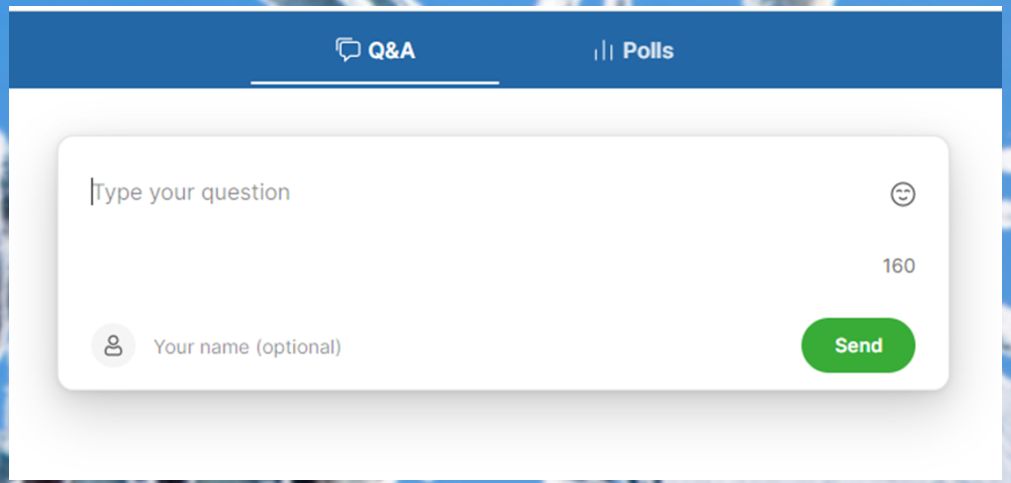
Texas RE
Winter Weatherization Workshop

October 2, 2024

AGENDA

- Kick-off and Instructions
- Executive Welcome
- PUCT Weatherization Activities
- FERC & NERC Weatherization Updates
- Inquiries & Alerts
- ERCOT Winterization Activities
- Weatherization Compliance
- RRC Winterization Activities
- Winter Weather Forecast & Historical Extremes
- Thermal Generator Winter Prep and Lessons Learned
- Winterization for Renewables

To submit questions during the workshop, please visit **slido.com** and enter today's participant code: **TXRE**



Welcome & Instructions

Matthew Barbour
Texas RE
Communications & Training Manager

Antitrust Admonition

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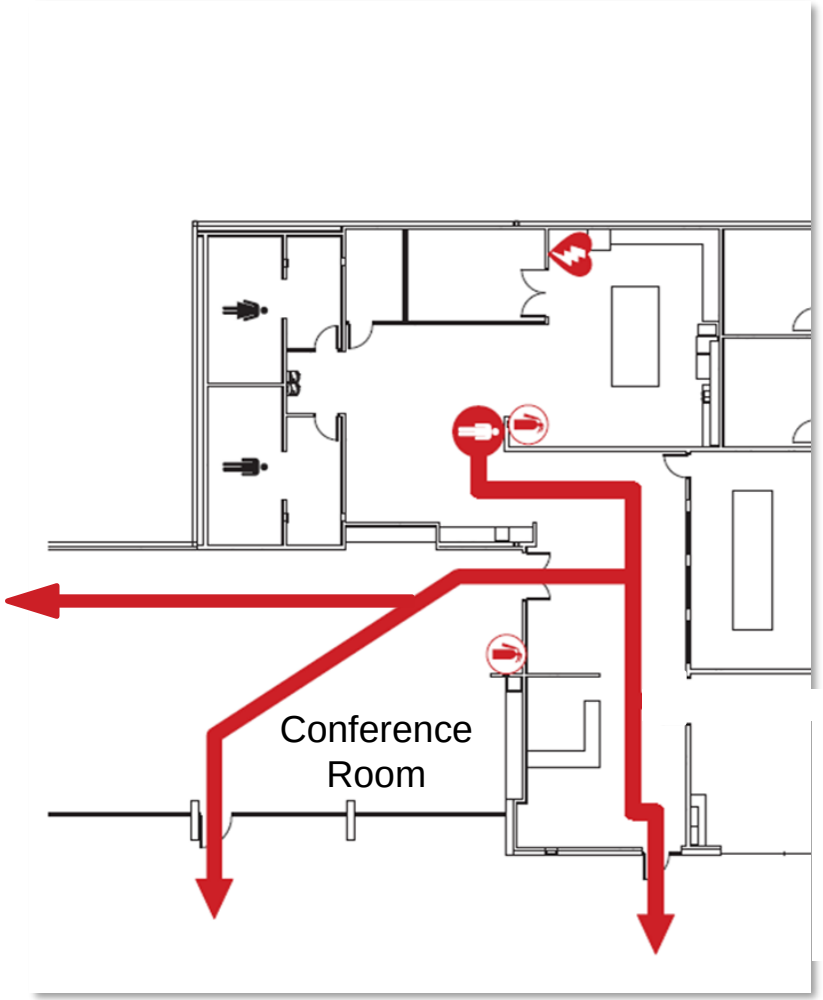
Notice of this meeting was posted on the Texas RE website and this meeting is being held in public. Participants should keep in mind that the listening audience may include members of the press, representatives from various governmental authorities, and industry stakeholders.

Safety Moment

In case of emergency, evacuate through the nearest door

Rally point is in the front parking lot



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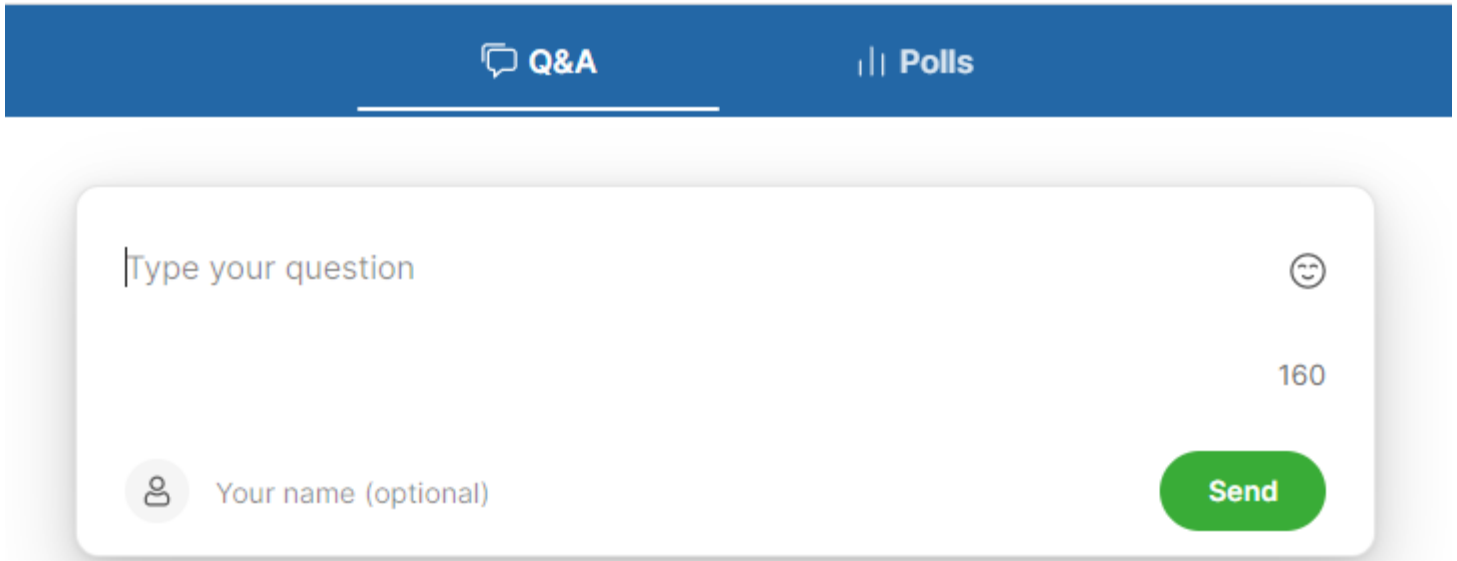
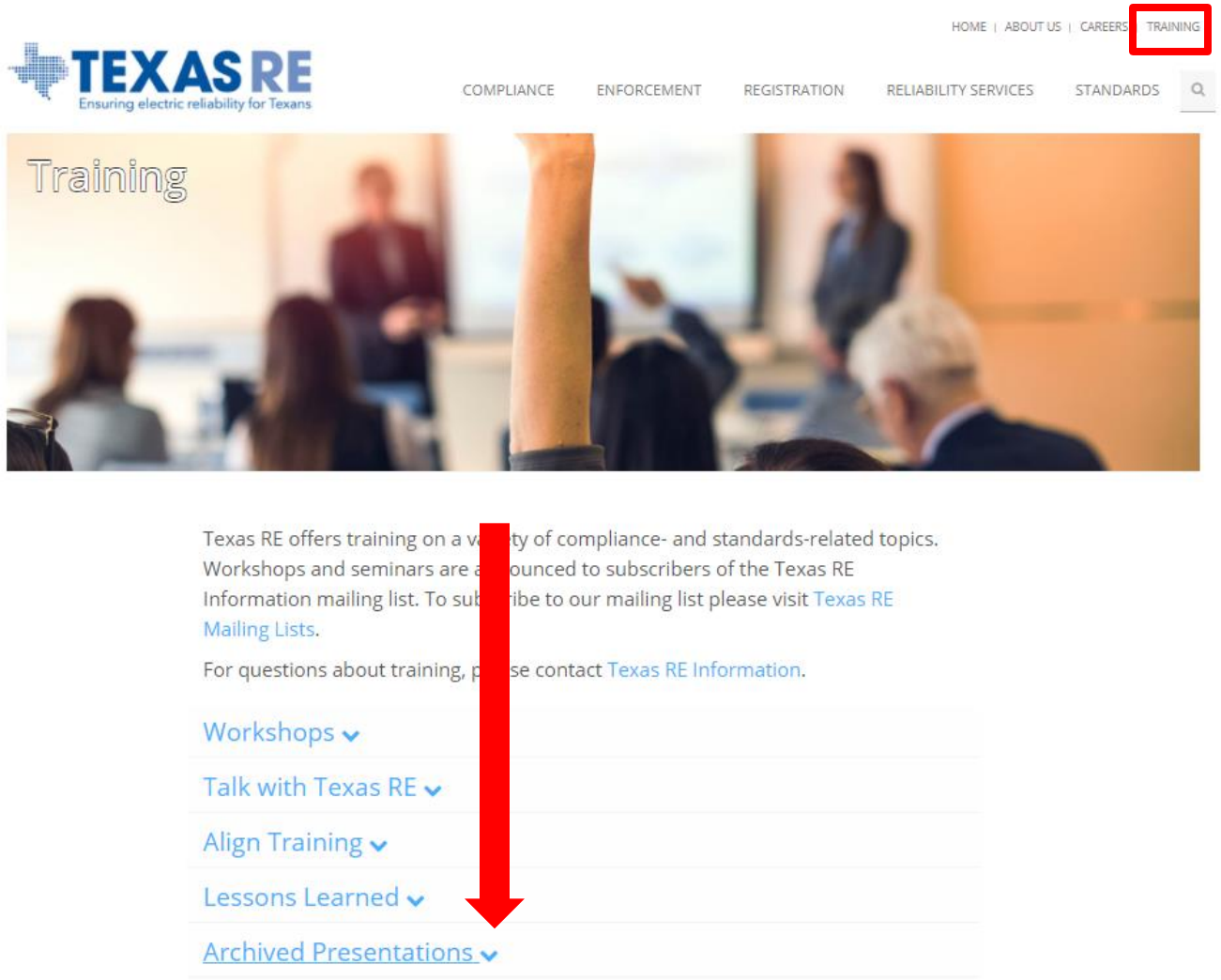
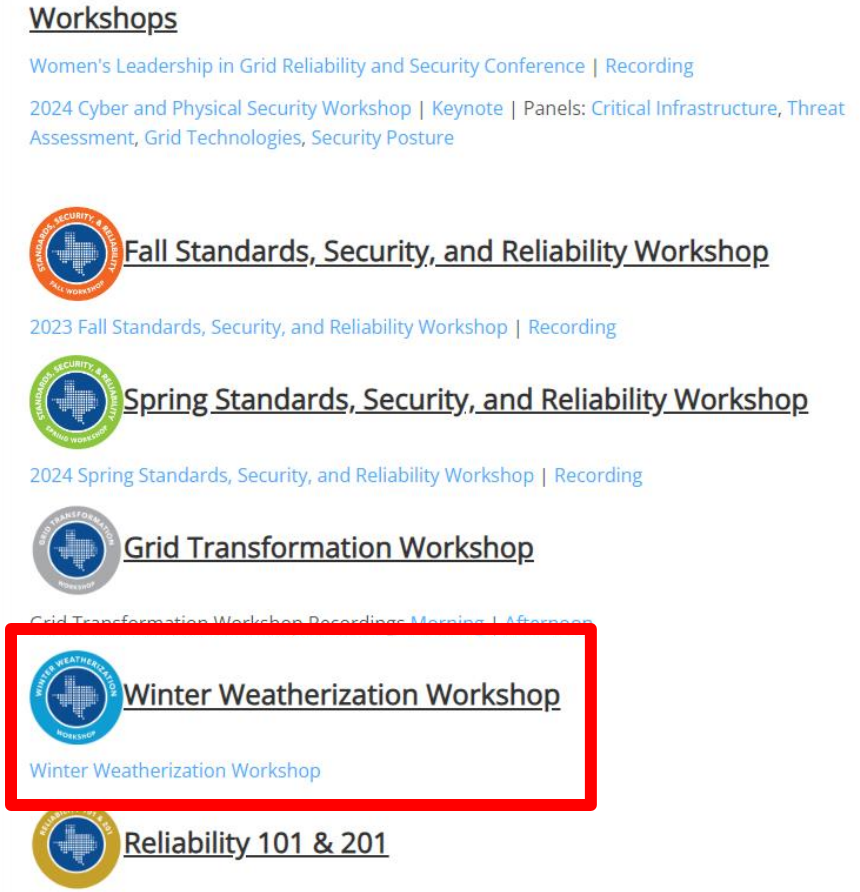
slido



Training Page





Upcoming Texas RE Events

October 9, 2024

Electric and Oil & Natural Gas Coordination

October 16, 2024

Understanding New Generator Obligations

November 20, 2024

Fall Standards, Security, and Reliability Workshop

Social Media

/texas-reliability-entity-inc

@Texas_RE_Inc

/TexasReliabilityEntity

Executive Welcome

Joseph Younger
Texas RE
Vice President & Chief Operating Officer

Weather Preparation Update

October 2, 2024

Connie Corona
Executive Director
Public Utility Commission of Texas

Winter Inspections 2023-24

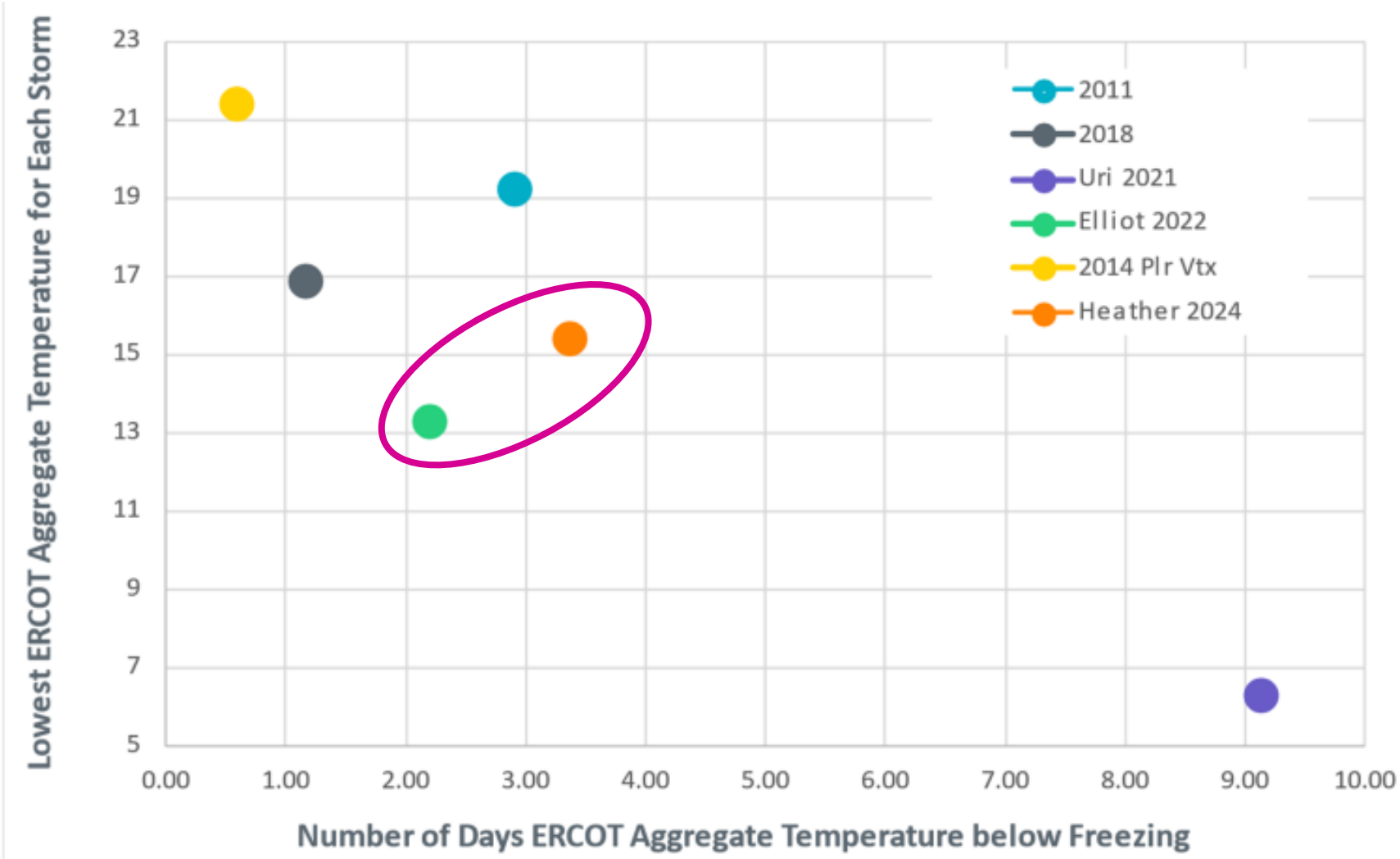
- Inspections began on December 1, 2023
- ERCOT inspected:
  - 340 generation resources
  - 129 transmission voltage substations and switchyards
- 5 cure periods

Winter Storm Heather

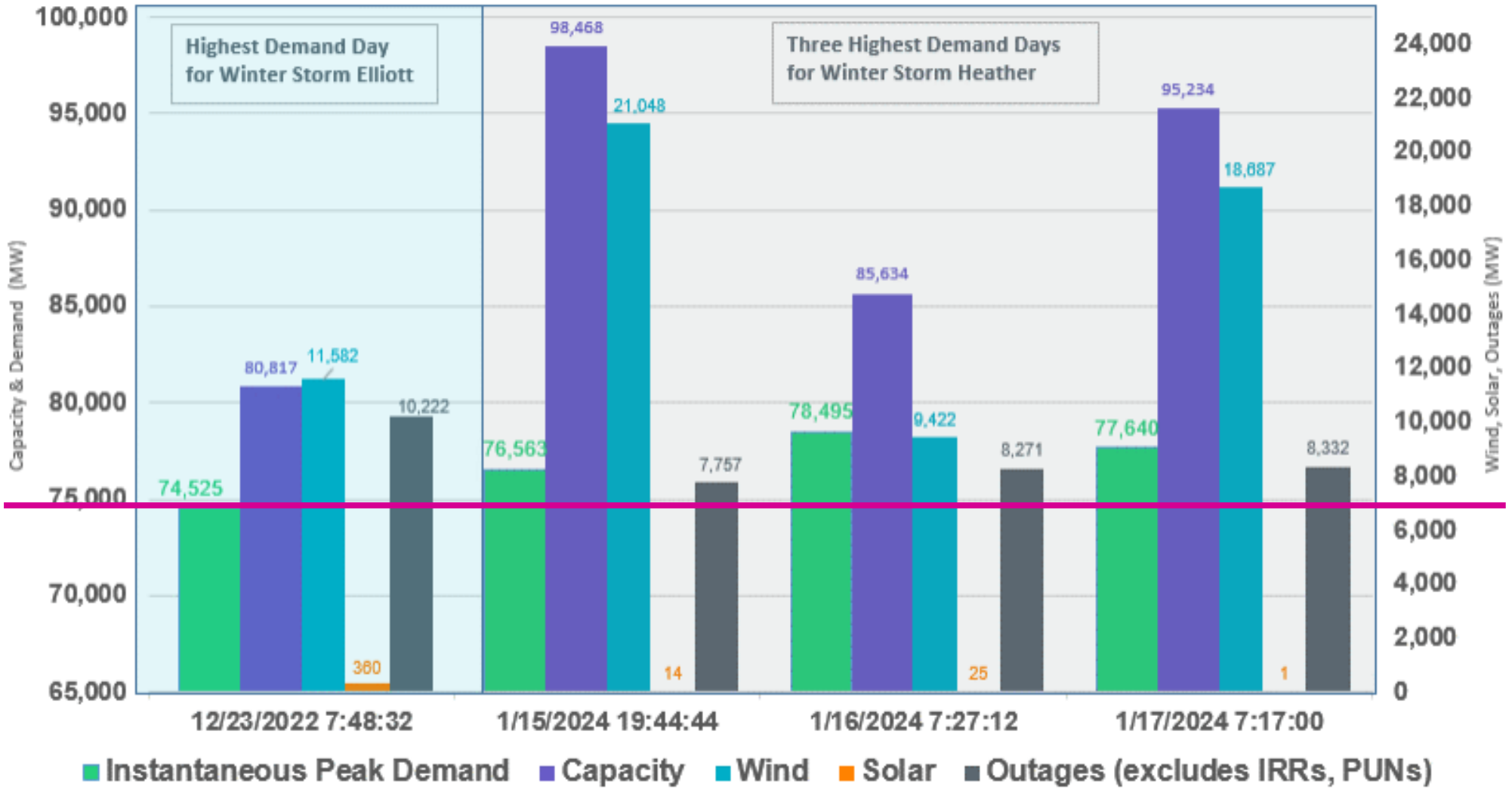
- Peak demand of 78,134 MW on January 16, 2024
  - Surpassed previous winter peak demand record set during Winter Storm Elliott (74,525 MW) in December 2022 by 3,970 MW

- Winter Storm Heather was the third coldest and second most long-lasting of the last 15 years

Winter Storm Severity Comparison



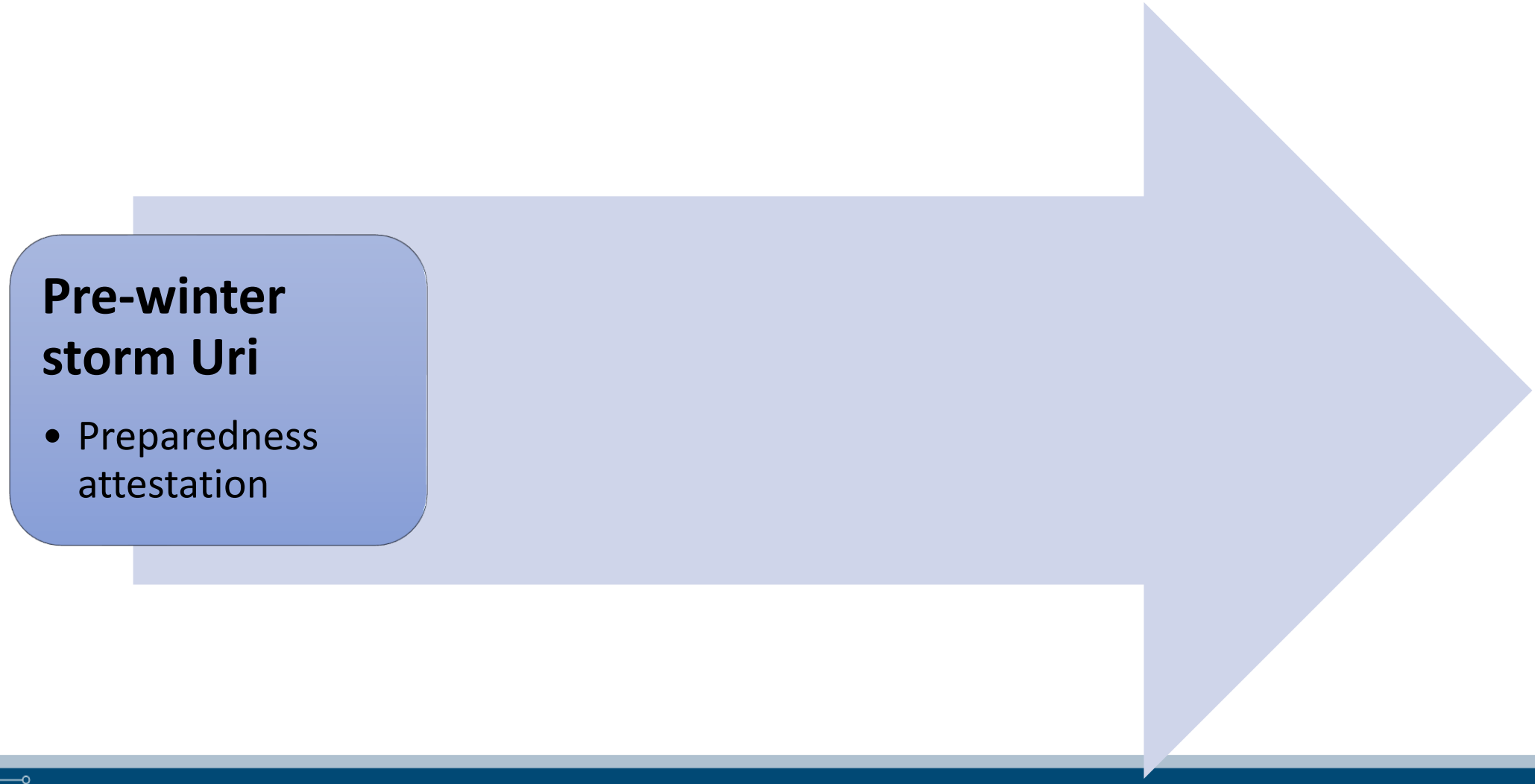
Winter Storm Elliott and Heather: System Analysis at Peak Demand



Summer Weather Preparation

- Second year of summer inspections - Texas is the first in the nation
- Approximately 600 inspections of generation and transmission began June 1, 2024
- Final inspection report in October 2024

Evolution of Weather Prep



Evolution of Weather Prep

Pre-winter storm Uri

- Preparedness attestation

2021

- Phase I weatherization
  - ✓Implement prior recs from 2011-12
  - ✓Fix known issues from 2020-21
  - ✓Notarized attestation
  - ✓Winter inspections
- Critical natural gas facilities identification

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2022

- Phase II weatherization
  - ✓Requires weather prep for winter and summer
  - ✓Winter and summer inspections
  - ✓Independent engineering assessment of repeated or major weather-related outages

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2022

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2023

- Wind chill requirements

2024

ERCOT Weatherization Customer Service Management

Evolution of Weather Prep

Pre-winter storm Uri

- Preparedness attestation

2021

- Phase I weatherization
  - ✓Implement prior recs from 2011-12
  - ✓Fix known issues from 2020-21
  - ✓Notarized attestation
  - ✓Winter inspections
- **Critical natural gas facilities identification**
- **Emergency Operations Plans**
- **Texas Energy Reliability Council (TERC)**

2022

- Phase II weatherization
  - ✓Requires weather prep for winter and summer
  - ✓Winter and summer inspections
  - ✓Independent engineering assessment of repeated or major weather-related outages
- **Firm fuel product**
- **Electricity supply chain map**
- **ERCOT weatherization workshops**

2023

- Wind chill requirements

2024

ERCOT Weatherization Customer Service Management

TEXAS RE

FERC & NERC Weatherization Updates

Rachel Coyne
Executive Chief of Staff
Texas RE

Cold Weather Projects – Past, Present, Future

History of Events

2011 Southwest Cold Weather Event

- Generators were not winterized
- 2012 – the North American Electric Reliability Corporation (NERC) submitted SAR to create mandatory winterization standard
- Operating Committee created a Reliability Guideline: Generating Unit Readiness
- Standards Committee rejected the SAR

2014 Polar Vortex

- Unplanned generation outages and derates

2018 South Central U.S. Cold Weather Event

- Failure to properly prepare or winterize generation facilities for cold temperatures

2021 Winter Storm Uri

- Failure to properly prepare or winterize generation facilities for cold temperatures

2022 Winter Storm Elliot

- Largest controlled firm shed in Eastern Interconnection

Timeline

February 2021
Winter Storm Uri

August 24, 2021
Order approving EOP-011-2, IRO-010-4, and TOP-003-5

October 6, 2021
Project 2021-07 Extreme Cold Weather Grid Operations, Preparedness, and Coordination SAR

November 2021
Joint Inquiry February 2021 Cold Weather Outages in Texas and South Central U.S.

February 16, 2023
Order Approving EOP-011-3 and EOP-012-1

June 27, 2024
Order Approving EOP-011-4 and EOP-012-2

October 1, 2024
Effective Date EOP-011-4 and EOP-012-2

March 27, 2025
Filing Deadline for EOP-012 Revisions

Effective Since April 1, 2023

EOP-011-2 (Project 2019-06)

- Emergency Preparedness and Operations

IRO-010-4 (Project 2019-06)

- Reliability Coordinator Data Specification and Collection

TOP-003-5 (Project 2019-06)

- Operational Reliability Data

February 16, 2023, FERC Order

Approved EOP-011-3, EOP-012-1

Directives

- Modify applicability to capture all Bulk Electric System (BES) needed, exclude only generation resources not relied on in freezing weather
- Address concerns regarding declarations of constraints
- Ensure generators don't exclude units incapable of operating for 12 continuous hours from complying with the standard
- Corrective Action Plan (CAP) deadlines
- Decrease the 60-month implementation timeline
- Submit a plan for collecting and assessing data prior to—and after implementation of—EOP-012-1
- Annual information submittals to the Federal Energy Regulatory Commission (FERC) to assess implementation of declarations

June 27, 2024, FERC Order

Approved EOP-012-2, EOP-011-4 including Implementation Plan

Five Directives

- Revise definition of Generator Cold Weather Constraint and clarify requirements for declared constraints
- Periodic review of Generator Cold Weather Constraint declarations
- Revisions to Corrective Action Plan implementation timelines
- NERC to receive and review validity of Generator Cold Weather Constraints
- Extensions of Corrective Action Plans are pre-approved and operating limitations communicated

Effective October 1, 2024

Standards (Project 2021-07)

- EOP-011-4
- EOP-012-2

Definitions

- Generator Cold Weather Critical Component
- Fixed Fuel Supply Component
- Generator Cold Weather Reliability Event
- Generator Cold Weather Constraint
- Extreme Cold Weather Temperature

Effective October 1, 2025

TOP-002-5 (Project 2021-07)

- Operations Planning

EOP-011-4 (Effective October 1, 2024)

Need for TOPs/BAs to determine reliability impacts

Add Operator-controlled manual Load shedding during Emergencies

Provisions for excluding natural gas infrastructure Loads that are essential to the reliability of the BES

Requirement for TOPs to annually identify and notify Distribution Providers that are required to assist with the mitigation of operating Emergencies

TOPs must develop a Load shedding plan

EOP-012-2 (Effective October 1, 2024)

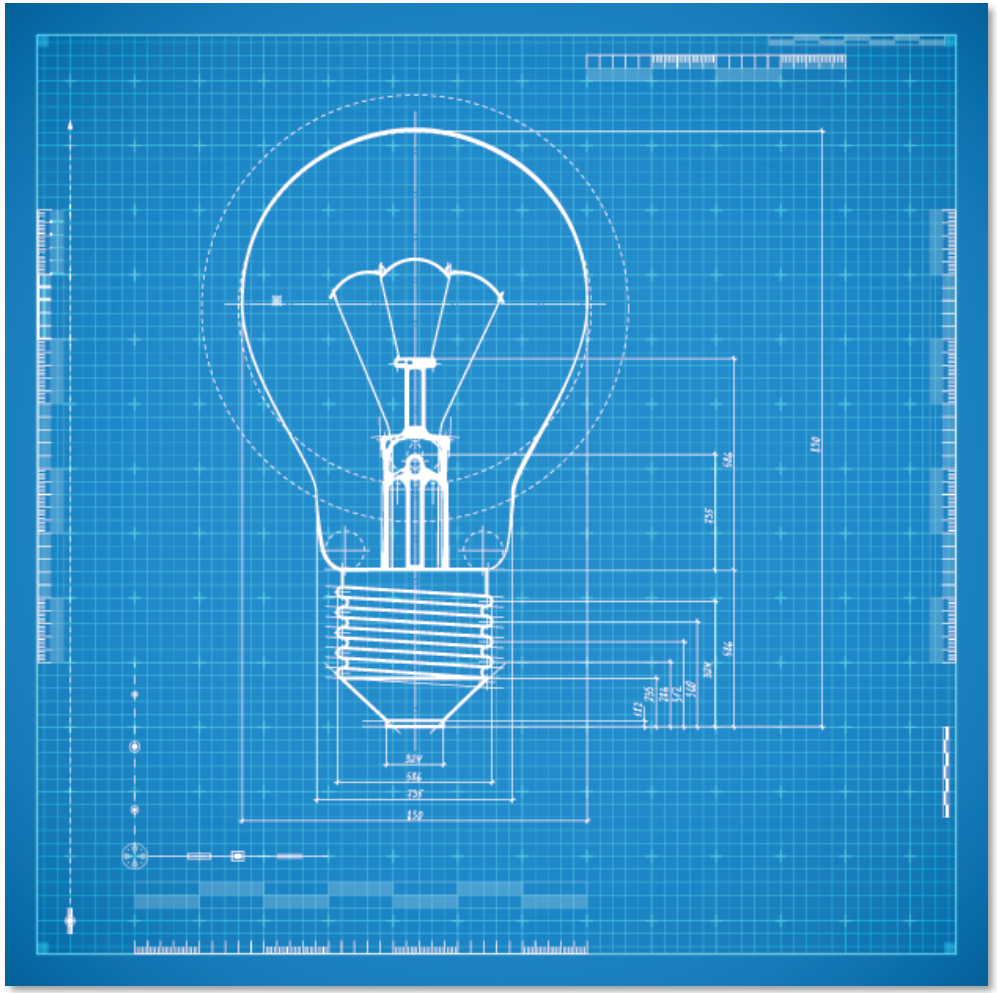
- Generator Owners shall implement freeze protection measures and cold weather preparedness plans
- Generating unit specific training
- Develop and implement CAP following Generator Cold Weather Reliability Event
- Fixed Fuel Supply Component glossary term
- Generator Cold Weather constraint glossary term
- Calculate Extreme Cold Weather Temperature
- More specificity around implementing freeze protection measures
- More specificity around CAPs
- Review Generator Cold Weather Constraint declaration every five years

Project 2024-03 Revisions to EOP-012-2

Address directives in the June 27, 2024, Order

SAR Public Comment Period: 7/18/2024 – 8/16/2024

Standards Committee Authorized Revisions to EOP-012-2: 9/6/2024



Project 2024-03 Timeline

Process Steps	Dates	Notes
Drafting team members seated	8/21/2024	Standards Committee (SC) August meeting
Standards Committee Executive Committee (SCEC) Authorize revisions	9/6/2024	SCEC Special Call
SC approval of initial ballot	10/16/2024	SC October meeting
Initial ballot	10/17/2024 - 11/5/2024	20-day initial ballot and comment period per waiver approved at July SC meeting
First additional ballot	12/3-20/2024	18-day additional ballot and comment period per waiver
Consideration of 321 Action	1/2-8/2025	Based on additional ballot results, NERC staff will consider the comments received and if 321 action should be proposed to the NERC Board to meet the FERC deadline.
Second additional ballot	1/29/2025 - 2/12/2025	15-day additional ballot per waiver
Final ballot	3/3-7/2025	5-day final ballot per waiver
NERC Board approval	TBD	Anticipated NERC Board approval mid-March
FERC Order filing deadline	3/27/2025	

Transmission System Planning Performance Requirements for Extreme Weather

Transmission System Planning Performance Requirements for Extreme Weather

FERC Issued Order No. 896 on June 15, 2023

- Around 30 directives
- Regulatory deadline: December 15, 2024

Order No. 896 Directives

Develop new or modified Standards

Develop Benchmark Events and Planning Cases based on major prior extreme heat and cold weather events and/or meteorological projections

Define “Wide-Area”

Identify entities responsible for developing Benchmark Events and Planning Cases, and for conducting transmission planning studies of Wide Area Events

- Entity responsible for establishing Benchmark Events
- Entities responsible for development of Planning Cases and conducting transmission planning studies of Wide-Area Events

Order No. 896 Directives Cont'd

Coordination among registered entities for information sharing

Concurrent/correlated generator and transmission outages

Conduct transmission system planning studies for extreme heat and cold weather events

- Steady state and transient stability analyses
- Sensitivity analysis
- Modifications to the traditional planning approach

Implement a CAP if performance standards are not met

Proposed NERC Reliability Standard TPL-008-1

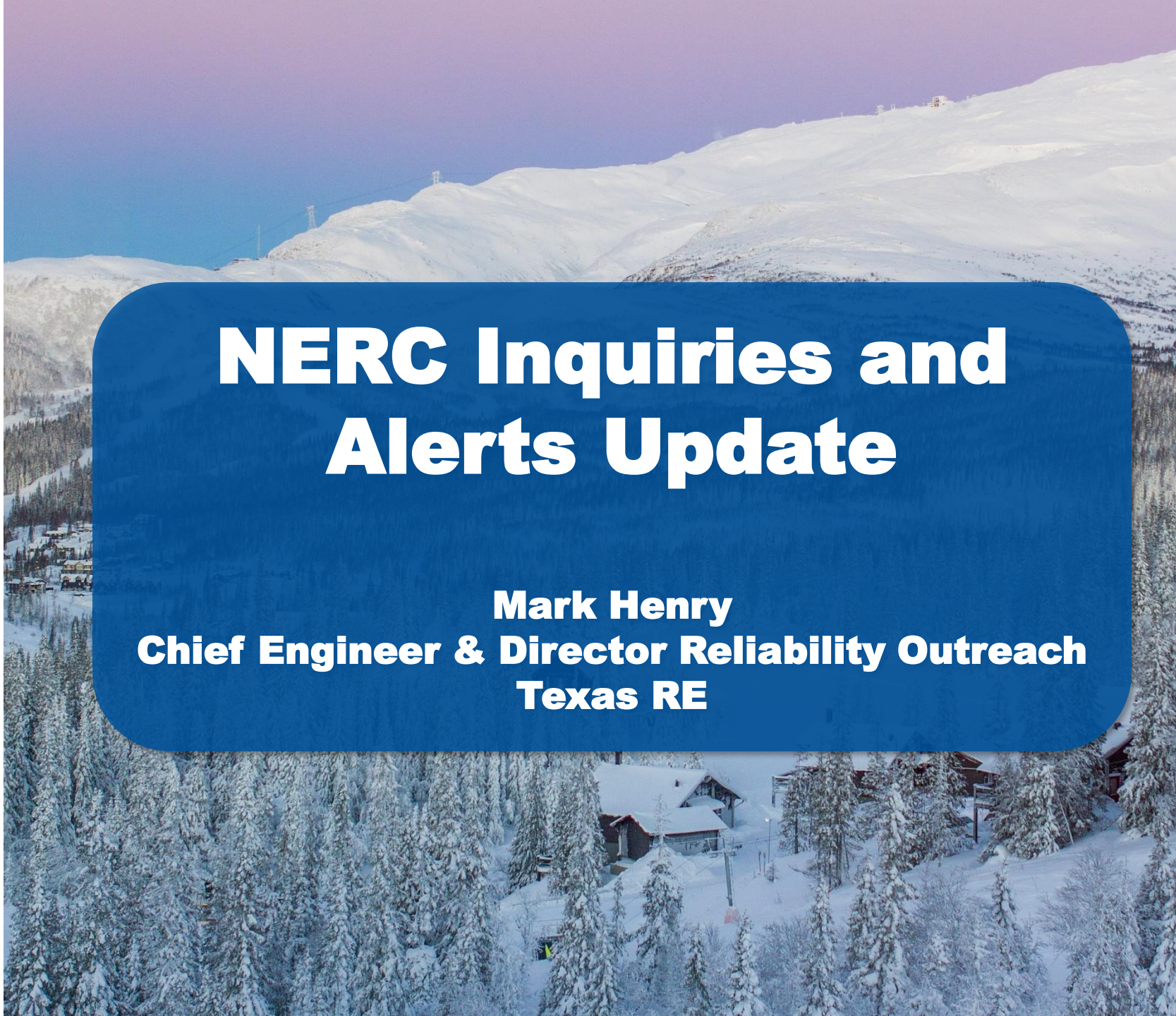
Title:	Transmission System Planning Performance Requirements for Extreme Temperature Events
Purpose	Establish Transmission system planning performance requirements to develop a BPS that will operate reliably during extreme heat and extreme cold temperature events.
Applicable	Transmission Planners
	Planning Coordinators
New Proposed Definition	Extreme Temperature Assessment
Ballot Results	TPL-008-1: 18.17%

Resources

- February 2021 Cold Weather Outages Report
- June 27, 2024, FERC Order
- Project 2024-03 Project Page **(includes timeline)**
- FERC Order No. 896
- Project 2023-07 Project Page

TEXAS RE
Ensuring electric reliability for Texans

TEXAS RE



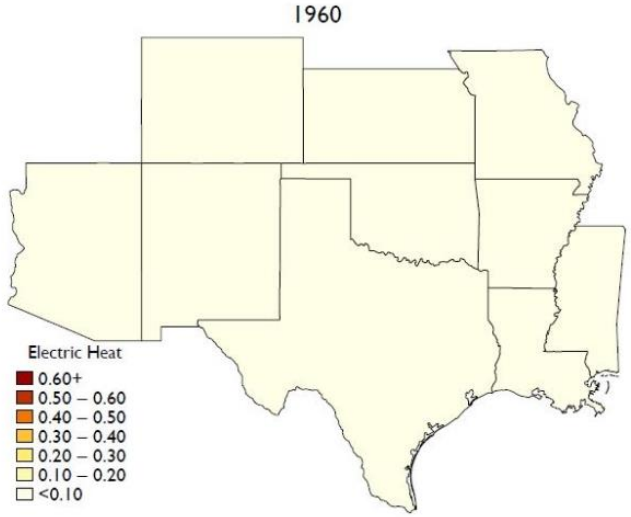
NERC Inquiries and Alerts Update

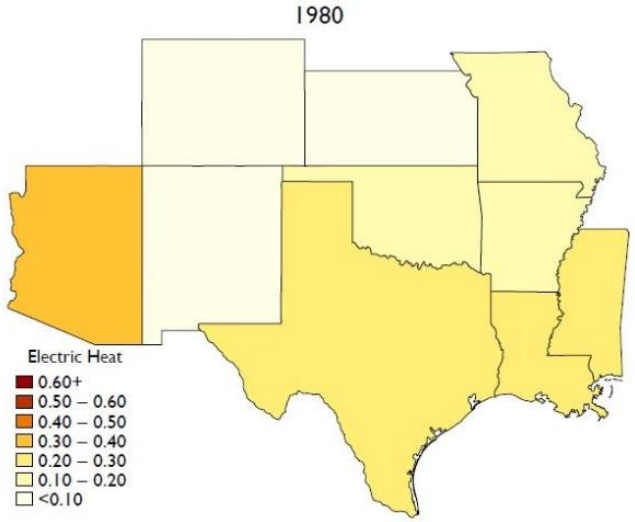
Mark Henry
Chief Engineer & Director Reliability Outreach
Texas RE

Overview

- Winter Storm Heather Review
- Winter Storm Recommendation Updates
- NERC Alerts
- NERC Section 1600 Data Collection
- Other Resources

Intro—Electric Residential Heating in Texas





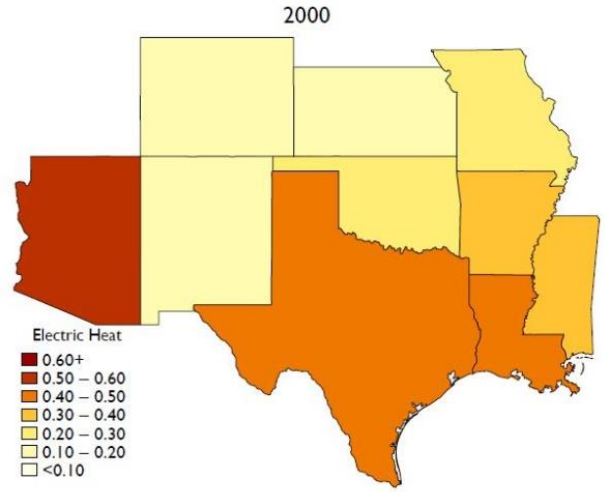
Texas households experience fewer than 2,000 heating degree days, compared to, for example, over 9,000 in Minnesota.

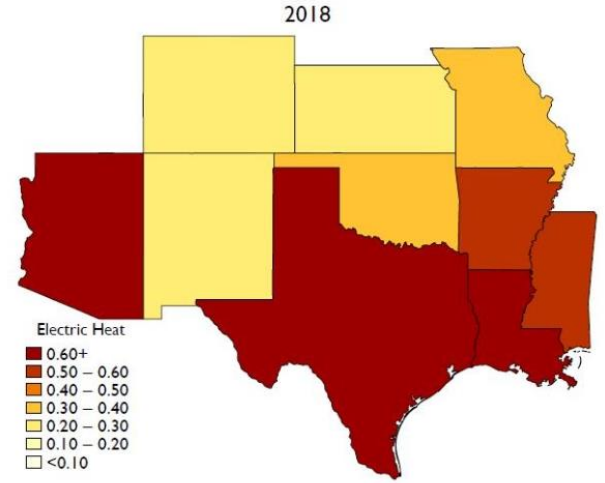
Electric heating with its lower capital and installation costs is a more economical option.

Homes in Texas tend to be less well-insulated than homes in colder parts of the country.

A single home can easily use 5,000 watts for heating … in electric furnace, baseboard heaters, or portable heaters. Many homes in Texas are also being built with heat pumps, generally more energy-efficient than electric resistance heating — but these efficiency benefits shrink considerably during very cold weather.

-Lucas Davis - Energy Institute Blog, UC Berkeley, https://energyathaas.wordpress.com/2021/02/22/the-texas-power-crisis-new-home-construction-and-electric-heating/





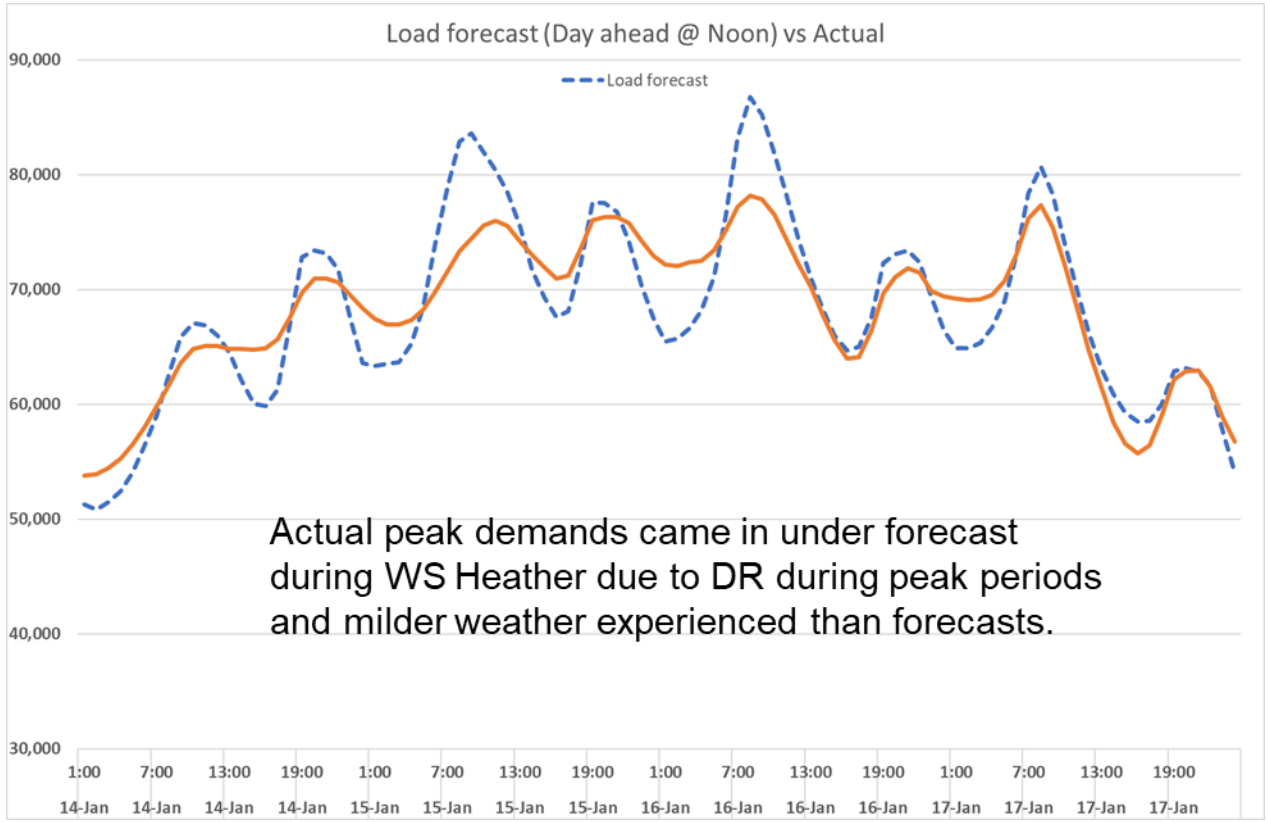
Winter Storm Heather Operational Performance

ERCOT's maximum peak demand during Winter Storm (WS) Heather was 78,495 MW, up 5.3% from December '22.

Significant demand response (DR) occurred during peak periods, with largest impact estimated at ~7,000 MW during morning peak on January 16.

Residential/commercial demand was lower compared to WS Elliott (temperatures were not as cold) but industrial demand was up, even after DR (high growth in this sector).

No significant increase in thermal generator outages during WS Heather; much lower overall than WS Elliot. Some gas availability and wind icing issues related to weather.



Overall natural gas supplies and transportation responded well. Over 11 bcf/d storage withdrawals on Jan. 15-16. Localized issues with compression, minor and quickly resolved; only slight production declines.

Winter Storms Uri and Elliott: Report Recommendation Updates

FERC and NERC established a website dashboard to track status of Winter Storm Uri and Elliott recommendations.

For grid reliability during extreme cold weather, FERC and NERC jointly proposed 39 recommendations (28 from the Winter Storm Uri report, and 11 from the Winter Storm Elliott report).

- Of **39** total recommendations, progress has been made on **two-thirds** of them. This includes completing development of generator cold weather reliability standards initially recommended by the Uri Report.
- Of the remaining **one-third** of the recommendations that still need attention, most require more work to improve natural gas cold weather preparedness and improvements to gas-electric coordination to reliably support the bulk-electric system.

The ERO Enterprise and FERC reviewed performance during Winter Storm Heather and reported to FERC Commissioners about generally positive performance by both electric and gas industries, supporting the work in progress to improve winter preparedness.

FERC Reliability Spotlight Dashboard

Recommendation Category	Recommendation Topics Summary	Status	
Freeze Protection	Cold Weather Reliability Standards, Rules for:		
	Electric Generation	Completed	PUCT rules and ERCOT inspections
	Natural Gas Facilities	More Progress Needed	Texas RRC rules and inspections
Gas-Electric Coordination	Identify Actions: Forums, Work Groups	Progressing as Expected	NAESB Gas Harmonization, Regulatory & Industry Groups (GEAR/GERA)
	Develop and Implement Actions	More Progress Needed	
Grid Operations	Bi-directional Power Transfer Studies	Progressing as Expected	Interregional Transfer Capability Study
	Load Shed Coordination and Training	Completed	ERCOT drills and PUCT projects
	Load Forecasting and Operational Planning	Progressing as Expected	NERC RSTC Panel in September
State-Level	Energy Efficiency Improvement Incentives	Progressing as Expected	Ongoing state and local efforts
	Enhance Emergency Response Centers	Progressing as Expected	
	Additional Deployable Demand Response	Progressing as Expected	Several ERCOT DR additions
Further Studies	ERCOT Additional Interconnection Links	Progressing as Expected	TAMU Studies; Southern Spirit
	Blackstart Cold Weather Reliability	Progressing as Expected	Texas study Dec. 2023; EI/WI Q1 2025
	Mechanical/Electrical Caused Outages	Progressing as Expected	EPRI study contract
	Low Frequency Effects - Generation	Progressing as Expected	Aimed at other Interconnections
	Dynamic Stability During Elliott Event	Progressing as Expected	
	Natural Gas Reliability for Grid Support	Progressing as Expected	
	Critical Natural Gas Infrastructure identification	More Progress Needed	PUCT and RRC completed, with update

Completed | Progressing as Expected | More Progress Needed

https://www.ferc.gov/ReliabilitySpotlight

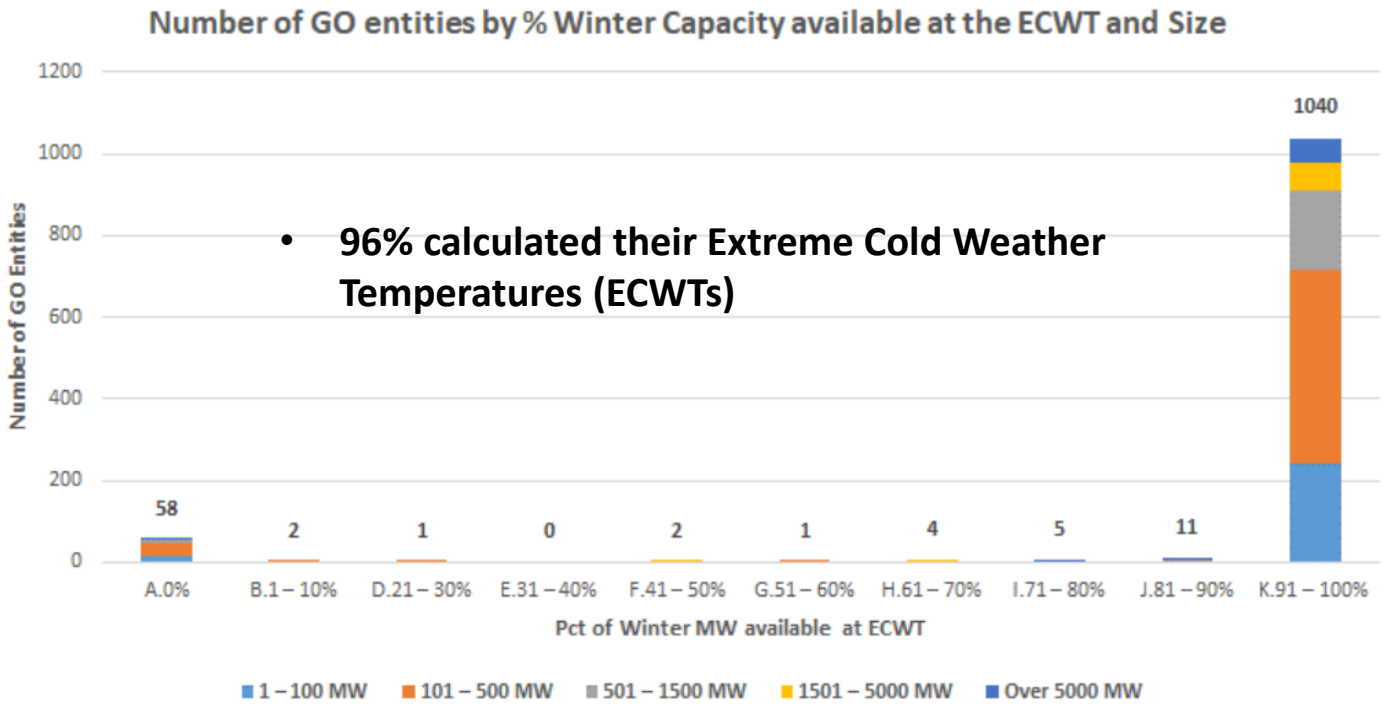
NERC Alerts

Since Winter Storm Uri, NERC has issued three NERC Alerts with data requests to understand winter readiness while standards were still not in effect

8/18/2021	**Industry Recommendation:** Cold Weather Preparations for Extreme Weather Events
9/12/2022	**Industry Recommendation:** Cold Weather Preparations for Extreme Weather Events II
5/15/2023	**Essential Actions to Industry:** Cold Weather Preparations for Extreme Weather Events III

NERC Level 3 Alert Findings and Follow-up in November 2023

- **Over 88% of all respondents had completed Essential Actions in part or full, or would do so by Winter 2023-24**
- **Responses indicated that freezing conditions remain a reliability issue for generators. Recurring concerns included improper heat trace; frozen instrumentation, transmitters or control valves; lack of fuel supply; fuel jelling; blade icing; and breaker tripping caused by low temperature and low air pressure**
- **252 out of 1160 GOs (22%) indicated they experienced a Cold Weather Reliability Event in the 2022-2023 winter season**
  - 160 (57%) said none of their net winter capacity would be considered at risk for the same causes for the winter ahead
  - 62 (22%) responded that almost all their net winter capacity would be at risk due to the same causes. Vast majority were wind farms citing some variant of blade icing



- **96% calculated their Extreme Cold Weather Temperatures (ECWTs)**

Cold Weather Data Collection

Newest Section 1600 Data Request

The Cold Weather Section 1600 Data Request was developed in response to a FERC directive to collect generator data to assess performance during cold weather events in its approval of EOP-012-1, in large part due to the five-year implementation plan coupled with the need to assess generator owner declared constraints and adequacy of the Extreme Cold Weather Temperature definition.

- FERC Order approving EOP-012-1 included directive to collect cold weather data, February 16, 2023
- NERC filed its plan with FERC on February 16, 2024
- Section 1600 data request posted for 45-day public comments June 14 - July 29, 2024
- Entities can expect to receive the data request in January 2025 with responses due by May 2025
- NERC's first annual information filing due October 1, 2025

NERC will also use GADS data and meteorological data to perform analysis of performance

What Information Will Be Requested?

On a per-generating unit basis, the items shown will be collected along with unit identifying data (from GADS)

ECWT – Extreme Cold Weather Temperature (from EOP-012)

Temperature Information				Capacity Information	
Unit ECWT (deg F)	Date ECWT Calculated	Minimum Operating Temp (deg F)	Maximum Operating Temp (deg F)	Total Net Winter Capacity (MW)	Total Capacity Operable at ECWT (MW)

Corrective Action Plans (CAPs)						Constraint Information	
Total Capacity that have CAPs developed (MW)	CAP Development Date	Projected CAP Completion Date	Did the Unit Experience an Extreme Cold Weather Event this Winter? (Y/N)	Is the Unit Under a CAP Because it was Identified as 'Similar Equipment'? (Y/N)	Description of the 'Similar Equipment' Identified (free text)	Unit Has a Constraint Identified? (Y/N)	Constraint Rationale (select from drop down)

Cold Weather Reports & Lessons Learned

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

NERC Information Resources (as of 11/7/2023) on Cold Weather Preparation and BPS Impacts

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

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
- January 2014 Polar Vortex Review
- FERC - NERC Report: 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.)

The Generating Unit Winter Weather Readiness - Current Industry Practices - Version 4 **(June 2023)** is a resource for helping develop generator cold weather preparation plans.

- FERC - NERC - Regional Entity Staff Report: The February 2021 Cold Weather Outages in Texas and the South Central United States
- FERC - NERC - Regional Staff Winter Storm Elliott Report: Inquiry into Bulk-Power System Operations During December 2022

Other Cold Weather Reports and Training Materials can be found on this site.

Cold weather related Lessons Learned:

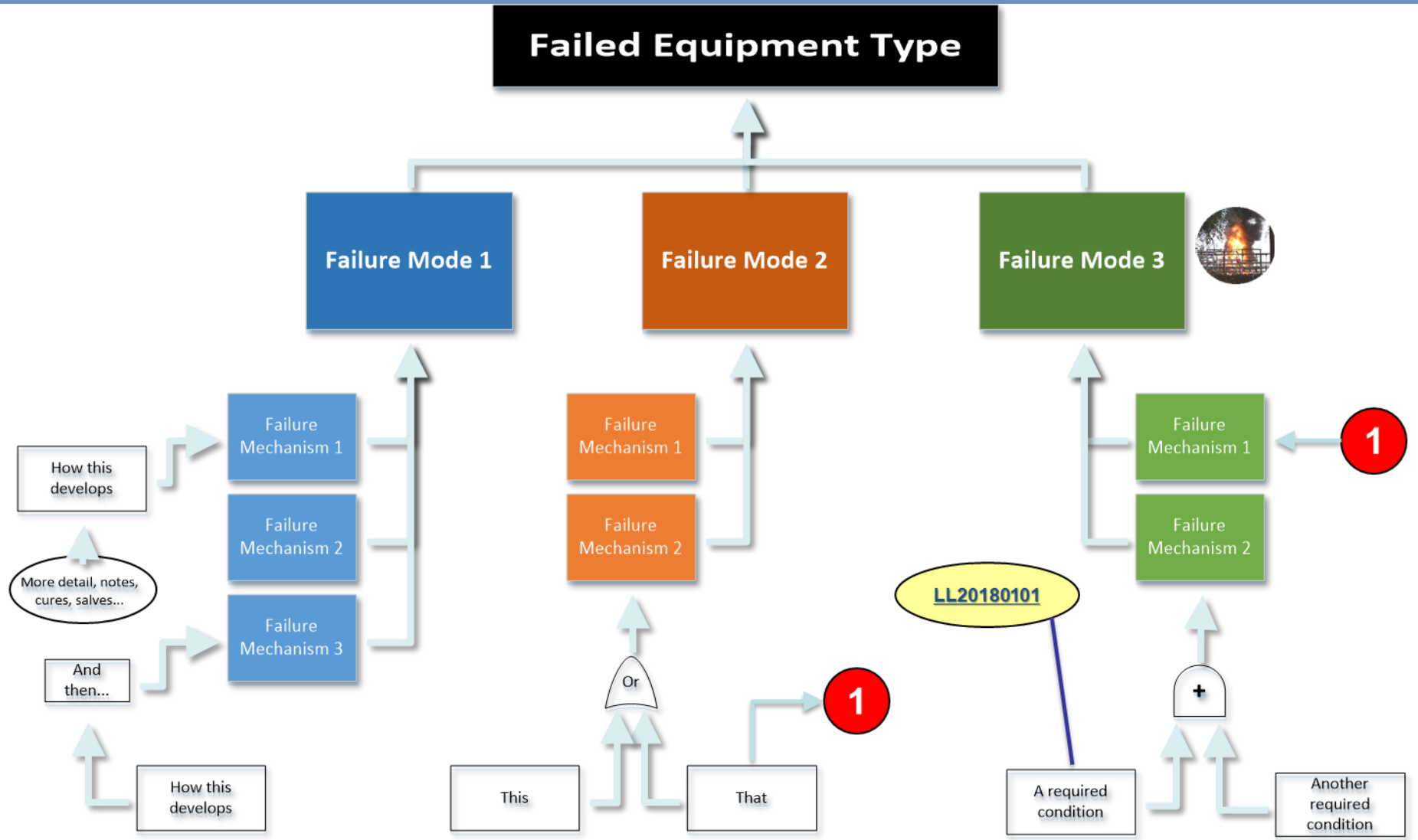
- LL20110902 Adequate Maintenance and Inspection of Generator Freeze Protection
- LL20110903 Generating Unit Temperature Design Parameters and Extreme Winter Conditions
- LL20111001 Plant Instrument & Sensing Equipment Freezing Due to Heat Trace & Insulation Failures
- LL20120101 Plant Onsite Material 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
- LL20220301 Managing UFLS Obligations and Service to Critical Loads during an Energy Emergency

RELIABILITY | RESILIENCE | SECURITY

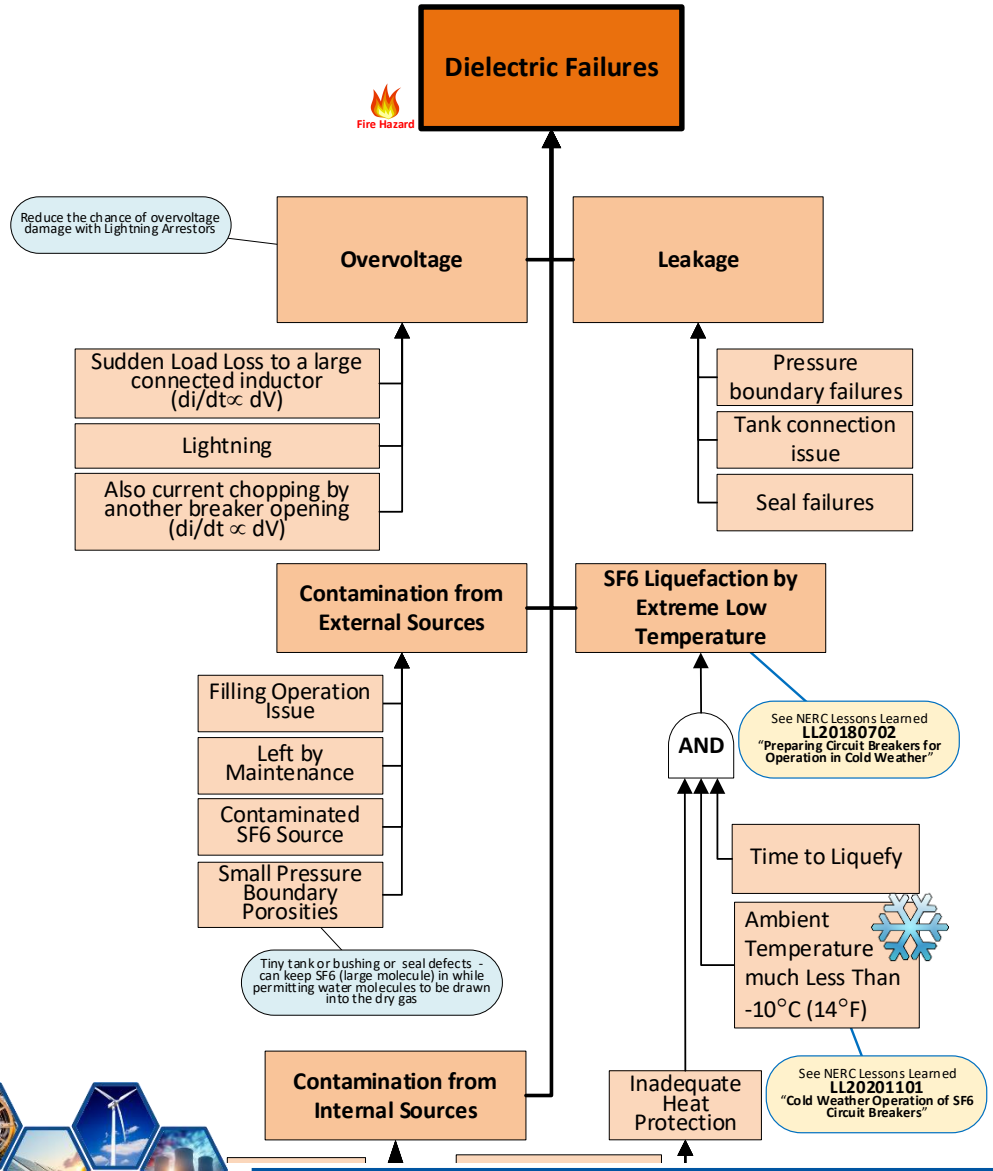
Failure Modes and Mechanisms—NERC Event Analysis Subcommittee

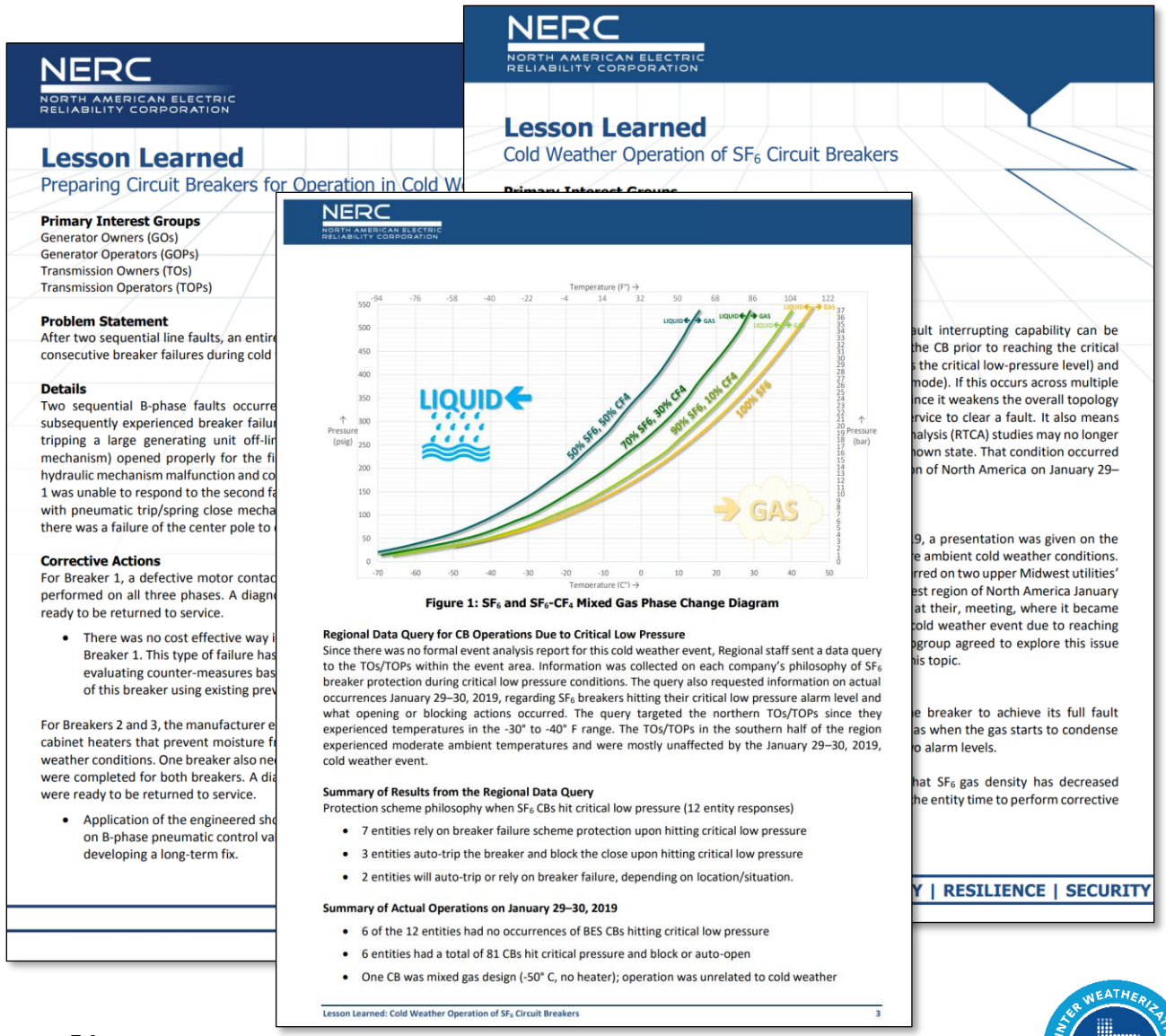
- **Failure Modes** are what gets your attention
- **Failure Mechanisms** are how the equipment gets going on the path to a failure
  - Equipment Failures have logical cause-and-effect relationships behind them.
  - Physical Evidence Examination and Root Cause Analysis can reveal what Failure Mechanisms were involved.
  - Aging is not a 'cause.' It is just a catch-all term for slow moving Failure Mechanisms.
  - Failure Mechanisms are detectable. Many can be stopped, or at least slowed down so they can be corrected before causing a failure.

Generic Failure Modes and Mechanisms Layout



Example with Cold-Related Failure Mechanisms for SF-6 Breakers





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Lesson Learned
Preparing Circuit Breakers for Operation in Cold W

Primary Interest Groups
Generator Owners (GOs)
Generator Operators (GOPs)
Transmission Owners (TOs)
Transmission Operators (TOPs)

Problem Statement
After two sequential line faults, an entire
consecutive breaker failures during cold

Details
Two sequential B-phase faults occurre
subsequently experienced breaker failu
tripping a large generating unit off-lir
mechanism) opened properly for the fi
hydraulic mechanism malfunction and co
1 was unable to respond to the second fa
with pneumatic trip/spring close mecha
there was a failure of the center pole to

Corrective Actions
For Breaker 1, a defective motor contac
performed on all three phases. A diagn
ready to be returned to service.

- There was no cost effective way i
  Breaker 1. This type of failure has
  evaluating counter-measures bas
  of this breaker using existing prev

For Breakers 2 and 3, the manufacturer e
cabinet heaters that prevent moisture fr
weather conditions. One breaker also ne
were completed for both breakers. A dia
were ready to be returned to service.

- Application of the engineered sh
  on B-phase pneumatic control va
  developing a long-term fix.

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Lesson Learned
Cold Weather Operation of SF_6 Circuit Breakers

Primary Interest Groups

Figure 1: SF_6 and SF_6-CF_4 Mixed Gas Phase Change Diagram

Regional Data Query for CB Operations Due to Critical Low Pressure
Since there was no formal event analysis report for this cold weather event, Regional staff sent a data query to the TOs/TOPs within the event area. Information was collected on each company's philosophy of SF_6 breaker protection during critical low pressure conditions. The query also requested information on actual occurrences January 29–30, 2019, regarding SF_6 breakers hitting their critical low pressure alarm level and what opening or blocking actions occurred. The query targeted the northern TOs/TOPs since they experienced temperatures in the -30° to -40° F range. The TOs/TOPs in the southern half of the region experienced moderate ambient temperatures and were mostly unaffected by the January 29–30, 2019, cold weather event.

Summary of Results from the Regional Data Query
Protection scheme philosophy when SF_6 CBs hit critical low pressure (12 entity responses)

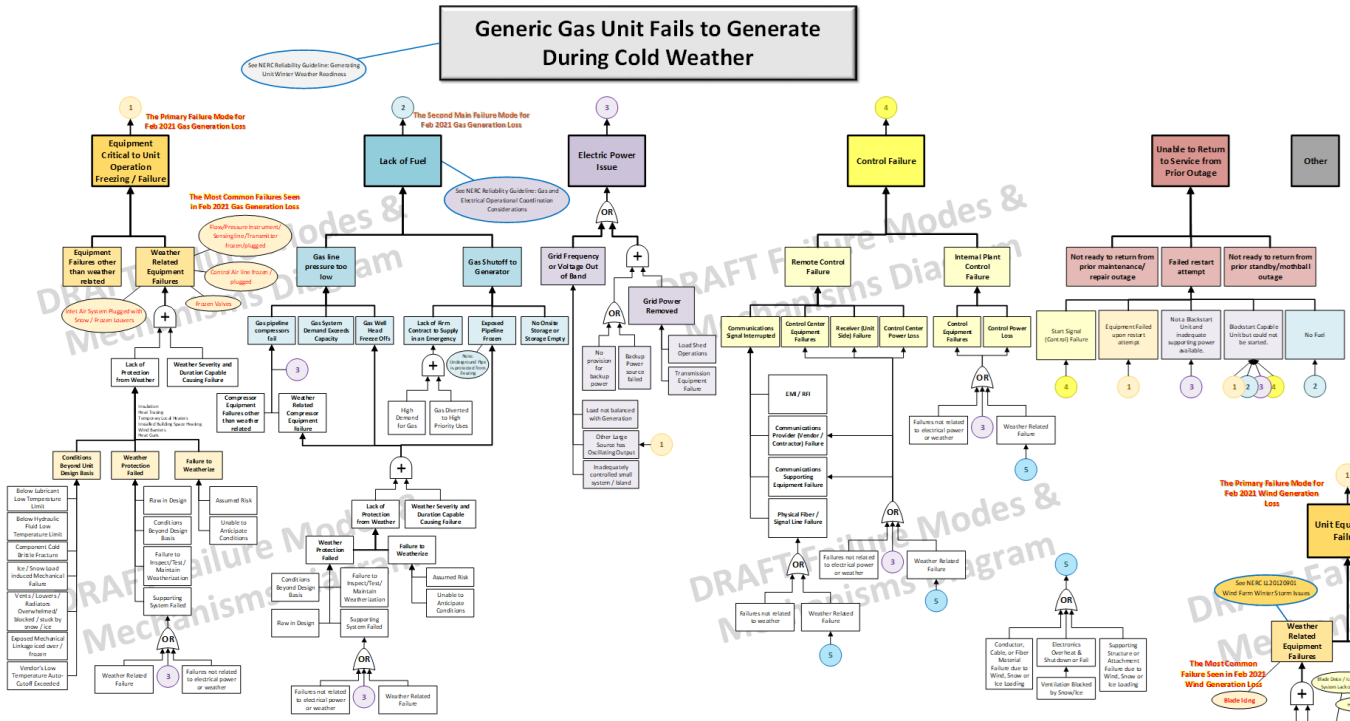
- 7 entities rely on breaker failure scheme protection upon hitting critical low pressure
- 3 entities auto-trip the breaker and block the close upon hitting critical low pressure
- 2 entities will auto-trip or rely on breaker failure, depending on location/situation.

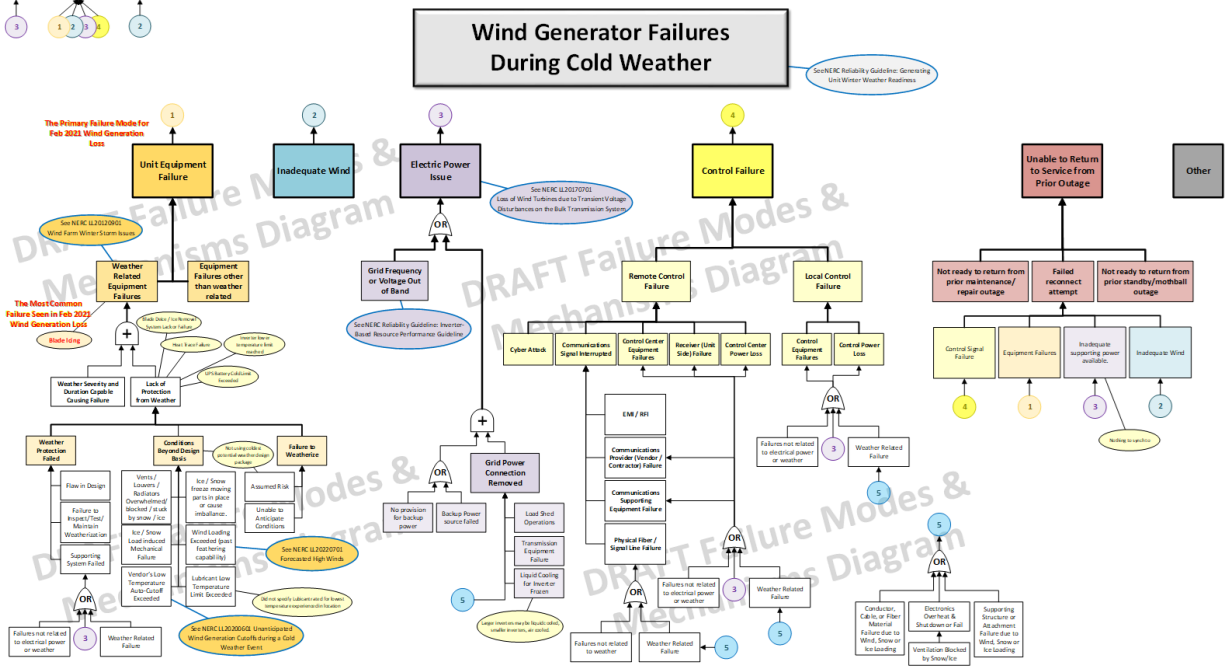
Summary of Actual Operations on January 29–30, 2019

- 6 of the 12 entities had no occurrences of BES CBs hitting critical low pressure
- 6 entities had a total of 81 CBs hit critical pressure and block or auto-open
- One CB was mixed gas design (-50° C, no heater); operation was unrelated to cold weather

Lesson Learned: Cold Weather Operation of SF_6 Circuit Breakers 3

Draft Generic Gas and Wind Generator Cold Weather Issues





Email information@texasre.org for a copy of charts or a list of all currently available

STILL Industry volunteers sought!

For more details, see Failure Modes & Mechanisms
Working Group webpage

North American Generator Forum Activities

NAGF Working Groups

The NAGF currently has six active Working Groups to address generation concerns

Cold Weather Preparedness

The CWP working group's primary focus is on NERC Project 2019-06 Cold Weather. There are multiple NAGF members on the associated Standards Drafting Team to ensure the generator perspective is understood and considered.

Join Us In Texas! November 6 – 7
2024 Compliance Conference and Annual Meeting virtually or in-person

https://generatorforum.org

TEXAS RE
Ensuring electric reliability for Texans

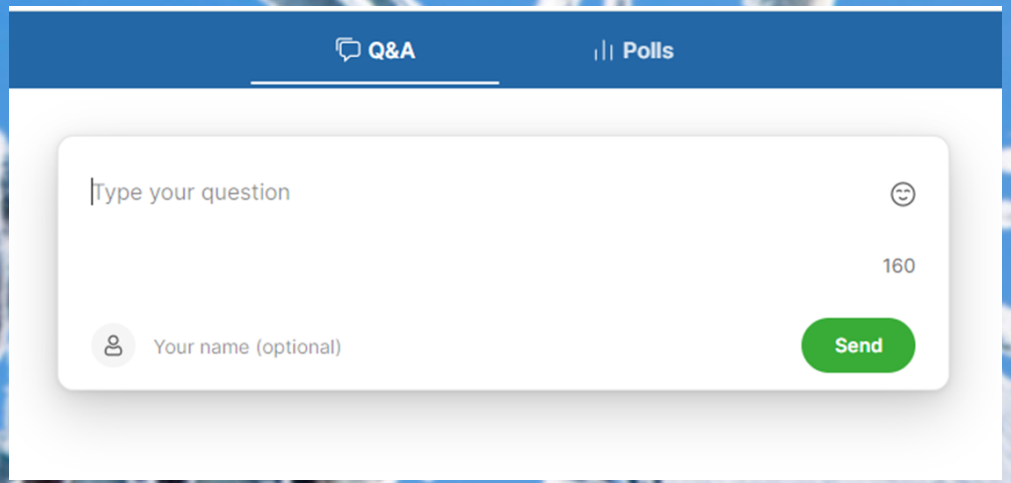
Texas RE
Winter Weatherization Workshop

Return: 10:55 a.m.

AGENDA

- Kick-off and Instructions
- Executive Welcome
- PUCT Weatherization Activities
- FERC & NERC Weatherization Updates
- Inquiries & Alerts
- **ERCOT Winterization Activities**
- Weatherization Compliance
- RRC Winterization Activities
- Winter Weather Forecast & Historical Extremes
- Thermal Generator Winter Prep and Lessons Learned
- Winterization for Renewables

To submit questions during the workshop, please visit **slido.com** and enter today's participant code: **TXRE**



ERCOT Winter Weatherization Update

Texas RE Winter Weather Workshop

David Kezell
ERCOT Director of Weatherization and Inspection

October 2, 2024

Extreme Winter Weather Background

When	What
Feb 2021	**Winter Storm Uri** results in >200 deaths and is the largest controlled load shed event in US history
Jun 2021	Texas Senate Bill (SB) 3 becomes law requiring weatherization of generation, transmission, and natural gas facilities
Oct 2021	Phase 1 TX Weather Emergency Preparedness rule adopted
Dec 2021	ERCOT Weatherization Inspections commence
Sep 2022	Phase II TX Weather Emergency Preparedness rule adopted
Dec 2022	**Winter Storm Elliott** impacts large parts of southern USA
Jan 2024	**Winter Storm Gerri and Heather** impact 16+ states with <0ºF temperatures simultaneously

Public Utility Commission of Texas (PUCT) Weather Emergency Preparedness Rule: Requirements Highlights

- **16 TAC §25.55 requires Market Participants (MPs – GOs and TOs) to:**
  - Establish and maintain weather preparation measures for both winter and summer seasons on both generation and transmission equipment
  - Make notarized declarations of preparedness in both winter and summer
  - Create a list of all cold- and hot-weather-critical components
  - Implement weather emergency preparation measures reasonably expected to ensure sustained operation at weather-zone-specific cold and hot conditions

- **Reasonably expected to ensure sustained operation:**
  - GOs and TOs implement measures
  - If operation is not sustained:
    - Find root cause(s)
    - Address the issue(s)
    - Take appropriate action at similar sites
    - Assure that actions are effective
    - Demonstrate sustained operation

Winter Requirement

Weather Zone	95th Percentile Minimum Average 72-Hour Wind Chill	99th Percentile Minimum Average 72-Hour Wind Chill
North	-5.0°	-10.5°
North Central	-0.5°	-5.1°
West	0.3°	-7.6°
Far West	1.3°	-5.2°
East	4.4°	-0.7°
Coast	18.1°	4.1°
South Central	8.4°	3.8°
Southern	16.3°	11.7°
Valley	20.0°	16.9°
Panhandle	-17.6°	-19.6°

Table 72: Historical Minimum 72-Hour Average Wind Chill Data

Comparison of PUCT Rule vs. EOP-012-2

This chart allows an effective comparison of some of the Texas 16 TAC § 25.55 rule requirements (in black) with estimated Extreme Cold Weather Temp requirements from NERC EOP-012-2 (in red)*.

It also demonstrates that both the rule and standard were not established to protect against all historically experienced temperatures (in blue) but rather to support increased system reliability during significantly cold conditions without being extreme in their levels of required protection measures.

	EOP-012-2 ECWT Est.	PUCT Phase II (New and Existing Gen and Trans)	EOP-012-2 ECWT Est. + 20mph Wind	Lowest Winter Storm URI Temp	Lowest Recorded Temp
ERCOT Weather Zone	**Lowest 0.2 Percentile Temp (ºF) (Updated Aug 2023)**	**95th Percentile Minimum Average 72-Hour Wind Chill (ºF) *(pg 58)***	***Wind Chill (ºF) from* Lowest 0.2 Percentile*Temp with 20 mph wind (Updated Aug 2023)***	**Feb 2021 Minimum Temp (ºF) *(pg 13)***	**Minimum Recorded Temp (ºF) *(pg 13)***
North	8.6	-5	-10.8	-4	-13
N. Central	15.6	-0.5	-1.6	-2	-8
West	11.6	0.3	-6.8	-4	-9
Far West	10.6	1.3	-8.1	-2	-11
East	16.5	4.4	-0.4	-6	-6
Coast	22.8	18.1	7.9	13	5
S. Central	18.5	8.4	2.3	7	-2
Southern	26.5	16.3	12.8	17	11
Valley	31.6	20.0	19.4	22	12
Panhandle	0.5	-17.6	-21.3	-11	-16

**The PUC rule and NERC standard have differing timelines for compliance. The PUC rule covers both generation and transmission facilities while the NERC standard covers just generating units.*

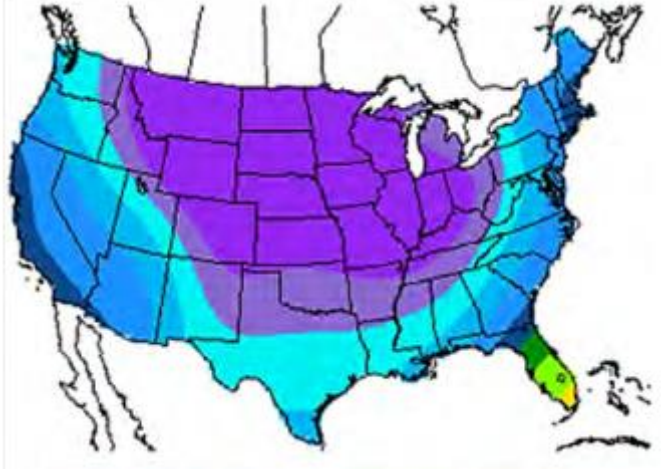
Winter Storm Uri, Elliott and Heather Minimum Temperatures

Winter Storm Uri

February 16, 2021, Actual Minimum Temperature

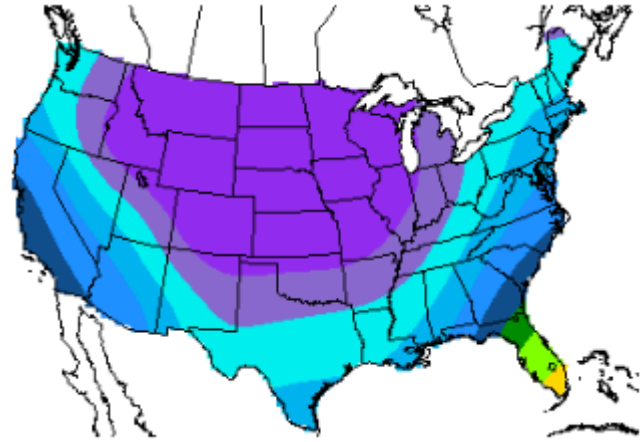
Winter Storm Elliott

December 23, 2022, Actual Minimum Temperature

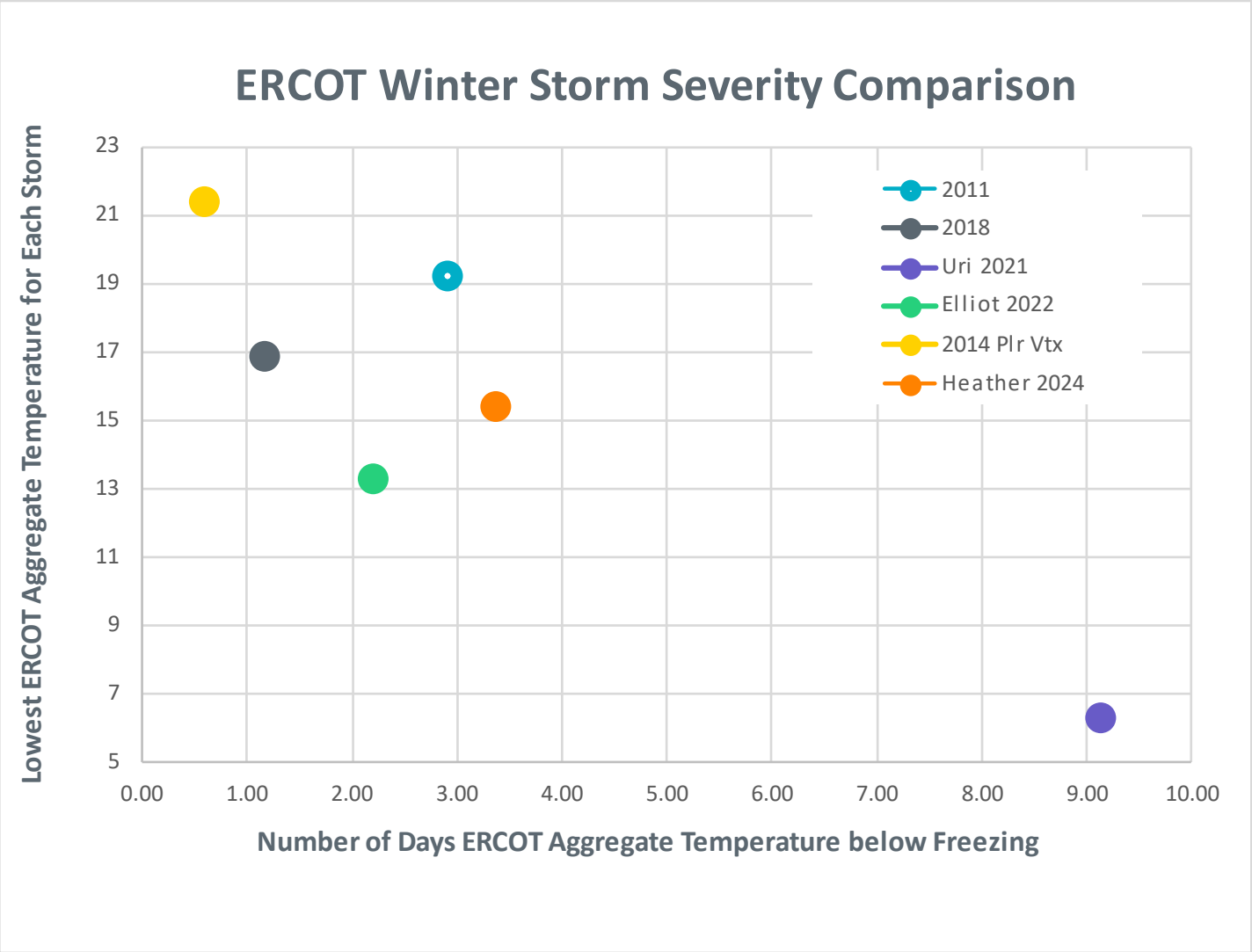


Winter Storm Heather

January 16, 2024, Actual Minimum Temperature



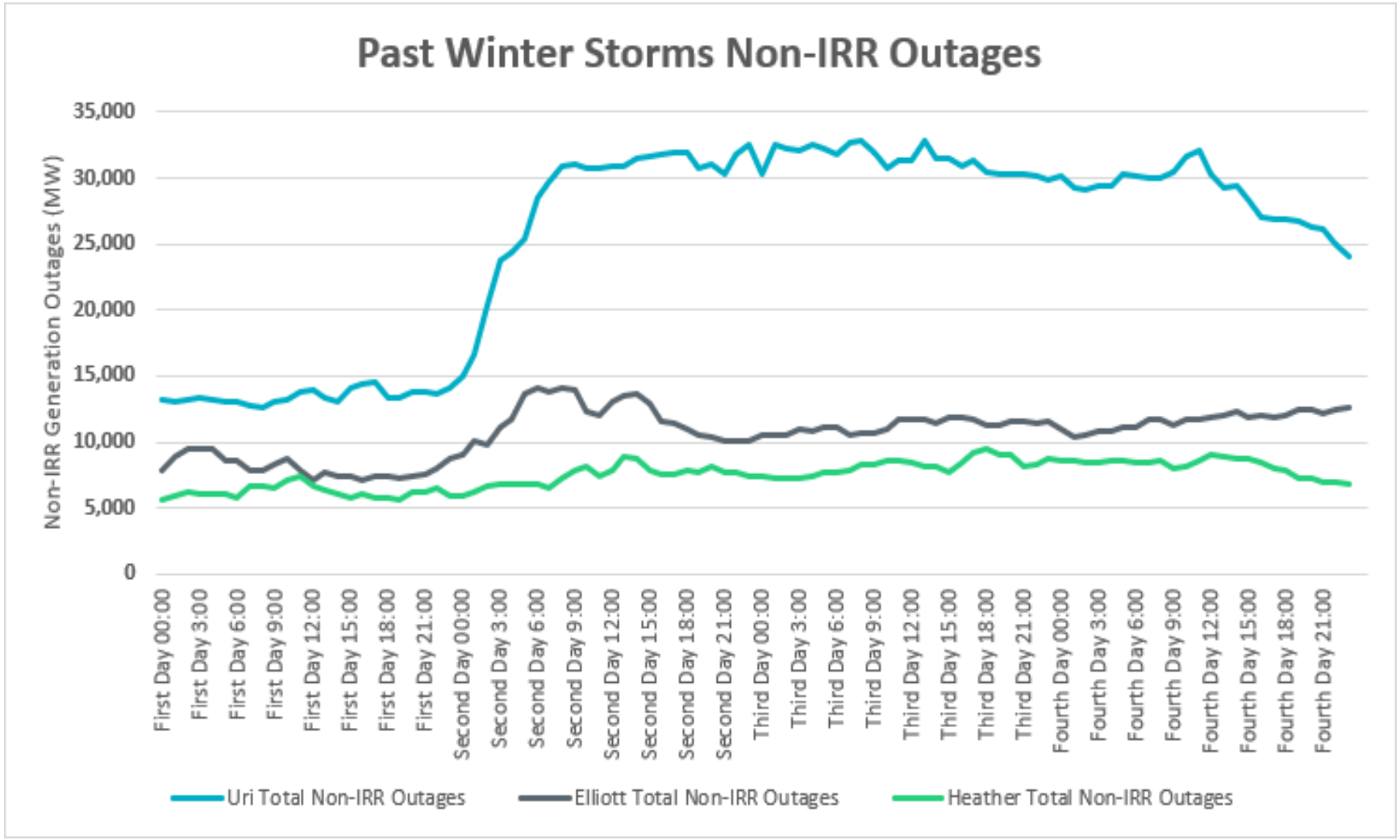
Severity Comparison of Winter Storms in ERCOT



Key Takeaway:
Winter Storm Heather was the third coldest and second longest lasting of the significant recent winter storms in Texas

Station ID	City	Weight	Temp (°F)	Product		
IAH	Houston	0.27	45.00	12.15		Coast
ABI	Abilene	0.03	32.00	0.96		West
CRP	Corpus Christi	0.07	40.00	2.8		South
AUS	Austin	0.17	38.00	6.46		South Central
SPS	Wichita Falls	0.03	32.00	0.96		North
DFW	Dallas Ft Worth	0.36	37.00	13.32		North Central
MAF	Midland	0.03	29.00	0.87		Far West
TYR	Tyler	0.04	44.00	1.76		East
ERCOT Load Weighted Temperature		1.00		39.28		
for	1/1/2021	at	00:00	hrs		

Forced Outage Level Comparison of Winter Storms in ERCOT



Key Takeaway:
Non-IRR outages during Winter Storm Heather (Jan 2024) remained lower than Winter Storm Elliott (Dec 2022) and Winter Storm Uri (Feb 2021)

What Comes Next?

- Phase I of the Texas Weather Emergency Preparedness rule was first adopted three years ago, and Phase II was adopted two years ago
- Winter 2023-2024 was the first year that the requirement to implement weather emergency preparation measures reasonably expected to ensure sustained operation at weather-zone-specific cold conditions applied
- Some minor improvements may be expected as refinements to cold weather plans and preparations are made
- NERC's EOP-012-2 standard may bring some limited additional benefit to ERCOT on existing facilities with more significant benefit likely for new facilities (COD post 10/1/27)
- Some generation entities have deliberately selected cold weather reliability design criteria that is more stringent than either the state rule or the NERC standard

Key Takeaway: Diligent application of freeze protection measures followed by consistent maintenance and monitoring of those measures is critical to delivering reliability results.

Winter Lessons Learned

- Annual inspections of thermal insulation and water-proofing are important
- Protection of Transmitters and Instrumentation systems is critical
- Seasonally replaceable wind blocks are very effective
- Frequent monitoring of freeze protection and instrument air drying systems increases confidence
- Assuring adequate quantities of supplies, chemicals, fuels, personnel, food, sleeping quarters, etc. is increasingly important for longer duration storms or those that inhibit travel/transport of resupply
- Monitoring of all cold weather critical components is vital. Accountability mechanisms are valuable
- For additional information see Best Practices & NERC Lessons Learned

Conclusions and Key Takeaways

- The Texas Weather Emergency Preparedness Rule is having a beneficial effect on system reliability. Active Market Participant diligence in weatherization preparation and maintenance activities are contributing substantially to reliability improvements.
- Collaborative discussions during inspections as well as corrective actions taken for any compliance deficiencies within provided cure periods have brought many benefits.
- Existing generation facilities complying with the PUCT's winter requirements are likely well-positioned for compliance with similar parts of NERC's EOP-12-2.
- More ERCOT weatherization information can be found at https://www.ercot.com/gridinfo/generation/summerready and https://www.ercot.com/gridinfo/generation/winterready

Q&A

Questions and Answers

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Cold Weather Efforts around the ERO Enterprise

Texas RE Winterization Workshop

Derek Kassimer
Compliance Assurance
October 2, 2024

RELIABILITY | RESILIENCE | SECURITY




Agenda

- Cold weather Standards (EOP-011-4, EOP-012-2, TOP-002-5)
- EOP-011-4 Implementation Plan
- FERC Order approving EOP-012-2 and directed modifications
- Performance review of winter storms Gerri and Heather
- Additional ERO Enterprise activities around cold weather

Cold Weather Standards Background

- During the week of February 14, 2021, for over two consecutive days, ERCOT averaged 34,000 MW of generation outages, nearly half of ERCOT's 2021 all-time winter peak Load of 69,871 MW

Project 2021-07 Development

- Project was developed in three phases
- Phase 1
  - February 2022 – September 2022
  - Key Recommendations 1d, 1e, 1f and 1j
  - EOP-011-3 and EOP-012-1
- Phase 2
  - October 2022 – September 2023
  - Key Recommendation 1a, 1b, 1c, 1g, 1h and 1i
  - EOP-011-4 and TOP-002-5
- Phase 3
  - October 2023 – February 2024
  - FERC Order Directives
  - EOP-012-2

FERC Order – Cold Weather Standards

- FERC issued an Order on June 27, 2024, highlighted by the approval of:
  - EOP-012-2 and its Implementation Plan
  - EOP-011-4 Implementation Plan
  - Retirement of EOP-011-2, EOP-011-3 and EOP-012-1
- FERC also directed modifications to 5 main areas within EOP-012-2, to be submitted to FERC within 9 months, March 27, 2025.

Implementation Plans

- EOP-012-2: **October 1, 2024**, apart from:
  - R3: Implement freeze protection measures to protect Generator Cold Weather Critical Components or develop a Corrective Action Plan
- EOP-011-4: **October 1, 2024**, apart from:
  - R1 Part 1.2.5: (new/revised portions applicable to UVLS, UFLS, critical natural gas infrastructure Loads): **April 1, 2027**
  - R2 Parts 2.2.8-2.2.9 (new/revised portions applicable to UVLS, UFLS, critical natural gas infrastructure Loads): **April 1, 2027**
  - R8: **April 1, 2027**, or 30 months past notification by a TOP to assist with mitigation of operating Emergencies
- TOP-002-5: **October 1, 2025**

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EOP-011-4 Requirement R1 Part 1.2.5

Effective on October 1, 2024

1.2.5. Operator-controlled manual Load shed, undervoltage load shed (UVLS), or underfrequency load shed (UFLS) during an Emergency that accounts for each of the following:

- **1.2.5.1.** Provisions for manual Load shedding capable of being implemented in a timeframe adequate for mitigating the Emergency;
- **1.2.5.2.** Provisions to minimize the overlap of circuits that are designated for manual Load shed, UVLS, or UFLS and circuits that serve designated critical loads which are essential to the reliability of the BES;
- **1.2.5.3.** Provisions to minimize the overlap of circuits that are designated for manual Load shed and circuits that are utilized for UFLS or UVLS;
- **1.2.5.4.** Provisions for limiting the utilization of UFLS or UVLS circuits for manual Load shed to situations where warranted by system conditions;
- **1.2.5.5.** Provisions for the identification and prioritization of designated critical natural gas infrastructure loads which are essential to the reliability of the BES as defined by the Applicable Entity; and

1.2.6. Provisions to determine reliability impacts of:

- **1.2.6.1.** Cold weather conditions; and
- **1.2.6.2.** Extreme weather conditions.

Redline Language - Effective on April 1, 2027

1.2.5. Operator-controlled manual Load ~~shedding~~shed, undervoltage load shed (UVLS), or underfrequency load shed (UFLS) during an Emergency that accounts for each of the following:

- **1.2.5.1.** Provisions for manual Load shedding capable of being implemented in a timeframe adequate for mitigating the Emergency;
- **1.2.5.2.** Provisions to minimize the overlap of circuits that are designated for manual Load shed, UVLS, or UFLS and circuits that serve designated critical loads which are essential to the reliability of the BES;
- **1.2.5.3.** Provisions to minimize the overlap of circuits that are designated for manual Load shed and circuits that are utilized for ~~underfrequency load shed (~~UFLS~~)~~ or ~~undervoltage load~~UVLS;

  ~~shed (UVLS); and~~
- **1.2.5.4.** Provisions for limiting the utilization of UFLS or UVLS circuits for manual Load shed to situations where warranted by system conditions~~.~~;
- **1.2.5.5.** Provisions for the identification and prioritization of designated critical natural gas infrastructure loads which are essential to the reliability of the BES as defined by the Applicable Entity; and

1.2.6. Provisions to determine reliability impacts of:

- **1.2.6.1.** ~~cold~~Cold weather conditions; and
- **1.2.6.2.** ~~extreme~~Extreme weather conditions.

Requirement R2 Part 2.2.8 and Part 2.2.9

Effective on October 1, 2024

2.2.8. Provisions for excluding critical natural gas infrastructure loads which are essential to the reliability of the BES, as defined by the Applicable Entity, as Interruptible Load, curtailable Load, and demand response during extreme cold weather periods within each Balancing Authority Area;

2.2.9. Provisions for Transmission Operators to implement operator-controlled manual Load shedding, undervoltage Load shedding, or underfrequency Load shedding in accordance with Requirement R1 Part 1.2.5; and

2.2.10. Provisions to determine reliability impacts of:

2.2.10.1. Cold weather conditions; and

2.2.10.2. Extreme weather conditions.

Redline Language - Effective on April 1, 2027

2.2.8. Provisions for excluding critical natural gas infrastructure loads which are essential to the reliability of the BES, as defined by the Applicable Entity, as Interruptible Load, curtailable Load, and demand response during extreme cold weather periods within each Balancing Authority Area;

~~**2.2.8.**~~**2.2.9.** Provisions for Transmission Operators to implement operator-controlled manual Load ~~shed~~shedding, undervoltage Load shedding, or underfrequency Load shedding in accordance with Requirement R1 Part 1.2.5; and

~~**2.2.9.**~~**2.2.10.** Provisions to determine reliability impacts of:

~~**2.2.9.1.**~~**2.2.10.1.** ~~cold~~Cold weather conditions; and

~~**2.2.9.2.**~~**2.2.10.2.** ~~extreme~~Extreme weather conditions.

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Requirement R8

Effective Date - The later of:
(1) April 1, 2027, OR
(2) 30 months following notification by a TOP under EOP-011-4 R7 to assist with the mitigation of Operating Emergencies

R8. Each Distribution Provider, UFLS-Only Distribution Provider, and Transmission Owner notified by a Transmission Operator per R7 to assist with the mitigation of operating Emergencies in its Transmission Operator Area shall develop, maintain, and implement a Load shedding plan. The Load shedding plan shall include the following, as applicable: *[Violation Risk Factor: High] [Time Horizon: Real-Time Operations, Operations Planning, Long-term Planning]*

8.1. Operator-controlled manual Load shedding, undervoltage Load shedding, or underfrequency Load shedding during an Emergency that accounts for each of the following:

8.1.1. Provisions for manual Load shedding capable of being implemented in a timeframe adequate for mitigating the Emergency;

8.1.2. Provisions to minimize the overlap of circuits that are designated for manual, undervoltage, or underfrequency Load shed and circuits that serve designated critical loads which are essential to the reliability of the BES;

8.1.3. Provisions to minimize the overlap of circuits that are designated for manual Load shed and circuits that are utilized for UFLS or UVLS;

8.1.4. Provisions for limiting the utilization of UFLS or UVLS circuits for manual Load shed to situations where warranted by system conditions; and

8.1.5. Provisions for the identification and prioritization of designated critical natural gas infrastructure loads which are essential to the reliability of the BES as defined by the Applicable Entity.

8.2. Provisions to provide the Load shedding plan to the Transmission Operator for review.

FERC Order – Cold Weather Standards

- FERC directed modifications to EOP-012-2
  - Clarify GCW Constraint to be objective and sufficiently detailed AND to remove all references to “reasonable cost,” “unreasonable cost,” “cost,” and “good business practices” (replace with objective, unambiguous, and auditable terms)
  - NERC process for GCW Constraint (receive, review, evaluate, and confirm the validity in a timely fashion
  - Shorten and clarify Corrective Action Plan (CAP) implementation timelines and deadlines
  - Extension of CAP implementation deadline beyond the maximum implementation timeframe required is pre-approved by NERC AND ensure operating limitations are provided during the period of extension
  - Implement more frequent reviews of GCW Constraint declarations to verify that the declaration remains valid

Project 2024-03 – Developing EOP-012-3

- Project 2024-03 Timeline
  - Initial Ballot – 10/17/24 – 11/5/24
  - First Additional Ballot – 12/3/24 – 12/20/24
  - Consideration of 321 Action – 1/2/25 – 1/8/25
  - Second Additional Ballot – 1/29/25 – 2/12/25
  - Final Ballot – 3/3/25 – 3/7/25
  - FERC Order Filing Deadline – 3/27/25

Performance Review of January 2024 Arctic Storms

- Winter Storms Gerri and Heather – January 10 – 17, 2024
- A performance review, limited in scope and focusing on *qualitative* data. Different than winter storm inquires (Uri) which is comprehensive with a focus on *quantitative* data
- Results of the review:
  - Zero system operator-initiated Load shed
  - Natural gas and electric entities were better prepared for the cold weather and had improved coordination and communication before and throughout
  - Generators reported fewer derates/outages compared to prior winter storms
  - Showed the continued implementation of recommendations from Winter Storms Uri and Elliot will have a positive impact on the operation of the BES

Performance Review of January 2024 Arctic Storms

- Natural gas performance
  - Entities were prepared through communication, protection measures, testing and training
  - Implemented recommendations from Winter Storm Uri report
- Electric system planning and operations
  - There was heightened communication and coordination between generators and Reliability Coordinators and Balancing Authorities
  - Improved forecasting around weather, system Load and wind were observed
- Generator performance
  - Proactive generator commitment to offset any outages occurred
  - Greater use of winter weather preparation checklists

FERC Cold Weather Preparedness Dashboard

- FERC and NERC developed a dashboard to track and provide updates to the status of recommendations from FERC-NERC winter storm analyses

Legend

Completed | Progressing as Expected | More Progress Needed

Recommendation Category	Recommendation Topics Summary	Status
Freeze Protection	Cold Weather Reliability Standards, Rules for:	
	Electric Generation	Completed
	Natural Gas Facilities	More Progress Needed
Gas-Electric Coordination	Identify Actions: Forums, Work Groups	Progressing as Expected
	Develop and Implement Actions	More Progress Needed
Grid Operations	Bi-directional Power Transfer Studies	Progressing as Expected
	Load Shed Coordination and Training	Completed
	Load Forecasting and Operational Planning	Progressing as Expected

2024 Cold Weather Small Group Advisory Sessions

- The ERO Enterprise hosted a general session as well as various one-on-one sessions the week of May 6, 2024, to cover compliance monitoring approaches and answer questions around EOP-012-2, EOP-011-4 and TOP-002-5
- General Session - approximately 500 attendees
- One-on-one sessions – Originally 40 companies (60+ NCRs) registered, ended up with approximately 25 sessions
- From all questions discussed, developed FAQ document; 150 questions condensed to 108 and publicly posted on the NERC website

Section 1600 Cold Weather Generator Data Collection

- Part of the FERC Order approving EOP-011-3 and EOP-012-1 issued on February 16, 2023, FERC directed NERC to develop a plan to collect data on generating unit winterization
- FERC approved the data collection plan in May 2024
- Deadline to submit data is May 15, 2025. Changes/updates may be made until June 15, 2025
- NERC must provide its report on the data to FERC by October 1, 2025

Additional Cold Weather Activities

- EOP-011-4, EOP-012-2 and TOP-002-5 RSAWs have been posted to the NERC website
- Cold Weather Preparedness CMEP Practice Guide is being updated
- Cold Weather training is being developed for Regional Compliance Monitoring and Enforcement staff
- NERC held their 2024 Cold Weather Webinar in early September

Questions and Answers

Railroad Commission of Texas

Winter Preparedness

Mysti Doshier, Assistant Director
October 2, 2024








Fiscal Year 2024 Inspections

- Regional inspectors completed 7,276 inspections including winter and summer season. Inspections are conducted on a tier basis starting with priority one, two, then three

Fiscal Year 2024 Inspection Outlook

- Regional inspectors are prepared to complete over 7,000 inspections including winter and summer starting with tier one facilities.

- Regional inspectors conducted outreach to saltwater disposal operators to ensure they understood reporting requirements as well as inspections.

Fiscal Year 2025 Inspection Outlook

- Supply chain letters mailed to operators on September 9, 2023, advising what facilities would be subject to inspection and reporting requirements

- Total facilities subject to inspection: 6,418

Regulated Industry Outreach

- A Notice to Industry will be sent to operators in late October

- The purpose is to educate industry on the upcoming requirements, attestations, and weather preparedness by December 1 of each year, and the reporting requirements in the event of a Weather Emergency

- April 2024 conducted webinar for EOP submissions due August 1, 2024

- July 2024 conducted several classes at the Regulatory Conference

Agency Coordination

- RRC continues to have regularly scheduled meetings with PUC and ERCOT to discuss any issues that need to be addressed in preparation for the upcoming winter season

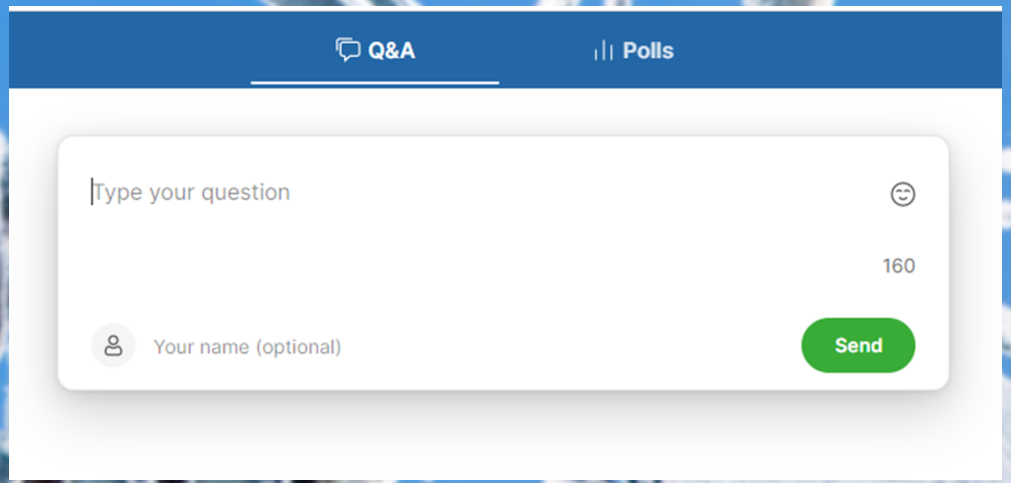
Texas RE
Winter Weatherization Workshop

Return: 12:55 p.m.

AGENDA

- Kick-off and Instructions
- Executive Welcome
- PUCT Weatherization Activities
- FERC & NERC Weatherization Updates
- Inquiries & Alerts
- ERCOT Winterization Activities
- Weatherization Compliance
- RRC Winterization Activities
- **Winter Weather Forecast & Historical Extremes**
- Thermal Generator Winter Prep and Lessons Learned
- Winterization for Renewables

To submit questions during the workshop, please visit **slido.com** and enter today's participant code: **TXRE**



2024-25 Preliminary Winter Weather Outlook

Chris Coleman
ERCOT Supervisor of Operational Forecasting

Winter Weatherization Workshop
October 2, 2024

Agenda

- Updating the summer
- Quick look at fall
- Review of last winter (and other recent winters)
- Expectations for the upcoming winter

Updating Summer 2024

- **June-August 2024** was the **6th hottest** on record for Texas (since 1895, based on **mean** temperatures); however, it was significantly cooler than the previous two years

- The 6th hottest Jun-Aug mean was due especially to minimum temperatures. Jun-Aug 2024 **minimum** temperatures ranked **4th warmest** all-time (and close to the past two summers)

Texas Average Temperature

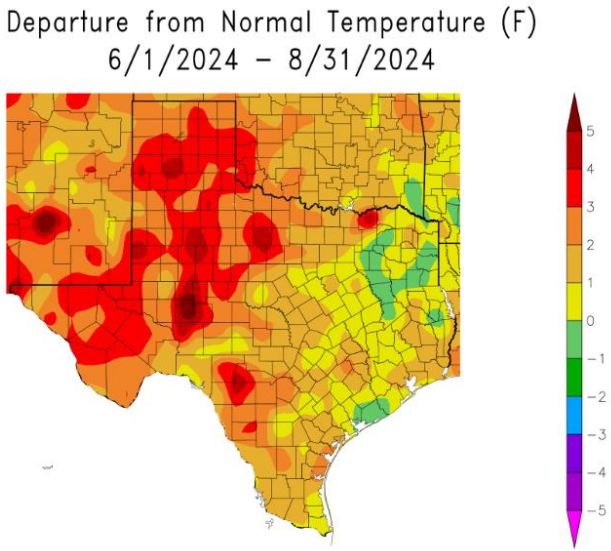
June-August

Period	Average Temperature	Rank (out of 130)	Anomaly 1901-2000 Mean: 81.3°F
June-August 2011	86.8°F	130	5.5°F
June-August 2023	85.3°F	129	4.0°F
June-August 2022	84.8°F	128	3.5°F
June-August 1934	84.2°F	127	2.9°F
June-August 1998	84.2°F	127	2.9°F
June-August 1980	84.0°F	125	2.7°F
June-August 2024	84.0°F	125	2.7°F
June-August 2018	83.8°F	123	2.5°F
June-August 1953	83.5°F	122	2.2°F
June-August 2020	83.4°F	121	2.1°F

Texas Minimum Temperature

June-August

Period	Minimum Temperature	Rank (out of 130)	Anomaly 1901-2000 Mean: 69.1°F
June-August 2011	73.4°F	130	4.3°F
June-August 2022	72.6°F	129	3.5°F
June-August 2023	72.5°F	128	3.4°F
June-August 2024	72.3°F	127	3.2°F
June-August 1998	71.7°F	126	2.6°F
June-August 2018	71.7°F	126	2.6°F
June-August 2010	71.5°F	124	2.4°F
June-August 1980	71.2°F	123	2.1°F
June-August 2016	71.1°F	122	2.0°F
June-August 2020	71.1°F	122	2.0°F



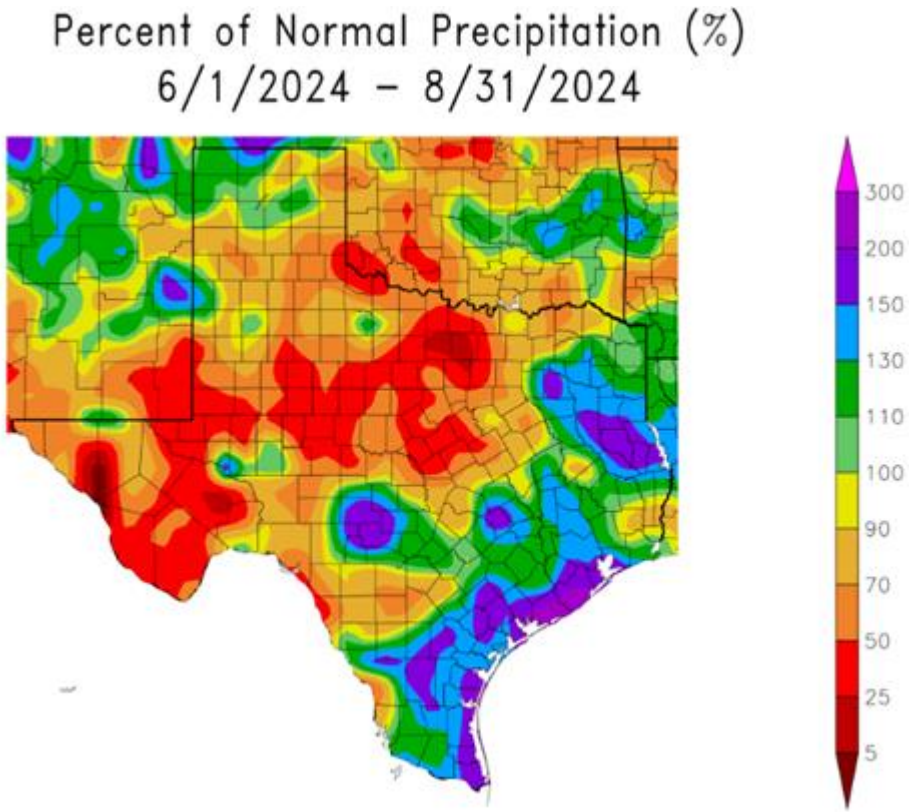
- 100-degree days (through 9/11/24):
  - Dallas: **23** days. (2023: 55)
  - Houston: **9** days. (2023: 22)
  - Austin: **30** days. (2023: 80)
  - San Antonio: **25** days. (2023: 58)
  - Abilene: **40** days (2023: 66)
  - McAllen: **54** days (2023: 97)

All locations listed – except McAllen (2022) – have recorded their fewest 100-degree days since 2021

Updating Summer 2024

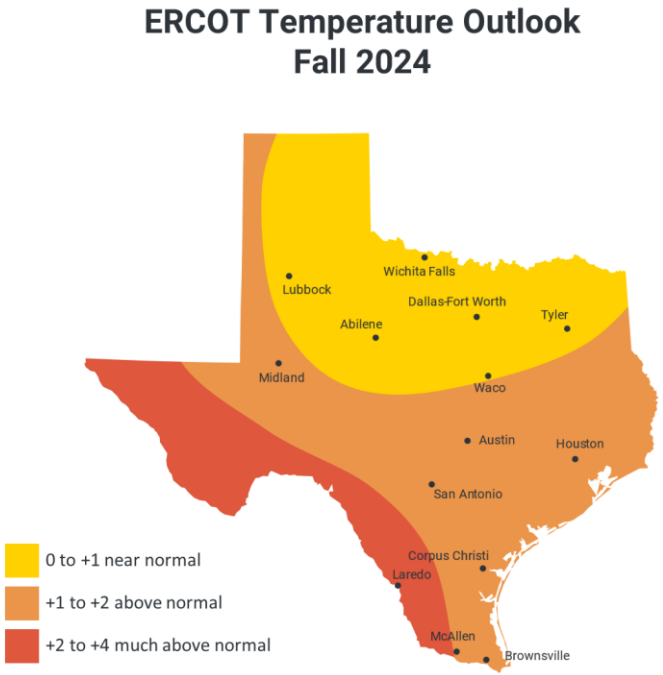
- **June-August 2024** was the **75th driest** on record for Texas, which was not nearly as dry as last year's June through August period which ranked 7th

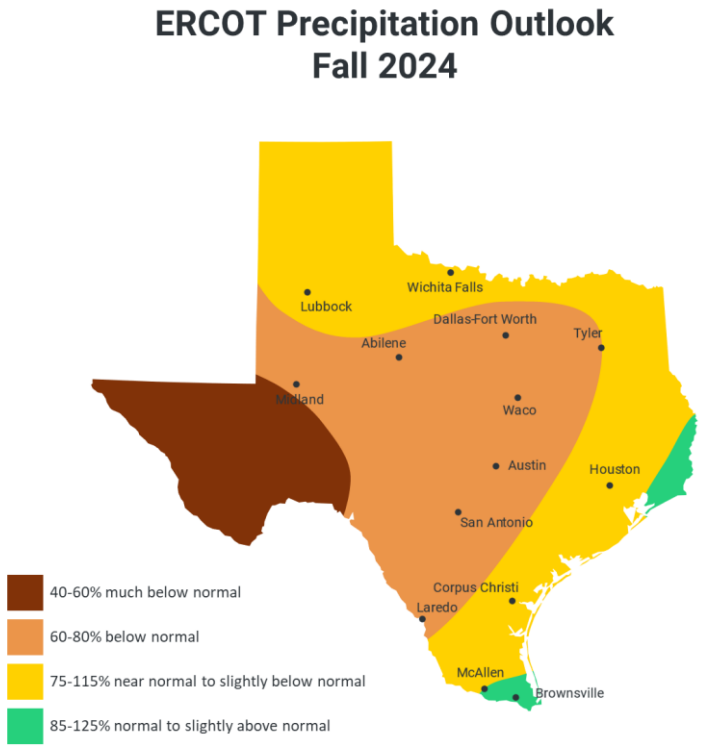
Period	Precipitation	Rank (out of 130)	Anomaly 2009-2023 Mean: 7.31in
June-August 1935	8.48"	81	1.17"
June-August 1997	8.24"	79	0.93"
June-August 1949	8.23"	78	0.92"
June-August 1927	7.85"	77	0.54"
June-August 1995	7.83"	76	0.52"
June-August 2024	7.77"	75	0.46"
June-August 1962	7.75"	74	0.44"
June-August 2005	7.67"	73	0.36"
June-August 1938	7.55"	72	0.24"
June-August 1909	7.48"	71	0.17"
June-August 1990	7.47"	70	0.16"



- June through August 2024 was the hottest recorded for Texas in a summer with above normal precipitation
- It was the only of the top 20 hottest Jun-Aug periods to record above normal rainfall
- Only 3 other top 50 hottest summers in Texas also recorded above normal precipitation: 2024: 6th hottest, 2010: 21st hottest, 2016: 33rd hottest, 1899: 47th hottest

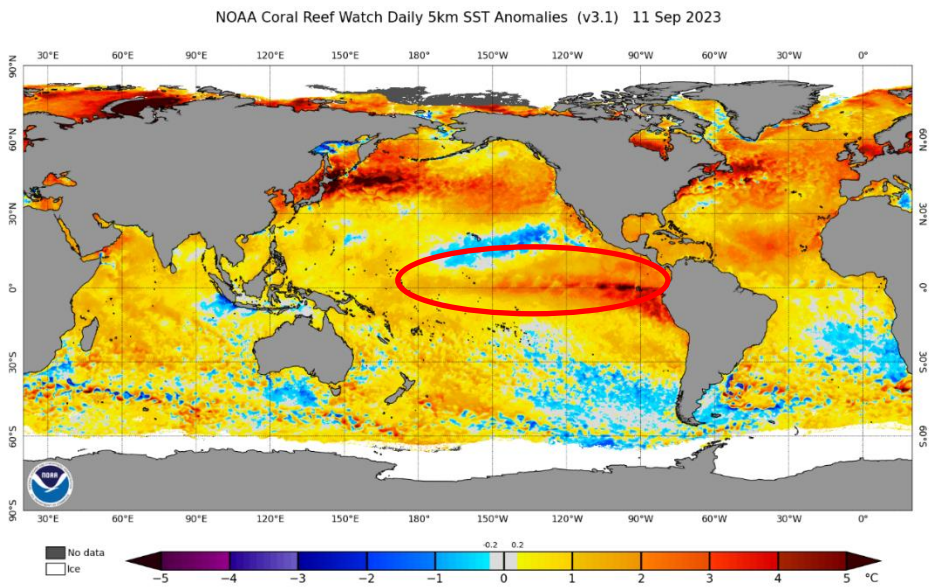
Quick Look at Fall Weather

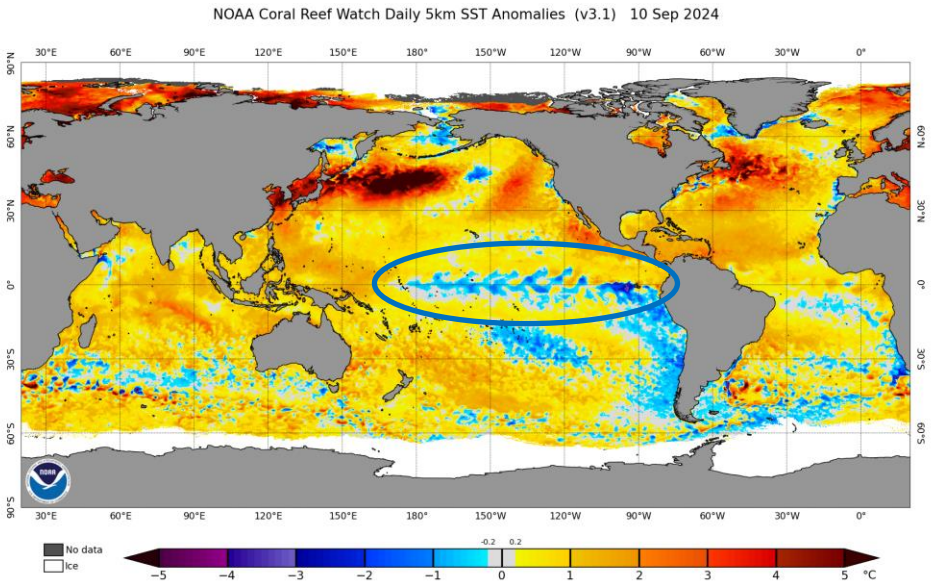




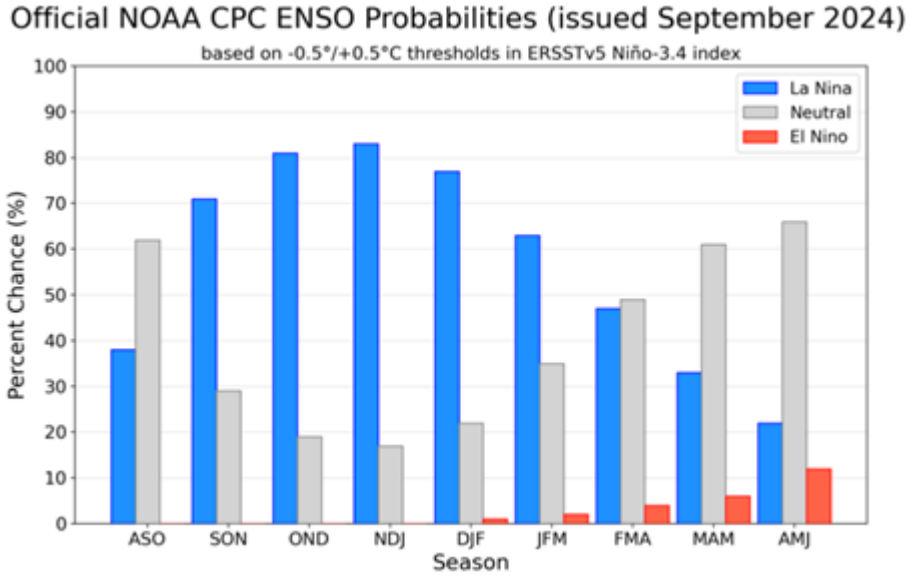
- The forecast for this fall (Oct-Nov) is mostly above normal temperatures and below normal precipitation
- November currently shows greater above normal temperature potential than October (but neither look below normal)

La Niña



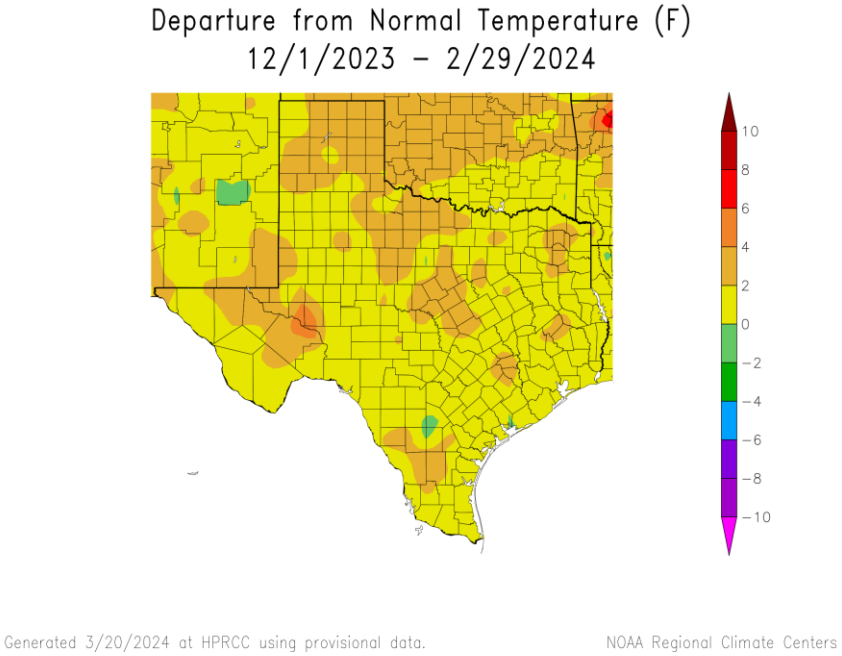


- La Niña is slowly taking shape and is expected to continue through the winter season
- This will mark 4 of 5 winters under the influence of La Niña



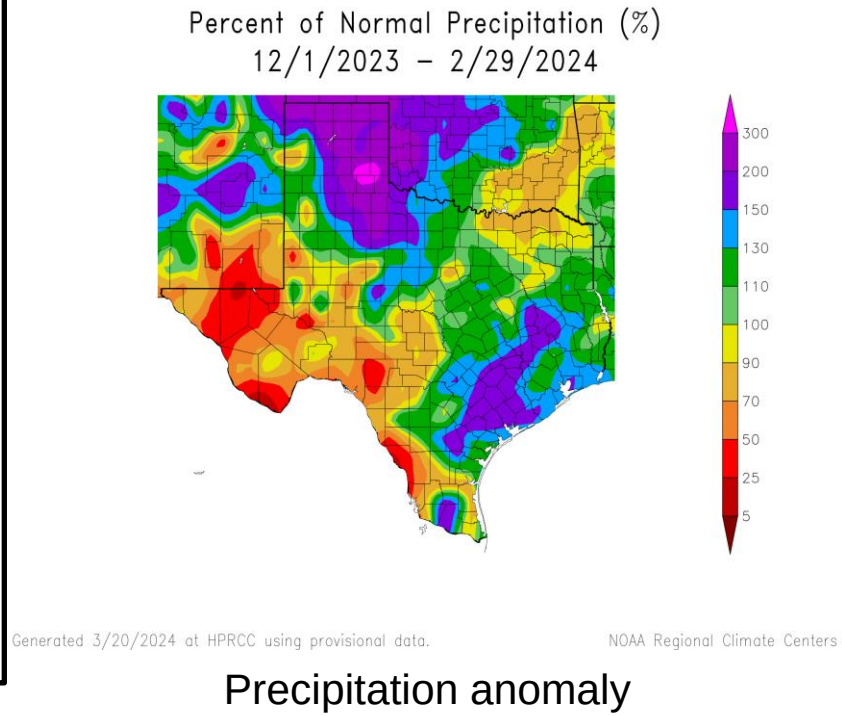
Reviewing Last Winter

ERCOT winter (Dec 1 – Feb 28)



Temperature anomaly

- Last winter was the **12h warmest** on record (129 historical winters)
- However, it featured a period of extreme cold in mid-January (Winter Storm Heather)
- ERCOT's new winter peak record was set on 1/16/24. DFW fell to 12°, Houston was 18°, Austin was 17°, while San Antonio recorded a low of 19°. The LRGV saw lows in the upper 20s, while Lubbock dropped to 5°
- This emphasizes the point made annually – mild (above normal) winters can and do have periods of extreme cold
- Last winter was the 30th wettest on record (129 historical winters). It was the wettest winter since 2011-12, with El Niño likely playing a role



Precipitation anomaly

Precip Anomaly

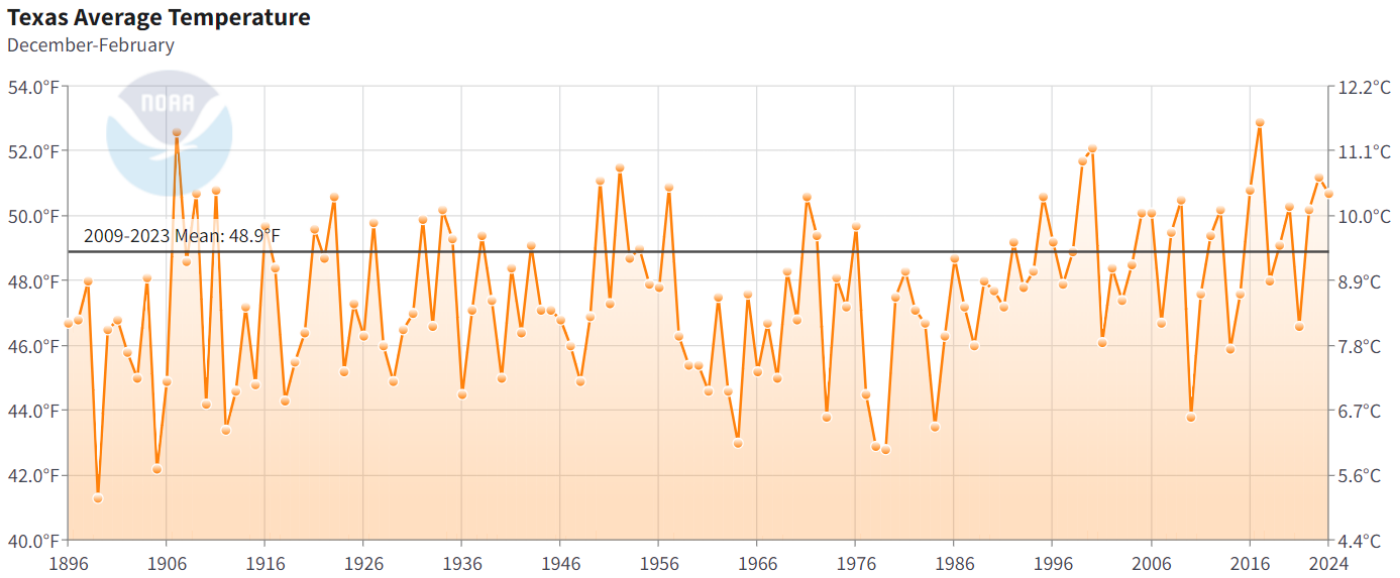
Mean Temperature Ranking of Recent Texas Winters (129 historical winters)

2023-24	**118th** coldest (12th warmest)
2022-23	**124th**
2021-22	**110th**
2020-21	42nd
2019-20	**113th**
2018-19	94th
2017-18	76th
2016-17	**129th** coldest (warmest winter on record)
2015-16	**120th**
2014-15	68th
2013-14	**30th**
2012-13	**110th**
2011-12	99th

Since 2001, only 3 winters have ranked in the coldest third (1-43) of historical winters (2020-21, 2013-14, and 2009-10)

Seasonal Rankings – what is normal?

- ❑ "Normal" may no longer be the best way to express seasonal (or monthly, or possibly even daily) temperatures
- ❑ As Texas keeps having many more above normal temperature seasons, it keeps raising the bar for what is "normal"
- ❑ **We commonly use a 15-year normal (2009-2023). Applying that normal to all historical winters (1895-2024) results in only 37 of 129 winters coming in above normal**
- ❑ This is why I'll oftentimes give all-time rankings and comparisons with recent years (in addition to or instead of "normal")



Extreme Cold Occurrences

ENSO phase during winters with extreme cold:

	la nina	neutral	el nino
since 1950	12	8	9
since 83-84	9	4	2
since 16-17	4	0	1

5 of the most recent 8 winters
Have brought extreme cold to Texas

2023-24
2022-23
2020-21
2017-18
2016-17

Extreme cold has impacted ERCOT more frequently in recent winters – even though the winters as a whole have been frequently mild

This winter should be approached with the potential for an extreme cold event; in fact, recent trends suggest a greater-than-average chance of occurrence

In those 5 winters, Dallas has recorded 14° or colder, Houston has recorded 21° or colder, and Austin has recorded 19° or colder

In the previous 25 winters (1991-92 through 2015-16), only 4 of the winters met that criteria for Dallas, 5 for Houston, and 3 for Austin

It's not unusual for a period of extreme cold to occur in an otherwise mild-to-warm winter

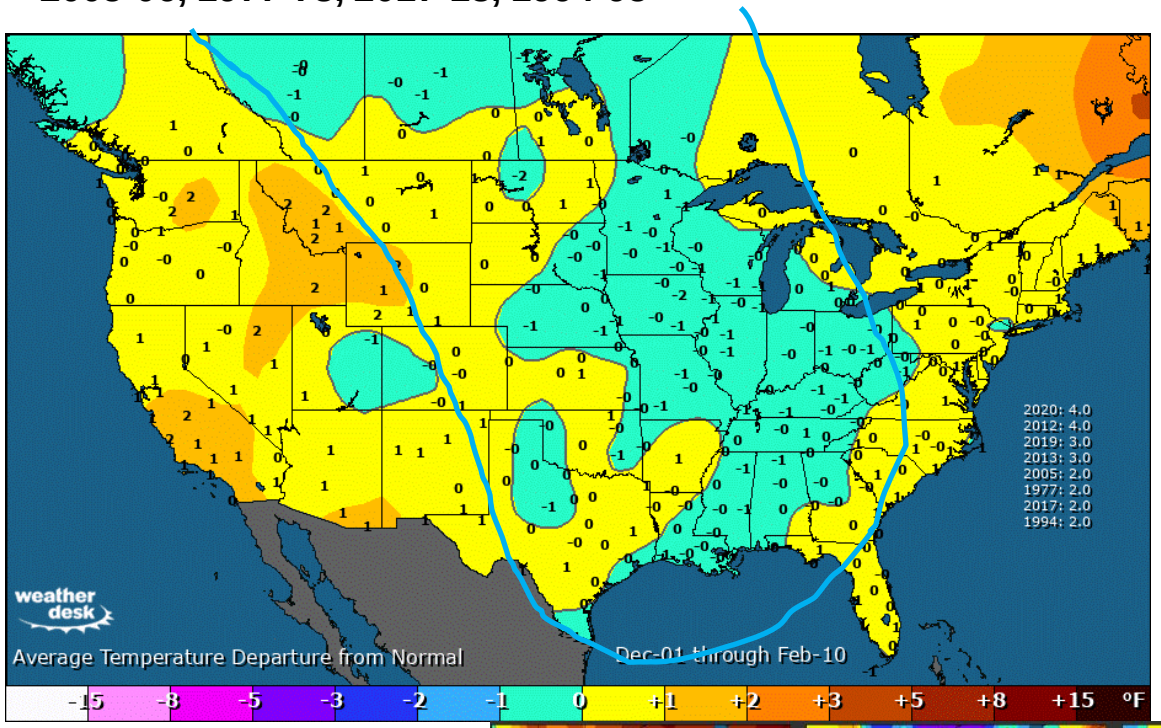
3 of the past 5 winters meeting
The cold extreme criteria have
Ranked in the top 12 warmest
Winters of all-time (129 historical)

2016-17, 2022-23, and 2023-24

Since 1988-89, 10 of 14 winters with cold extremes have ranked in the warmest half of all winters

Preliminary Winter 2024-25 Temperature Outlook

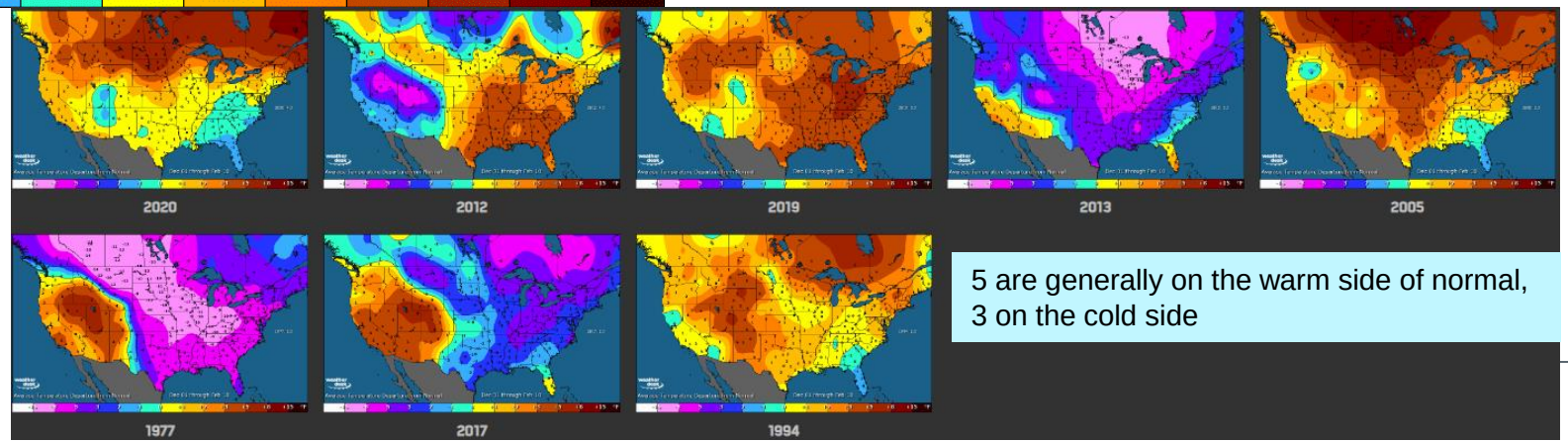
Analog weighted consensus: 2020-21, 2012-13, 2019-20, 2013-14, 2005-06, 1977-78, 2017-18, 1994-95



Coldest temps for DFW

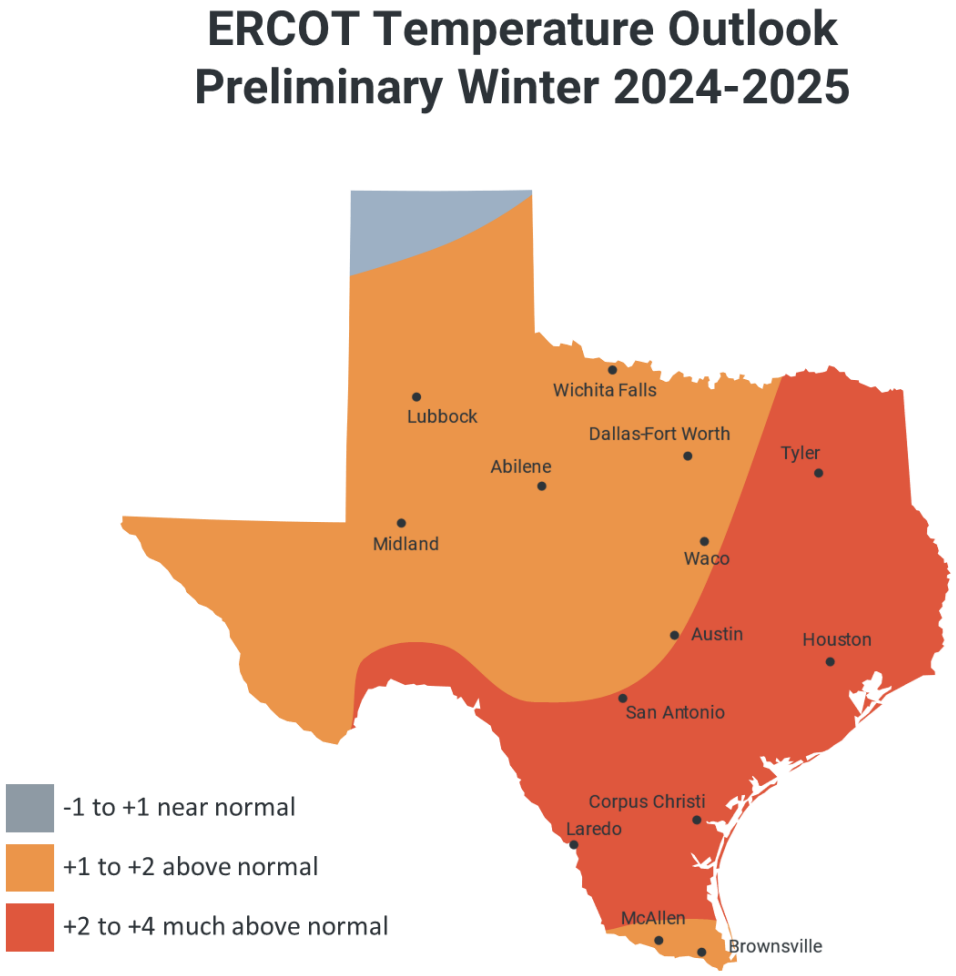
2020-21: -2° (27° thru 2/10)
2012-13: 22°
2019-20: 25°
2013-14: 15°
2005-06: 15°
1977-78: 9°
2017-18: 13°
1994-95: 25°

The all-time historical average coldest day is 14° at DFW; this century alone, 17°



5 are generally on the warm side of normal, 3 on the cold side

Preliminary Winter 2024-25 Temperature Outlook



The winter is forecasted to see above normal temperatures across almost all of Texas

This is an average across three months and doesn't dismiss the potential for a period of extreme cold

Recent winters have had similar patterns and drivers that yielded a significant polar outbreak impacting Texas

Precipitation Ranking of Recent Texas Winters (129 historical winters)

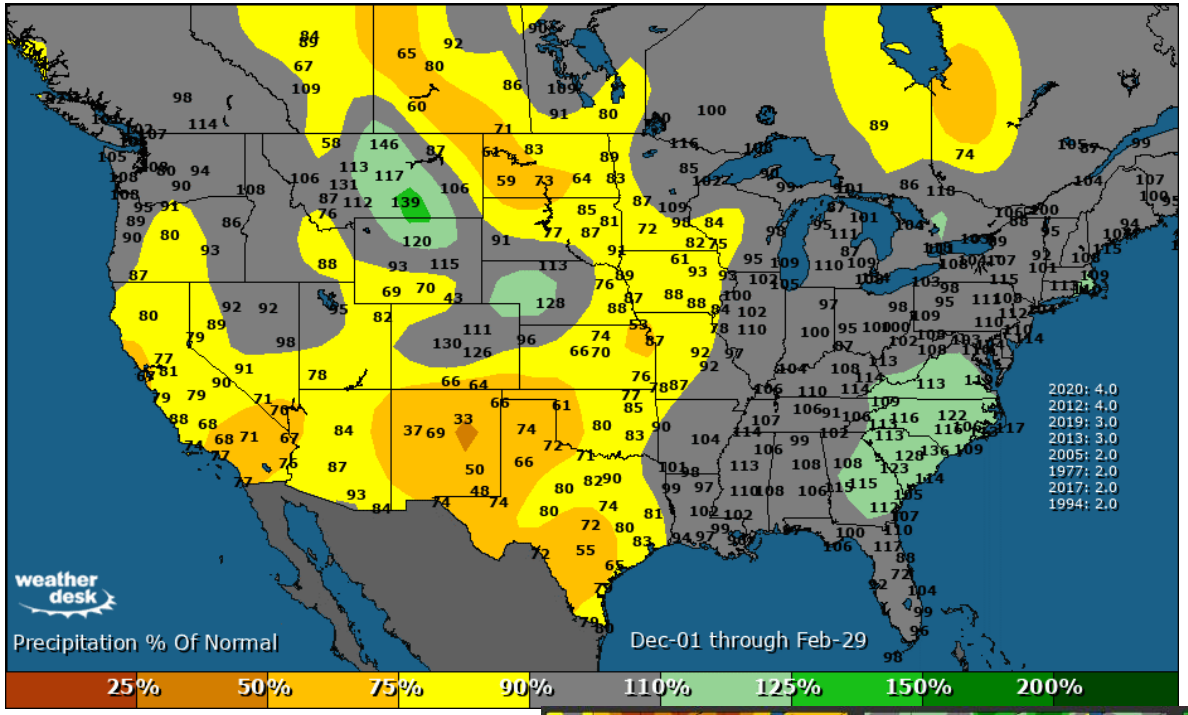
2023-24	**104th driest (E)**
2022-23	45th (L)
2021-22	**10th (L)**
2020-21	58th (L)
2019-20	66th (E)
2018-19	91st (E)
2017-18	75th (L)
2016-17	**98th (L)**
2015-16	59th (E)
2014-15	74th (E)
2013-14	**12th (N)**
2012-13	63rd (N)
2011-12	**120th (L)**

Over the past 6 winters, La Niña has resulted in the 3 driest winters and El Niño in the 3 wettest (the upcoming winter will be a La Niña)

(E) = El Niño, (L) = La Niña, (N) = neutral

Preliminary Winter 2024-25 Precipitation Outlook

Analog weighted consensus: 2020-21, 2012-13, 2019-20, 2013-14, 2005-06, 1977-78, 2017-18, 1994-95



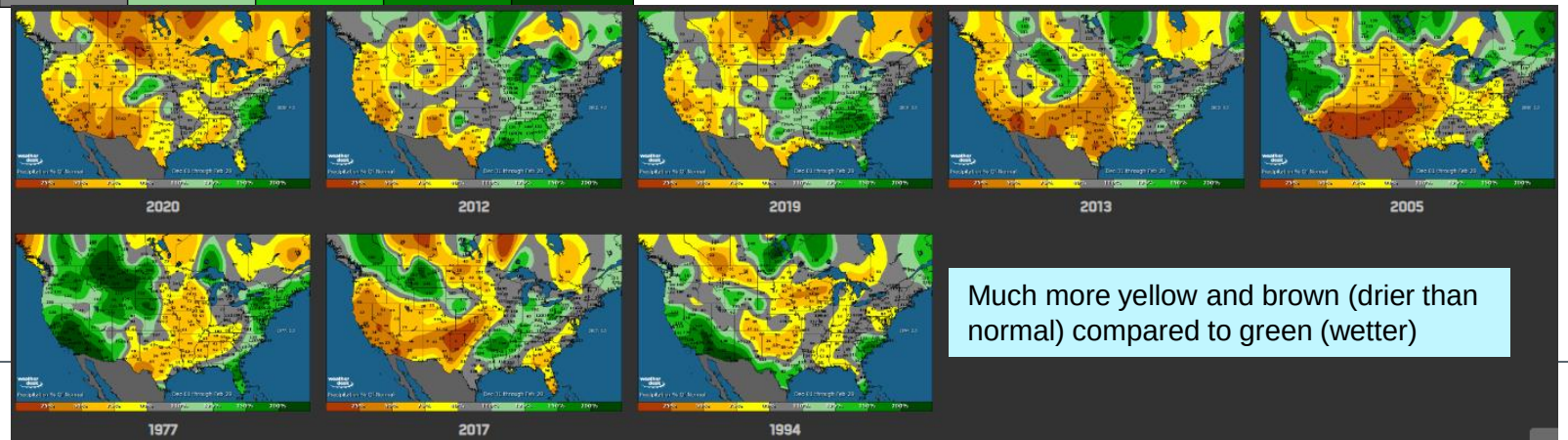
Snowfall for Dallas-Fort Worth

2020-21: 5.0”
2012-13: 0.8”
2019-20: 0.2”
2013-14: 2.9”
2005-06: trace
1977-78: 17.6”
2017-18: trace
1994-95: trace

(17.6” is the winter record)

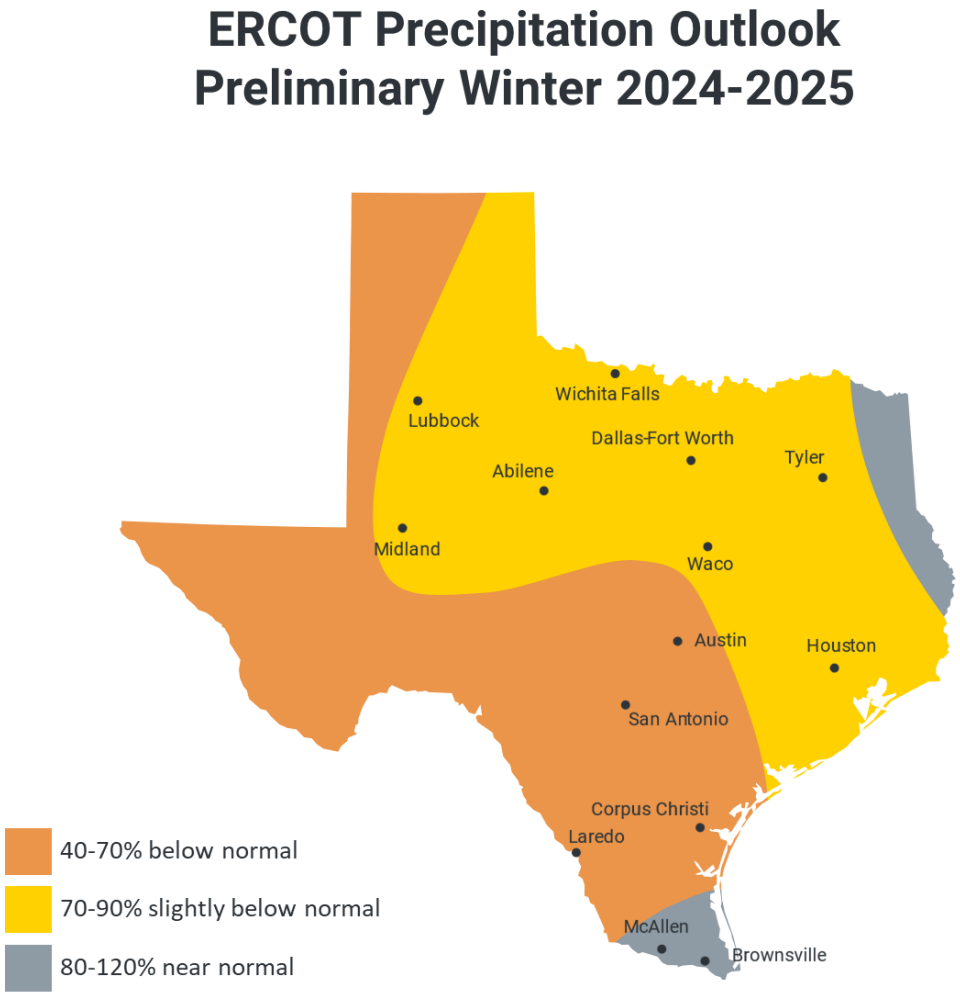
The analogs point more heavily toward a dry winter than a warm winter

There isn’t enough consistency with the analogs, however, to predict snow potential this winter



Much more yellow and brown (drier than normal) compared to green (wetter)

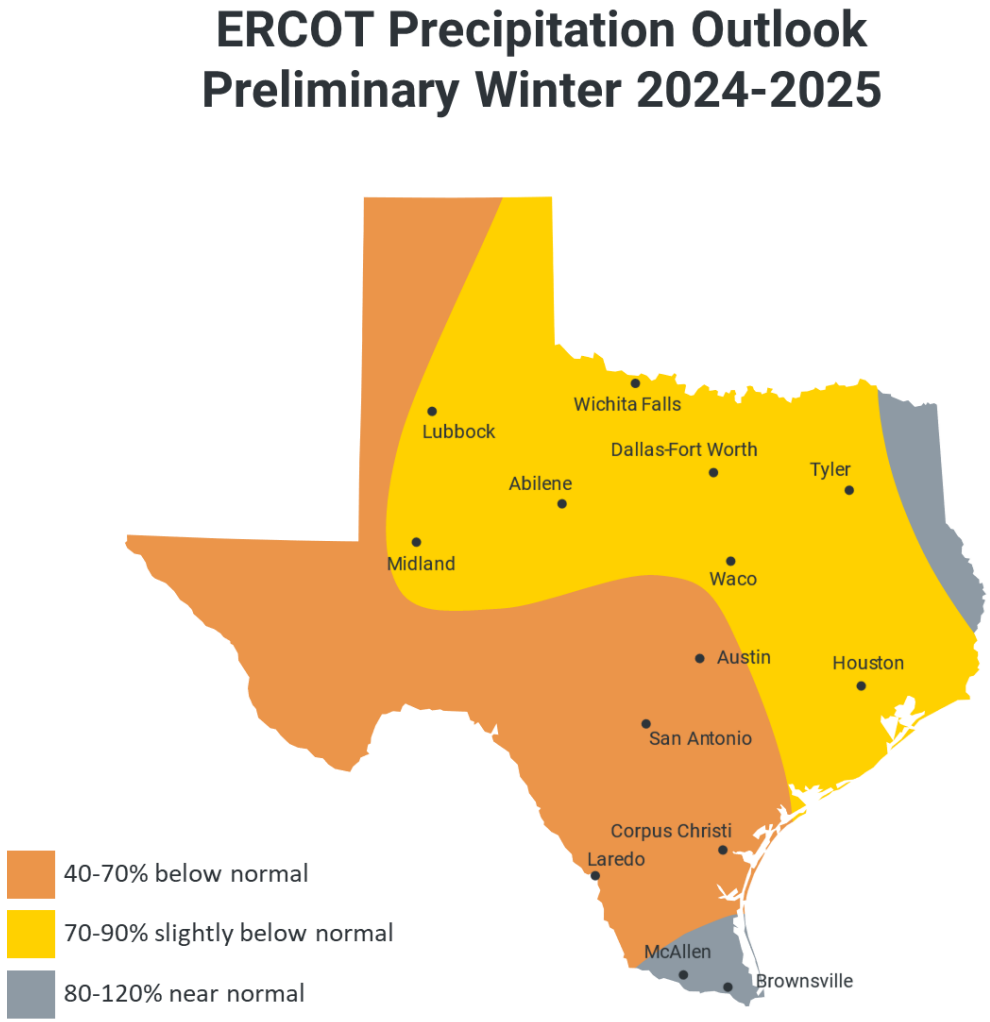
Preliminary Winter 2024-25 Precipitation Outlook



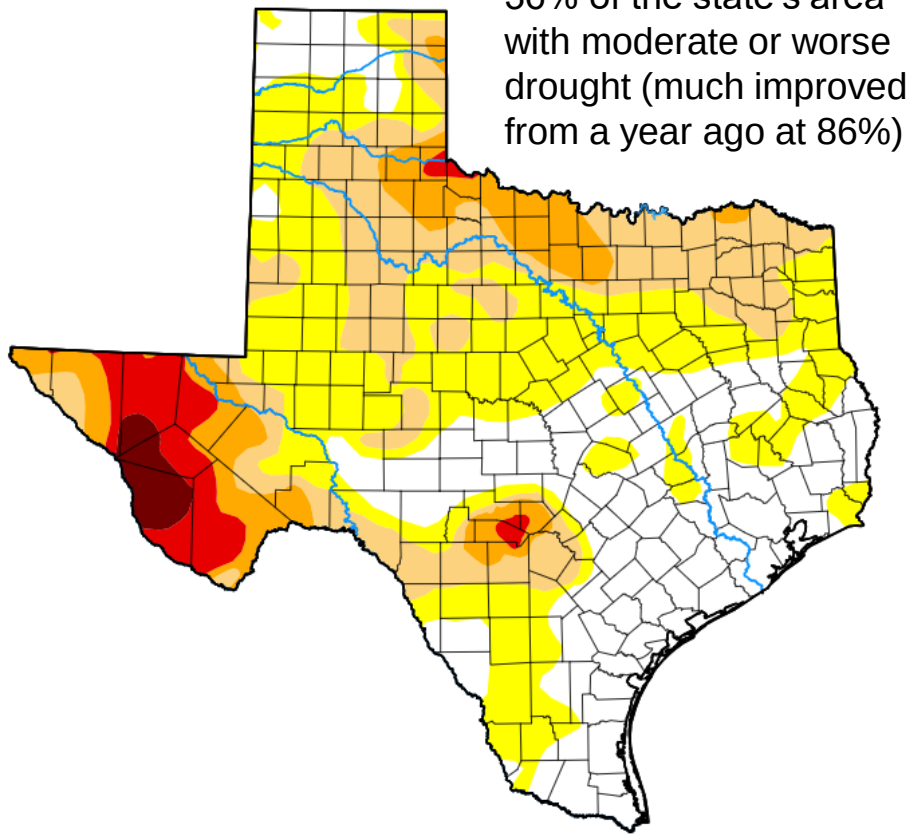
The winter is forecasted to see below normal precipitation across almost all of Texas

This winter is very likely to be drier than last winter (which was the wettest in over a decade)

Winter 2024-25 Precipitation Outlook vs Drought



Current Drought:
36% of the state's area with moderate or worse drought (much improved from a year ago at 86%)



The winter precipitation outlook suggests increasing drought

Preliminary Winter Weather Outlook Summary

- The preliminary winter forecast suggests a mostly mild and dry winter in Texas
- Recent winter trends suggest a cold outbreak impacting Texas is possible again this winter.
  - La Niña tends to support this better than El Niño
  - This does not mean a period of extreme cold is being predicted for Texas this winter but rather, many of the conditions that supported recent polar outbreaks are still in play
- Drought could be a greater concern going into next spring than last (only 23% of the state was impacted by drought heading into last spring)

- There is not a strong correlation between the winter temperature anomaly and period(s) of extreme cold
- **Each and every winter should be accompanied by a mindset for a period of extreme cold**

The final winter forecast will be published in November

PROENERGY

Winter Weather Preparation and Lessons Learned

Kevin Chaffin, Director of O&M

PROENERGY OVERVIEW

VERTICAL INTEGRATION, TOTAL FOCUS ON LM AERODERIVATIVES

Aeroderivative Life-Cycle Services

AeroAdvantage

The only independent Level-IV engine depot
On-campus manufacturing & domestic supply chain
Overhaul, manufacturing, and technology expertise

OEM Equipment & Turnkey EPC

PowerFLX

Standardized LM6000 power block
Turnkey packages and engines
18-month comprehensive warranty

Project Development & Asset Management

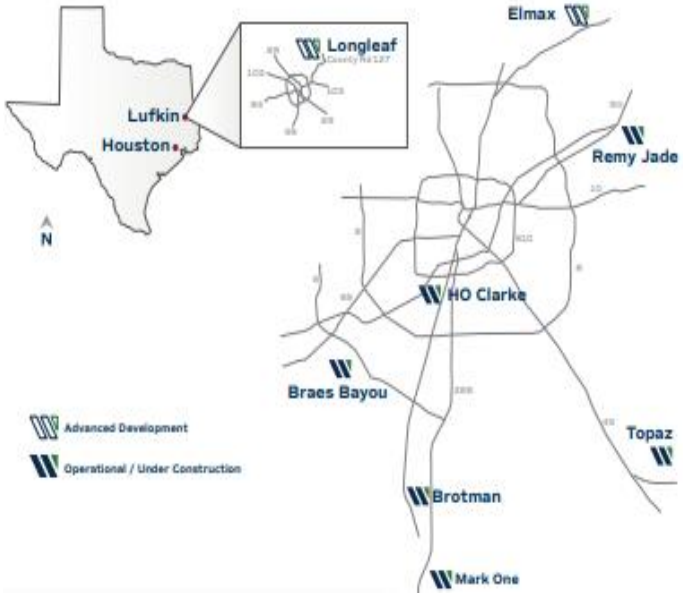
WattBridge

Independent Power Producer
Reduced COD risk
All sites storage-ready (BESS)

WATTBRIDGE

2.4 GW AND COUNTING

Sites Operating in Texas



* Indicates the Commercial Operations Date for Phase I of the project.

KEY TO SUCCESS

Maintaining a Cold Weather Plan

Maintain comprehensive cold weather plan that meets requirements of 16 TX ADC § 25.55 and EOP-012-2

Annually review the plan to incorporate any necessary updates

Helpful Sections in the Plan to Document Compliance

Extreme Cold Weather Temperature Calculations (R1)

Cold Weather Critical Component List, including freeze protection measures

Generating units Cold Weather Data (R1.2)

Summary Table Outlining R4 requirements

Cold Weather Monthly Event Checklist (including annual inspections)

Cold Weather Round Sheet

Operating History Temperatures

What is a cold weather critical component ?

Any generating unit component or system, or associated Fixed Fuel Supply Component, that is under the Generator Owner's control, **and is susceptible to freezing issues**, the occurrence of which would likely lead to a Generator Cold Weather Reliability Event (de-rate, failed start or forced outage). This definition excludes any component or system or associated Fixed Fuel Supply Component located inside a permanent building with a heating source that regularly maintains the space at a temperature above 32 degrees Fahrenheit (0 degrees Celsius).

Area	System	Cold Weather Critical Component	EOP-012-2 Cold Weather Critical Component	Type of Protection Required	Inspection/Testing/Actions Required
BOP	Instrument Air	Compressor	Yes	Permanent enclosure	No additional inspection required If unit is offline, during a cold weather event, opens the low point drains to the atmosphere to cycle the instrument air compressors and prevent air moisture
BOP	City Water Connection	Water Connection	No	Place a temporary enclosure around connection	Ensure enclosure is intact and in good condition
Unit Specific	Fuel Gas	Solenoid Gas and Air Regulator	Yes	Temporary heat tracing and insulation	Plug in the temporary heat tracing prior to a cold weather event Ensure heat tracing is operational and verify the insulation is installed

PROENERGY

Implementing Protections for Cold Weather Components

HO Clarke Operated Continuously During Storm Uri

After each winter season, the plan is reviewed and updated

Improvements to Air Compressor Protections

- 2021 DURING URI
- 2023 INSTALLATION OF PERMANENT STRUCTURE

Lessons Learned

Review Cold Weather Critical Components and update plan if unexpected failures occur

- Added permanent structures around certain critical components
- Created a four-hour event round sheet to conduct additional inspections to ensure all heaters and protections functional
- Insulation added to solenoid gas and air regulator valves
- Added additional requirements for operators to open the low point drains to the atmosphere, to cycle the instrument air compressors and prevent air moisture on the instrument air compressor
- ROC Operators start recirculation of water for the demin forwarding pumps to prevent freezing

INSPECTION READINESS

Helpful Documentation

- Organize files based on requirement
- Ensure operations teams save documentation in correct locations
- Site Binders
  - PUCT Inspection FAQs and Responses (internal document outlining responses to requirements in PUCT rule)
  - Cold Weather Operations Plan
  - Inspection Checklists
  - Annual Training and/or Plan Review Records

Thank You

PROENERGY

CONTACT

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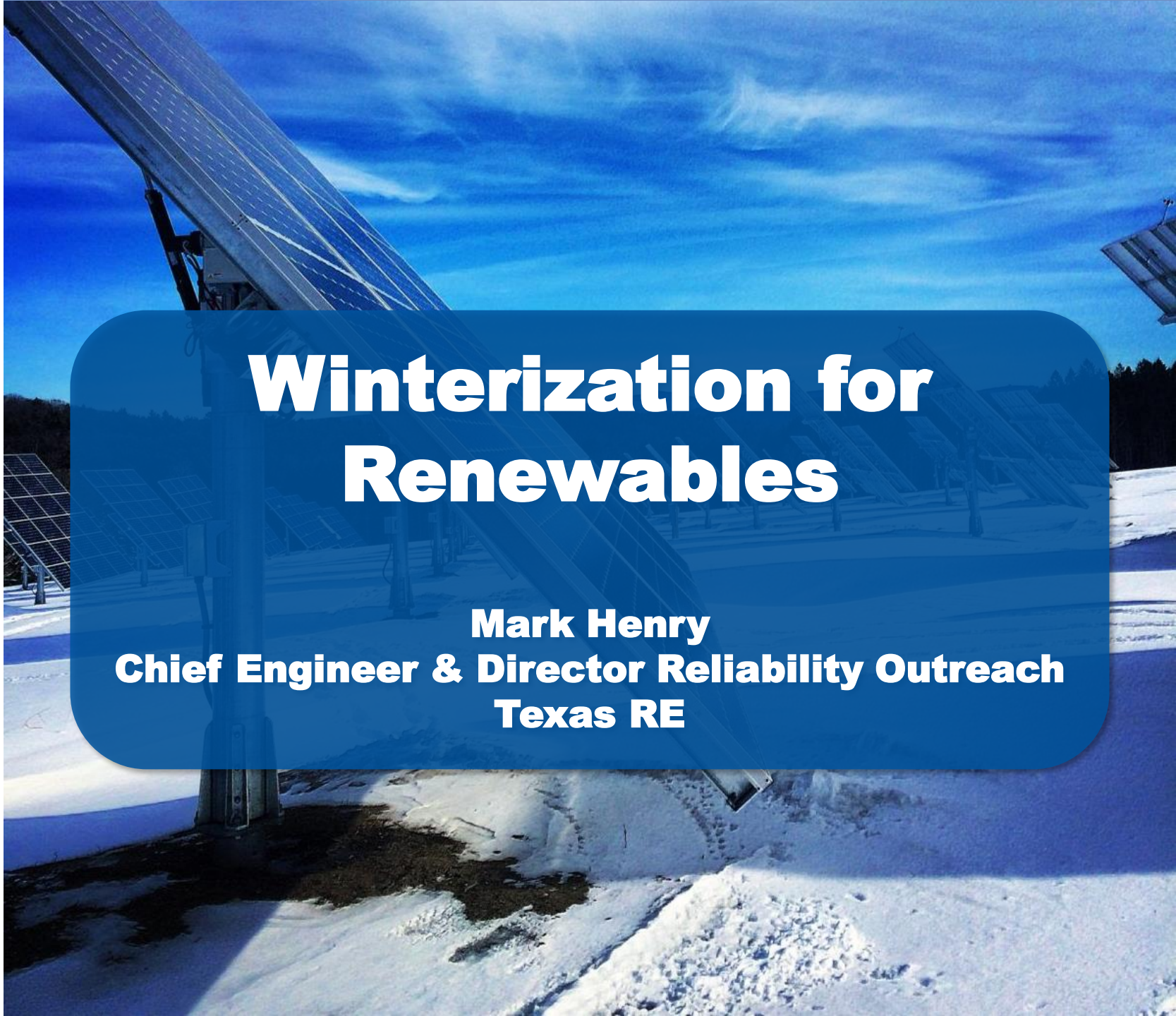
Kchaffin@proenergyservices.com
Director of O&M

TEXAS RE



Winterization for Renewables

Mark Henry
Chief Engineer & Director Reliability Outreach
Texas RE

Observations from Winter Storm Uri Data Requests

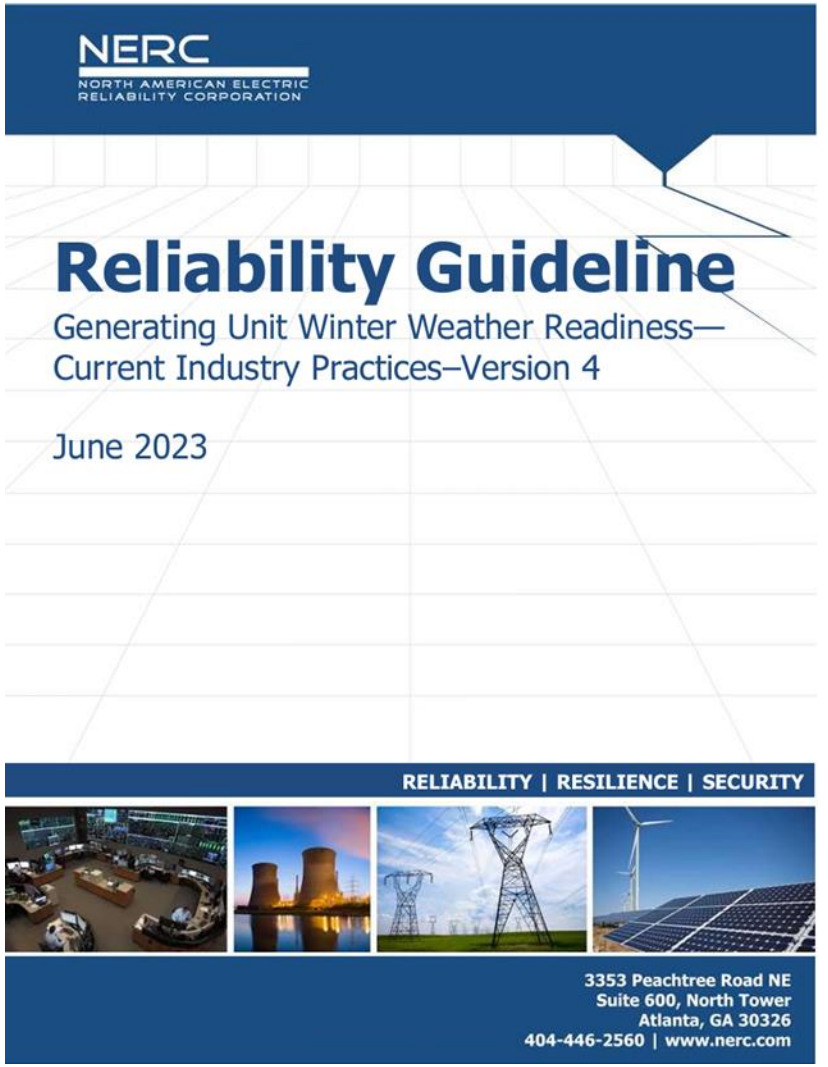
The following slides contain extracts from responses furnished for the ERO FERC Inquiry, anonymized and paraphrased, showing some of the problems encountered as well as solutions applied before, during and after February 2021.

They are offered to provide additional details not covered in the report and promote awareness of potential trouble spots, as well as best practices.

Ice-free sonic wind sensor with integrated heating (dotted line)

Generator Winter Readiness Guideline

- Safety
- Management Roles and Expectations
- Processes and Procedures
- Evaluation of Potential Problem Areas with Critical Components
- Testing
- Training
- Communications



Inverter-Based Resources Recommendation Guidelines

- Check adequacy of tracking systems' lube oil for expected temperature during cold weather
- Check accessibility of roads throughout the facility
- Ensure anemometer functionality
- Ensure freeze protection measures, such as antifreeze or heaters, to address expected temperatures for a location
- Ensure winterization measures for battery systems and liquid-cooled inverters
- Ensure blade de-icing capabilities are known

Potential Problem Areas – Temperature in Enclosed Spaces

Controls and lubricating systems can be affected – examples:

- HVAC units faulted due to low temperatures, causing the Battery Management System (BMS) to fault and Plant Control System (PCS) to turn off. The BMSs were successfully reset after both faults, but the PCSs could not be reset until the ambient temperature within each unit increased.
- Considering the wind chill factor, cabinet temperatures were below the design threshold of the inverter AC contactors
- Severe cold weather can affect the cooling system for each inverter. Such impact on one inverter can result in 4,000 KVA loss. To resolve this concern, glycol temperature check will be conducted once a year
- In October, staff will clean the filters in the inverters to increase their availability to support winter load on the BES and will test the operability of MET tower control box heaters
- Turbines experienced downtime primarily due to heating elements inside various control and electrical cabinets, including operating fluids such as oil, requiring adequate amount of time to warm-up to their required operating temperatures
- It is stated in the winterization plan that all cooling equipment for radiators should be disabled for cold weather events. Include heater testing in the maintenance cycle prior to the winter season
- Substation control house HVAC was inspected

Potential Problem Areas – Main Substation

Examples:

- **After several days of the icing derate with no load or generation to maintain operating temperatures of the main power transformer, the oil temperature reached ambient temperatures of less than -10°C and a low-level trip was activated. The OEM has been contacted to evaluate oil level tolerances that would provide additional cold temperature operating margin above the trip setpoint without creating adverse issues when the transformer oil expands during full load and higher ambient conditions.**
- **Took maintenance outage on MPT2 *[main power transformer]* to fix LTC2 *[load tap changer]* motor start switch; icing problem.**
- **Low SF6 gas pressure sensor tripped breakers. Breaker heating blankets could not maintain SF6 gas above minimum setpoint due to extreme cold temperatures. Equipment protection system in breakers performed as designed by tripping when safe SF6 gas pressure was below minimum limits because ambient temperature fell below operating minimum.**
- **Contractor will conduct visual inspection of the substation to ensure no debris has collected where it could cause an operational hazard …. (and) visual inspection of the transmission line connection to ensure the structures and cables are not damaged and do not present an operational hazard.**

Preseason Preparation Positives

"Cold weather parameter checks" *[design details]* has been added to the Cold Weather Preparation checklist

Entity performs annual in-depth inspection and maintenance of its turbines. Functional testing of heating elements of all control and electrical cabinets is a mandatory requirement. Also, inspection and functional testing of UPS system and verification of nitrogen accumulator pressure in the turbine emergency system

Entities annually verify that 1) heaters are operational, 2) that the ambient temperature sensor readings are accurate, and 3) SCADA systems are scanned for temperature related issues

Entity has added certain changes including: WTG cold weather-related parameter verification, substation UPS checks, backup generator inspection checklist, Supplemental Winter Preparation Checklist (contains O&M facility and vehicle-specific items)

The backup generator *[in the substation]* is tested monthly and the applicable fuel supply is measured on the same interval

Operations Timeframe Activity

Emergency Response Team (ERT) was activated prior to the storm to provide support and coordination for all assets. Activation of the ERT triggers daily meetings and coordination across a broad geographic area. Personnel were mobilized and staged throughout the highest impacted locations; engineering teams were activated for technical support across all technologies

As part of the response to the event notifications, all non-critical maintenance work was stopped prior to the storm

Discussed individually with staff and in morning meetings to ensure adequate facility preparations, water, drip in faucets, site staffing, safety, and maintenance during extreme cold, maintaining proper derate values in outage request for accurate HSL

Inspections were carried out daily for substation generators, faults on the 138Kv line and for communication loss. Visual inspections using binoculars and drones were conducted at a safe distance. Weather conditions were monitored to verify when temperatures would reach a point for the ice to melt on the turbine blades

The entity had meetings to discuss road conditions, safe access, vehicle and travel safety

Additional nitrogen was ordered to ensure any blade pitch accumulators requiring attention during the cold weather could be attended to. Site vehicles were verified to have enough fuel to allow for proper operation as required

Wind Turbine Low Temperature Limits Actions on the Spot

Derates and turbine faults occurred due to extreme cold weather. Prior to this event the facility had not experienced sustained low temperatures of this magnitude. Minimum ambient operation temperature was changed from -15C to -30C. This change remains in place to help avoid future problems.

Turbines began faulting for low ambient temperature on the evening of the 14th. Vendor G Engineering confirmed that the turbine components were properly rated for the *Vendor Optional Equipment* parameters, so those parameters were updated immediately.

Turbine parameters are set to shut down the controllers when the cabinet temperature reaches 0 Celsius. A vendor gave temporary approval to lower the parameters to -20C for the duration of the event.

TEXAS RE
Ensuring electric reliability for Texans

Wrap-Up

Thank you for coming!

You will receive a short survey via e-mail. Please complete it to help Texas RE develop future outreach.