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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Preparation for Severe Cold Weather

2021 Webinar

Hosted by the ERO Event Analysis Program
September 2, 2021

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- Assist industry in adjusting focus toward the winter season and provide supporting information for cold weather preparation.

- Introduction/Opening Remarks/Tribute – Matt Lewis
- Cold Weather Generator Failure Modes & Mechanisms –Rick Hackman
- Winter/Cold Weather Prep Resources – Rick Hackman
- ERO Winter Reliability Assessment – Stephen Coterillo
- Natural Gas and Electrical Operational Coordination Considerations Guideline – Mike Knowland



Jule Tate

August 7, 1961–June 11, 2021

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Cold Weather Generator Failure Modes & Mechanisms

Plus: Cold Weather Prep Resources

Rick Hackman

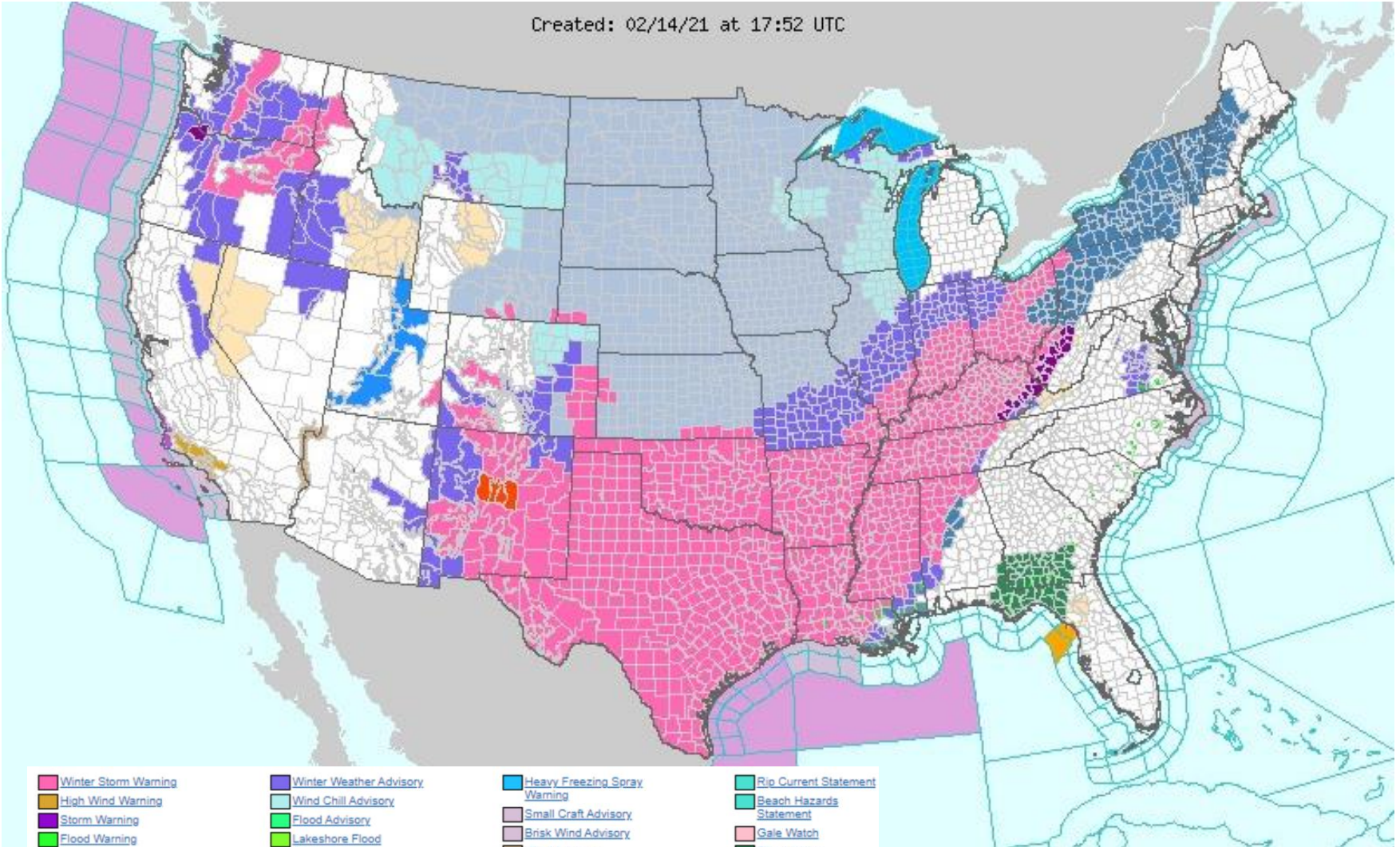
September 2, 2021

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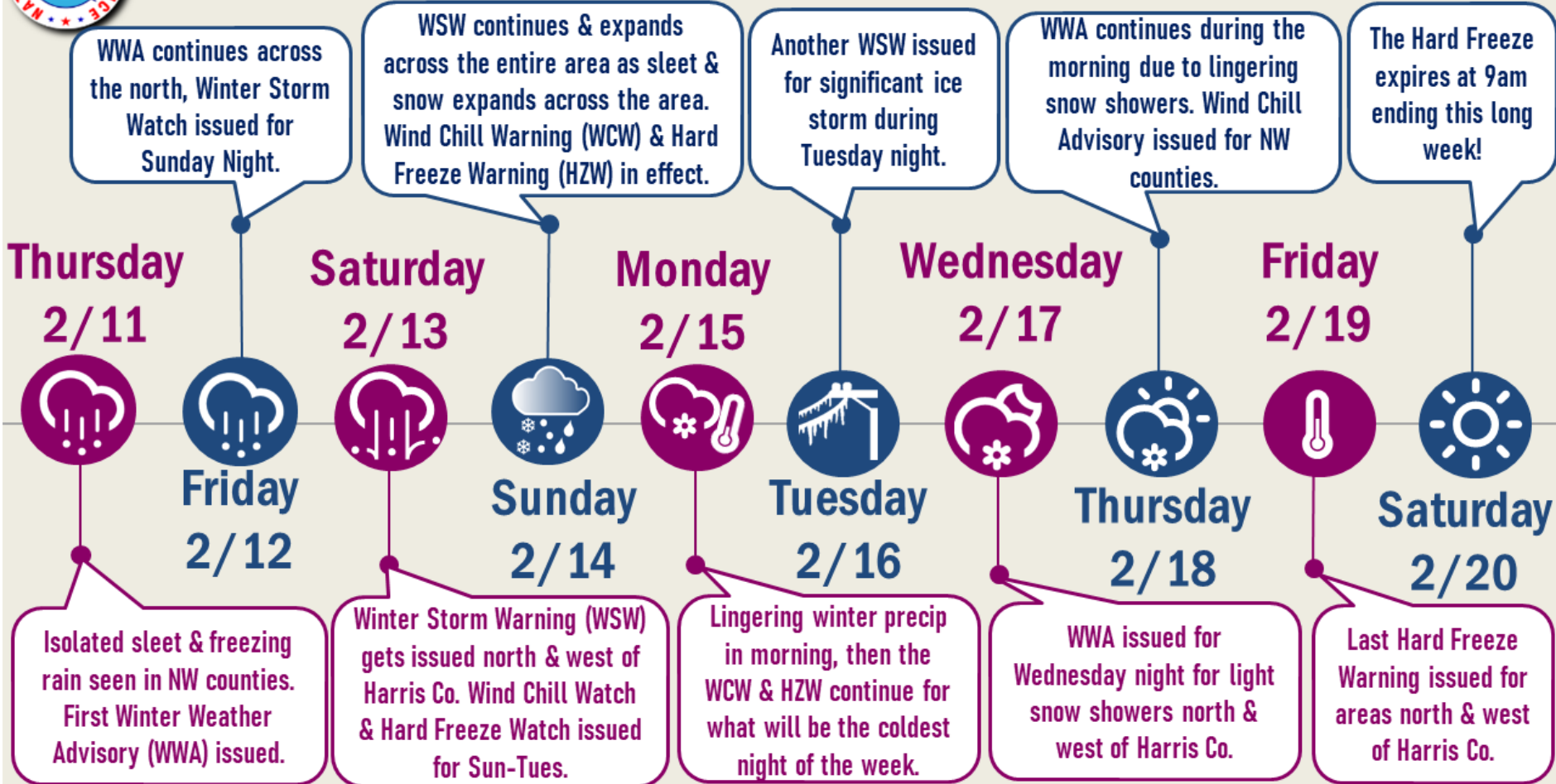


- | | | | |
|---|--|--|---|
| ■ Winter Storm Warning | ■ Winter Weather Advisory | ■ Heavy Freezing Spray Warning | ■ Rip Current Statement |
| ■ High Wind Warning | ■ Wind Chill Advisory | ■ Small Craft Advisory | ■ Beach Hazards Statement |
| ■ Storm Warning | ■ Flood Advisory | ■ Brisk Wind Advisory | ■ Gale Watch |
| ■ Flood Warning | ■ Lakeshore Flood Advisory | ■ Wind Advisory | ■ Flood Watch |
| ■ Gale Warning | ■ Coastal Flood Advisory | ■ Frost Advisory | ■ Fire Weather Watch |
| ■ Wind Chill Warning | ■ High Surf Advisory | ■ Freezing Spray Advisory | ■ Special Weather Statement |

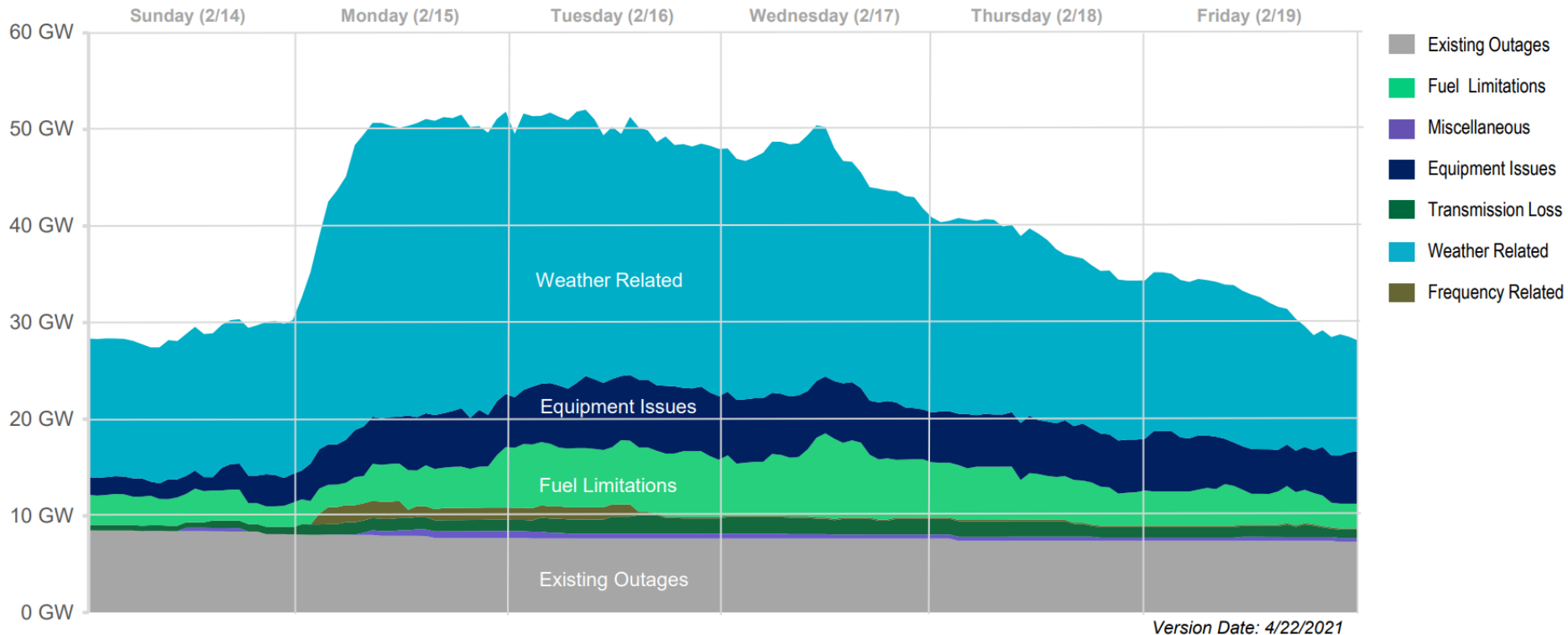


February Winter Outbreak Timeline

NATIONAL WEATHER SERVICE
OCEANIC AND ATMOSPHERIC ADMINISTRATION
Houston, TX



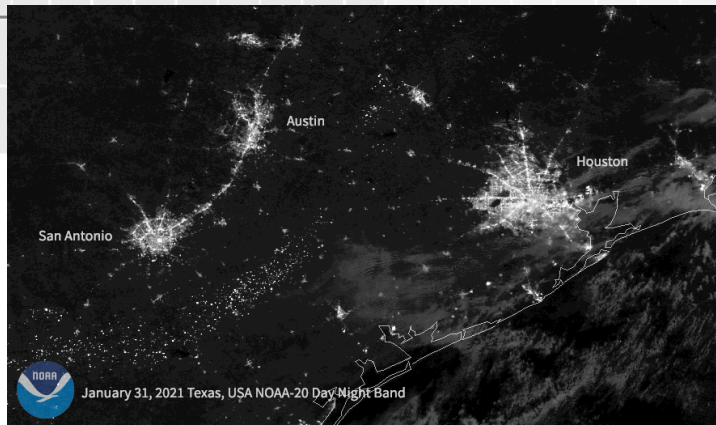
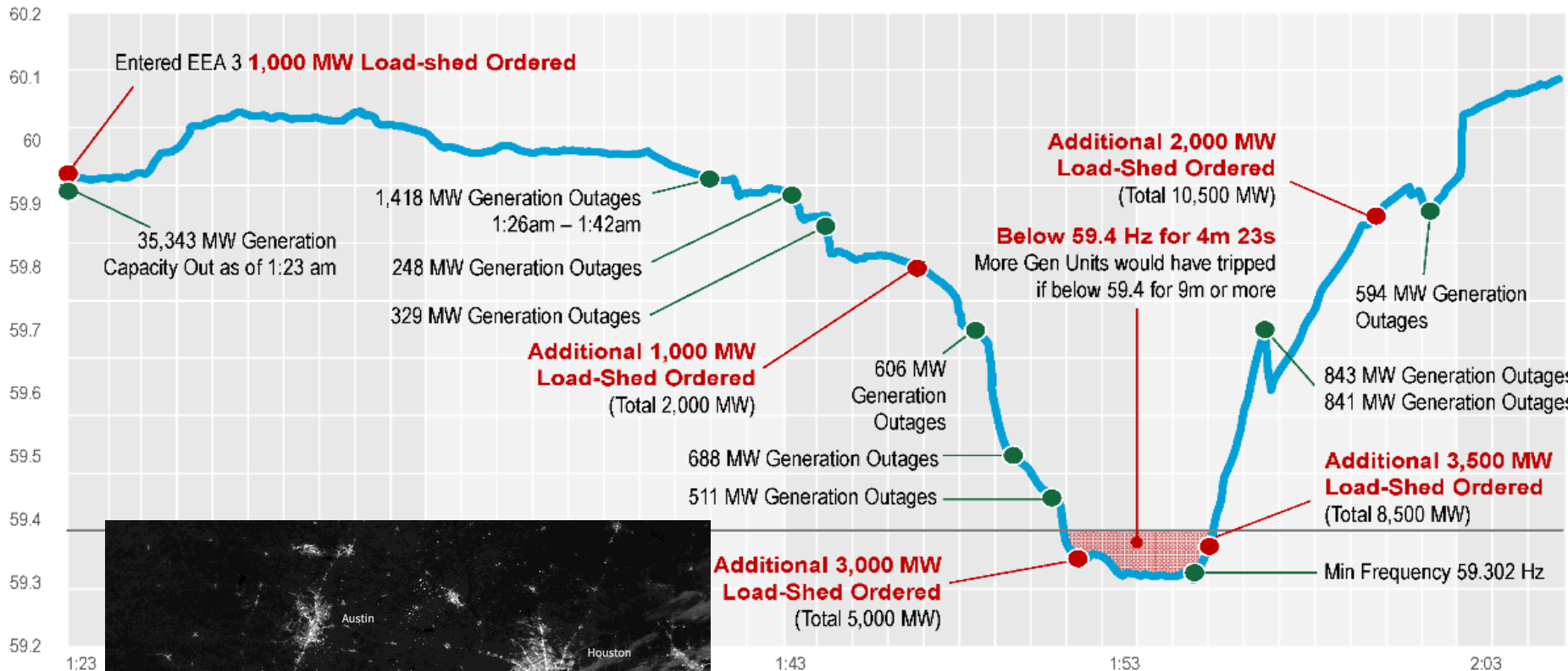
Net Generator Outages and Derates by Cause (MW) February 14 – 19, 2021



Net generator outages at the beginning of each hour on February 14-19, 2021, by cause category.



Rapid Decrease in Generation Causes Frequency Drop



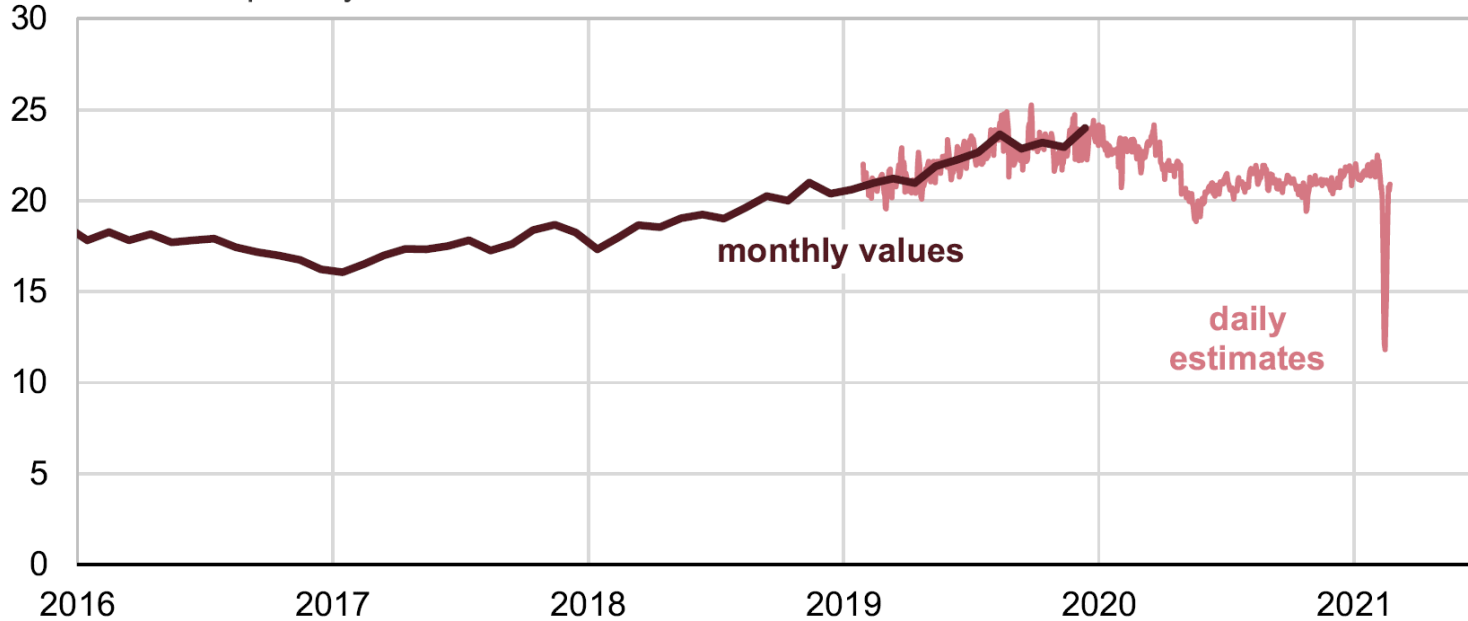
PUBLIC



Texas natural gas production fell by almost half during recent cold snap

Texas dry natural gas production (Jan 2016–Feb 2021)

billion cubic feet per day



Source: U.S. Energy Information Administration, *Natural Gas Monthly*, and daily estimates from IHS Markit

Reliability Guideline

Natural Gas and Electrical Operational Coordination Considerations

Applicability

Reliability Coordinators (RC), Balancing Authorities (BA), Transmission Operators (TOP), Generator Owners (GO), and Generator Operators (GOP)

Preamble

It is in the public interest for NERC to develop guidelines that are useful for maintaining or enhancing the reliability of the Bulk Electric System (BES). The Reliability and Security Technical Committee (RSTC) is, per its charter authorized by the NERC Board of Trustees (Board), to develop Reliability and Security Guidelines. Guidelines establish voluntary codes of practice for consideration and use by BES users, owners, and operators. These guidelines are developed by the technical committees and include the collective experience, expertise, and judgment of the industry. Reliability guidelines do not provide binding norms or create parameters by which compliance to standards is monitored or enforced. While the incorporation and use of guideline practices is strictly voluntary, the review, revision, and development of a program using these practices is strongly encouraged to promote and achieve the highest levels of reliability for the BES. Nothing in this guideline negates obligations or requirements under an entity's regulatory framework (local, state, or federal), and all parties must take those requirements into consideration when implementing any of the guidance detailed herein.

Metrics

Pursuant to the Commission's Order on January 19, 2021, *North American Electric Reliability Corporation*, 174 FERC ¶ 61,030 (2021), reliability guidelines shall now include metrics to support evaluation during triennial review consistent with the RSTC Charter¹.

Baseline Metrics

- Performance of the BPS prior to and after a reliability guideline as reflected in NERC's State of Reliability Report and reliability assessments (e.g., the Long Term Reliability Assessment and seasonal assessments)
- The use and effectiveness of a reliability guideline as reported by industry via survey
- Industry assessment of the extent to which a reliability guideline is addressing risk as reported via survey

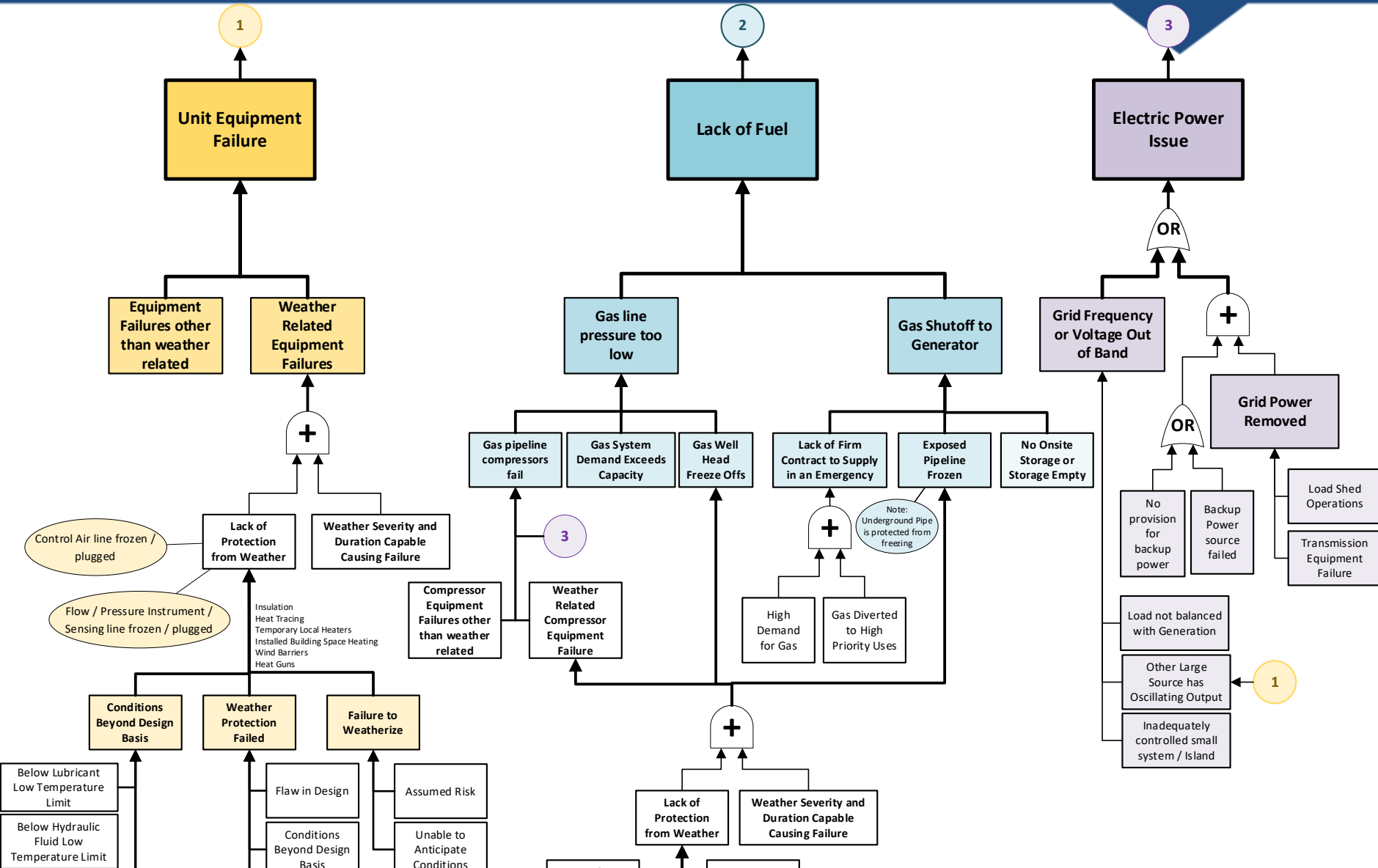
Specific Metrics

The RSTC or any of its subcommittees can modify and propose metrics specific to the guideline in order to measure and evaluate its effectiveness.

¹ <https://auth.internal.nerc.com/comm/RSTC/Pages/default.aspx>

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Gas_Electric_Guideline.pdf

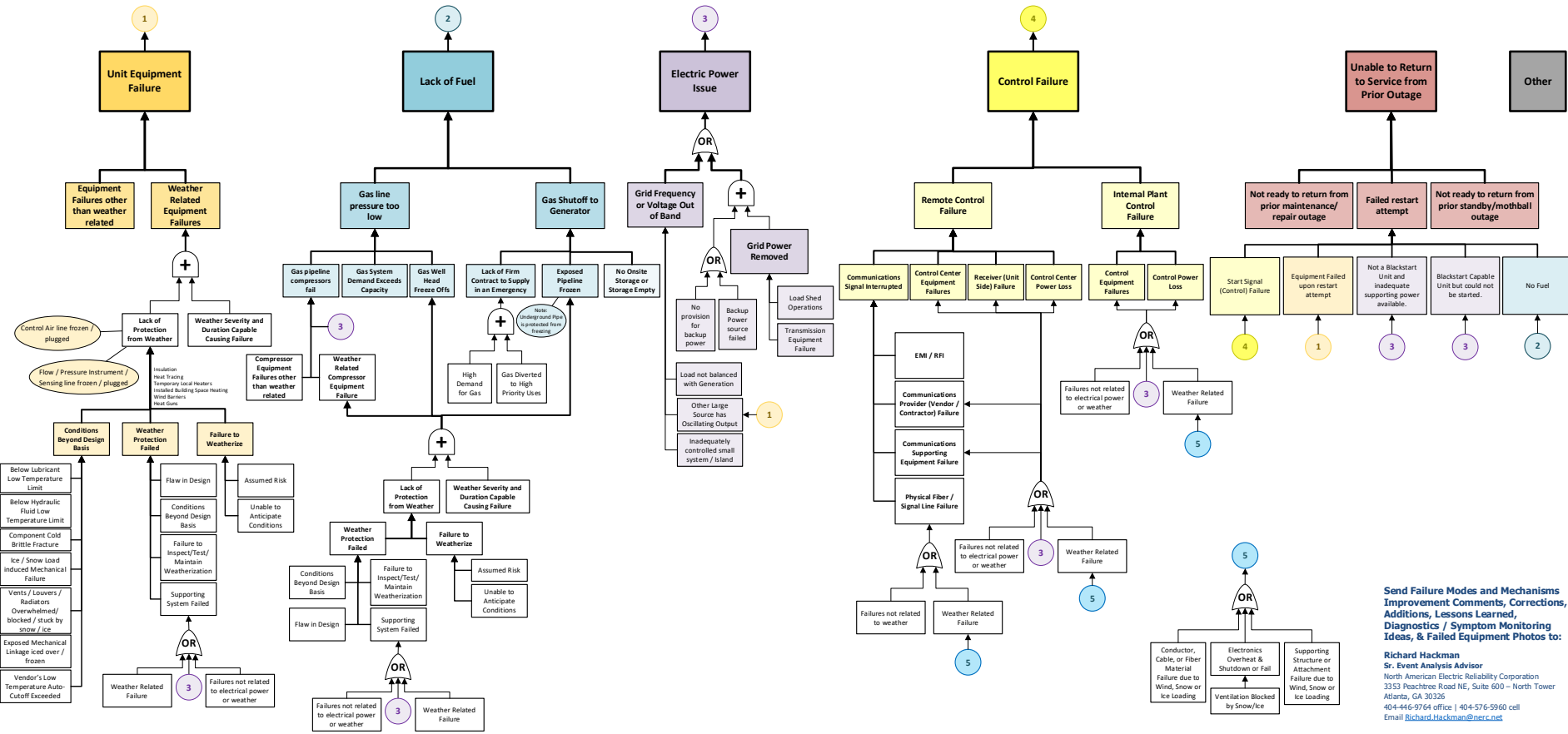
Generic Gas Unit Cold Weather Issues



Generic Gas Unit Cold Weather Issues

Generic Gas Unit Fails to Generate During Cold Weather

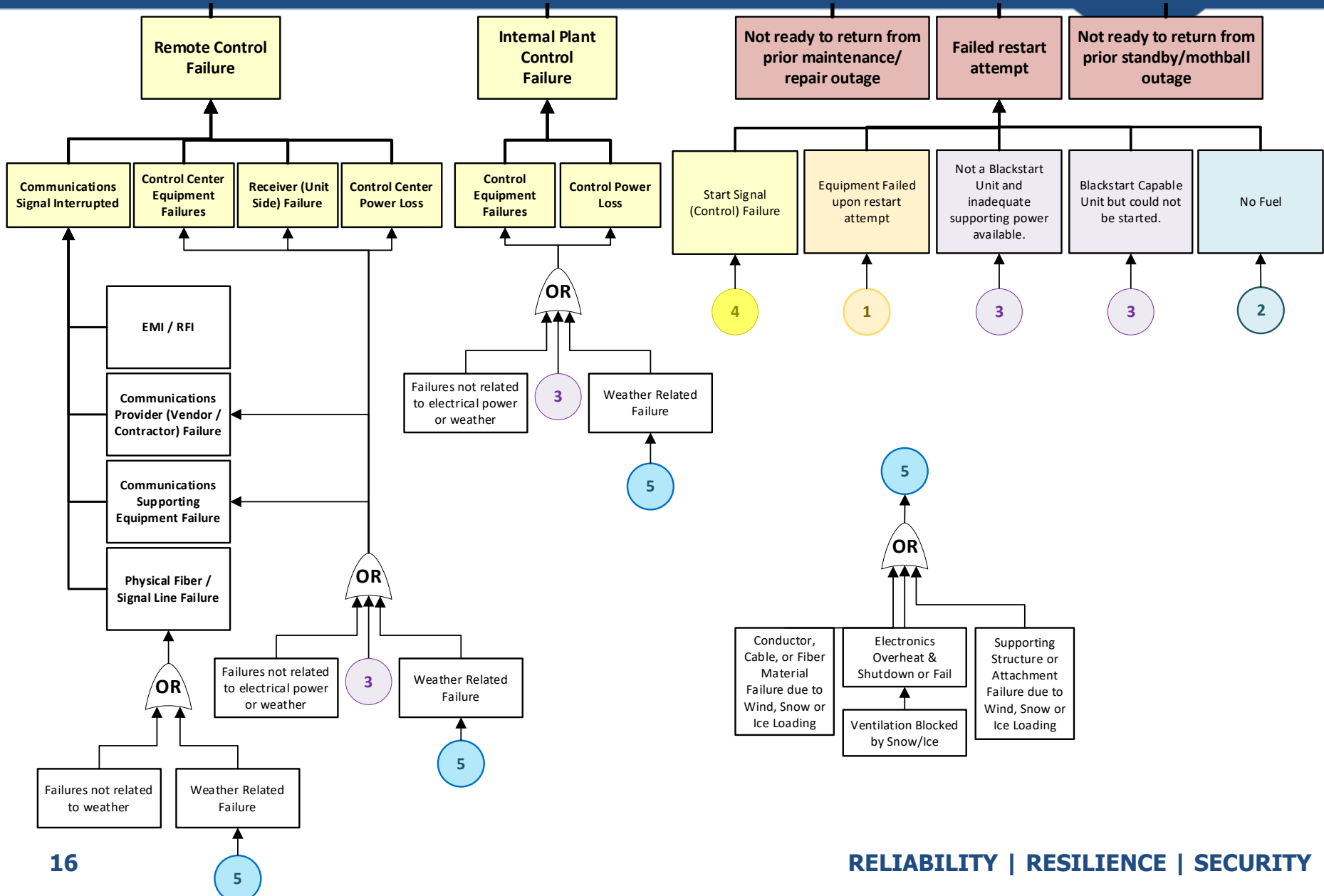
See NERC Reliability Guideline: Generating Unit Winter Weather Readiness



Send Failure Modes and Mechanisms Improvement Comments, Corrections, Additions, Lessons Learned, Diagnostics / Symptom Monitoring Ideas, & Failed Equipment Photos to:

Richard Hackman
Sr. Event Analysis Advisor
North American Electric Reliability Corporation
3353 Peachtree Road NE, Suite 600 – North Tower
Atlanta, GA 30326
404-446-9764 office | 404-576-5960 cell
Email Richard.hackman@nerc.net

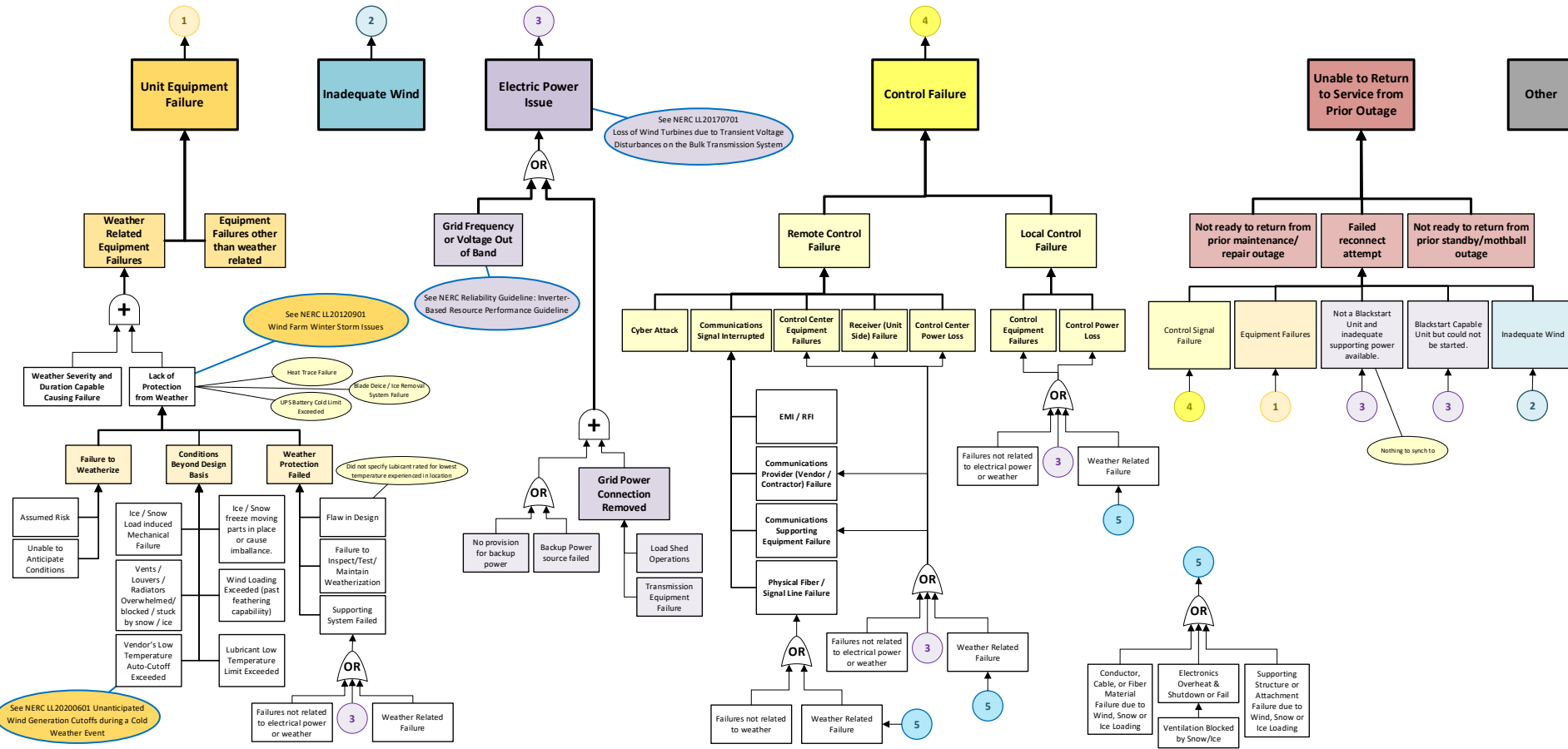
Generic Gas Unit Cold Weather Issues



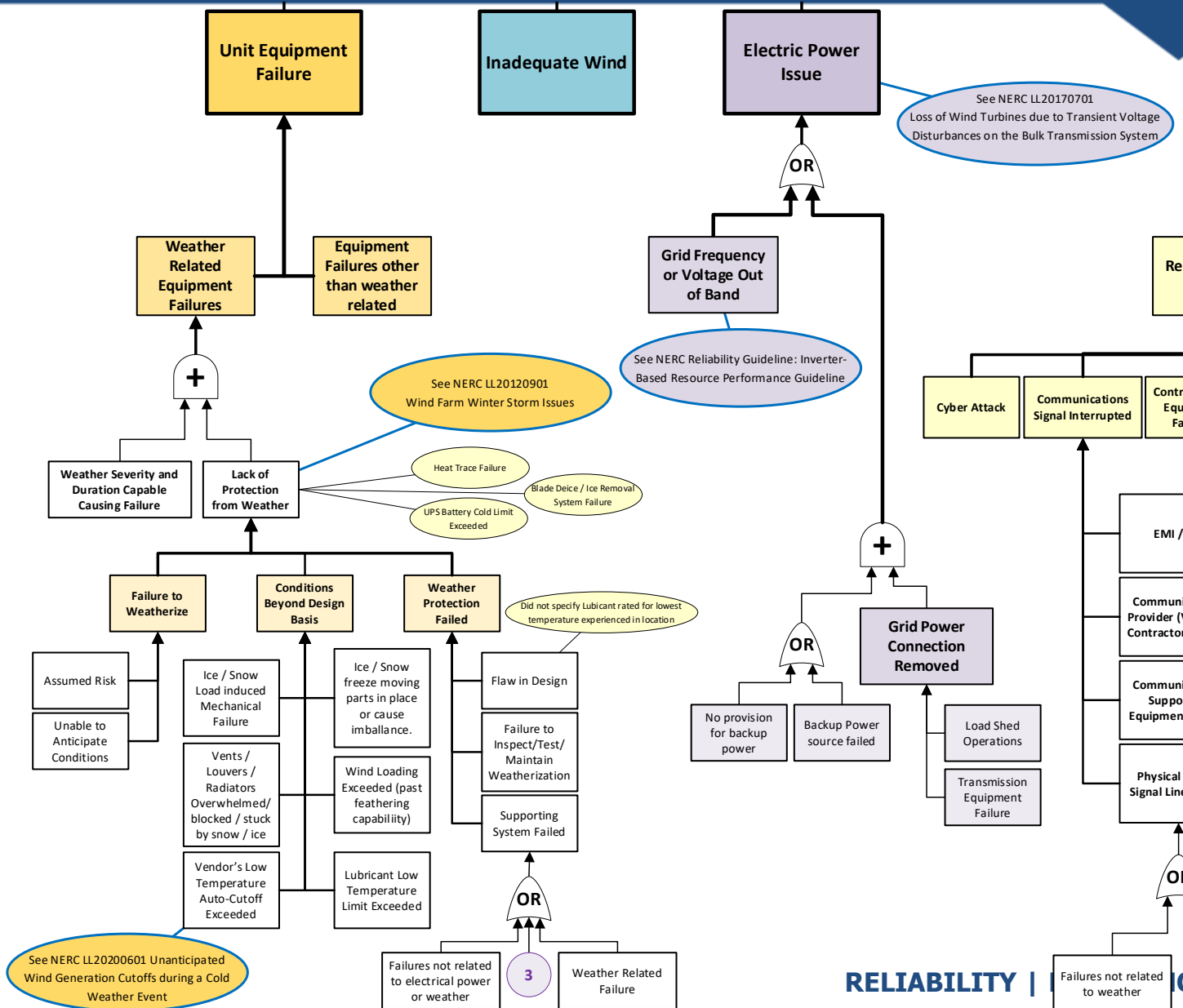
Wind Generator Cold Weather Issues

Wind Generator Failures During Cold Weather

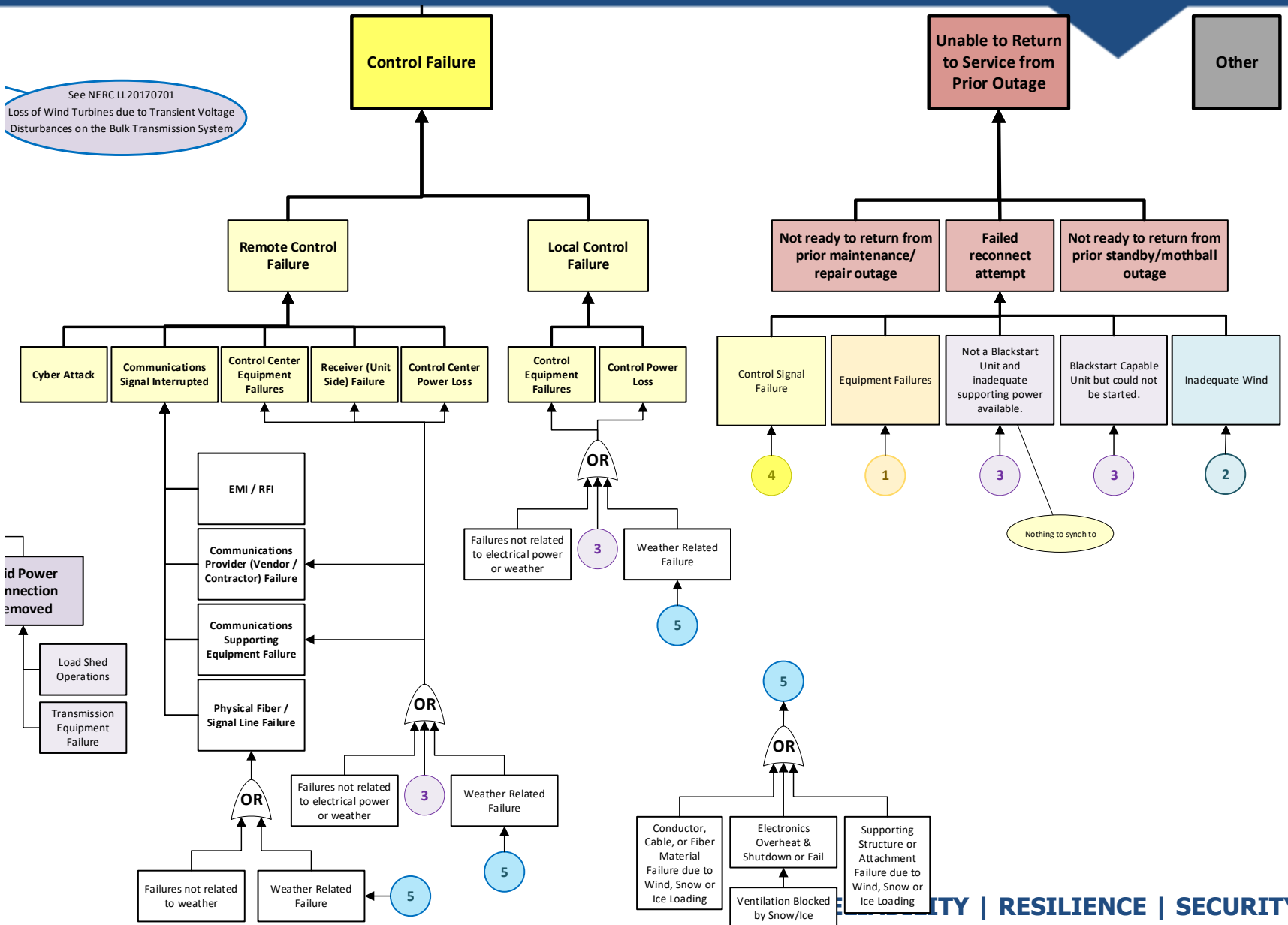
See NERC Reliability Guideline: Generating Unit Winter Weather Readiness



Wind Generator Cold Weather Issues



Wind Generator Cold Weather Issues



NERC Information Resources on Cold Weather Preparation and BPS Impacts

(as of 2/11/2021)

NERC has been collecting and sharing information on cold weather preparation and BPS impacts for years via Webinars, Special Reports, Lessons Learned, Failure Modes & Mechanisms, and other resources.

Version 3 of the [Generating Unit Winter Weather Readiness Reliability Guideline](#) was approved by the RSTC at the end of 2020. The changes between versions 2 and 3 were discussed in the 2020 [Winter Weather Webinar](#).

Here are links to some cold weather resources:

Reports on major BPS-impacting Cold Weather events

- [Outages and Curtailments during the Southwest Cold Weather Event of February 1-5, 2011](#)
 - [Winter Weather Readiness for Texas Generators](#), (2011)
 - [January 2014 Polar Vortex Review](#)
 - [The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018](#) (There are a number of 'sound practices' from the industry, starting on page 100.)
- Other Cold Weather Reports and Training Materials can be found [on this site](#).

Cold weather related Lessons Learned:

- [LL20110902 Adequate Maintenance and Inspection of Generator Freeze Protection](#)
- [LL20110903 Generating Unit Temperature Design Parameters and Extreme Winter Conditions](#)
- [LL20111001 Plant Instrument & Sensing Equipment Freezing Due to Heat Trace & Insulation Failures](#)
- [LL20120101 Plant Onsite Material and Personnel Needed for a Winter Weather Event](#)
- [LL20120102 Plant Operator Training to Prepare for a Winter Weather Event](#)
- [LL20120103 Transmission Facilities and Winter Weather Operations](#)
- [LL20120901 Wind Farm Winter Storm Issues](#)
- [LL20120902 Transformer Oil Level Issues During Cold Weather](#)
- [LL20120903 Winter Storm Inlet Air Duct Icing](#)
- [LL20120904 Capacity Awareness During an Energy Emergency Event](#)
- [LL20120905 Gas and Electricity Interdependency](#)
- [LL20180702 Preparing Circuit Breakers for Operation in Cold Weather](#) (also 2018 Webinar w/FMM)
- [LL20200601 Unanticipated Wind Generation Cutoffs during a Cold Weather Event](#)
- [LL20201101 Cold Weather Operation of SF6 Circuit Breakers](#)

Winter Weather Webinars from 2012 – 2020 can be found [on this site](#).

Annual Winter Reliability Assessments 2003/2004 thru 2019/2020 can be found [on this site](#).



Reliability Guideline

Generating Unit Winter Weather Readiness
Current Ind

Preamble:
The objective of critical to promote are not binding monitored or en revising, or deve

Purpose:
This reliability gu BPS. Although th normally expose winter weather maintaining indiv a collection of b strictly voluntary local conditions i impact weather e

Assumptions:

1. Each BPS maintain NRC reg procedu
2. Balancing dispatch needed t be accor events, appropr
3. What co to make for each its norm

Guideline Deta:
An effective wint should generally

2018
2019 FERC and NERC Staff Report
The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018



Questions and Answers

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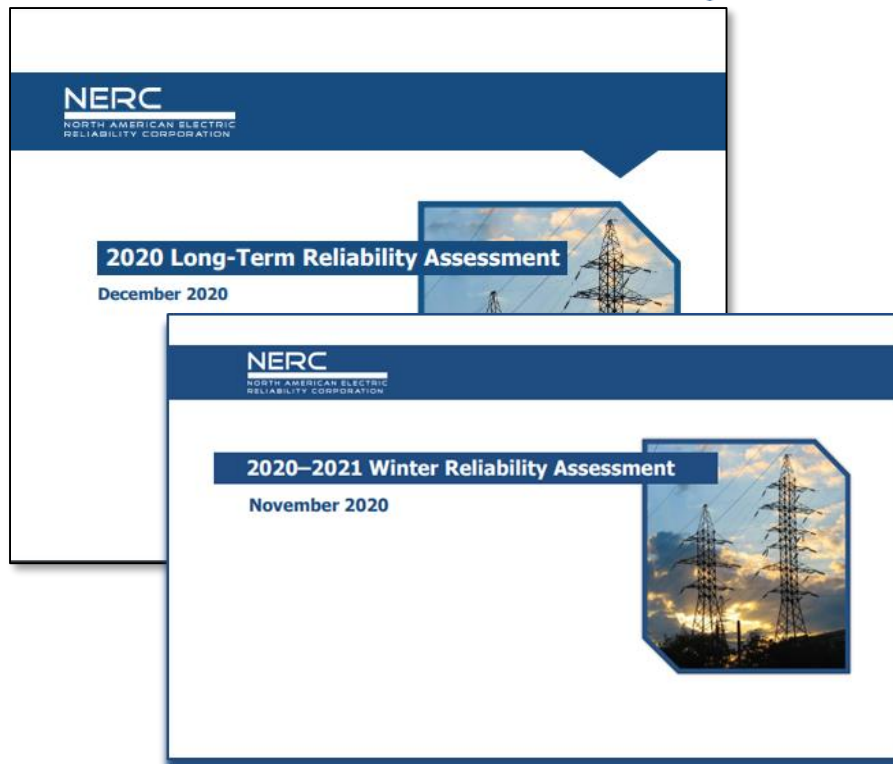
NERC Winter Reliability Assessment

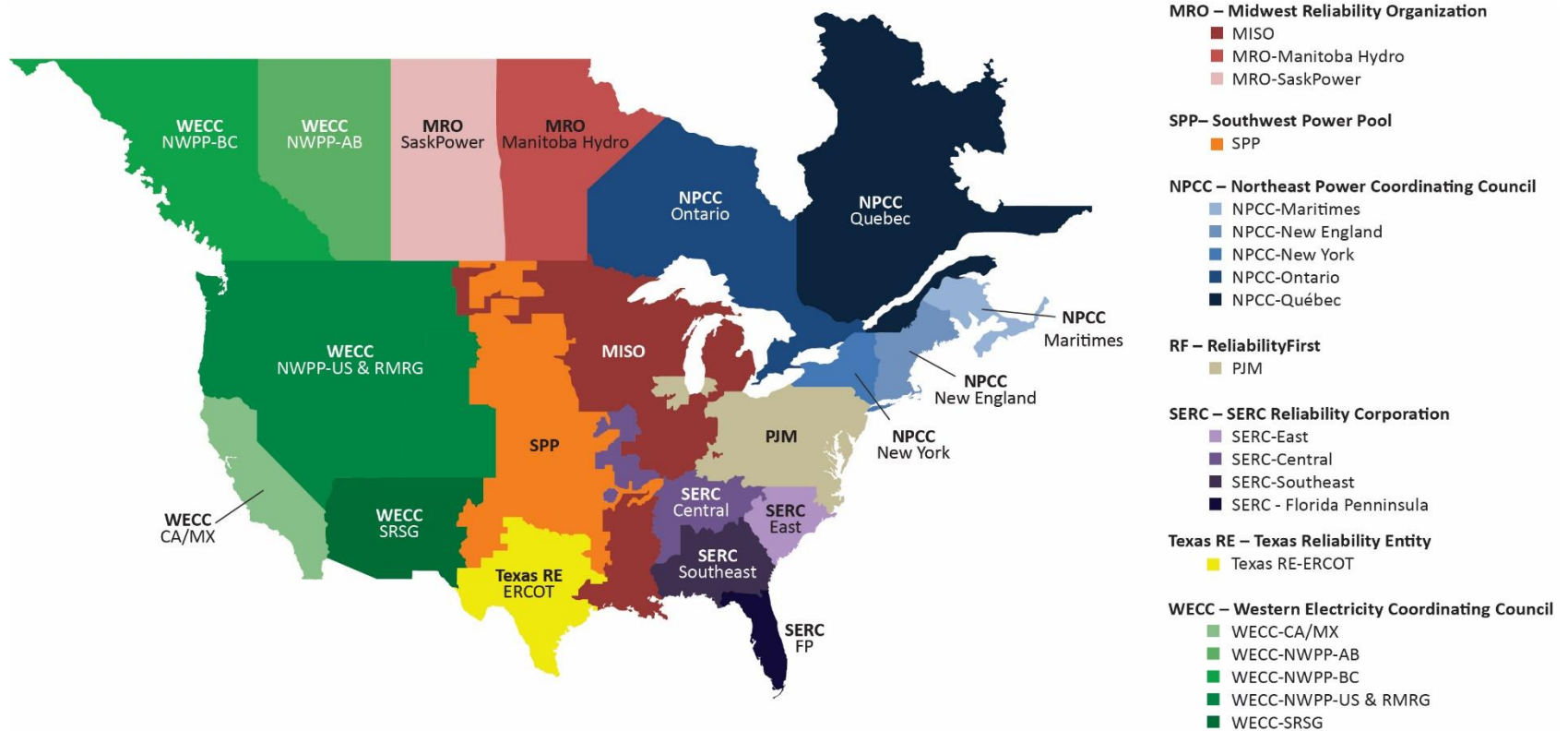
Stephen Coterillo, Engineer Reliability Assessments
Winter Readiness Webinar
September 2, 2021

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NERC's long-term, seasonal, and special reliability assessments help the Electric Reliability Organization deliver on its vision of a highly reliable and secure bulk power system

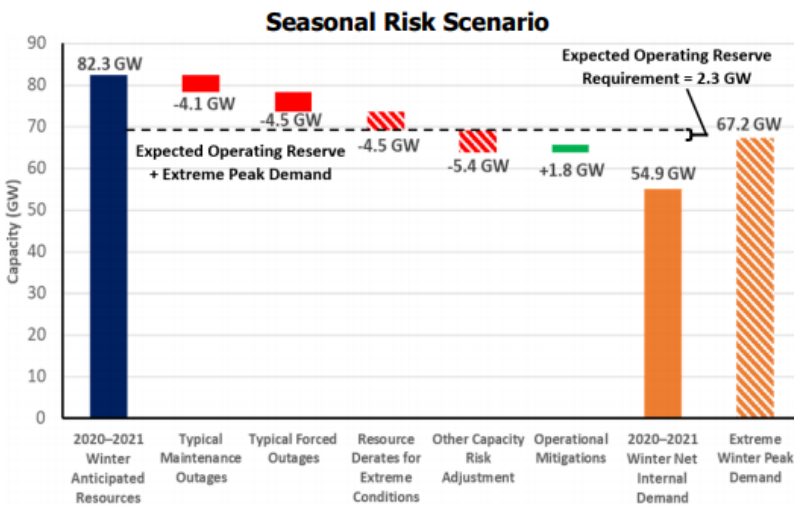




- NERC's Winter Reliability Assessment (WRA) examines potential regional resource deficiencies and operating reliability concerns
 - Describes industry preparations to manage seasonal risks
- Developed with subject matter experts from each assessment area and reviewed by stakeholders



- Adequate Installed Capacity
- Extreme Weather Risks
- Energy Assurance Concerns



Reliability Risks during Extreme Weather Events and/or Fuel Supply Disruptions

- Deterministic scenario analysis
 - Expected (average) conditions
 - Extreme conditions based on a scenario event (e.g., polar vortex scenario)
 - Identify high-risk period—not necessarily peak demand hour
- Probability-based risk analysis
 - Probabilistic measures could include expected unserved energy or load-loss hours
- Insights from NERC Level 2 Alert

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Level 2 NERC Alert Posted

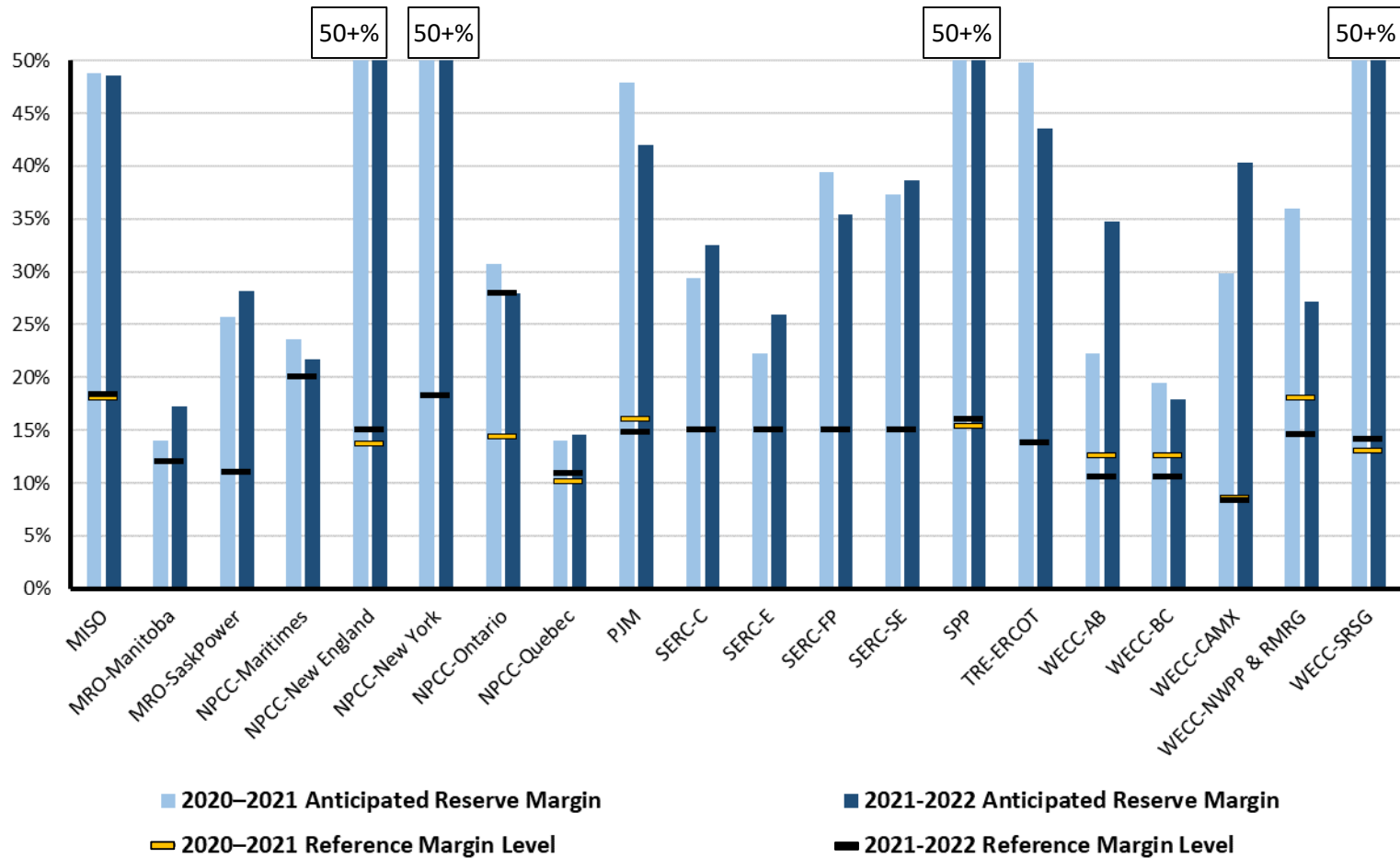
Recommendation to Industry
Cold Weather Preparations for Extreme
Weather Events

[Click here for Alerts](#)
[Click here for Cold Weather Preparations for Extreme Weather Events Alert](#)

ATLANTA – NERC issued a Level 2 Extreme Cold Weather Alert to Reliability Coordinators (RCs), Balancing Authorities (BAs), Transmission Operators (TOPs), and Generator Owners (GOs). The alert includes five recommendations, as well as a series of questions, that are intended to evaluate the Bulk Electric System's winter readiness.

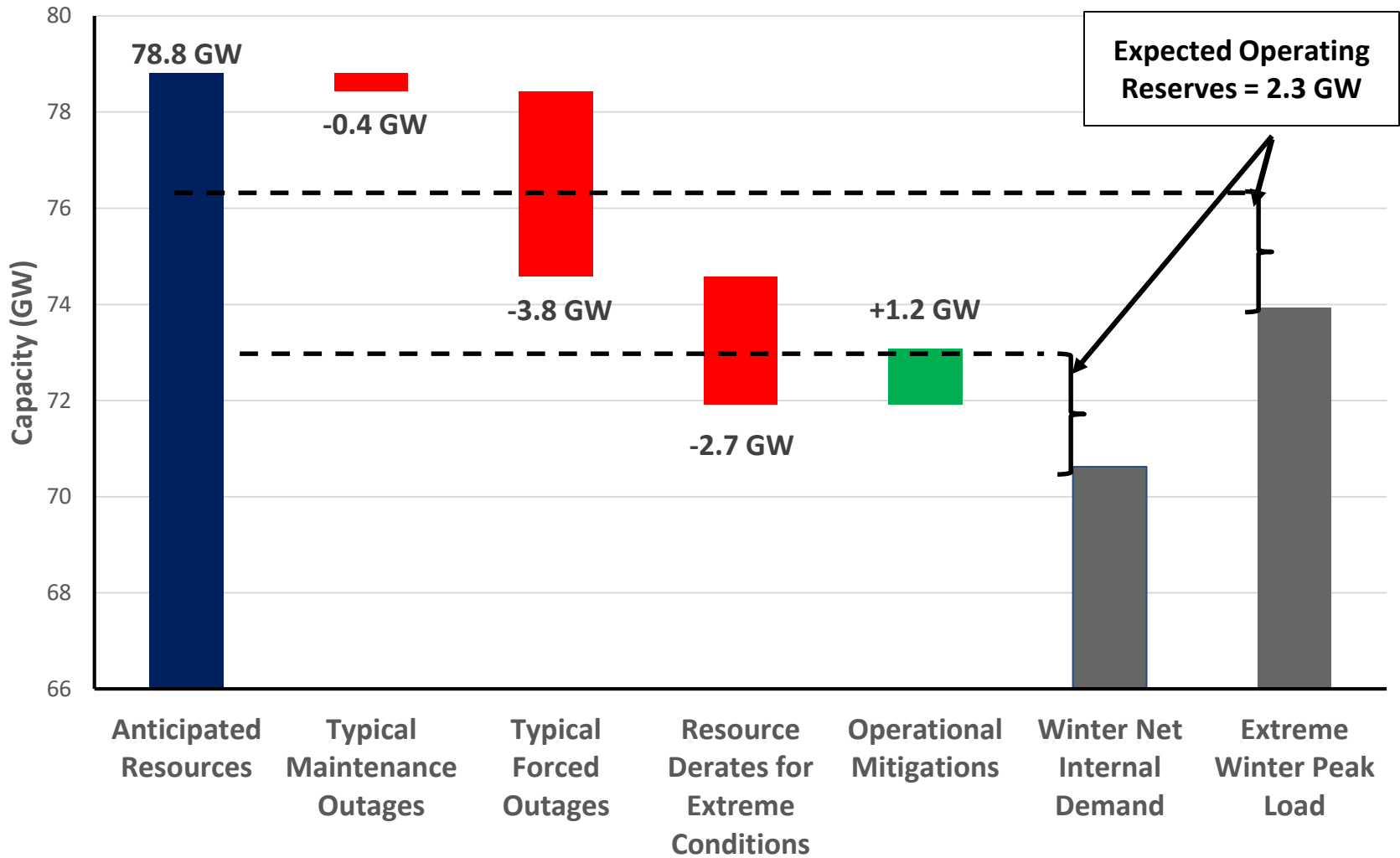
NERC registered entities should note that only entities registered as the above mentioned will be able to view and respond to the alert in the NERC Alert System. However, the alert is public and may be viewed at the link above. The alert has a response due date of September 17, 2021.

Preliminary Reserve Margin Year-on-Year Comparison



Preliminary Data Indicates Resource Capacity will be Adequate for Winter

- Each assessment area is providing data for operational risk scenario
- Scenarios provide additional insight into winter reliability risks
 - Consider extreme winter peak loads
 - Account for **resource derates and outages due to extreme winter conditions**
 - Compare resources with expected operating reserve requirements provided by NERC assessment areas
- Data can be used for an operational risk waterfall chart



- 2021-2022 WRA will be published in November
- Load-serving entities, system operators, and generator operators can promote winter readiness by:
 - Ensuring lines of communication are open for periods of system stress
 - Conducting drills on alert programs to ensure they are prepared to signal need for conservative operations
 - Preparing for demand-side conservation measures and condition customers to their need and efficacy
 - Reviewing non-firm customer inventories and rolling blackout procedures to ensure natural gas and other critical infrastructure loads are not affected



Questions and Answers

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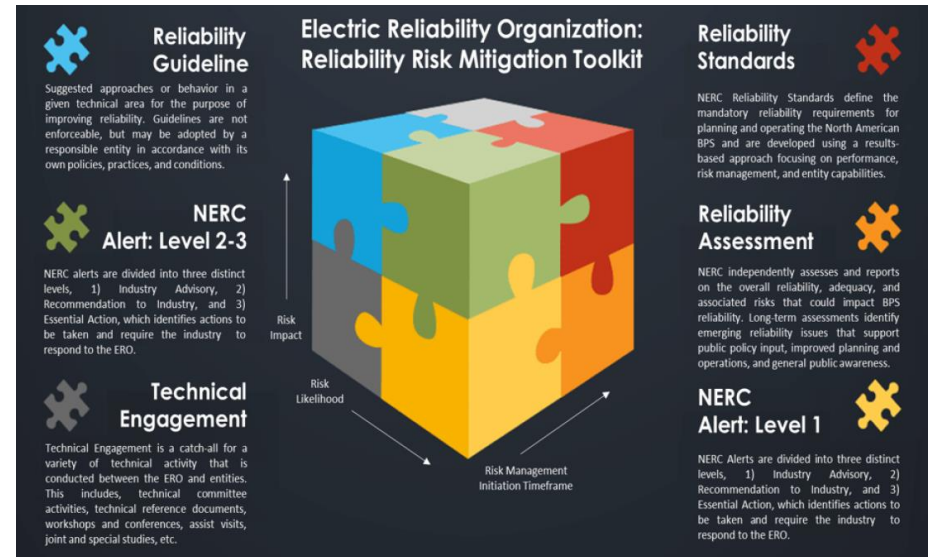
Natural Gas and Electrical Operational Coordination Considerations Guideline

Mike Knowland
September 2, 2021

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- Reflect the collective experience, expertise and judgment of the industry.
- The objective of the Reliability Guidelines is to provide suggested approaches or behavior in a given technical area for the purposes of improving reliability.
- Reliability Guidelines are not enforceable like NERC's Reliability Standards. Rather, their incorporation into industry practices may be adopted by a responsible entity in accordance with its own policies, practices, and conditions.



Reliability Guideline
Suggested approaches or behavior in a given technical area for the purpose of improving reliability. Guidelines are not enforceable, but may be adopted by a responsible entity in accordance with its own policies, practices, and conditions.

NERC Reliability Guideline Content:

- Establish Gas and Electric Industry Coordination Mechanisms
- Preparation, Supply Rights, Training and Testing
- Establish and Maintain Communication Channels
- Gathering, Sharing Information and Situational Awareness

- Establish Contacts
 - Most important aspect of gas and electric coordination
 - Should be done before emergency conditions arise
- Communication Protocols
 - FERC Order 787 allows sharing non-public information
- Information Exchange:
 - Real-Time operating information (both verbal and electronic)
 - Outage planning and coordination meetings (face-to-face when possible)
 - Sharing normal, abnormal, and emergency conditions to ensure implications are understood
- Coordinate Procurement timelines
 - Align timelines for operating plans with gas procurement cycles

- Identify Critical Components
 - Review and adjust load shed plans
 - Consider restoration priority and the impact on the restoration plan
- Operating Reserve
 - Consider losses of fuel forwarding facilities
 - Risk based procurement

- **Assessments:**
 - Developing a detailed understanding of where and how the gas infrastructure interfaces with the electricity industry
 - Understand how electric resources depend on gas pipelines:
 - Level and quantity of capacity service
 - Understand priority of electric load
 - Identify gas contingencies – identify single contingencies and how gas contingencies may impact electric system restoration
- **Emergency Procedure Testing and Training**
 - Recognize abnormal operating conditions and support extreme contingencies
 - Drills and exercises
- **Generator testing**
 - Dual fuel auditing – limitations on alternate fuel, time requirements and expected actions for fuel switch (e.g. swap on the fly or not)

- Capacity and Energy Assessments
 - Similar to existing practices, adding impact of fuel restrictions
 - Energy analysis accounting for limited inventory resources
 - Understanding the impact of LDC demand outside of the Region
- Winter Readiness Reviews
 - Seasonal readiness training
 - Fuel availability, emergency plans, weather forecasts, freeze protection, environmental permitting, fuel surveying protocols, unit availability
- Extreme Weather Readiness Reviews
 - Winter event readiness, generator readiness, freeze protection, alternate fuels, environmental permitting
 - Include reviewing the response to extreme summer events (e.g. hurricanes)

- Industry Coordination
 - Upcoming operations, outage coordination, status updates
 - Communication protocols for normal, abnormal, emergency conditions
 - Consideration for variable resource availability
- Emergency Notification to Stakeholders
 - Proactive notification for enhanced situational awareness
 - Coordinated response by electric, gas, and regulatory communities

- Fuel Surveys and Energy Emergency Protocols
 - Determination of energy adequacy
 - Establish basis for additional communication
- Fuel Procurement
 - Comparing expected electric operations to scheduled gas (if available)
 - Establish basis for additional communication
- Gas System Visualization
 - Control Room displays
 - System arrangement via one-line displays

- The NERC RSTC web page has links to this and other Reliability Guidelines
- <https://www.nerc.com/comm/Pages/Reliability-and-Security-Guidelines.aspx>
 - Go to <https://www.nerc.com>
 - Under the Committees menu, select **Reliability and Security Technical Committee (RSTC)**
 - Click the link for **Reliability and Security Guidelines, and Technical Reference Documents**
 - There are more than 30 Reliability Guidelines on Balancing, Energy Assurance, Operations, Protection and Control, Resource Performance, and Transmission Planning

- **Reliability and Security Guidelines, and Technical Reference Documents**



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Questions and Answers



- Implementation of ERO Policies, Procedures, and Programs for 2021/2022 Winter Energy Readiness – John Moura
- EOP-011 Cold Weather Preparedness – Jordan Mallory
- Cold Weather Preparations for Extreme Weather Events Recommendation to Industry Level 2 Alert – Darrel Richardson
- ERO Extreme Conditions Energy Management – Mark Henry
- Joint NERC-FERC 2021 Winter Event Inquiry Update – Kiel Lyons

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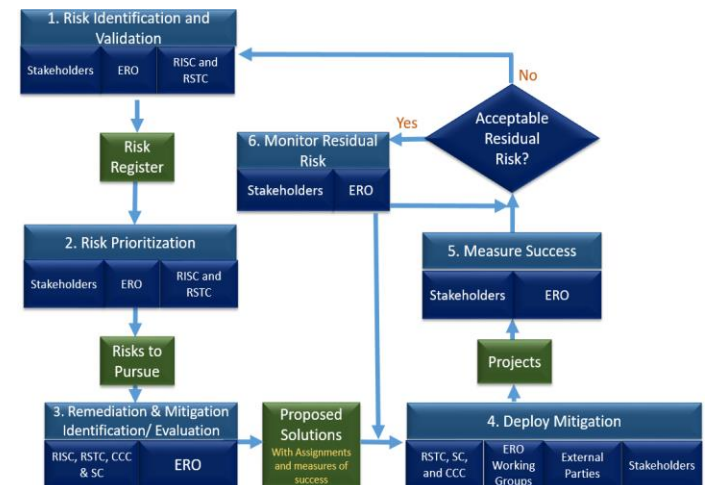
Implementation of ERO Policies, Procedures, and Programs for 2021/22 Winter Energy Readiness

John Moura, Director of Reliability Assessment and Performance Analysis
Winter Preparation for Severe Cold Weather – 2021 Webinar
September 2, 2021

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- ERO concerned with cold weather risks for some time
- 2021 cold weather event spurs action
- Joint Inquiry providing valuable information
- Enhancements to Reliability Standards at final stages, but implementation periods will take up to 18 months

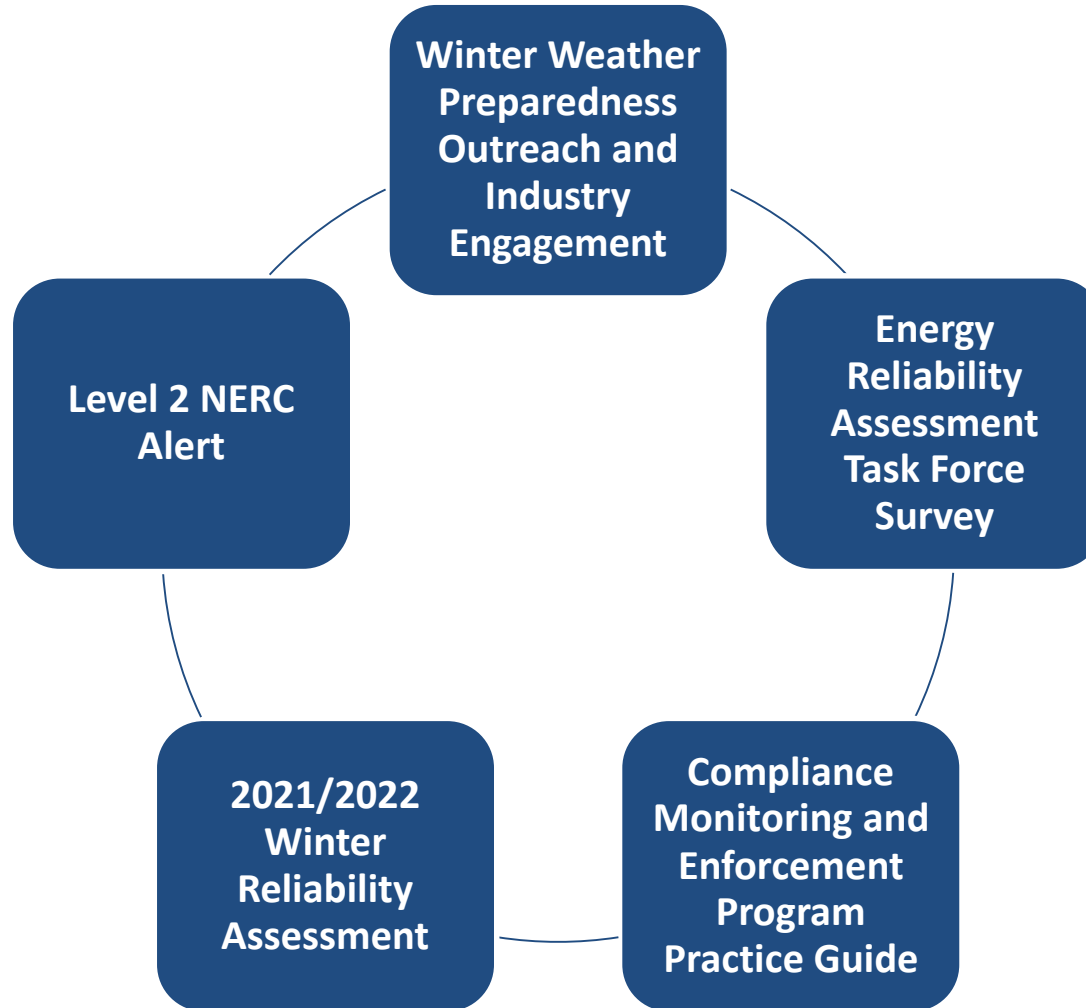


Current (**FERC-approved**) ~~draft~~

- EOP-011
 - TOP and BA emergency plans include cold weather impacts
 - GO have cold weather preparation plans
 - Appropriate freeze protection measures (self determined)
 - Annual inspection
 - Know operating limits
 - Awareness training on plans
- IRO-010 and TOP-003
 - RC and TOP data specifications to include requesting operating limits

Future plans

- Implement actions from FERC/NERC inquiry
- Standard for RC and/or BA seasonal emergency energy management plans
- RC standard for rolling three week emergency energy management plan



- General Support of NERC's efforts to prepare for upcoming winter
- Industry Concerns:
 - Alert's administrative burden
 - Tailored approach vs. prescriptive approach is preferred
 - Amount of time available to act before the 2021/2022 winter
 - Lack of jurisdiction over natural gas/fuel supply to generators
 - Market pricing signals must support winter preparation and operation



Thank you -- Questions?

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EOP-011

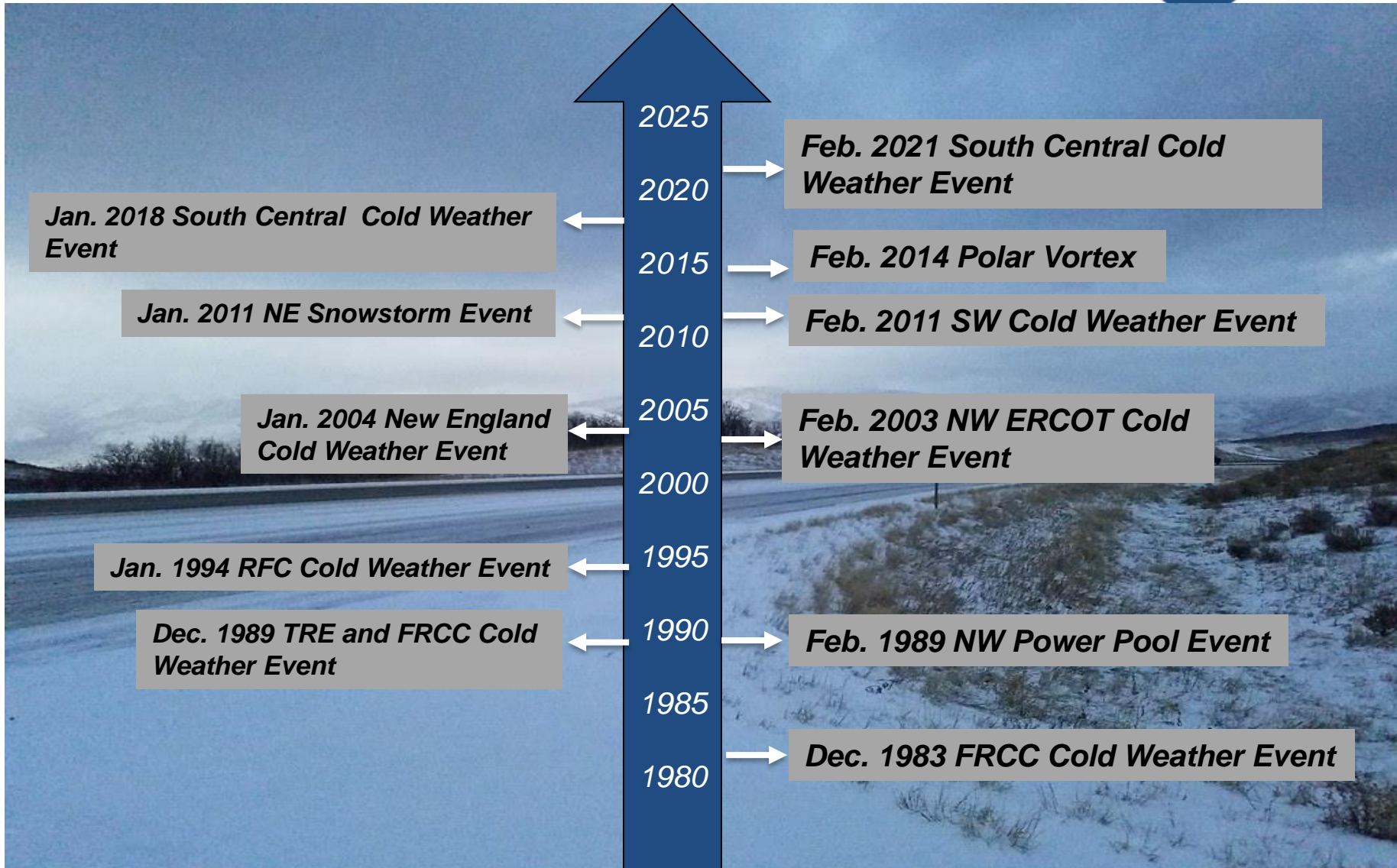
Cold Weather Preparedness

Jordan Mallory, Sr. Standards Developer
Winter Weather Prep Webinar
September 2, 2021


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- Cold Weather Event Timeline
- Similarities
 - EOP-011
 - Generating Unit Winter Weather Readiness – Current Industry Practices



- If you have used this guideline:
 - Each BPS generation owner and operator is responsible and accountable for maintaining generating unit reliability.
 - Entities should develop and apply plant-specific winter weather readiness plans, as appropriate, based on factors such as geographical location, technology and plant configuration.

- Requirement R1 (TOP) and Requirement R2 (BA)
 - Not a new requirement
 - Partial new subpart 1.2.6 and 2.2.9
- Provisions to determine reliability impacts of
 - Provisions to determine reliability impacts of
 - Cold weather conditions and
 - Extreme weather conditions  *Not new*

- Requirement R7 GOP
 - New requirement
 - Cold weather preparedness plan
 - Generating unit(s) freeze protection measure based on geographical location and plan configuration
 - Annual inspection and maintenance of generating unit(s) freeze protection measures
 - Generating unit(s) cold weather data, to include
 - Capability and availability
 - Fuel supply and inventory concerns
 - Fuel Switching capabilities
 - Environmental constraints
 - Generating unit(s) minimum
 - Design temperature, historical operating temperature, or current cold weather performance temperature determined by an engineering analysis.

- Requirement R8 GOP
 - New requirement
 - Training
- Train GOP personnel on the GO cold weather preparedness plan(s).

- Approved by FERC on August 24, 2021
 - Implementation plan: first day of the first calendar quarter that is 18 months following the date order.
 - April 1, 2023

- **Similarities**
 - Owner/operator responsible and accountable for maintaining generating unit reliability.
 - Entities should develop and apply a plant-specific winter weather readiness plans, based on geographical location.
 - Training
- **Additional Items from EOP-011-2**
 - May be a couple of new subparts required now that you did not have in your plan to-date.



Questions and Answers

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Cold Weather Preparations for Extreme Weather Events

Recommendation to Industry Level 2 Alert

Darrel Richardson , Principal Technical Advisor Power Risk Issues and
Strategic Management (PRISM)

September 2, 2021

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- NERC issued a Level 2 Recommendation to Industry Alert on August 18, 2021: Cold Weather Preparations for Extreme Weather Events.
 - Two extreme cold weather events have occurred in the past four winter seasons. The February 2021 extreme cold weather event stressed the need to ensure the safe, resilient, and reliable operation of the Bulk Electric System.
 - The recent extreme cold weather events across large portions of North America have highlighted the need to assess current operating practices and identify some recommended improvements, so that system operations personnel are better prepared to address these challenges.
 - The events have caused major interruptions to resources, transmission paths and ultimately, end-use customers. This alert will assist in determining the winter readiness of Reliability Coordinators (RCs), Balancing Authorities (BAs), Transmission Operators (TOPs), and Generator Owners (GOs).

There are 5 recommendations to industry in the alert

- Recommendation #1

- Reliability Coordinators (RCs), Balancing Authorities (BAs), and Transmission Operators (TOPs) should create, or add to, seasonal operating plans for the upcoming winter season at least two months before their winter season, with special emphasis on meeting extreme cold weather energy requirements (while also considering resource limitations such as extreme cold temperatures for a prolonged period of time along with the effects that icing and snow impacts may have on equipment, etc.) Energy aspects of this plan should be informed and updated as per seasonal planning operating plans. RCs, BAs, and TOPs should communicate these plans to GOs within their operating area.

- **Recommendation #2**

- Generator Operators (GOs) should review RCs, BAs, and TOPs seasonal operating plans to ensure they contain the current generator availability, fuel supplies, and other related assumptions. Actions should be taken as appropriate based on weather forecasts, resulting capacity, and energy analyses to facilitate readiness while allowing adjustments to be made so there is time for GOs to make the necessary arrangements to maximize the availability of the resources, including, but not limited to, the replenishment of fuel, supplies, labor, and equipment. GOs should maintain communications with fuel suppliers and be prepared to manage resources with fuel switching.

- Recommendation #3

- GOs should communicate to their RCs, BAs, and TOPs, forecast and actual unit de-rates during extreme cold weather events and conditions considering the following factors: unavailability due to weather, fuel constraints (gas restrictions), de-rates for alternate fuels, and potential concerns with increased outages or delayed starts based on unit ambient ratings and historical performance. These communications should be part of the seasonal, outage coordination, day-ahead, and real-time energy assessments.

- Recommendation #4
 - Manual and Automatic Load Shedding

- Recommendation #5
 - GOs should conduct dual fuel assessments to ensure resources can switch to the alternate fuel and monitor how much alternate fuel is on site. GOs should also assess generating unit weatherization plans, the implementation of freeze protection measures and factors that could impact availability including minimum operating temperature, and application of heat tracing equipment and wind breaks. GOs should inspect and maintain their weatherization measures ahead of the upcoming winter season, before the onset of, and during extreme cold weather conditions.

- Initial acknowledgement of receipt was required by August 23, 2021 Midnight Eastern via NERC Alert System.
- Responses to questions are required to be submitted via the NERC Alert System by September 17, 2021 Midnight Eastern
- Questions included in the alert for RC, BA, TOP, and GO functional groups.
- All registered entities belonging to the RC, BA, TOP, and GO functional groups are required to acknowledge receipt of the alert and respond, as applicable.



Questions and Answers

ERO Extreme Conditions Energy Management

Roadmap for Ongoing Evaluation

Mark Henry—Director, Reliability Services

Texas RE

NERC Winter Weather Webinar

September 2, 2021

Strong Regions + Strong NERC = Brilliant ERO

- Extreme Weather Events
 - Texas
 - California
- Multi-Day Extreme Heat/Cold
- Changing Resource Mix
- List of Reliability Considerations (NERC)
- Roadmaps – Two Teams:
 - Extreme Heat
 - Extreme Cold
- Operating Time Horizon

- Key Recommendations
 - Combined Winter/Summer
- Two Tables (Winter/Summer)
 - 12 Reliability Issues
 - Key Considerations
 - Team Discussion/Recommendations
 - Time Horizon
- Presentation
 - Shared with Energy Reliability Assessment Task Force (ERATF) late July
 - Circulated to NERC groups working with ERATF surveys

Roadmap – Key Recommendations

- Reliability Assessments
 - Energy vs. Capacity
 - Seasonal, Outage Coordination and Real-time
 - Ramping Capabilities, Etc.
 - Import Capability
- Seasonal Operating Plans

Roadmap – Key Recommendations

- Plant Availability Factors
 - De-rates
 - Weather Impacts
 - Fuel Constraints
 - Starting Capabilities
- Manual Load Shedding
 - Sub-sector Critical Loads (Compressor Stations, Water Systems, etc.)
 - Demand Response
 - Confirmed Capability

A stylized map of North America, including the United States, Canada, and Mexico. The map is rendered in shades of blue and grey. A prominent horizontal band of a darker blue color runs across the middle of the map, behind the main title text.

Questions and Answers

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Joint NERC-FERC 2021 Winter Event Inquiry Update

Kiel Lyons
September 2, 2021

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Questions and Answers