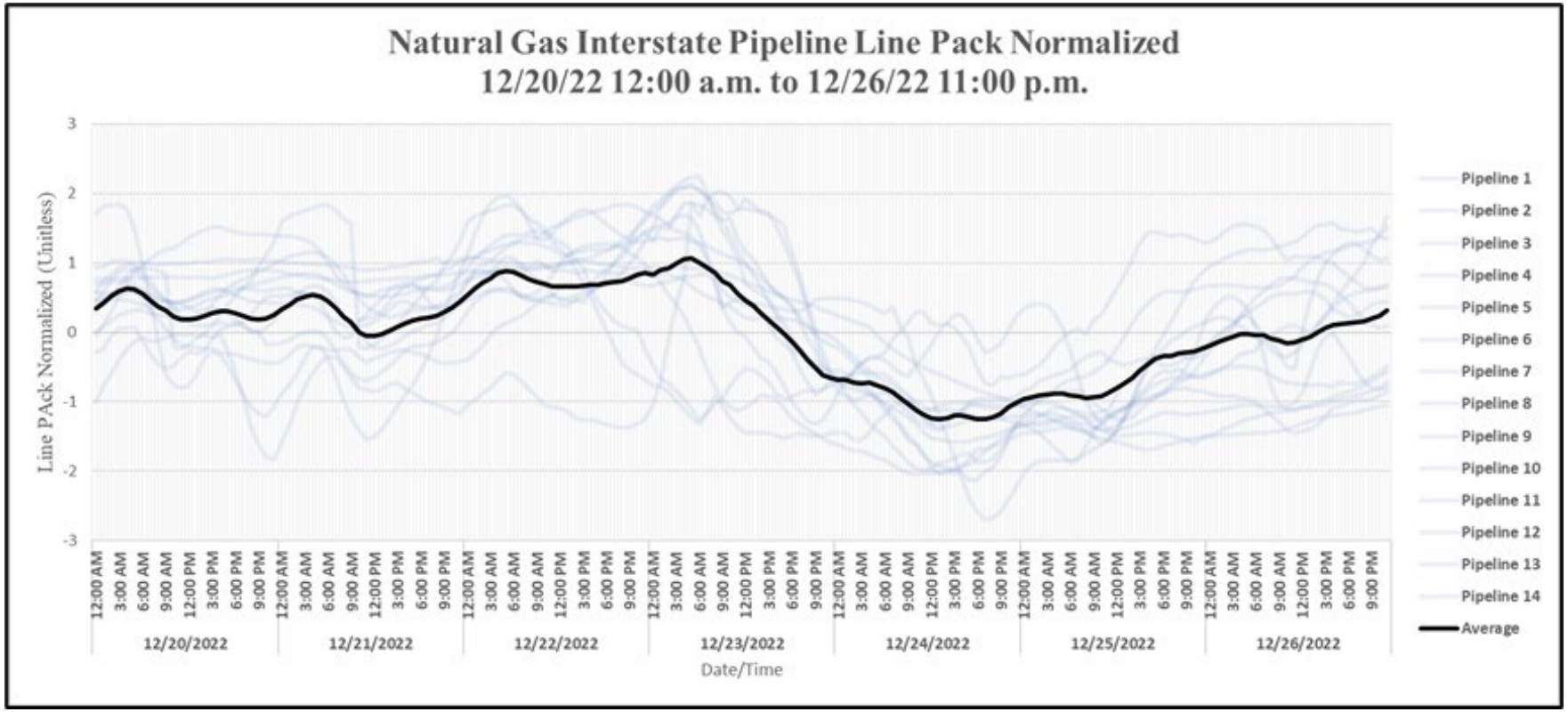
- Demand peaked close in time to when production reached its low point
- Residential/commercial sector had the greatest increase in demand
- Demand excludes natural gas that generators would have consumed had they not experienced an outage, derate, or failure to start





Natural Gas Production Declines and Delivery Facility Disruptions

- Natural gas pipeline operators managed system line pack and storage to maintain system integrity despite decreasing receipts on multiple pipelines and increased demand.

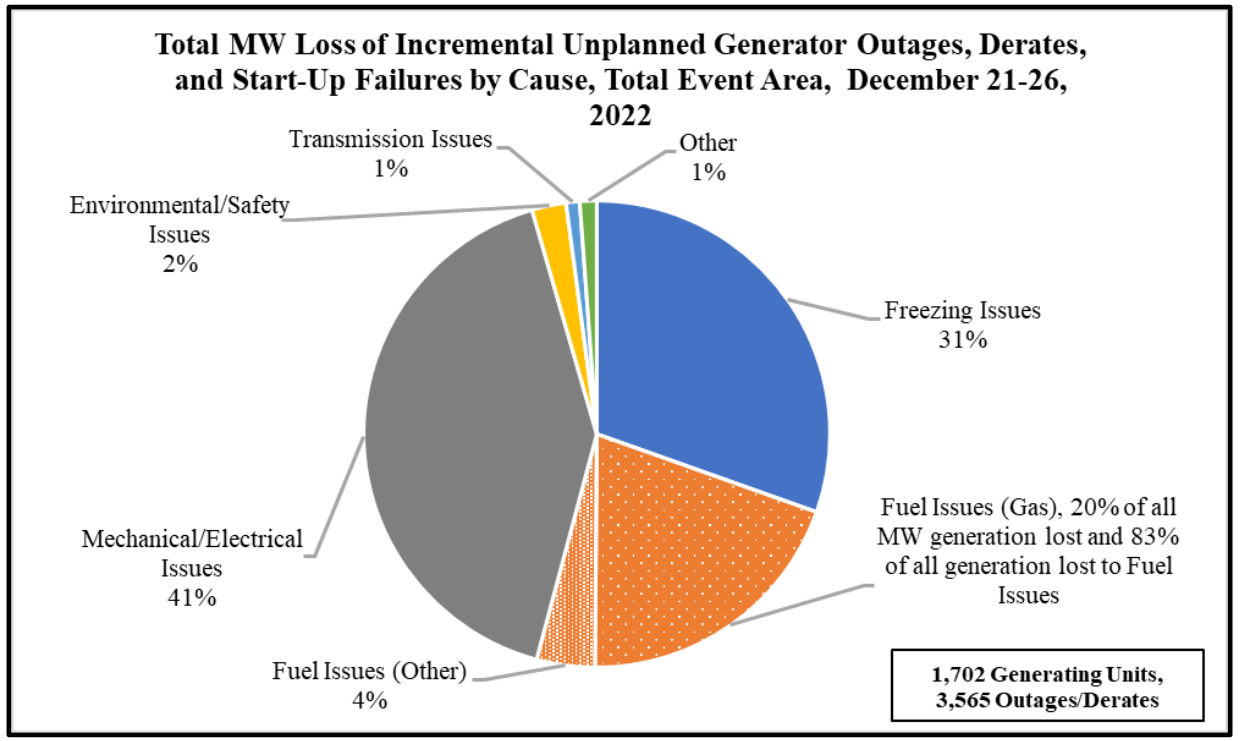


ConEd Natural Gas Operations - 12/24/22 Reliability Threatening Delivery Pressure Decreases Across all Pipelines

- Pipeline pressures at the city gate for ConEd of NY, the natural gas Local Distribution Company for Manhattan, declined precipitously during the morning of December 24. At noon on 12/24/22, ConEd learned on a call with the four interstate gas pipeline companies serving its city gate that their "storage withdrawals were at maximum, line-pack had been expended across the entire transportation system, and low inlet pressures at area meter stations would not recover until demand decreased."
- ConEd declared a Gas System Emergency. It was able to maintain necessary pressure on its system by, among other things, activating its LNG facility.
- Had ConEd's city gate pressures continued to decline, it was in danger of losing pressure below the level needed to operate the system resulting in loss of service to all or portions of its system.
- Loss of natural gas service to its system would not only have left many customers in the life-threatening position of being without heat during extreme cold; but would likely have caused extensive property damage due to damaged water pipes. Restoring service to impacted customers would have required entering each customer site and manually re-lighting gas appliance pilots. Even with assistance of mutual assistance resources, this process could have taken several months.

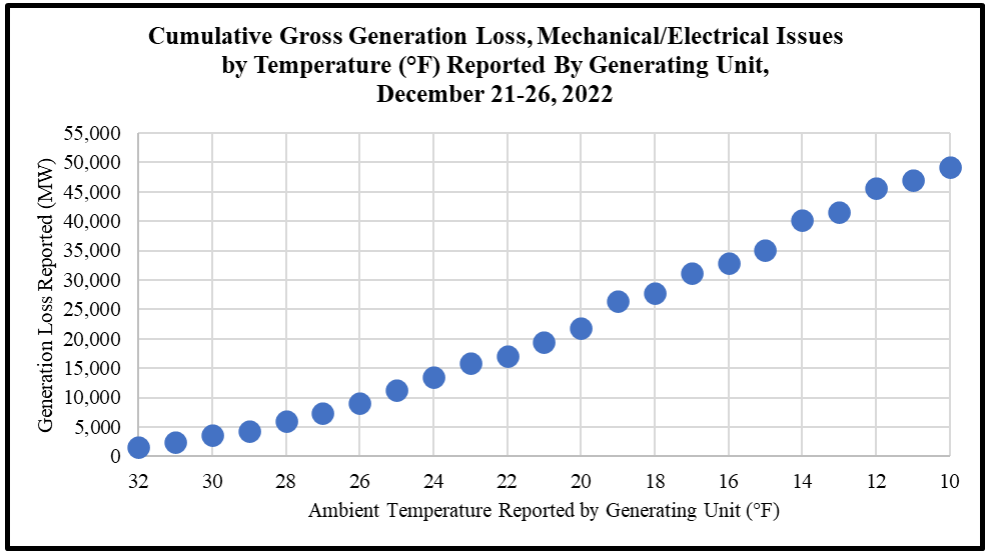
Unplanned Generation Losses Cause Analysis

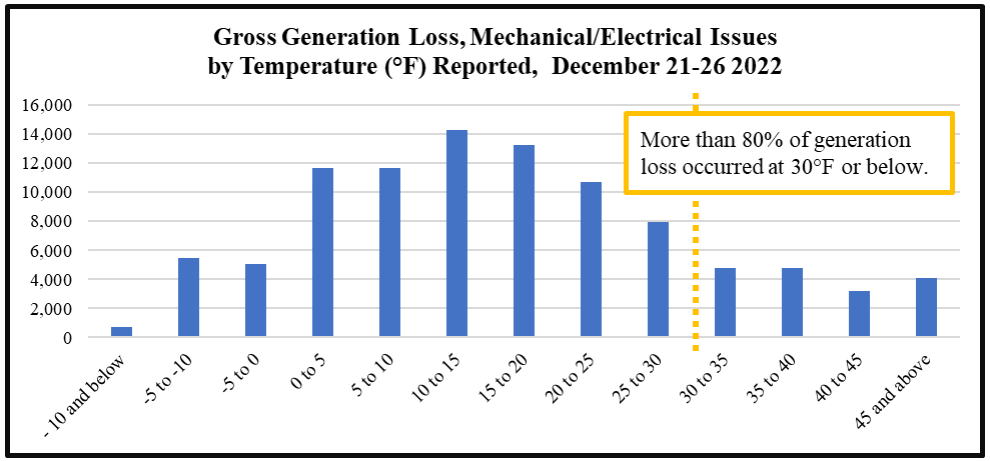
- 55 **percent** of the generating unit outages, derates, and failures to start, were caused by:
  - Freezing Issues (31 **percent**)
  - Fuel Issues (24 **percent**)
    - Natural Gas Fuel Issues were 20 **percent** of all causes and other fuels were 4 percent)
- 41 **percent** indicated by Generator Owners to be caused by **Mechanical/Electrical Issues,** but the team found them to be correlated with subfreezing temperatures



Unplanned Generation Losses Cause Analysis
Mechanical/Electrical Issues

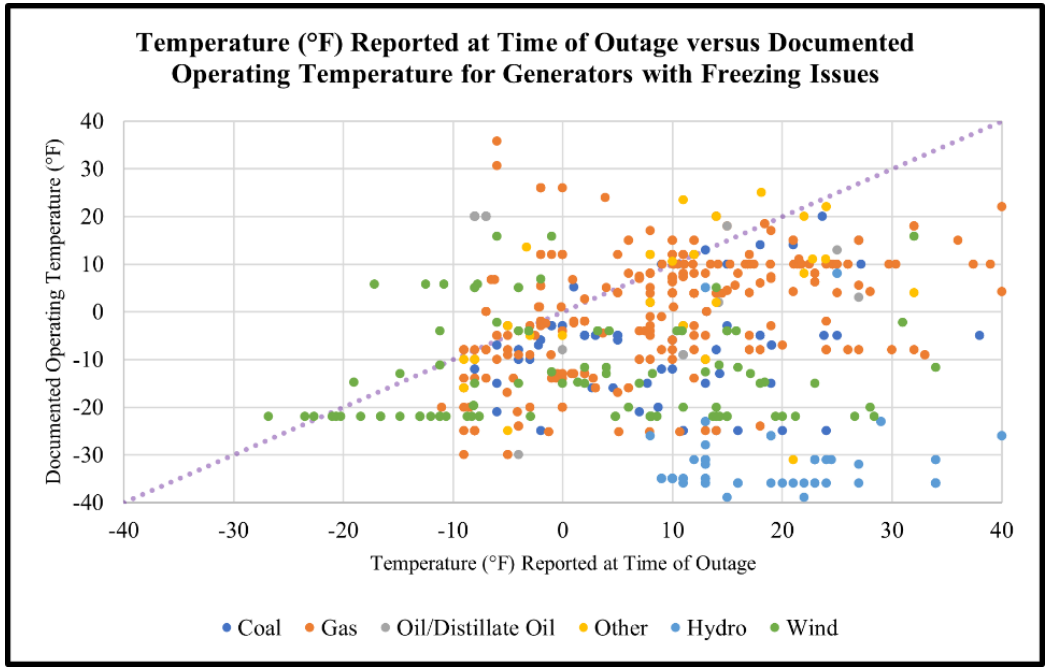
- Those that were attributed to having "**Mechanical/Electrical Issues**" increased with decreasing ambient temperatures
- Same pattern seen in 2018 and 2021 cold weather events
- 80 **percent** of generation lost from this cause occurred at or below 30 degrees Fahrenheit
- More than 49,000 MW lost between 32 and 10 degrees
- 87 **percent** of generation losses occurred **above** documented operating temperature for the generating unit





Unplanned Generation Losses Cause Analysis
Freezing Issues

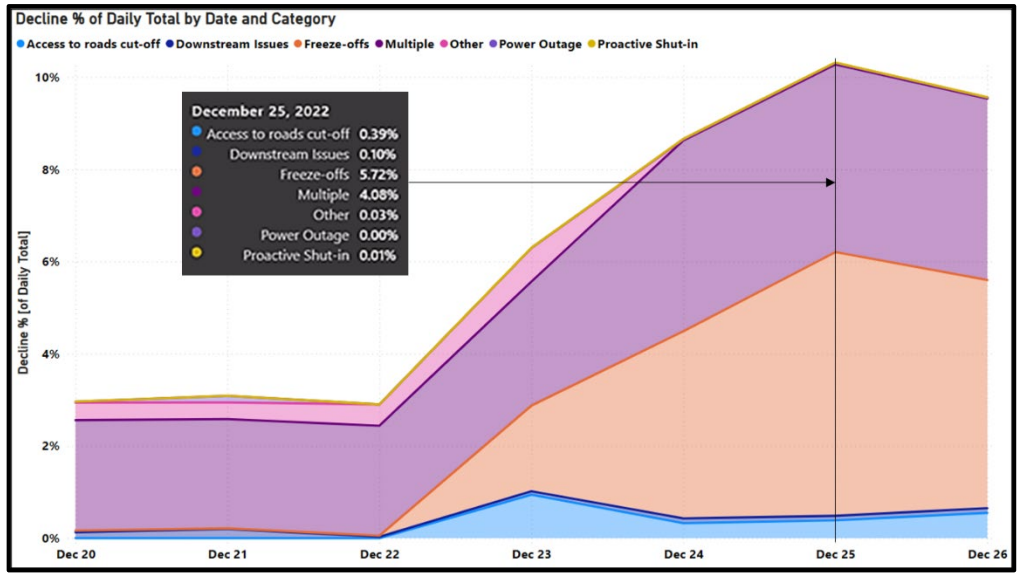
- Of those generating unit outages, derates, and failures to start that were attributed to "**Freezing Issues**" nearly 80% occurred at ambient temperatures that were above their documented minimum operating temperatures.
- Frozen transmitters, sensing lines and instrumentation continue to dominate, combined for 41.8 **percent** of all outages by MW attributed to Freezing Issues
- Next-largest single sub-cause was frozen valves, at 10.7 **percent**
- Wind turbine blade icing was not as predominant as in Winter Storm Uri

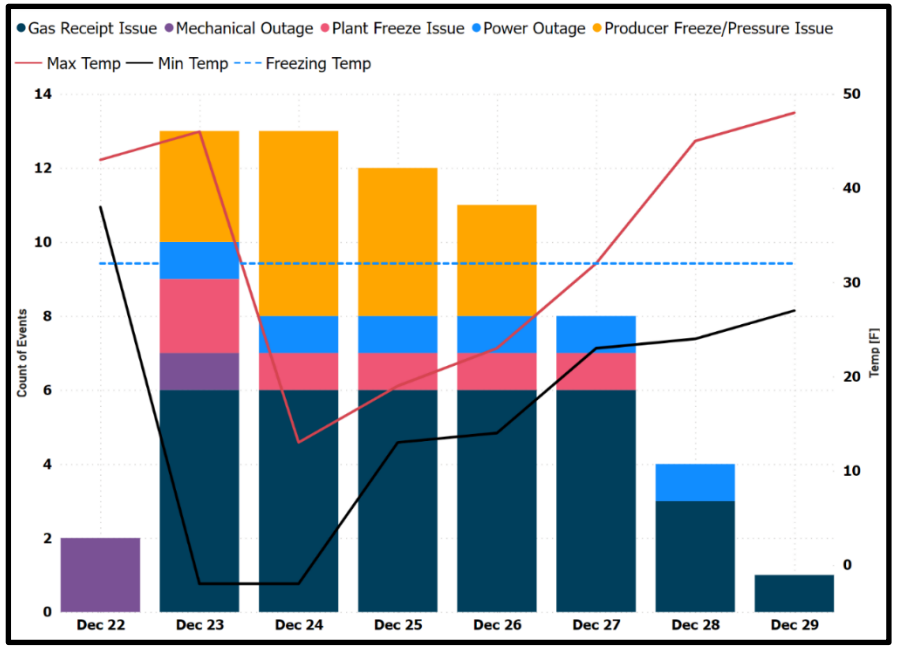


Approximate U.S. Geographic Region	Unplanned Unavailable Generation Due to Freezing Issues (Percent of MW)
New York	5%
MidAtlantic/Midwest	27%
Central/South Central	33%
Southeast	43%
Total Event Area	**31%**

Natural Gas System Cause Analysis
Production and Processing

- **Production Infrastructure**
  - Wellhead freeze-offs, other equipment freezing (ranged from 16 to 55 percent of the production event causes for December 23 through December 25)
  - Poor road conditions due to storm/cold weather, preventing maintenance
- **Processing Facility Operating Issues**
  - Reduction in receipt (production) volume (ranged from 71 to 84 percent of the processing facility event causes for December 22 through December 26)
  - Processing plant disruptions and outages caused by freezing and mechanical issues (up to 16.6 percent)

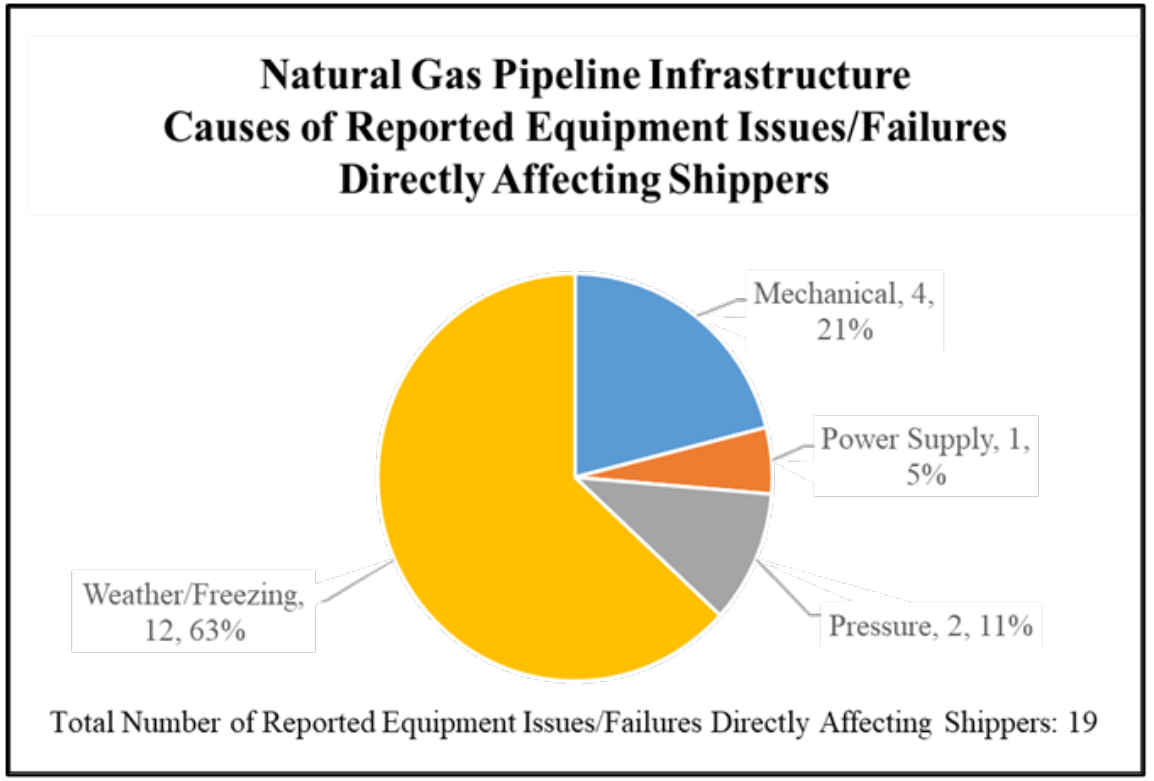




Natural Gas System Cause Analysis
Pipelines

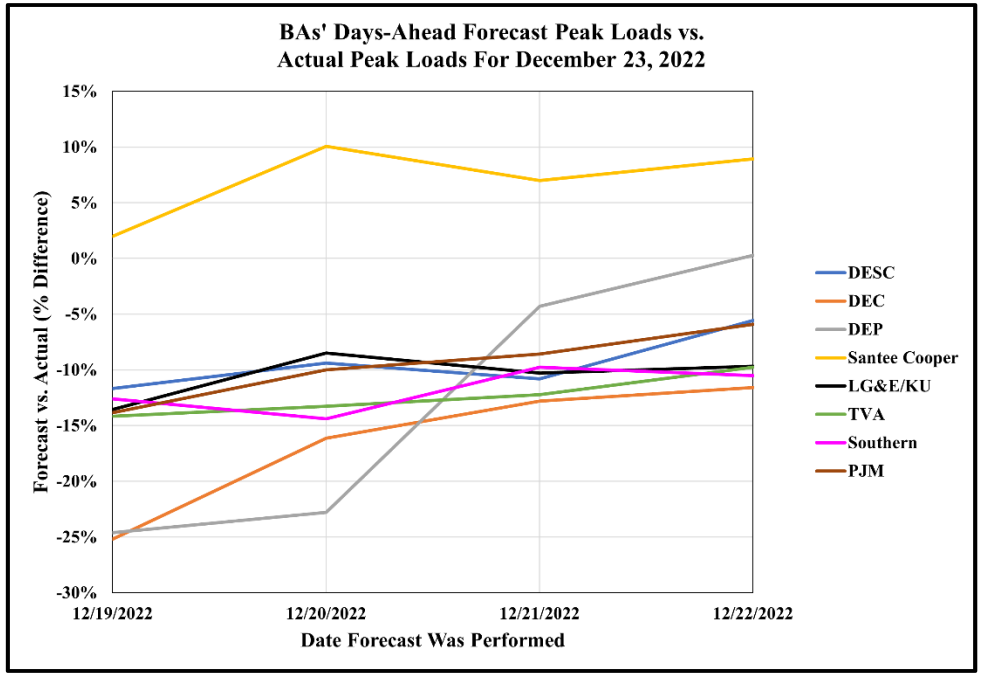
- **Pipeline Infrastructure**
  - Equipment issues directly affecting shippers (e.g., end-users such as generating units, LDCs):
    - Weather/freezing issues (majority)
    - Mechanical issues
  - Interstate pipelines mitigated other equipment issues to avoid impacts to shippers.

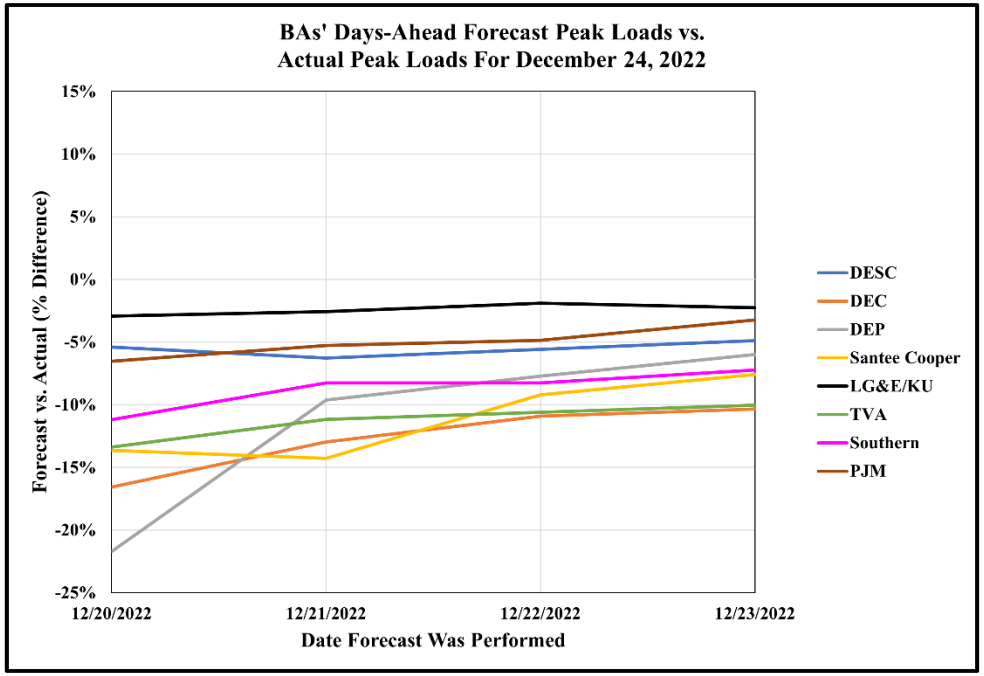
- **63** natural gas-fired generating unit outages/derates, totaling 10,038 MW, were due to firm gas transportation curtailments during the Event.



Electric Grid Operations Analysis
BA Short-Term Load Forecasts

- Although BAs projected higher electricity demands for the impending winter storm, most core BAs significantly underestimated the peak loads in advance of December 23 and 24, the most extreme cold weather days of the Event





Selected Recommendations:
Generator Cold Weather Reliability

Recommendation 1(a): Findings support the need for prompt development and implementation of the remaining recommended revisions to the Reliability Standards from 2021 Report Key Recommendation 1 to strengthen generators' ability to maintain extreme cold weather performance.

Recommendation 1(b): Findings from the Report support the need for robust monitoring by NERC and the Regional Entities of compliance with the currently effective and approved generator cold weather Reliability Standards, to determine if reliability gaps exist. NERC should identify the generating units that are at the highest risk during extreme cold weather and work with the Regional Entities (and Balancing Authorities, if applicable) to perform cold weather verifications of those generating units until all of the extreme cold weather Standards proposed by the 2021 Report are approved and effective.

Recommendation 1(c): Generator Owners/Operators should assess their own freeze protection measure vulnerability, and NERC or the Regional Entities should perform targeted cold weather verifications pursuant to a risk-based approach.

Selected Recommendations:
Generator Cold Weather Reliability

<u>Recommendation 2</u>: NERC should initiate a technical review of the individual causes of cold-weather-related unplanned generation outages caused by Mechanical/ Electrical Issues during the Event to identify the root causes of these failures with the goal of determining what can be done to reduce the frequency of these outages during extreme cold weather events. The study should also consider whether additional Reliability Standards are appropriate to address the root causes of these issues. The study should be conducted by either an independent subject-matter expert such as the Electric Power Research Institute or an academic institution, with participation by Generation Owners/ Generation Operators on scoping and providing generating-unit-specific technical expertise.

Selected Recommendations:
Natural Gas Infrastructure Cold Weather Reliability

Recommendation 4: Legislation by Congress and state legislatures (and/or regulation by entities with jurisdiction over natural gas infrastructure reliability) is needed to establish reliability rules for natural gas infrastructure necessary to support the grid and natural gas local distribution companies that address the needs described in 4(a), (b) and (c).

Recommendation 4(a): Because extreme cold weather events have repeatedly impaired the production, gathering, processing, and transportation of natural gas, the reliability rules suggested in Recommendation 4 should address, among other topics, the need for natural gas infrastructure reliability rules, from wellhead through pipeline, requiring cold weather preparedness plans, freeze protection measures, and operating measures for when extreme cold weather periods are forecast, and during the extreme cold weather periods.

Recommendations:
Natural Gas Infrastructure Cold Weather Reliability

Recommendation 4(b): The reliability rules suggested in Recommendation 4 should address, among other topics, the need for regional natural gas communications coordinators, with situational awareness of the natural gas infrastructure similar to the grid's Reliability Coordinators, that can share timely operational communications throughout the natural gas infrastructure chain and communicate potential issues to, and receive grid reliability information from, grid reliability entities.

Recommendation 4(c): The reliability rules suggested in Recommendation 4 should address, among other topics, the need to require natural gas infrastructure entities to identify those natural gas infrastructure loads that should be designated as critical for priority treatment during load shed and provide criteria for identifying such critical loads.

Selected Recommendations:
Natural Gas – Electric Coordination for Cold Weather Reliability

Recommendation 5: The North American Energy Standards Board should convene natural gas infrastructure entities, electric grid operators, and LDCs to identify improvements in communication during extreme cold weather events to enhance situational awareness.

Recommendation 7: An independent research group (e.g., selected National Laboratories from the Department of Energy), should perform one or more studies to analyze whether additional natural gas infrastructure, including interstate pipelines and storage, is needed to support the reliability of the electric grid and meet the needs of natural gas Local Distribution Companies. The study should include information about the cost of the infrastructure buildout.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

The full report can be found at:

https://www.ferc.gov/news-events/news/ferc-nerc-release-final-report-lessons-winter-storm-elliott

or

https://www.nerc.com/news/Headlines%20DL/Elliott%20report%20final.pdf