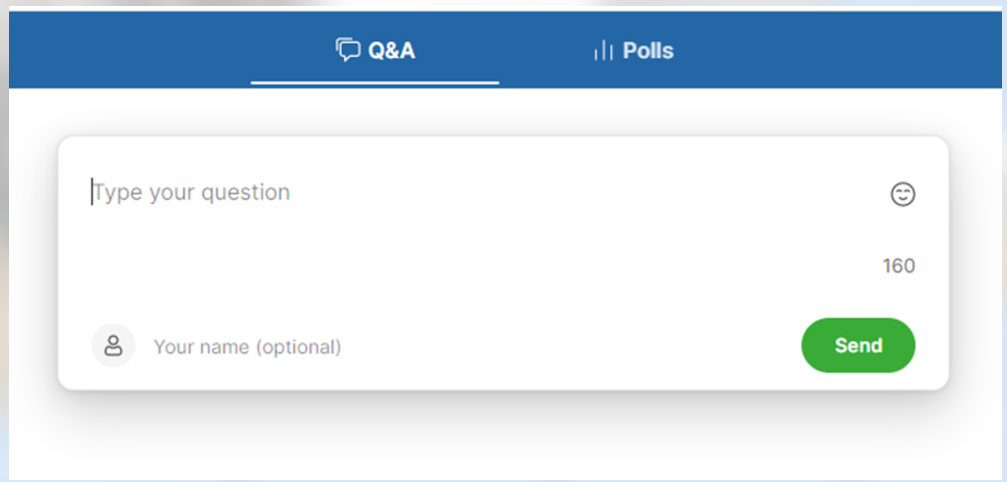
Day 2: September 21, 2022

Begins at 9:00 a.m. Central

- FERC and ERO Report – Update on Winter Weather Standards
- PUCT Winterization Activities Update
- Railroad Commission Winterization Actives Update
- ERCOT Winterization Activities Update
- 2022-23 Preliminary Winter Weather Outlook and Review of Historical Winter Extremes
- Thermal Generator Winter Weather Prep and Lessons Learned
- Renewable Generation Winter Weather Prep and Lessons Learned

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



Welcome and Instructions

Matthew Barbour– Texas RE
Manager, Communications and Training

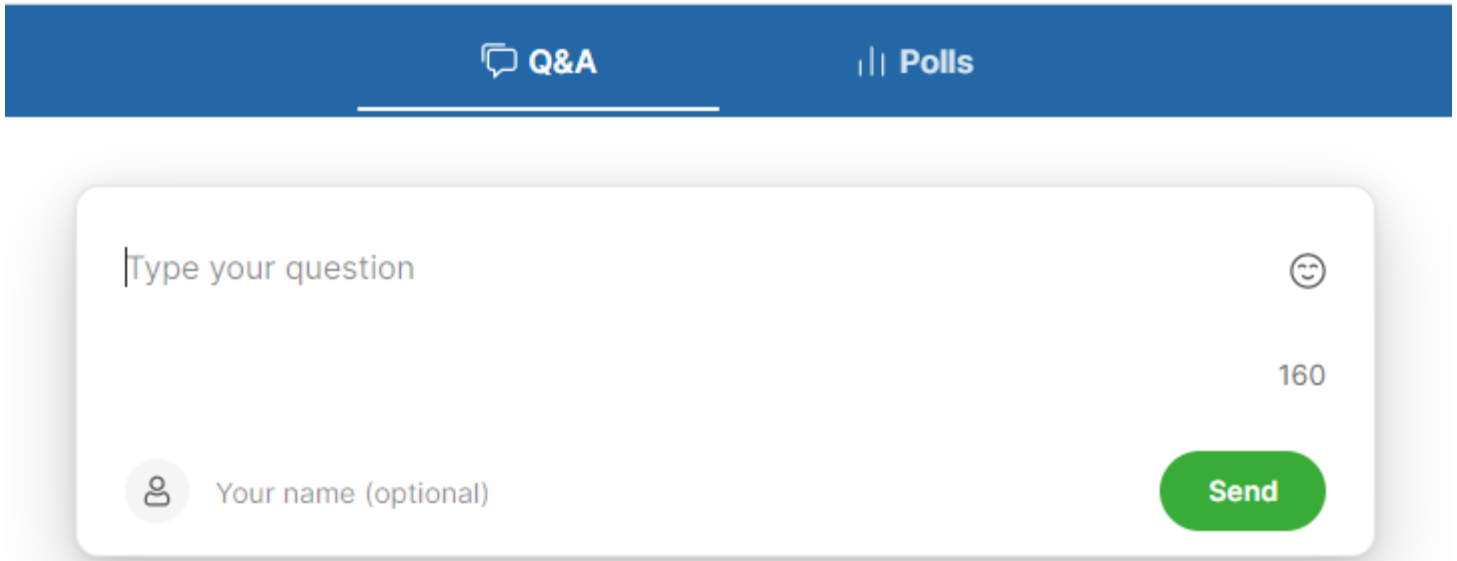
Antitrust Admonition

Texas Reliability Entity, Inc. (Texas RE) strictly prohibits persons participating in Texas RE activities from using their participation as a forum for engaging in practices or communications that violate antitrust laws. Texas RE has approved antitrust guidelines available on its website. If you believe that antitrust laws have been violated at a Texas RE meeting, or if you have any questions about the antitrust guidelines, please contact the Texas RE General Counsel.

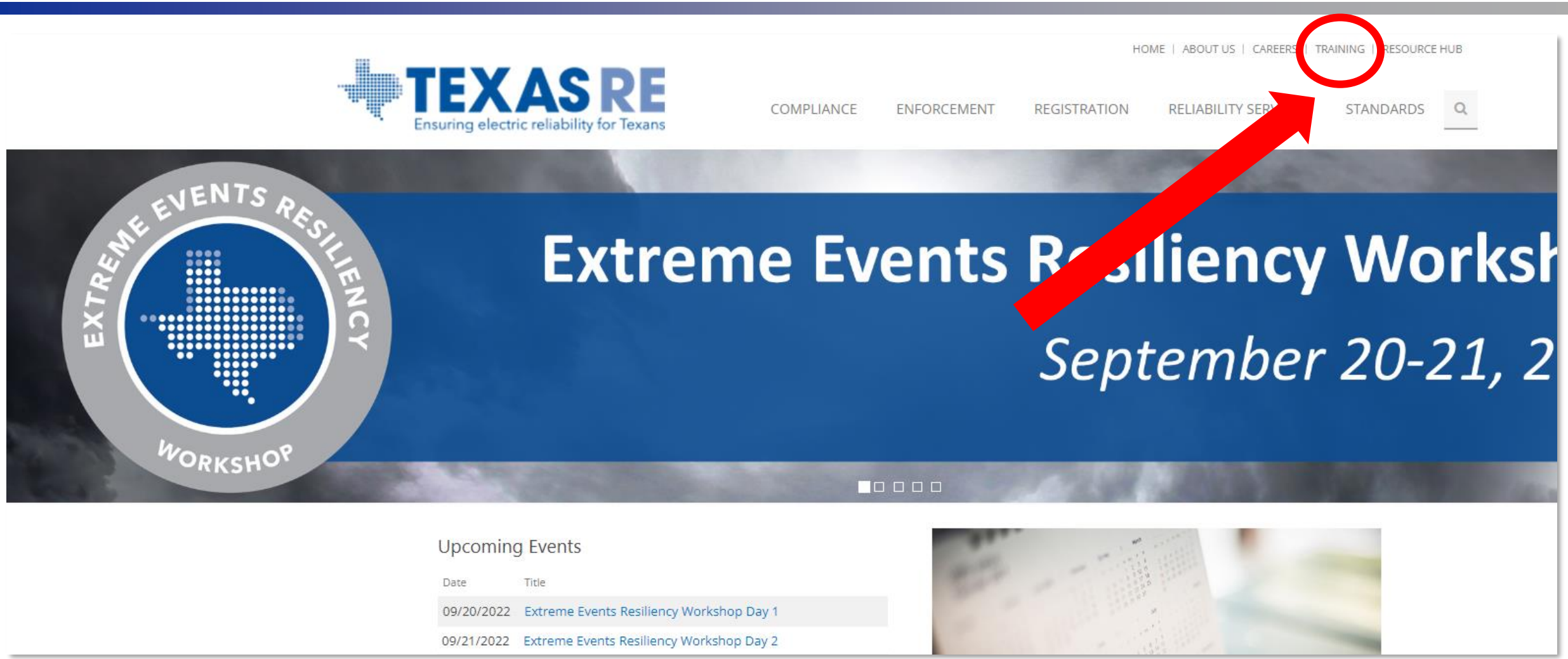
Notice of this meeting was posted on the Texas RE website and this meeting is being held in public. Participants should keep in mind that the listening audience may include members of the press, representatives from various governmental authorities, and industry stakeholders.

Questions

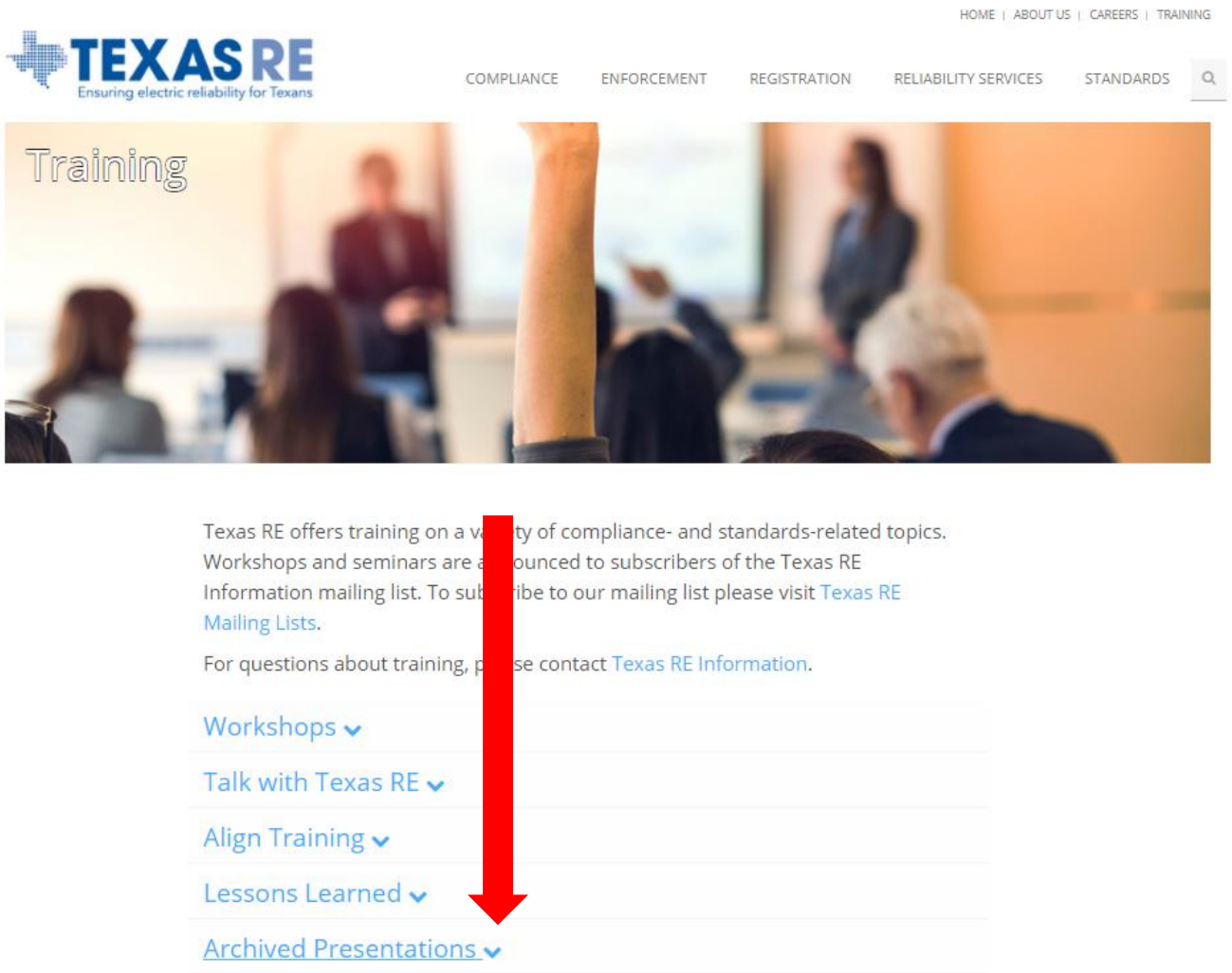
To submit questions during the workshop, please visit **slido.com** and enter today's participant code: **TXRE**



Workshop Materials



Training Page



Acronym Guide

09/22/2022	NSRF Meeting
10/06/2022	Monitoring and Situational Awareness Technical Conference
10/20/2022	NSRF Meeting
10/20/2022	Monitoring and Situational Awareness Technical Conference
10/27/2022	Fall Standards, Security, and Reliability Workshop
11/08/2022	Talk with Texas RE: CIP-008
11/09/2022	NERC Board of Trustees Meeting
11/09/2022	Energy Industry Vendors Summit
11/10/2022	NERC Board of Trustees Meeting
11/17/2022	NSRF Meeting
12/01/2022	Talk with Texas RE: Virtualization BCSI in the Cloud
12/08/2022	Talk with Texas RE: Certification

News

Align Page

Helpful Links

Texas RE Info Sheet
Acronym Guide
Mailing List
Texas RE Welcome Packet
Ethics Hotline
Texas RE Extranet Instructions
WebCDMS

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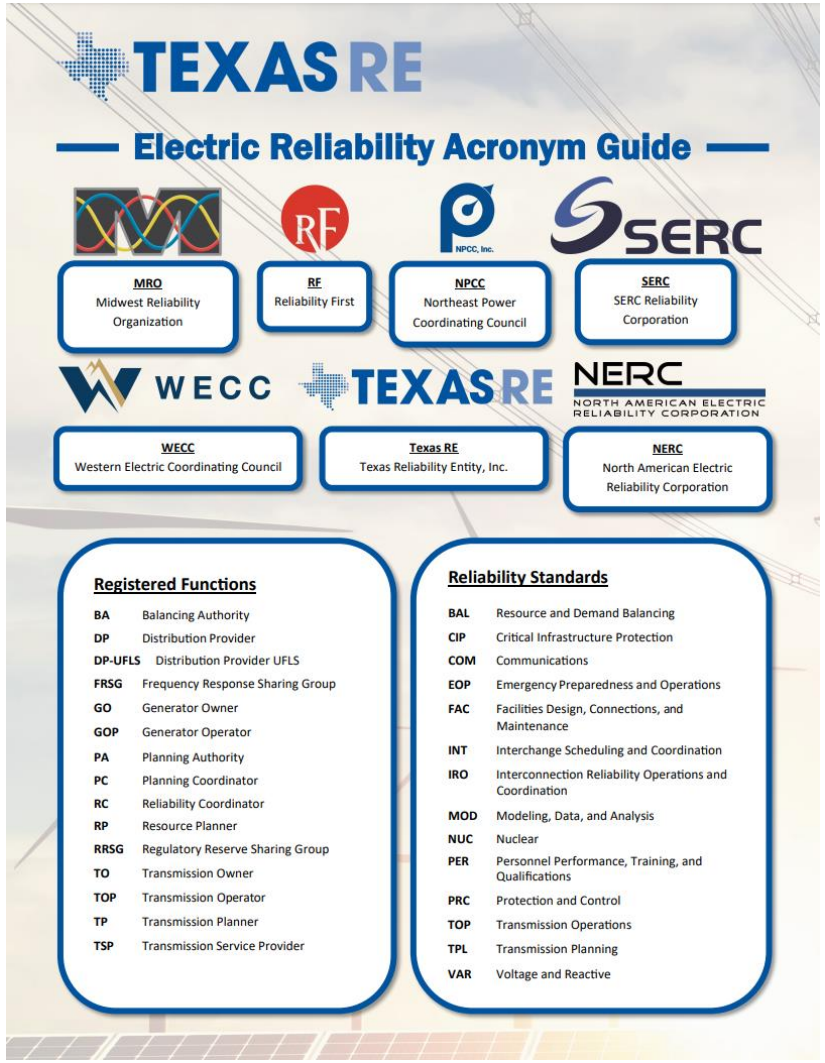
Email Us
8000 Me
Texas 78
512-583-
Texas RE



Social Media

/texas-reliability-entity-inc

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TEXAS RE
Ensuring electric reliability for Texans

EXTREME EVENTS RESILIENCY WORKSHOP

Executive Welcome
Jim Albright
Texas RE President & CEO

FERC and ERO Report - Update on Winter Weather Standards

Mark Henry – Texas RE
Director, Reliability Services & Registration

Agenda

- ERO-FERC Inquiry Follow-up
- Project 2021-07
- Other Winter- Related Activities

February 2021 Event Joint Inquiry Report

February 2021 Cold Weather Outages in Texas And South-Central United States

- **Regions Affected: MISO South, SPP, and ERCOT**
- **Joint Inquiry Participants: FERC, NERC, MRO, NPCC, RF, SERC, Texas RE, WECC, DOE, and NOAA**
- **Published November 2021**
- **28 Recommendations (not all applicable to NERC and Regions**
  - Nine key recommendations, including Reliability Standards changes
  - Five recommendations for further study
  - Each has recommended timeframes for implementation
    - before Winter 2021/2022
    - before Winter 2022/2023
    - before Winter 2023/2024

Most are recommended within these timeframes

Full Report

Recommendation 1 – Generator Winter Standard Revisions

- Standards Authorization Request (SAR) Posted for comment November 2021 with 10 Recommendations based on Joint Inquiry
- Standards Committee accepted revised SAR February 25, 2022, and authorized drafting team to begin work in two phases
- Standards Drafting Team (SDT) developed and posted initial version for public comment and ballot ended June 21, 2022
- SDT modified draft and posted second version on August 3, 2022

Project 2021-07 SAR Phase 1 Due Winter 2022/2023

Develop and implement corrective action plan (CAP) for identified equipment of outages, failures to start, or derate

Conduct annual unit-specific cold weather preparedness training

Retrofit existing generating units and design new units to operate to specified ambient temperature and weather conditions

Load shed procedures should only be used for manual load shed as a last resort and should start with the final stage

Proposed EOP-011-3 Emergency Operations

Operator-control manual load shed procedures must account for the following:

- Minimize overlap between circuits designated for manual load shed, UVLS/UFLS or critical loads
- Limit utilization of UFLS/UVLS circuits for manual load shed to situations warranted by system conditions
- Passed first ballot in June

EOP-012-1 Extreme Cold Weather Preparedness and Operations

EOP-012-1 is a new standard split from EOP-011-2 to separate generation requirements related to extreme cold weather.

Requirements R3 and R5 are carried over from EOP-011-2 (R7 and R8), which was revised under Project 2019-06 Cold Weather, Note EOP -11-2 is still effective April 1, 2023.

Requirements R1, R2, R4, and R6 are new requirements.

Summary:

- R1 – freeze protection criteria and updates to freeze protection systems
- R2 – exclusion basis with 5-year review
- R3 – cold weather preparedness plans
- R4 – 5-year review of minimum temperatures, cold weather plans and freeze protection measures
- R5 – annual training on cold weather preparedness plans
- R6 – corrective action plans for freezing events

Second Ballot Results – Ballot ended 9/1/2022

Passed!

	Ballot	Non-binding Poll
Standard	Quorum / Approval	Quorum / Supportive Opinions
EOP-012-1	91.40% / 69.43%	89.00% / 72.36%
Implementation Plan	90.71% / 78.70%	

Project 2021-07 Next Steps

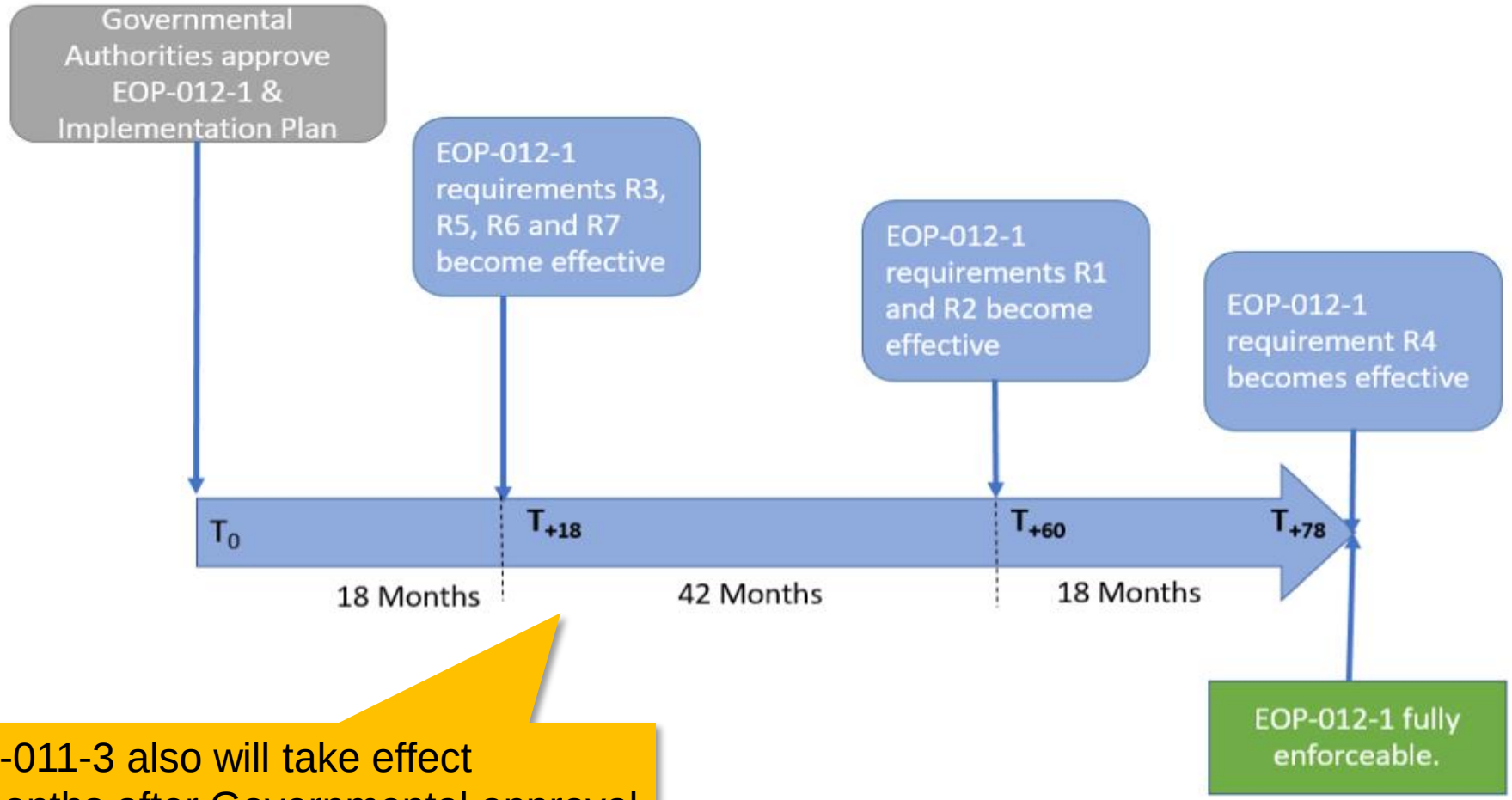
Final ballot in late September – minimal changes expected

NERC Board Approval expected in October 2022

FERC approval anticipated in late 2022

Again, requirements from EOP-011-2, which was revised under Project 2019-06 Cold Weather, take effect April 1, 2023.

EOP-012-1 Implementation Plan



EOP-011-3 also will take effect
18 months after Governmental approval

Project 2021-07 SAR Phase 2 Due Winter 2023/2024

- Identify cold weather critical components and systems for each generating unit
- Identify and implement freeze protection measures for the cold weather critical components and systems
- Account for effects of precipitation and accelerated cooling effect of wind when providing temperature data
- Determine the generating unit capacity that can be relied upon during “local forecasted cold weather”
- Operating plans should prohibit use for demand response of critical natural gas infrastructure loads
- Protect critical natural gas infrastructure loads from manual and automatic load shedding

Study Recommendations in the Joint Inquiry Report

Electric Generation and Grid Studies/Analysis

- Cold Weather Effects-Mechanical, Electrical Systems
- Generator Protection Settings/ UFLS Coordination
- Further Study of Additional ERCOT Interconnection Links
- Further Study of ERCOT Black Start Unit Reliability
- ERCOT Generators to Review Low-Frequency Effects
- Further Study of Low-Frequency Effects in Eastern and Western Interconnections

Gas-related and other Recommendations in the Report

Electric/Natural Gas Operations, Coordination Improvements	• Further study of Critical Natural Gas Loads Identification • Develop/enhance Emergency Response Centers
Natural Gas Facility Winter Preparedness	• Require Natural Gas Cold Weather Preparedness Plans • Establish Natural Gas -Electric Reliability Forum • Further Study to Address Natural Gas Supply Shortfalls • Natural Gas Facility Freeze Protection Measures (voluntary) • Natural Gas Production Facilities SCADA Control
Electric Generation and Demand Incentives and Initiatives	• Generator Compensation Opportunities - Retrofit Costs • Additional Rapidly-Deployable Demand Response • Retail Incentives for Energy Efficiency Improvements

Operational Recommendations in the Joint Inquiry Report

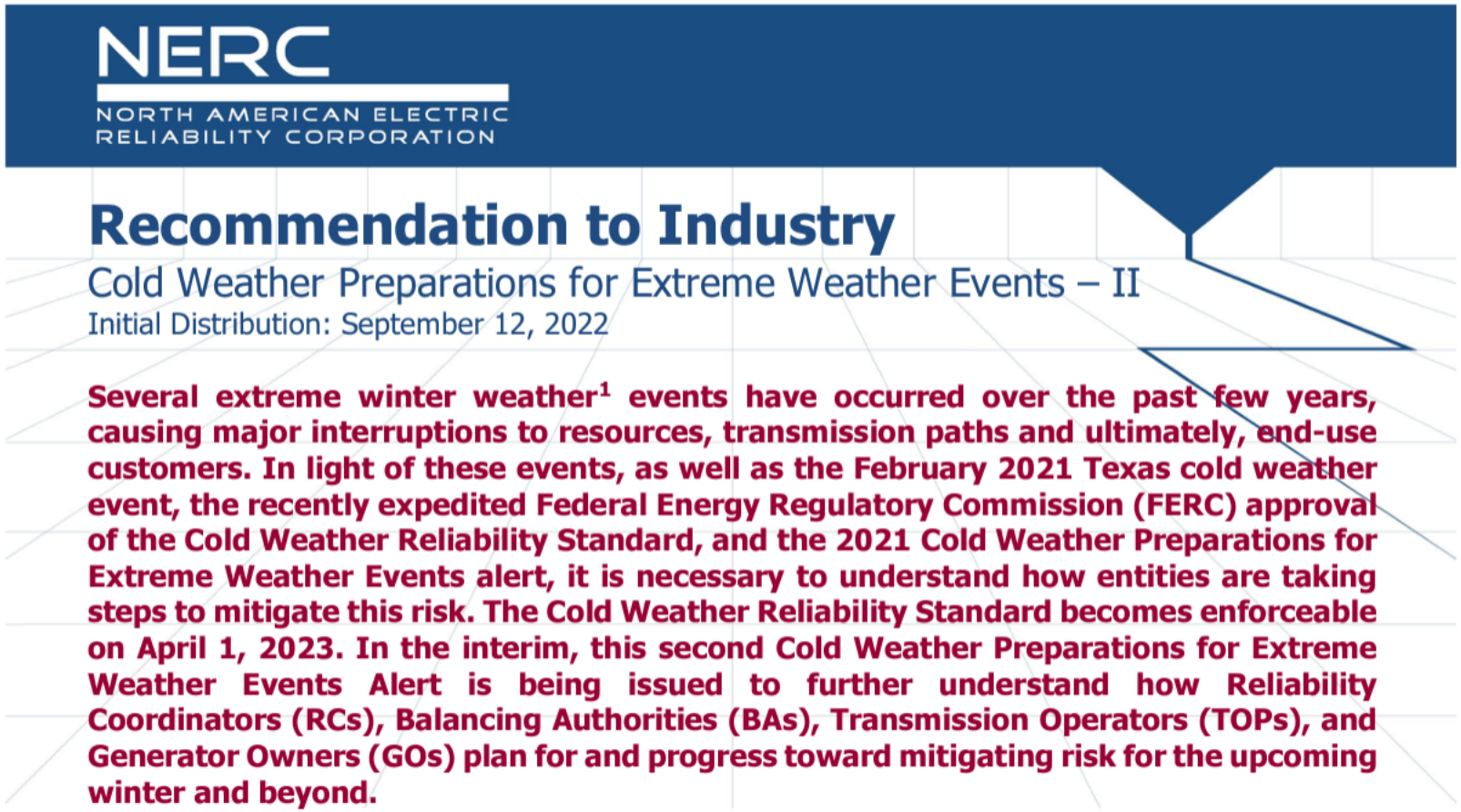
GO/GOP Winter Readiness Voluntary Improvements

- Understanding Generator Natural Gas Contract Risks
- Generator Use of Weather Forecasts for Operating Plans
- Freeze Protection Inspections and Maintenance Timing
- **Generator Winter Readiness Technical Conference – April 2022**

PC/RC/BA/TOP Winter Readiness Voluntary Improvements

- Operator-Training Rotational Firm Load Shed Simulations
- Improve Near-term Load Forecasts
- Analyze Intermittent Generation to improve Load Forecast
- Perform Bi-Directional Seasonal Transfer Studies
- Improve Rotational Load Shed Plans
- Report Times for Generation and Transmission Outages
- Peak Load Forecasts and Reserve Margin Calculations

Second NERC Alert on Cold Weather Preparedness



NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Recommendation to Industry

Cold Weather Preparations for Extreme Weather Events – II

Initial Distribution: September 12, 2022

Several extreme winter weather[1] events have occurred over the past few years, causing major interruptions to resources, transmission paths and ultimately, end-use customers. In light of these events, as well as the February 2021 Texas cold weather event, the recently expedited Federal Energy Regulatory Commission (FERC) approval of the Cold Weather Reliability Standard, and the 2021 Cold Weather Preparations for Extreme Weather Events alert, it is necessary to understand how entities are taking steps to mitigate this risk. The Cold Weather Reliability Standard becomes enforceable on April 1, 2023. In the interim, this second Cold Weather Preparations for Extreme Weather Events Alert is being issued to further understand how Reliability Coordinators (RCs), Balancing Authorities (BAs), Transmission Operators (TOPs), and Generator Owners (GOs) plan for and progress toward mitigating risk for the upcoming winter and beyond.

- Reporting and approval required by October 6, 2022
- Questions included for RC, BA, TOP, and GO functions.
- Generator questions broken down by types – coal, gas, wind and solar
- Eight recommendations covering extreme winter weather preparation and operations.

Other Activities

- NERC Winter Guideline Revisions
- NERC Winter Seasonal Assessment
- FERC NOPR (RM22-10-000) on Transmission System Planning Performance Requirements for Extreme Weather – issued June 16, 2022
- PUCT Rulemakings and ERCOT Rules
- Texas Railroad Commission Rule Changes

Resources

February 2021 Cold Weather Outages in Texas and the South Central United States (Joint Inquiry Report)

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

TEXAS RE
Ensuring electric reliability for Texans

PUCT Winterization Activities Update

Thomas Gleeson
PUCT, Executive Director

Senate Bill 3

Required the weatherization of all generation and transmission infrastructure

Requires ERCOT to perform inspections of facilities to ensure compliance with standards

Directs ERCOT to perform load shed exercises prior to winter and summer

Creates the Electric Supply Chain Security and Mapping Committee

Directs the PUC to redesign the ERCOT market with a focus on sustained reliability

Formalizes the Texas Energy Reliability Council

PUC TEXAS

Electric Infrastructure Weatherization

Weatherization Rules Phase 1 – Adopted October 1, 2021

- Requires electric generation and transmission equipment to comply with winter weather readiness recommendations.
  - Generation – 2012 Quanta Technology Report on Extreme Weather Preparedness Best Practices
  - Transmission – 2011 FERC/NERC Report on Outages & Curtailments
- Directs companies to repair known, acute onset issues resulting from Winter Storm Uri

PUC TEXAS

Electric Infrastructure Weatherization

Weatherization Rules Phase 2 – Published May 26, 2022

- Requires weather emergency preparation measures reasonably expected to ensure sustained operation during winter and summer
- Requires use a 95th percentile min/max temperature standard for both hot and cold weather requirements
- Requires ERCOT to inspect each generation resource at least once every three years
- Requires ERCOT to inspect at least 10% of TSP substations or switchyards at least once every three years

PUC TEXAS

Firm Fuel Supply Service

Purpose: Firm Fuel Supply Service (FFSS) provides additional grid reliability and resiliency during extreme cold weather and compensates generation resources that meet a higher resiliency standard.

Implementation: ERCOT procures Firm Fuel Supply Service Resources (FFSSRs) to provide FFSS using a Request-for-Proposal (RFP) process. ERCOT issued the RFP for the next contact term (November 15, 2022, through March 15, 2023) on June 30, 2022.

Eligibility: Natural gas generation resources with on-site fuel or off-site storage with the entity owning and controlling the storage and pipeline to deliver the gas.

Procurement: ERCOT will procure 3,000-4,000 MW of FFSS at a cost not to exceed $54 Million for the obligation period covered by this RFP. ERCOT may procure more or less than this range depending on the specific offers received.

Future: The PUC continues to discuss ideas centered on increasing the procurement and expanding the eligibility requirements.

PUC TEXAS

Mapping Committee Overview

Purpose

- Map the electricity supply chain
- Identify key critical infrastructure sources in the electric supply chain
- Establish best practices for extreme weather preparation
- Designate priority service needs

Members

- PUC and RRC Executive Directors
- TDEM Chief
- ERCOT CE0

Meetings

- Committee met monthly since summer 2021, including 2 public meetings
- 6 working groups met multiple times each month

Map Adopted – April 29, 2022

- 65,000 facilities
- 60,000 miles of electric transmission lines
- 21,000 miles of gas transmission pipelines

PUC TEXAS

Questions?

PUC TEXAS

Railroad Commission of Texas

Railroad Commission Winterization Activities Update

Natalie Dubiel
Attorney, Office of General Counsel

Introduction

- Required by Senate Bill 3
- RRC had to adopt rules no later than 6 months following the production of the Texas Electricity Supply Chain Security and Mapping Committee map
- Map was adopted early; therefore Rule 3.66 was adopted early

Introduction

- Electricity Supply Chain Map was adopted on April 29, 2022
  - RRC had until October 29, 2022 to adopt weatherization rule
- Proposed on June 28, 2022
- Adopted on August 30, 2022
- Effective on September 19, 2022
- Must be implemented by required facilities no later than December 1, 2022

(a) Applicability

- Rule 3.66 applies to individual facilities
  - Gas Supply Chain Facilities; and
  - Gas Pipeline Facilities

- An operator under the RRC's jurisdiction may have only a portion of its total facilities subject to Rule 3.66

(a) Applicability

- Gas Supply Chain Facility
  - Included on the Electricity Supply Chain Map; and
  - Designated as critical in Rule 3.65 (relating to *Critical Designation of Natural Gas Infrastructure*)

(a) Applicability

- Gas Pipeline Facility
  - Directly serves a natural gas electric generation facility operating solely to provide power to the electric grid for the Electric Reliability Council of Texas (ERCOT) power region or for the ERCOT power region and an adjacent power region; and
  - Included on the Electricity Supply Chain Map

(c) Preparedness Standards

- By December 1 of each year, an operator of a facility must “implement weather emergency preparation measures intended to:
  - Ensure sustained operations during a weather emergency; and
  - Correct weather-related forced stoppages that prevented sustained operation due to previous weather emergencies

(c) Preparedness Standards

- By December 1 of each year, an operator of a facility must “implement weather emergency preparation measures intended to:

  1. Ensure **sustained operations** during a weather emergency; and
  2. Correct weather-related forced stoppages that prevented sustained operation due to previous weather emergencies

(c) Preparedness Standards

- Sustained Operations
  - Safe operation of a gas pipeline facility or a gas supply chain facility such that the facility does not experience a major weather-related forced stoppage or weather-related forced stoppage in production, treating, processing, storage, or transportation of natural gas.

(c) Preparedness Standards

- By December 1 of each year, an operator of a facility must “implement weather emergency preparation measures intended to:
  - Ensure sustained operations during a **weather emergency**; and
  - Correct weather-related forced stoppages that prevented sustained operation due to previous weather emergencies

(c) Preparedness Standards

- Weather Emergency
  - Weather conditions such as freezing temperatures, freezing precipitation, or extreme heat in the facility's county or counties that result in an energy emergency as defined by §3.65
  - A weather emergency does not include weather conditions that cannot be reasonably mitigated such as tornadoes, floods, or hurricanes

(c) Preparedness Standards

- Weather Emergency
  - Energy Emergency is defined in Rule 3.65 as a firm load shed event
  - Rule 3.65 is currently proposed for amendments, including to broaden the definition of “Energy Emergency”
    - Comments are due October 12, 2022

(c) Preparedness Standards

- By December 1 of each year, an operator of a facility must “implement weather emergency preparation measures intended to:
  - Ensure sustained operations during a weather emergency; and
  - Correct **weather-related forced stoppages** that prevented sustained operation due to previous weather emergencies

(c) Preparedness Standards

- Weather Related Forced Stoppage
  - An unanticipated and/or unplanned outage in the production, treating, processing, storage, or transportation of natural gas that is caused by weather conditions such as freezing temperatures, freezing precipitation, or extreme heat and occurs during a weather emergency

(c) Preparedness Standards

- Major Weather-Related Forced Stoppage
  - A weather-related forced stoppage that is the result of the deliberate disregard of this section or that results in:
    A. a loss of production exceeding 5,000 Mcf of natural gas per day per oil lease;
    B. a loss of production exceeding 5,000 Mcf of natural gas per day per gas well;
    C. a loss of gas processing capacity exceeding 200 MMcf per day;
    D. a loss of storage withdrawal capacity exceeding 200 MMcf per day; or
    E. a loss of transportation capacity exceeding 200 MMcf per day

(c) Preparedness Standards

- By December 1 of each year, an operator of a facility must “implement **weather emergency preparation measures** intended to:
  - Ensure sustained operations during a weather emergency; and
  - Correct weather-related forced stoppages that prevented sustained operation due to previous weather emergencies

(c) Preparedness Standards

- Preparation Measures
  - Weatherization using methods a reasonably prudent operator would take given
    - the type of facility,
    - the age of the facility,
    - the facility's critical components,
    - the facility's location, and
    - weather data for the facility's county or counties such as data developed for the Commission by the state climatologist

(d) Weather Readiness Attestation

- By December 1 of each year, an operator shall submit the Weather Emergency Readiness Attestation.
- Attestation must:
  - Meet certification/signatory requirements
  - Include an attachment describing all activities engaged in by the operator to implement the requirements of subsection (c) of this section, including a description of the weatherization methods utilized by the operator to weatherize each type of facility

(e) Inspections

- RRC will inspect facilities to ensure compliance with Rule 3.66
- Will prioritize inspections of oil leases and gas wells producing greater than 5,000 Mcf per day of natural gas and facilities storing, processing, or transporting greater than 200 MMcf per day of natural gas
- Further prioritization in descending order in accordance with a facility's production volume or storage, processing, or transportation capacity

(e) Inspections

- Two types of inspections:
  - Inspections for preparedness based on Attestation
  - Weather Related-Forced Stoppages inspections

(f) Notifications

- Must immediately notify the RRC through the Critical Infrastructure online portal:
  - Weather-related forced stoppages that are not resolved within 24 hours
  - Weather-related forced stoppages that are due to loss of electric power that are not resolved within 24 hours

(f) Notifications

- Must call the RRC's Critical Infrastructure telephone number within 1 hour of discovery:
  - Major weather-related forced stoppages that are not resolved within 24 hours
  - Major weather-related forced stoppages that are due to loss of electric power that are not resolved within 24 hours

(f) Notifications

- Repeated or major weather-related forced stoppages may result in the requirement for an operator to contract with a “qualified person” to assess the operator’s weather emergency preparedness
- Operator required to submit a written assessment

(g) Enforcement

- Per Senate Bill 3, enforcement mechanisms are different depending on the type of facility
- However, enforcement for all types of facilities will utilize the same penalty classification table

(g) Enforcement

- Gas Supply Chain Facilities
  - RRC will pursue administrative violations of the rule for adjudication only
  - After an order finding a violation of Rule 3.66 has been entered by RRC, RRC will refer violation to the Office of the Attorney General
  - Office of Attorney General will file suit for collection of penalties utilizing Rule 3.66's penalty classification table

(g) Enforcement

- Gas Pipeline Facilities
  - RRC has administrative penalty authority
  - RRC will adjudicate alleged violations
  - If violation order is issued, RRC will collect penalties utilizing Rule 3.66's penalty classification table

Critical Infrastructure Division

- CID was formed shortly after Senate Bill 3 became effective
- 77 employees as of 9/1/2022
- Approximately 60 inspectors located throughout the state

Critical Infrastructure Division

- Conducts routine and targeted inspections
- Will work with RRC's Enforcement Section on violations
- Manages CID online filing system (Rule 3.65)
- Will manage weather-related forced stoppage notifications

Critical Infrastructure Division

- Winter 2021-2022
  - Conducted more than 4,800 field site visits to observe on-site preparations for winter
  - Over 22,000 wells comprised of approximately 2,703 producing gas wells, 14,353 producing oil wells, 5,784 injection or service wells, and 526 processing plants, and other pipeline facilities that directly and non-directly serve gas-fired generators
  - 100 percent (37) of the state's intrastate underground natural gas storage facilities

Critical Infrastructure Division

- Winter 2022-2023
  - Gearing up CID and its inspectors to implement Rule 3.66
  - Continuing site visits in advance of December 1, the implementation deadline of Rule 3.66

Thank you!

Natalie.Dubiel@rrc.texas.gov

ERCOT
Winterization Activities Update

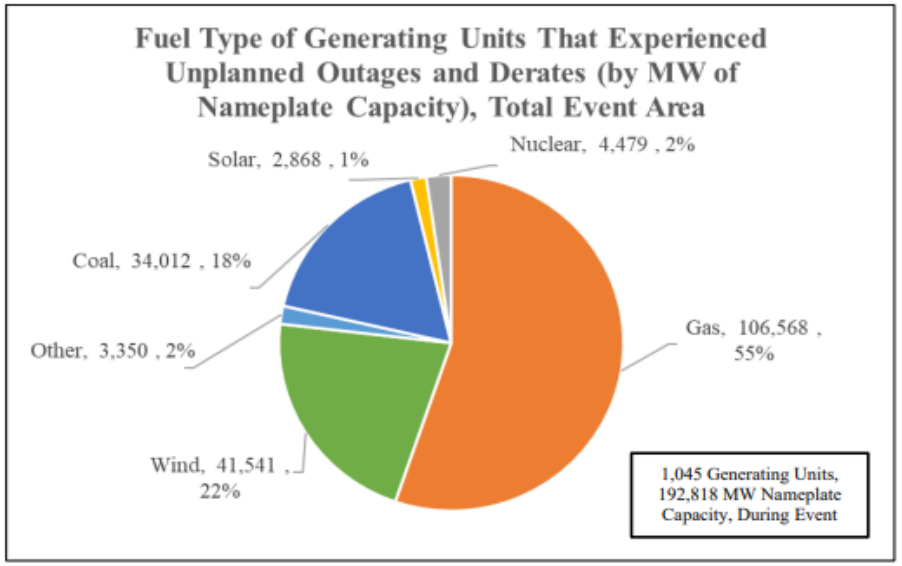
A Presentation at the Texas Reliability Entity's
Extreme Events Resiliency Workshop

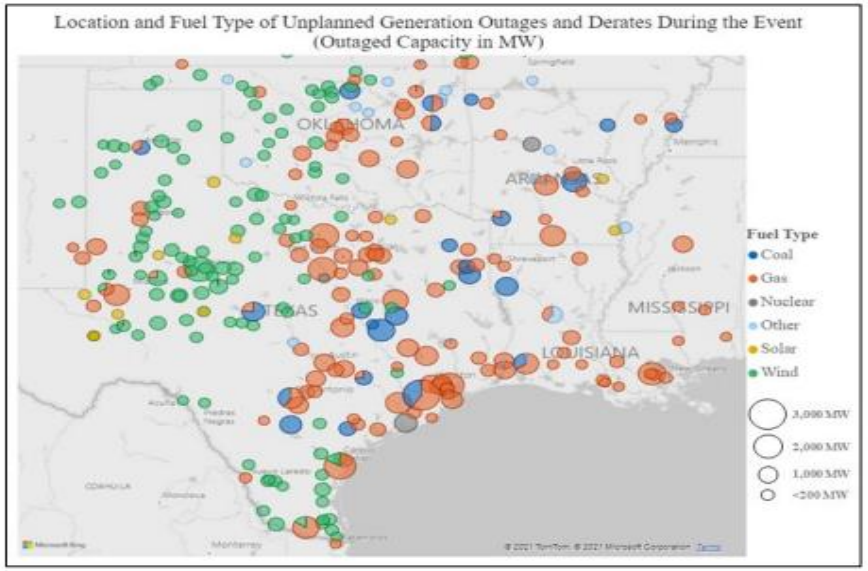
David Kezell
Director, Weatherization and Inspection
09/21/2022

Winter Storm Uri Impacts

The FERC-NERC-Regional Entity Staff Report: The February 2021 Cold Weather Outages in Texas and the South-Central United States described the following impacts from the winter storm.

- 1,045 BES generating units in Texas and the South-Central United States to experience 4,124 outages, derates, or failures to start between February 8 and 20, 2021.
- It was the largest controlled firm load shed event in U.S. history.
- More than 14 million people were ordered to boil drinking and cooking water.
- The deaths of more than 200 people in Texas were attributed to the power outages from causes including hypothermia, CO poisoning, and medical conditions exacerbated by freezing conditions.

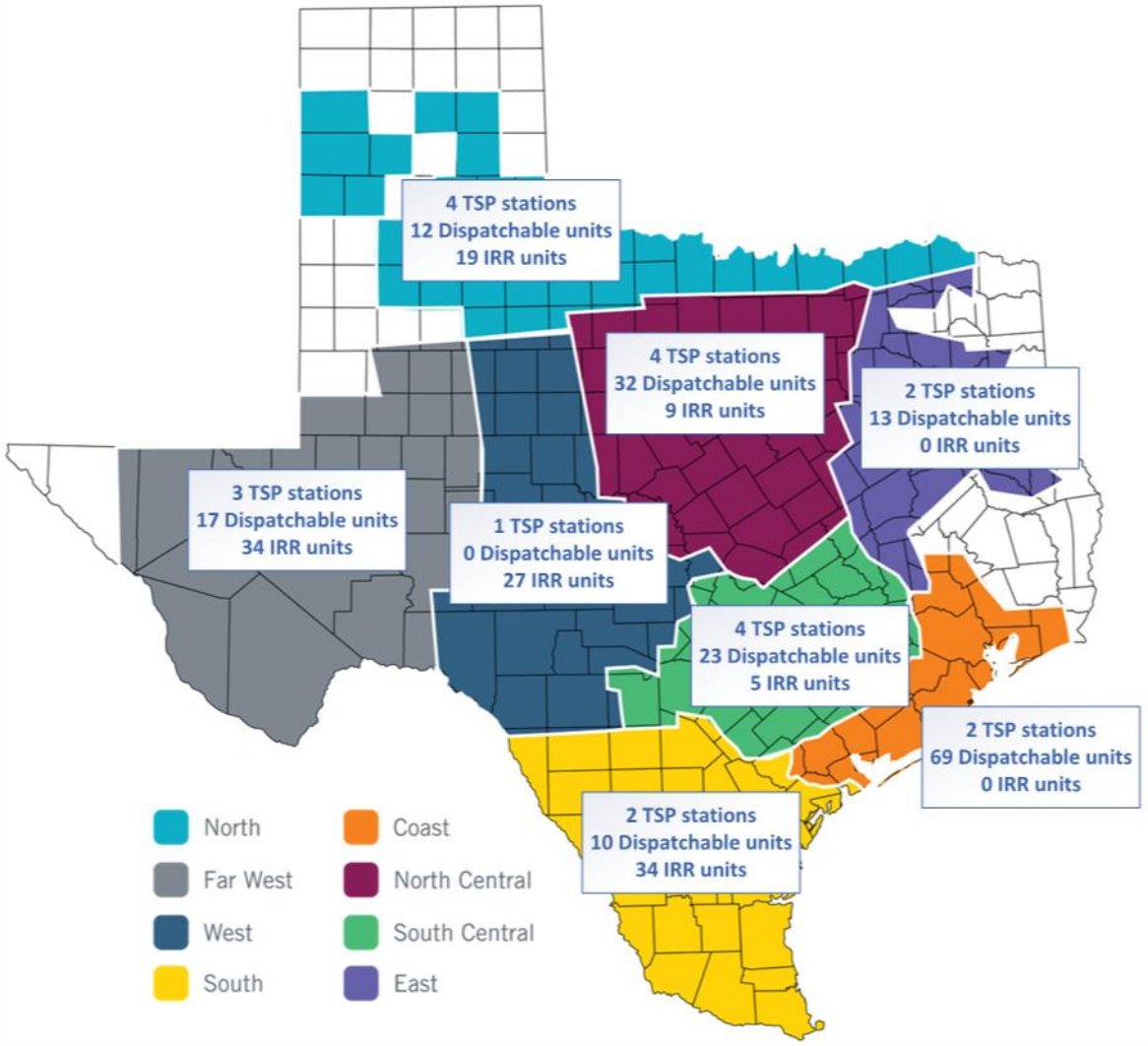




2021 Winter Weatherization Background

- Senate Bill 3 signed by Governor Abbott on June 8, 2021, requires weatherization of generation, transmission, and natural gas facilities.
- PUC Rule 25.55 (16 TAC § 25.55), finalized on October 19, 2021, established a first phase of winter weather emergency preparedness standards for generation and transmission facilities.
- New ERCOT Director of Weatherization and Inspection started October 11, 2021.
- Workshops held November 10 and 15, 2021, to instruct Market Participants (MPs) on ERCOT Winter Weather Readiness Report (WWRR) forms.
- ERCOT distributed WWRR forms to Resource Entities on November 12, 2021, and to TSPs on November 16, 2021.
- Market Participants submitted WWRRs on December 1, 2021.

December 2021 On-Site Weatherization Inspections



On-Site Inspections

22 Transmission
174 Dispatchable
128 IRR
324 Total

Completed between December 2, 2021, and December 22, 2021

Weatherization – Regulatory Developments

NERC

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

- Initial balloting issued in May 2022; second balloting issued in August 2022; final 8-day balloting period anticipated September 23-30, 2022.

Texas

- Senate Bill 3 signed by Governor Abbott on June 8, 2021, required weatherization of generation, transmission, and natural gas facilities.

- Phase I of PUC Rule 25.55 (16 TAC § 25.55), finalized on October 19, 2021, established winter weather emergency preparedness standards for generation and transmission facilities.

- Phase II of PUC Rule 25.55 (16 TAC § 25.55), draft published on May 19, 2022, establishes winter and summer weather emergency preparedness standards for generation and transmission facilities. Proposal for Adoption reviewed at 9/15/22 PUCT Open Meeting, not yet adopted.

- Railroad Commission of Texas adopted a rule on August 30, 2022, requiring implementation of weather emergency preparation measures intended to ensure sustained operations of natural gas infrastructure.

ERCOT Historical Weather Study

- ERCOT, in consultation with the Office of the Texas State Climatologist, developed a report providing various historical weather data. ERCOT submitted this report to the PUC on December 15, 2021. A revision was submitted in July 2022. It is found at https://interchange.puc.texas.gov/Documents/52691_6_1221755.PDF.

- Data from this report is referenced in the draft phase II weather emergency preparedness reliability standards.

Weather Zone	95th Percentile Minimum Average 72-Hour Temperature (Table 69)	95th Percentile Maximum Average 72-Hour Temperature (Table 67)
North	8.7°	96.1°
North Central	14.6°	95.4°
West	11.9°	92.9°
Far West	12.8°	92.7°
East	15.4°	91.6°
Coast	21.3°	90.1°
South Central	20.6°	92.3°
Southern	25.8°	88.9°
Valley	29.1°	88.6°
Panhandle	1.8°	90.3°

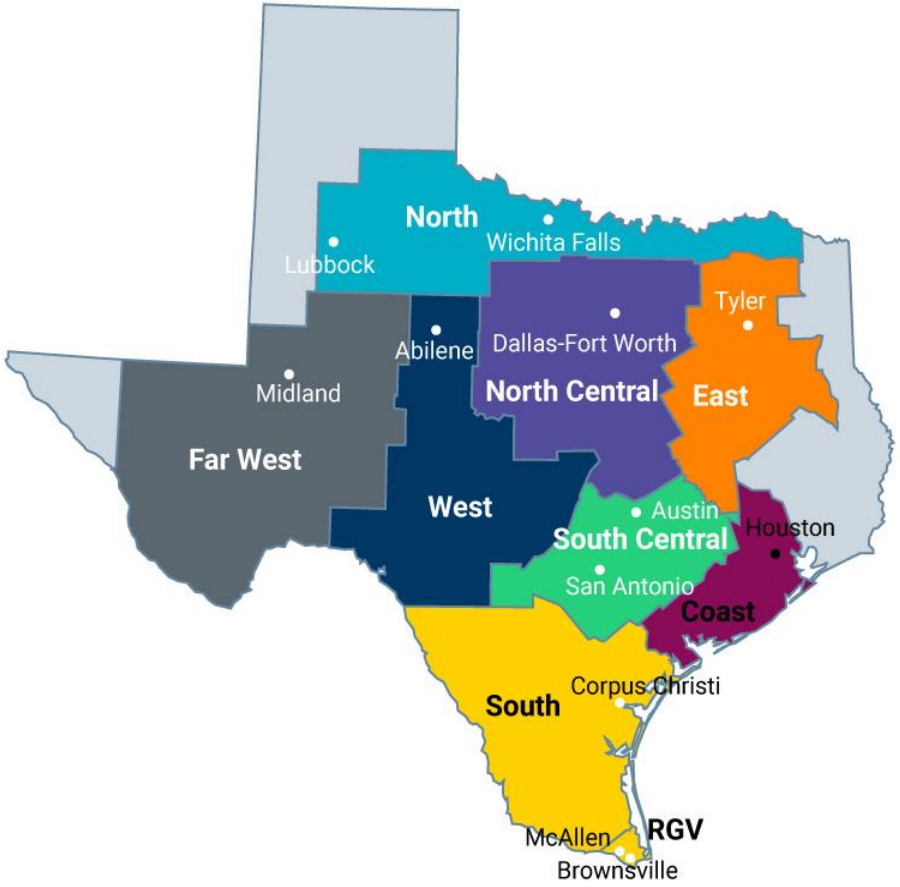
Draft Phase II PUC Rule § 25.55

- The draft 16 TAC §25.55 requires market participants to:
  - Establish and maintain weather preparation measures for both winter and summer seasons.
  - Make notarized declarations of preparedness in both summer and winter.
  - Beginning in 2023, create a list of all hot and cold weather critical components.

- Beginning in 2023, the rule establishes weather-zone-specific cold and hot temperatures at which MPs must implement measures reasonably expected to ensure sustained operation.

- ERCOT is responsible to:
  - Deliver biannual reports that address whether each GE and TSP has submitted a declaration.
  - Develop winter and summer inspection checklists for resources and TSPs.
  - Inspect to determine compliance (every resource 1x/3yr, 10% of TSP facilities 1x/3yr).
  - Provide inspection reports and establish cure periods for identified deficiencies.
  - Report to commission staff any entity that does not cure its deficiency(ies) within the cure period.
  - File an historical weather study every five years, next one in 2026.

ERCOT Inspection Team Development



- Developing an Inspector Training Program
- Hiring Inspectors
- Inspectors, with or without supplemental contracted support, will perform the on-site and/or remote inspections
- Declarations of preparedness as well as inspection reports will be treated as Protected Information and only be shared with the inspected party and the PUCT

Key Takeaways

- Effective weatherization of all facilities is essential to reliability during extreme cold and extreme hot weather conditions.

- Market Participants demonstrated high levels of compliance in Winter 2021-22.

- Going forward, inspections will occur in winter and summer for both generation resources and transmission facilities.

- The ERCOT Weatherization & Inspection Team
  - Anticipates hosting fall workshops for generation and TSP personnel to help prepare for winter
  - Conducts inspections to determine whether weatherization criteria are met
  - Provides reports:
    - To PUCT biannually addressing whether MPs have submitted declarations of preparedness
    - To MPs for each inspection of their facilities
    - To PUCT, if any Market Participant does not remedy deficiencies within an established cure period
  - Contribute to the increased reliability of the ERCOT Bulk Electric System

2022-23 Preliminary Winter Weather Outlook

Chris Coleman
ERCOT Sr. Meteorologist

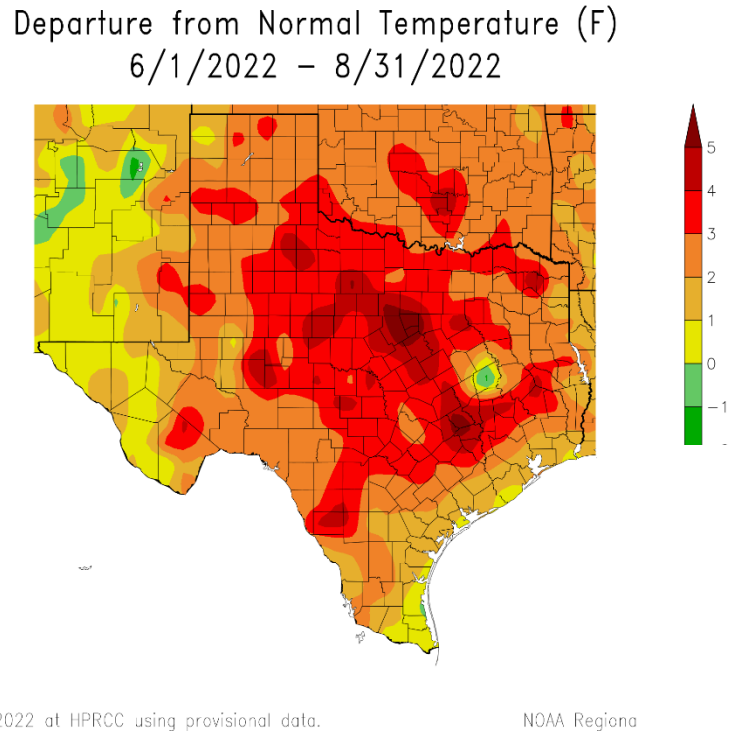
Generator Weatherization Workshop
Sep 21, 2022

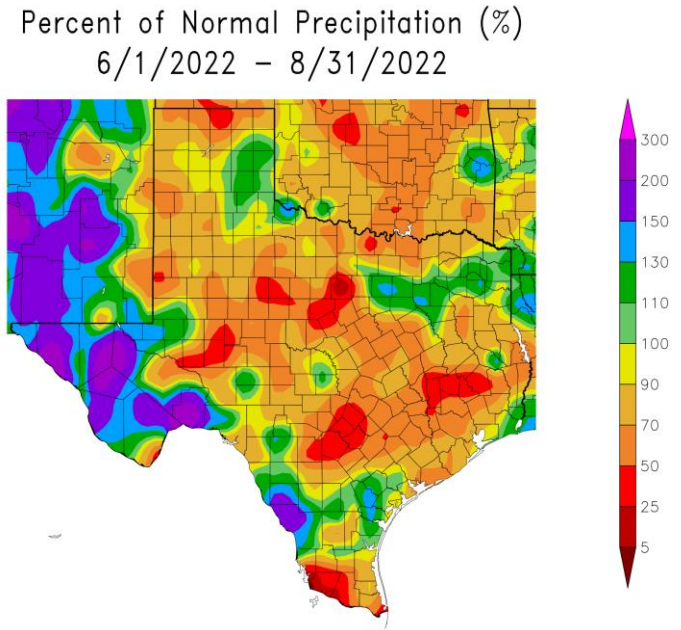
Agenda

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

Updating Summer 2022

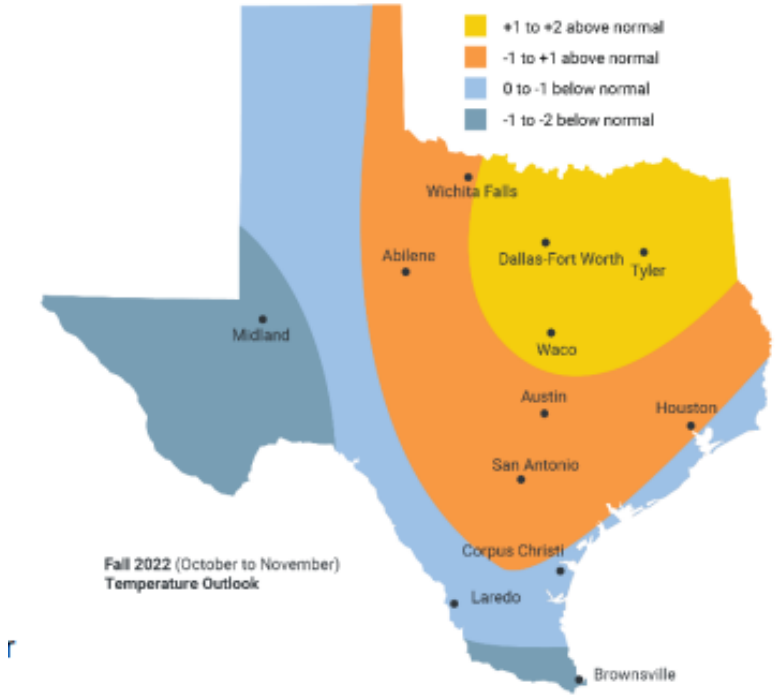
- June-August 2022 was the second hottest on record for the state of Texas, with only 2011 being hotter (POR 1895-current)
- The Jun-Aug period was the 39th driest on record. 2011 was the 1st driest. Summer 2022 ranks as the 5th driest this century
- 100-degree days:
  - Dallas: 47 days. 4th most on record (2011, 1980, 1956)
  - Houston: 22 days. Most since 2011, second most was 10 in 2015
  - Austin: 68 days. Tied for 3rd most with 2009 (2011, 1925). One more would put 2022 into #2
  - San Antonio: 58 days. Most since 2009 (59).

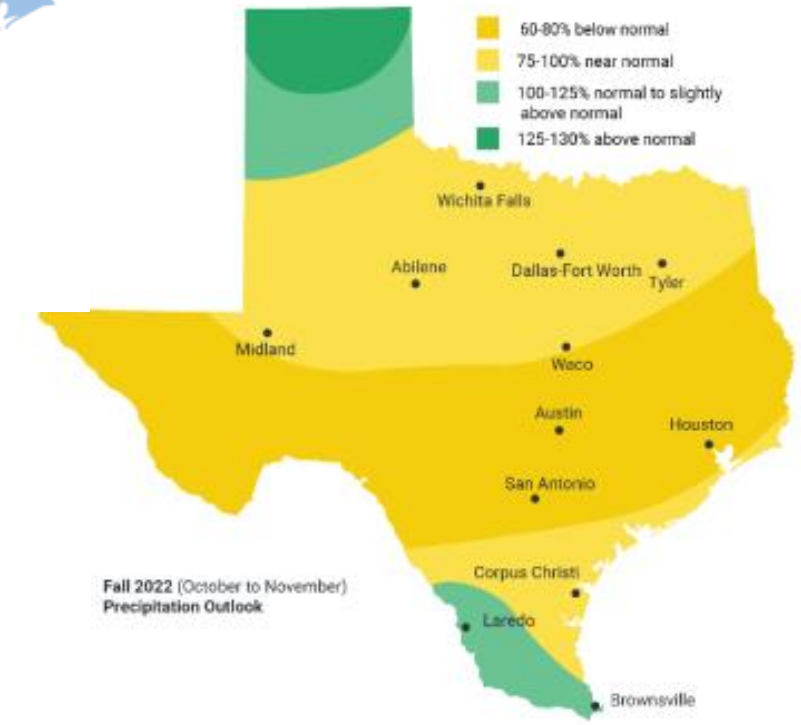




Fall 2022 Weather Outlook

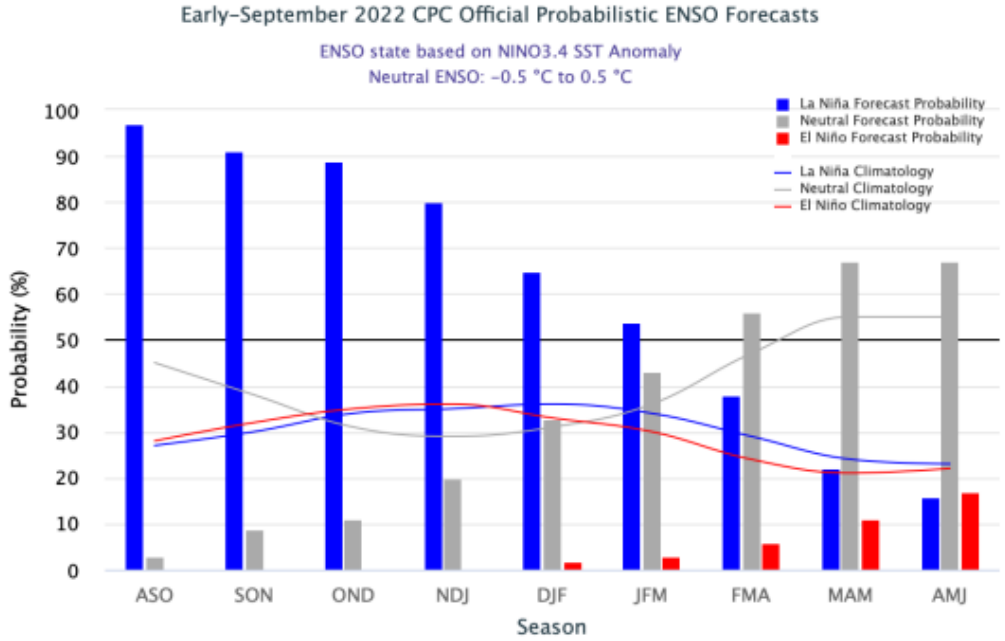
- Portions of West and South Texas – as well as along the Gulf Coast – are forecasted to see normal to slightly below normal temperatures
- The rest of the state is forecasted to see normal to slightly above normal temperatures
- Better chance this trends warmer rather than cooler
- Forecast guidance is stronger with precipitation
- Most of Texas is forecasted to experience drier-than-normal rainfall this fall





La Niña

- La Niña is expected to continue into the winter season
- This will be the third consecutive winter impacted by La Niña. Only three other times has a La Niña lasted into a third winter: 2000-01, 1975-76, and 1955-56 (the 1950s La Niña faded by mid-winter)
- While the forecasts currently predict the La Niña to end by spring, there's no historical precedence of such an event lasting beyond spring. The models may be trying to fade the La Niña because historically, that's what happened – but the history is very limited



Third-year La Niña winters:
2000-01: 34th coldest (of 127 historical)
1975-76: 24th warmest
1956-57: 7th warmest

La Niña winters:

2021-22: 18th warmest
2020-21: 85th warmest
2017-18: 50th warmest
2016-17: 1st warmest
2011-12: 27th warmest
2010-11: 58th warmest
2008-09: 14th warmest
2007-08: 25th warmest
2005-06: 18th warmest
2000-01: 94th warmest
1999-00: 3rd warmest
1998-99: 4th warmest
1995-96: 31st warmest
1988-89: 50th warmest
1984-85: 91st warmest
1983-84: 25th warmest
1975-76: 23rd warmest
1974-75: 67th warmest
1973-74: 48th warmest
1971-72: 27th warmest
1970-71: 11th warmest
1964-65: 58th warmest
1956-57: 7th warmest
1955-56: 55th warmest
1954-55: 53rd warmest
1950-51: 65th warmest

Of the 15 coldest winters since 1950, none have occurred during a La Niña

La Niña

- 26 La Niña winters since 1950

- As shown on the previous slide, 14 of the 26 La Niña winters have fallen in the warmest third of all winters (1895-current)
- 9 of the 26 have fallen in the middle third of all winters
- Only 3 of the 26 have fallen in the coldest third of all winters
- There is some correlation between La Niña and the unlikelihood of a cold winter; most winters lean mild

- The average coldest temperature during a La Niña winter in Dallas is 14.2°
- The average coldest temperature of all Dallas winters is 13.5°
- There's no correlation between La Niña and a winter with an extreme cold event
- However, dating back to 1898, there have only been 14 winters where the temperature in Dallas reached 5° or colder. Two of those occurred during La Niña winters – it can happen

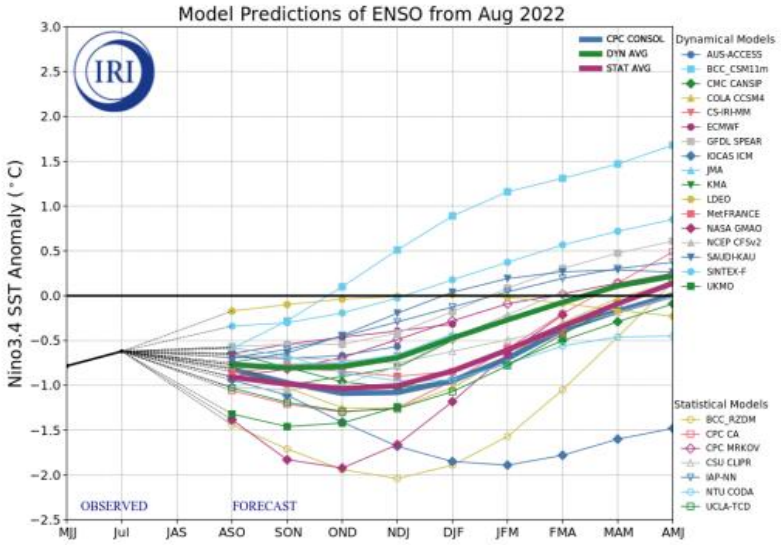


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 August 2022).

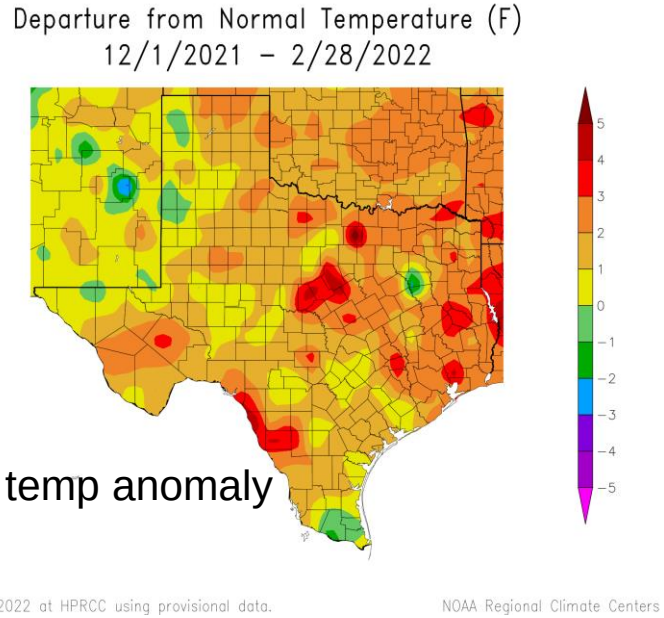
Third-year La Niña winters:
2000-01: 19°
1975-76: 11°
1956-57: 16°

La Niña winters (coldest temp at DFW):

2021-22: 19°
2020-21: -2°
2017-18: 13°
2016-17: 14° (1st warmest winter)
2011-12: 22°
2010-11: 13°
2008-09: 20°
2007-08: 23°
2005-06: 15°
2000-01: 19° (the coldest La Nina winter season)
1999-00: 23°
1998-99: 17°
1995-96: 8° (31st warmest winter)
1988-89: 13°
1984-85: 7°
1983-84: 5° (23rd warmest winter)
1975-76: 11°
1974-75: 17°
1973-74: 17°
1971-72: 15°
1970-71: 12°
1964-65: 15°
1956-57: 16°
1955-56: 14°
1954-55: 17°
1950-51: 6°

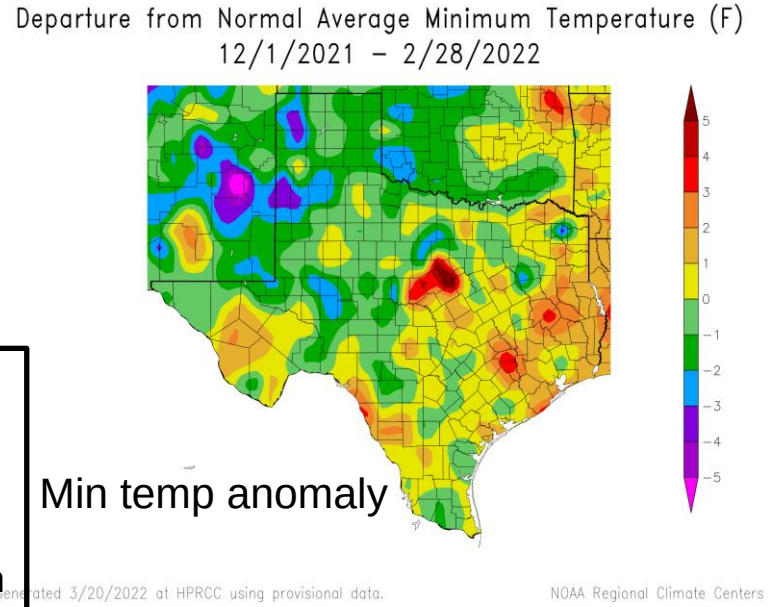
Reviewing Last Winter

ERCOT winter (Dec 1 – Feb 28)

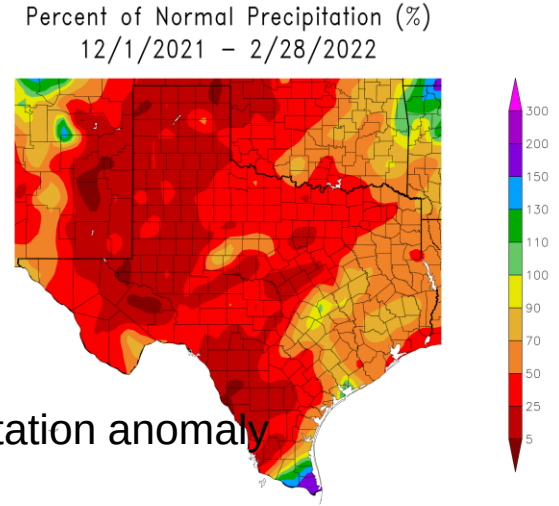


Mean temp anomaly

- Last winter was the 18th warmest on record (127 historical winters)
- The coldest period occurred on Feb 3-6, 2022. Dallas fell to 19°, Austin 21°, Houston to 27° (on three consecutive days), Brownsville 35, Abilene 13, Midland 7, Lubbock -1
- The 10th driest winter allowed for the minimum temperatures to trend less above normal (sometimes slightly below) than the maximum temperatures
- Winter of 2016-17 was the warmest on record for Texas



Min temp anomaly



Precipitation anomaly

Precip Anomaly

Austin Freezes

Camp Mabry Dec - Feb	total # of freezes	total # below 40	coldest temp
2021-22	15	35	21
2020-21	16	38	7
2019-20	3	24	30
2018-19	5	27	32
2017-18	15	36	18
2016-17	5	16	19
2015-16	4	29	31
2014-15	11	41	23
2013-14	22	48	22
2012-13	11	33	27
2011-12	7	23	27
2010-11	19	46	17
2009-10	23	51	17
2008-09	11	42	28
2007-08	14	41	25
2006-07	13	43	24
2005-06	8	35	23
2004-05	13	26	24
2003-04	6	36	28
2002-03	9	41	24
2001-02	11	44	25
2000-01	16	50	27
Averages:	11.7	36.6	23.6

Notice the anomaly in the winter of 2016-17
The coldest temperature was 19, but that winter had the second fewest freezes and second fewest days below 40 than any winter this century (it was the warmest winter ever for Texas)

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"
- For an extreme example, say the past ten years were the ten warmest on record of 125 historical years. Then let's say the next year ranks 11th of 125 . Based on the past 10 years, it would rank below the 10-year normal
  - We aren't quite to that extreme – but not far from it
- This is why I'll oftentimes give all-time rankings and comparisons with recent years (in addition to or instead of "normal")

Mean Temperature Ranking of Recent Texas Winters (127 historical winters)

2021-22	**108th coldest**
2020-21	42nd
2019-20	**113th**
2018-19	94th
2017-18	76th
2016-17	**127th coldest** (warmest winter on record)
2015-16	**119th**
2014-15	68th
2013-14	30th
2012-13	**111th**
2011-12	99th

Since 2001, only 3 winters have ranked in the coldest third (1-42) of historical winters (2009-10 is the other)

Winter vs Summer

Winter extremes happen quickly

- **A strong cold front moves through dropping temperatures sharply – sometimes 30-40 degrees in a matter of an hour or two.**
- **High wind speeds also tend to accompany strong cold fronts, resulting in even colder wind chills – and cold air that more readily penetrates buildings and other structures.**
- **A winter load peak can be 20,000+ MW greater than the day prior**

Summer extremes are typical, with an uninterrupted build of heat over an extended period

- **A hot summer pattern in Texas is the result of high pressure that parks itself over the state, limiting rain chances and cloud cover, while allowing the high angle of the Texas sun in the summer to reach its full impact**
- **It's commonly the day-after-day build of heat that result in load peaks during summer**
- **A summer load peak is likely only a few hundred to a couple thousand megawatts higher than the previous day**

Because of this difference, a summer long-range weather outlook tends to do a better job at capturing extremes and peaks than a winter long-range outlook. Remember, a very strong cold front can move through in an otherwise mild winter (cold winters are defined more by the frequency of cold fronts).

Preliminary Winter 2022-23 Temperature Outlook

From the Seasonal Updates page on ERCOT.com

Given the greater-than-typical uncertainty with the fall weather outlook, the winter forecast should come into better focus as the fall season evolves. That said, the majority of historical similar weather years do pose a threat to colder extremes impacting the ERCOT region this winter. Most similar years had a large pool of very cold air over much of Canada (below normal for Canada) that occasionally dropped south to impact large portions of the U.S.

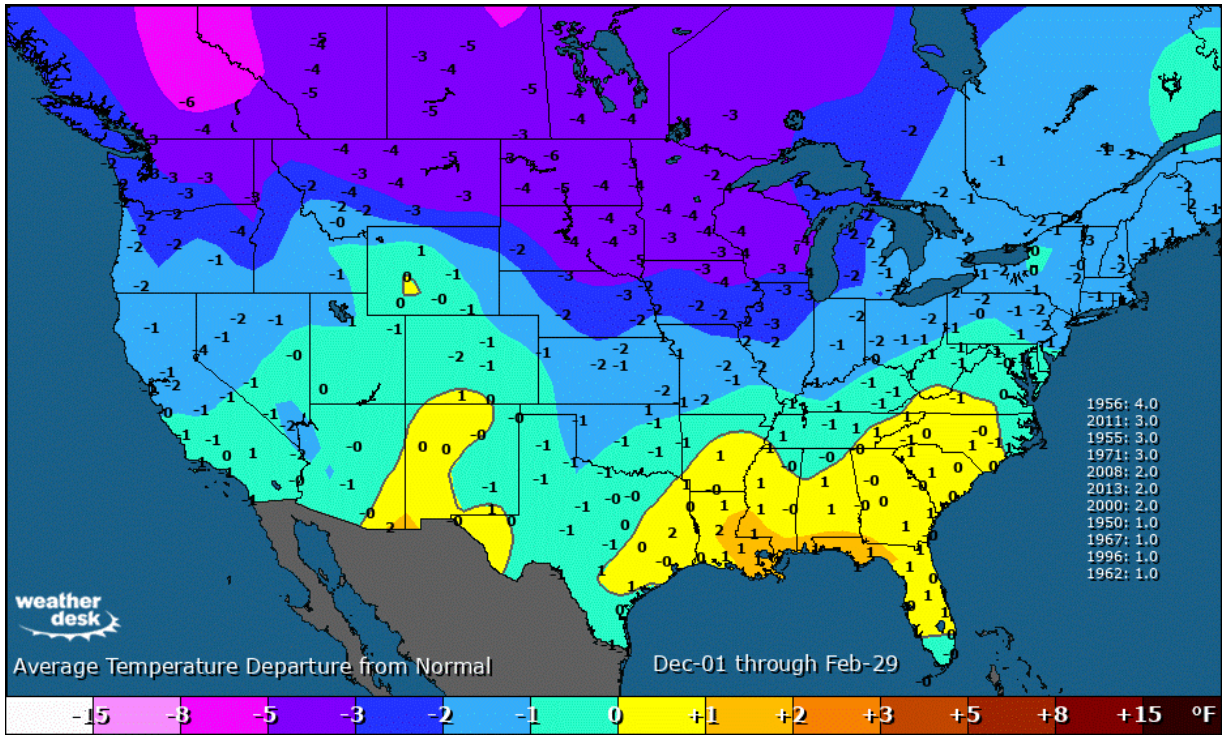
Recent changes are warmer

The winter of 2013-14 is one of those similar years; that was the winter when the term “polar vortex” became common in the media. The winter of 2013-14 had frequent cold fronts impacting Texas and resulted in a colder-than-normal winter. However, no one event was as cold as February 2021 or February 2011.

To note, some historically similar years were much milder. Thus, while some early signs suggest there is the potential for unseasonably cold air to impact the ERCOT region at least a time or two this winter, confidence in the forecast is low at this point. This will definitely need fine tuning and detailing as winter approaches.

Preliminary Winter 2022-23 Temperature Outlook

Analog weighted consensus: 1956-57, 2011-12, 1955-56, 1971-72, 2008-09, 2013-14, 2000-01, 1950-51, 1967-68, 1996-97, 1962-63

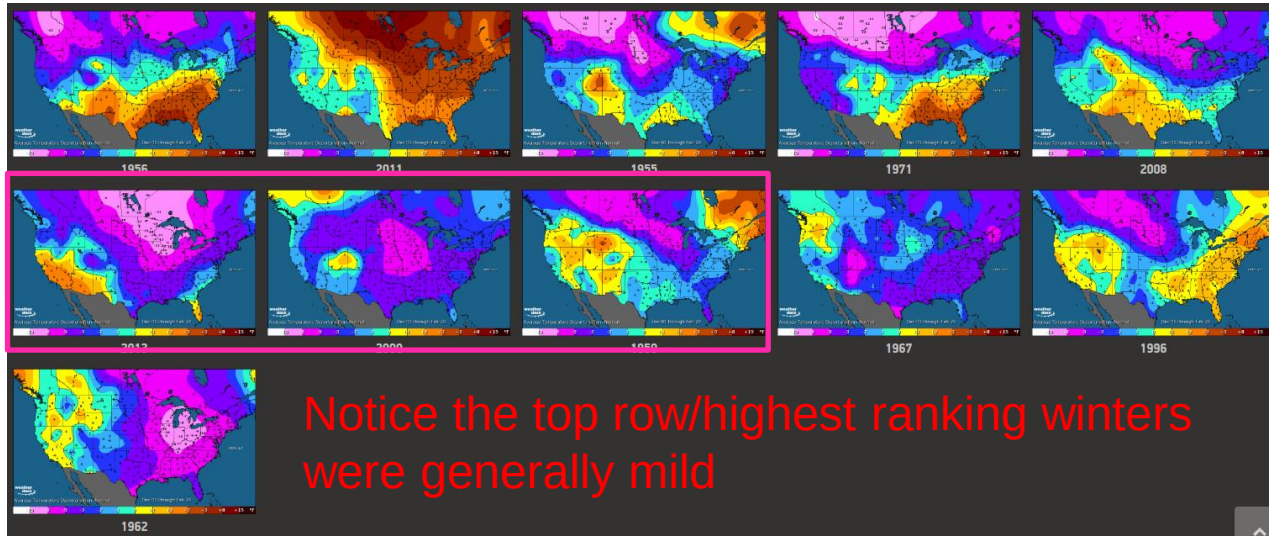


Note: all but one analog (historical match) has an abundance of below-normal cold over Canada – a stratospheric warming could result in the polar vortex breaking down to allow the colder air to drop south to Texas

Coldest temps for DFW; state temp rank

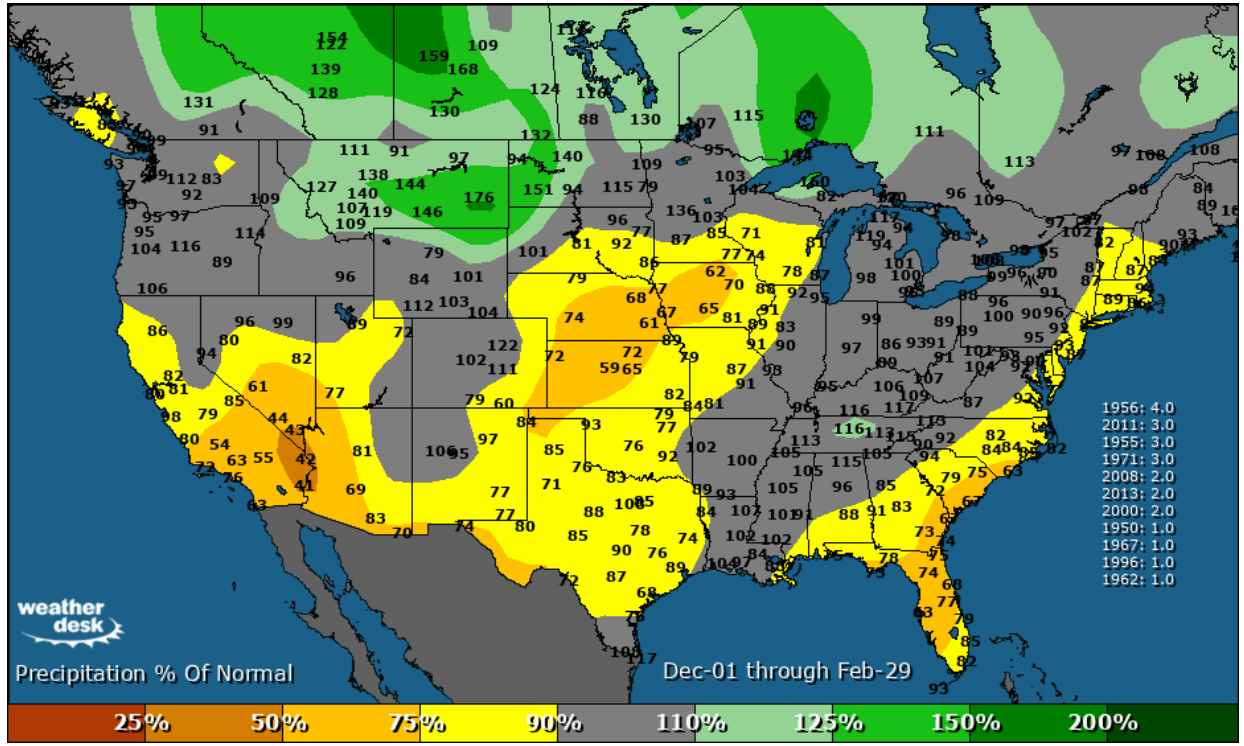
1956-57: 16°; 7th warmest
2011-12: 22°; 27th
1955-56: 14°; 55th
1971-72: 15°; 27th
2008-09: 20°; 14th
2013-14: 15°; 98th
2000-01: 19°; 94th
1950-51: 6°; 65th
1967-68: 12°; 105th
1996-97: 17°; 53rd
1962-63: 9°; 112th

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



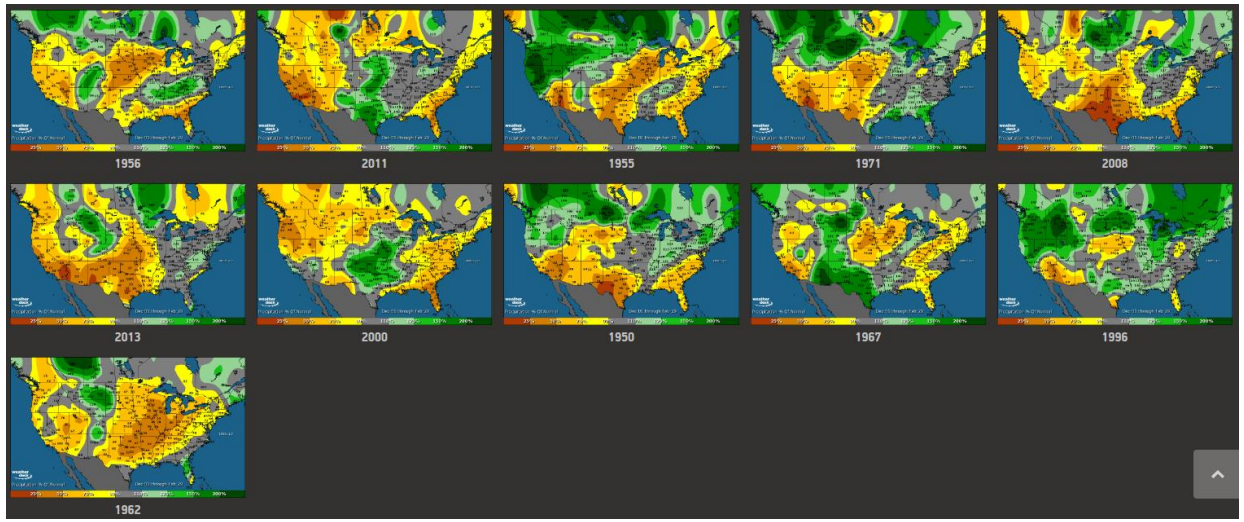
Preliminary Winter 2022-23 Precipitation Outlook

Analog weighted consensus: 1956-57, 2011-12, 1955-56, 1971-72, 2008-09, 2013-14, 2000-01, 1950-51, 1967-68, 1996-97, 1962-63

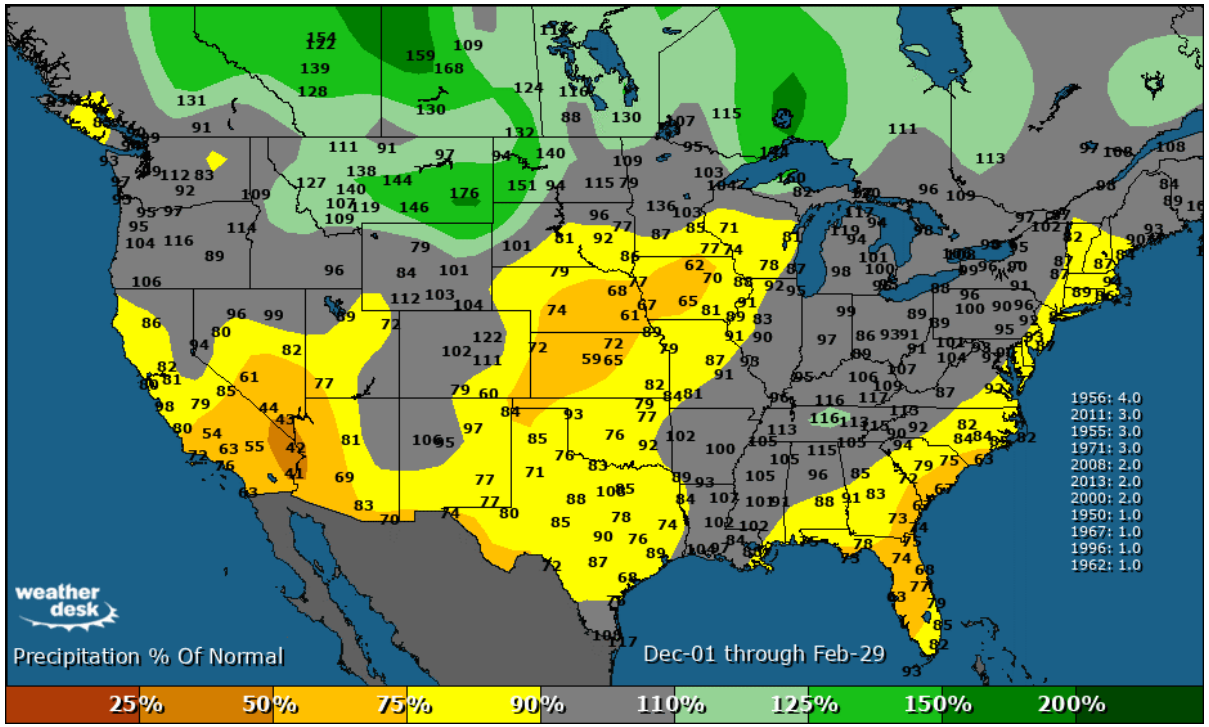


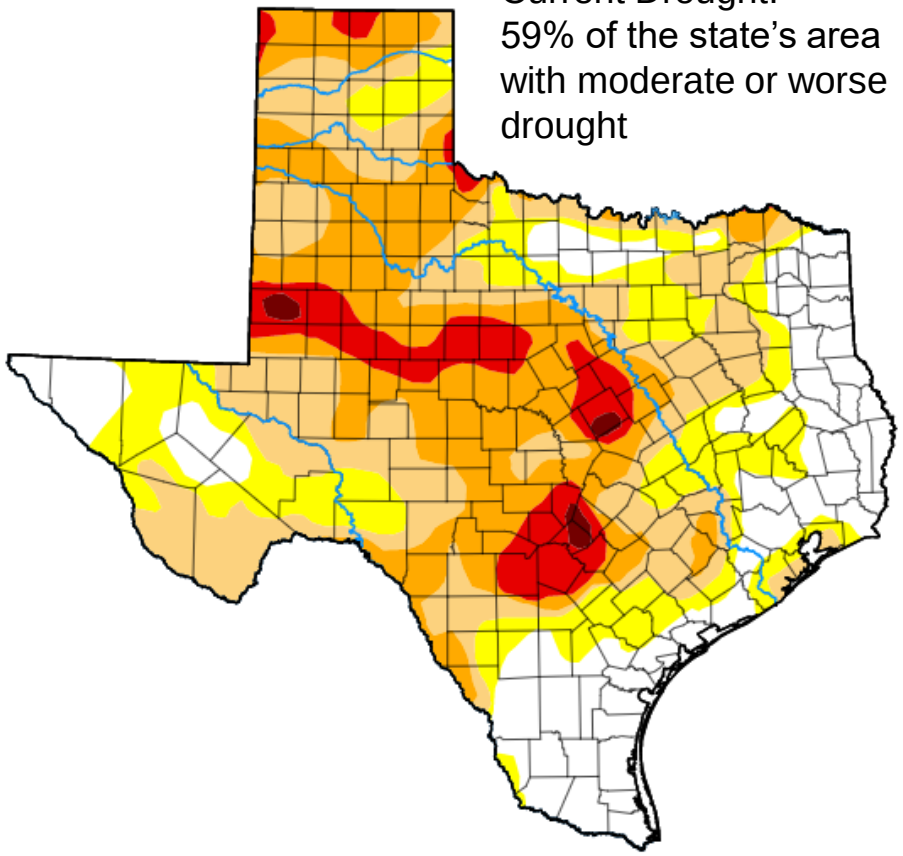
Note: only 4 of the 11 historical matches had a wet winter

Only 2 of the 11 historical similar winters were wet



Winter 2022-23 Precipitation Outlook vs Drought





Current Drought:
59% of the state's area with moderate or worse drought

While the drought has waned some since mid-August, it's unlikely over and could make a rebound (worsening drought) this fall and winter

Winter Weather Outlook Summary

- The preliminary winter forecast is currently updated to slightly above normal.
- There's greater potential for the winter to trend warmer than colder – but will need to see how fall progresses for the final forecast (due in early-November)
- The North American temperature pattern shows a high probability of below normal temperatures over much of Canada this winter. That may drop south to Texas a time or two in a polar vortex event
- There is no strong correlation between the winter temperature anomaly and period(s) of extreme cold
- The winter is forecasted to again be dry, which would act to sustain or increase the drought

- **Even the mildest/warmest winters are capable of producing a period of extreme to record breaking cold. Winter is a much more volatile weather pattern than the summer season. Extreme cold can only be forecast in the shorter-term – not long-range, several months out forecasts**
- That said, this winter has below normal odds for a period of extreme cold (i.e. single digits in Dallas)

Day 2: September 21, 2022

- FERC and ERO Report – Update on Winter Weather Standards
- PUCT Winterization Activities Update
- Railroad Commission Winterization Actives Update
- ERCOT Winterization Activities Update
- **2022-23 Preliminary Winter Weather Outlook and Review of Historical Winter Extremes**
- Thermal Generator Winter Weather Prep and Lessons Learned
- Renewable Generation Winter Weather Prep and Lessons Learned

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

Thermal Generator Winter Weather Prep and Lessons Learned

TEXAS RE
EXTREME EVENTS RESILIENCY WORKSHOP

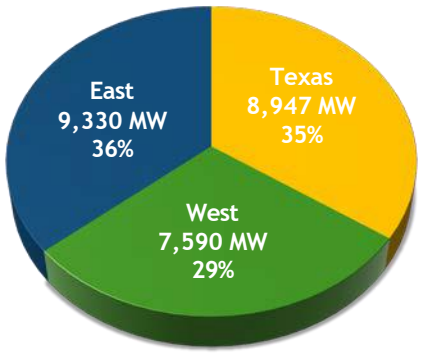
September 21, 2022

Calpine Corporation (National Portfolio ~26,000 MW)

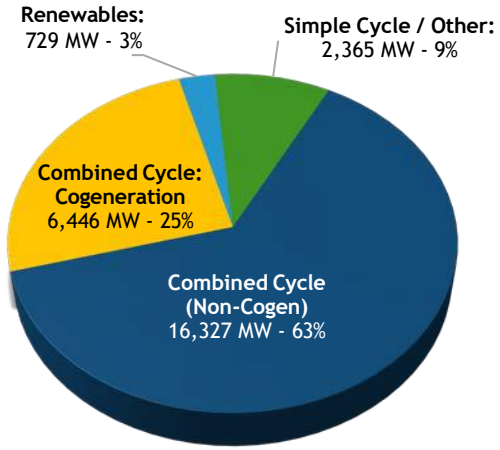
- Geographically diversified portfolio: Scale in America's most competitive power markets
- More than 2,300 employees
- Serve wholesale and retail customers in 22 states, Canada and Mexico
- Largest geothermal power producer in America
- Largest operator of combined heat and power (cogeneration) in America

Market	Calpine Rank (MW Gas-Fired Capacity)
Texas	#1
California	#1
New England	#3
Mid-Atlantic	#2

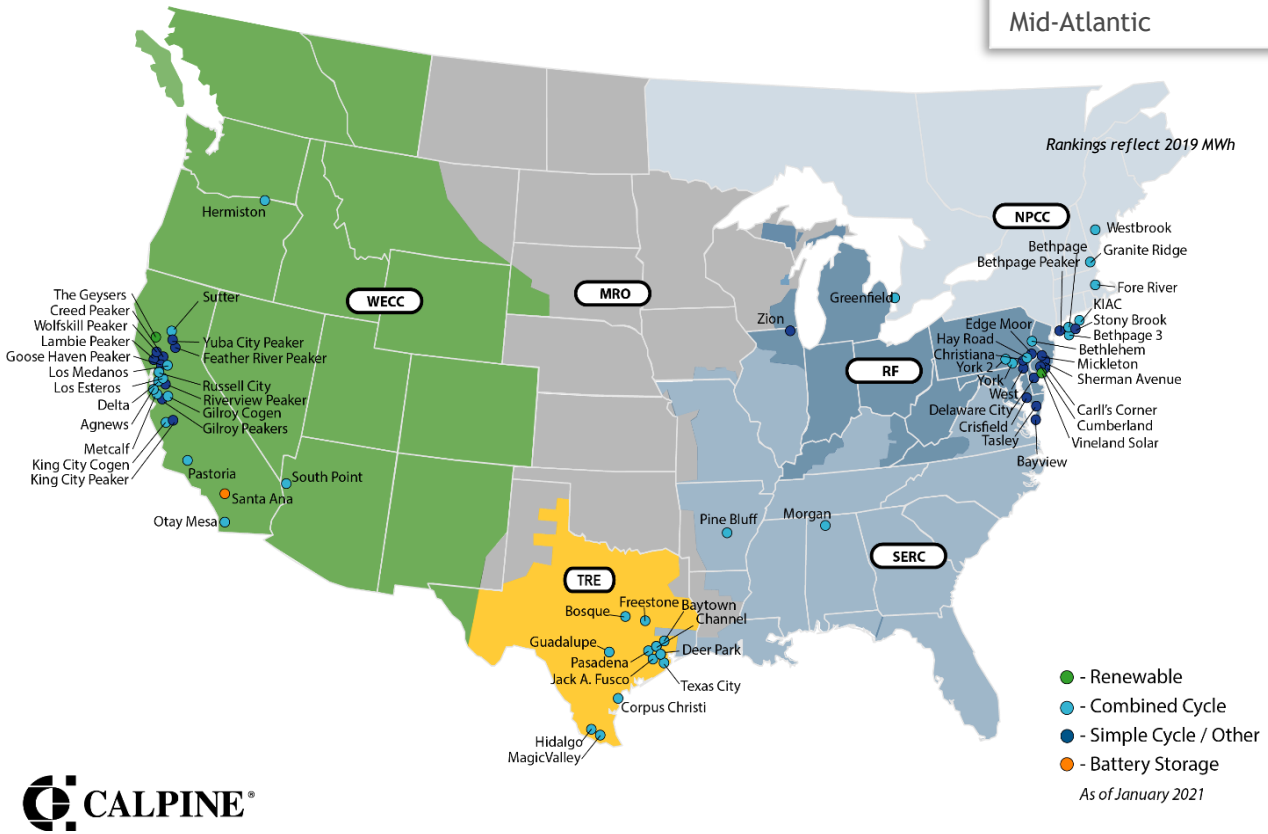
Geographic Diversity



Dispatch Technology



Figures reflect 2021 MW



CALPINE®

Gas Plant Winterization

1. Plant personnel health and safety is one of our core values.

2. Winter weather can present operational issues with sensitive instrumentation and critical equipment at a combined cycle power plant.

3. Operational challenges can exist with, among other things:
   - Process Instrumentation (e.g., drum level transmitters, pressure transmitters)
   - Air system dew points / valve and actuator operations
   - Ammonia systems (for plants with selective catalytic reduction systems [SCRs])
   - Water and steam systems
   - Steam drains
   - Lube Oil System
   - Cooling Water and Cooling Towers (Icing)
   - Makeup Water Intake Debris Screens
   - Gas regulation and pressure control
   - Combustion Turbine Inlet Filter Icing
   - Chemical Shortages / Supplies
   - Emission Sampling / CEMs systems

4. Winterization of combined cycle and simple cycle generation facilities should consider several factors, including among other things, the region in which the plant is located, the physical orientation of the facility, design of the facility, age of the facility and the experience of the facility in prior weather events. There is no one-size fits all solution with respect to winterization.

NOTE: *The comments contained herein reflect information gathered from the Calpine from its operational experiences and industry standards. This does not represent the only winterization strategies available. Each GO must individually evaluate its own facilities when establishing winterization plans.*

Combined Cycle Power Plant - ERCOT

Combined Cycle Power Plant – CA ISO

Combined Cycle Power Plant – NE ISO

Winter Readiness Sample Timeline

Winter Readiness Plans begin well in advance of the Winter:

1. Post-Winter meeting to review issues and incorporate lessons learned into the Winter Readiness Plan and the Winter Operations Procedures (March-April).
2. Initial Site-Specific Pre-Winter Readiness Meetings (May - July):
   - Review the implementation of the Plant Winter Readiness Plan and plan work
3. Final work scope and winterization work plan is in place (August - September).
4. Site-Specific Winter Operation Procedures reviewed and updated based on lessons learned, equipment additions, and any new industrial best practices (October).
5. Complete training on Winter Readiness for plant personnel (November).
6. Site-Specific Pre-Winter Readiness Reviews and Certification of Readiness (typically November).
7. Winter Preparations, including training completed by December 1.

Samples for Gas Plant Readiness

1. Document the minimum plant design operating temperature to determine the lowest ambient temperature at which the unit can reliably operate.

2. Review any modifications performed to the plant over the past years to assure these modifications meet the minimum plant design operating temperature, or if different, document the minimum temperature limitations of these modifications.

3. Review of the past winter's issues and experience with any equipment freezing.

4. Identify the critical equipment that may be impacted by cold weather.

5. Identify what type of heat tracing is used for the critical equipment and develop and perform annual preventative maintenance for the heat tracing systems prior to winter.

7. Document the maintenance performed on the instrument air system: how moisture is removed; what is the design dew point; how dew point is monitored

8. Perform a walkdown of the Critical Equipment's insulation and identify areas of insulation that should be considered for repairs prior to winter operation.

9. Check inventory of necessary consumables and supplies.

10. Test portable heaters and equipment in storage; check all space heaters.

Samples for Gas Plant Readiness

11. Complete all PM/CM Work Orders for Winter Readiness

12. Test permanent building space heaters.

13. Test Heat Tracing Systems.

14. Check glycol concentration in all closed loop cooling water systems to ensure that the fluid freezing point is at or below the site minimum design temperature.

15. Prepare for install of temporary wind breaks and place temporary heaters.
    - If tarps are used, make sure heavy-duty material that will last for the entire winter period.

16. Repair any leaks on outside critical components that may be subject to freezing.

17. Prepare critical staffing plans, including evaluation of need for additional staffing.

18. Drain all non-critical systems (Compressor wash, evaporative coolers, chillers).

19. Confirm available power supplies for heaters are tested.

20. Check and inspect all safety showers and eye wash stations for proper heater operation.

Winter Readiness Training

1. Conduct site specific training (Plant level Training)
2. Conduct Operational Drills at each facility (Independent Team)
3. Using the Operational Scenarios, conduct cross-training with plants with similar technologies
4. For Cogen Facilities – Conduct Tabletop Drills with hosts

Winter Readiness Event Staffing

1. Calpine's value system is the safety of our employees, preservation of the environment, and protection of the equipment. Accordingly, keeping our employees safe during an event is the first concern and will drive our behaviors

2. Salting and Sanding of the site is performed as required using direct or contracted staff

3. Employee Sequestration

4. Contractor Supplemental Staffing

5. Managers and plant support are broken into 2x 12-hour shifts for around the clock coverage with a manager leading each shift.

6. Off site support

Examples of Equipment Retrofits

1. Calpine utilizes an experiential process that assesses plant performance at the end of each winter season and conducts more advanced analysis when new, low temperature / windchill conditions are achieved

2. Critical System Reviews

3. Windbreaks and Enclosures upgraded to protect critical systems, floors and roofs included where required

4. As an option at some facilities, heated enclosures were added to the top of the HRSG at specific locations to allow personnel to get out of the weather and warm up (minimizes exposure time in the elements)

5. By the numbers (ERCOT Fleet)
    a. 623 heated and insulated enclosures
    b. 1050 Smart Transmitters
    c. 46,190 feet of 5-Watt heat trace with new power panels and electrical feeds

Examples – Heat Tracing

Heat Tracing Components

CONSTRUCTION

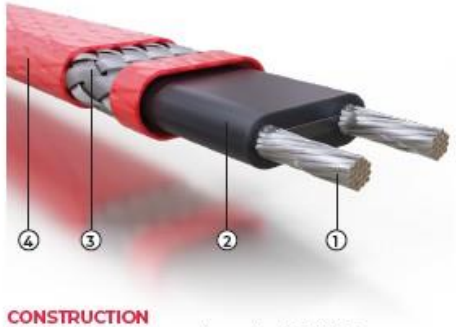
1 Process tube(s)

2 USX self-regulating electrical heat tracing

3 Heat reflective tape

4 Non-hygroscopic glass fiber insulation

5 Polymer outer jacket (ATP or TPU available)



CONSTRUCTION

1 Nickel-plated copper bus wires (16 AWG)

2 Monolithic co-extruded semiconductive heating matrix and fluoropolymer dielectric insulation

3 Nickel-plated copper braid

4 Fluoropolymer overjacket provides additional protection where exposure to chemicals or corrosives is expected.

Examples – Wind Breaks & Enclosures

Examples – Wind Breaks & Enclosures

Examples – Heated Instrument Enclosures

O’Brien Box (Instrument Enclosure)

Questions?

Ørsted

Renewable Generation Winter Weather Prep and Lessons Learned

Texas RE Extreme Events Resiliency Workshop

9/21/2022

Keith Smith

Winter Weather Preparation

Weatherization Planning

Winter Preparation

Site Monitoring

Event Preparation

Lessons Learned

Ørsted

Weatherization Planning

Cross Functional Project Team

- Operations
- Engineering
- Compliance
- Management

Weatherization Plan Review

- New Facilities
- New rules and regulations
- Lessons learned and associated corrective actions

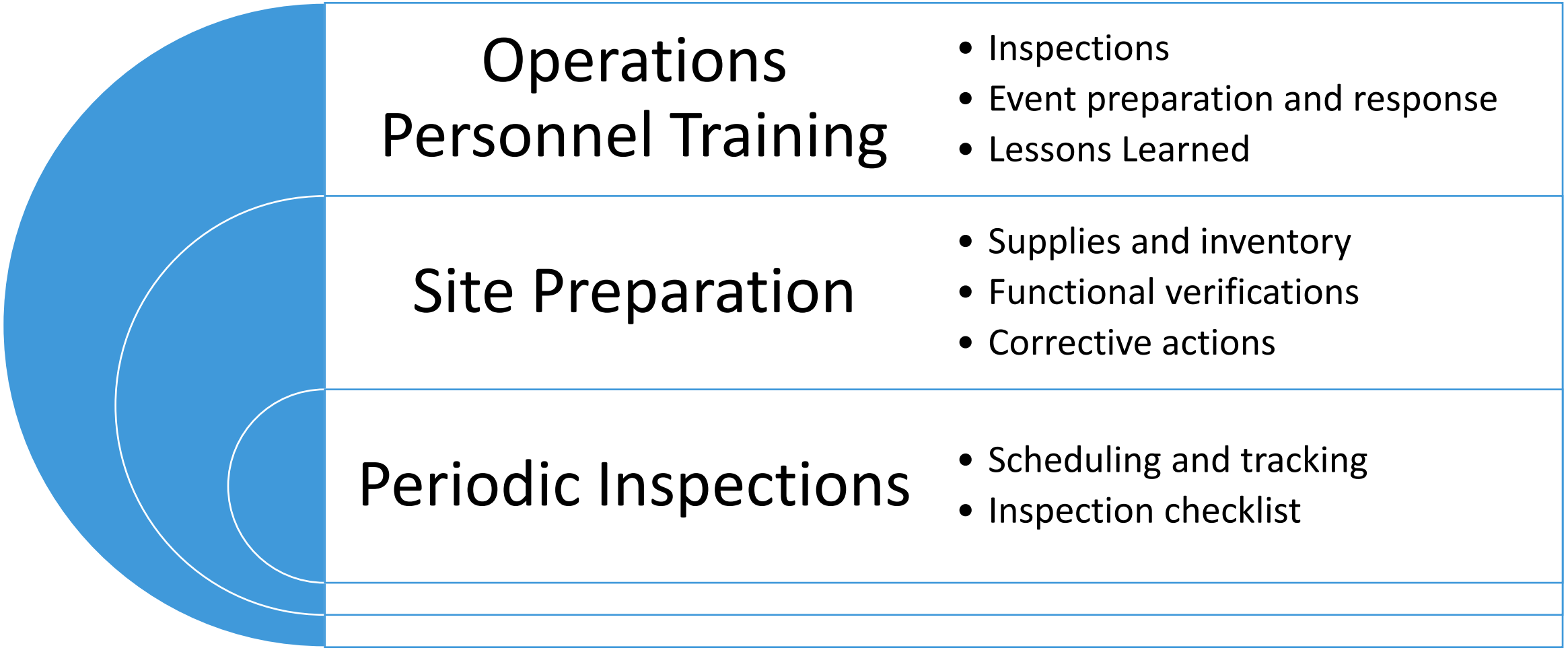
Schedule Development

- Site preparation
- Training
- Regulatory submissions

Management Reinforcement

- Tone at the top
- Weatherization as priority

Operational Preparation



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Technical Preparation

Operational parameter verification

- Temperature cut-outs
- Wind speed cut-outs

Operational limitation confirmation

- Minimum design temperatures
- Historical limitations

Site monitoring assessment

- Capabilities
- Verifications
- Potential enhancements

Site Monitoring

Site alarms

- Real-time monitoring
- Periodic reviews

Periodic inspections

- Implementation
- Documentation
- Tracking

Advanced data analytics

- Assess anomalies
- Refine methods

Event Preparation and Response

Preparation meeting

- [ ] Safety
- [ ] Ongoing or planned outages
- [ ] Conditions and impacts
- [ ] Recent lessons learned

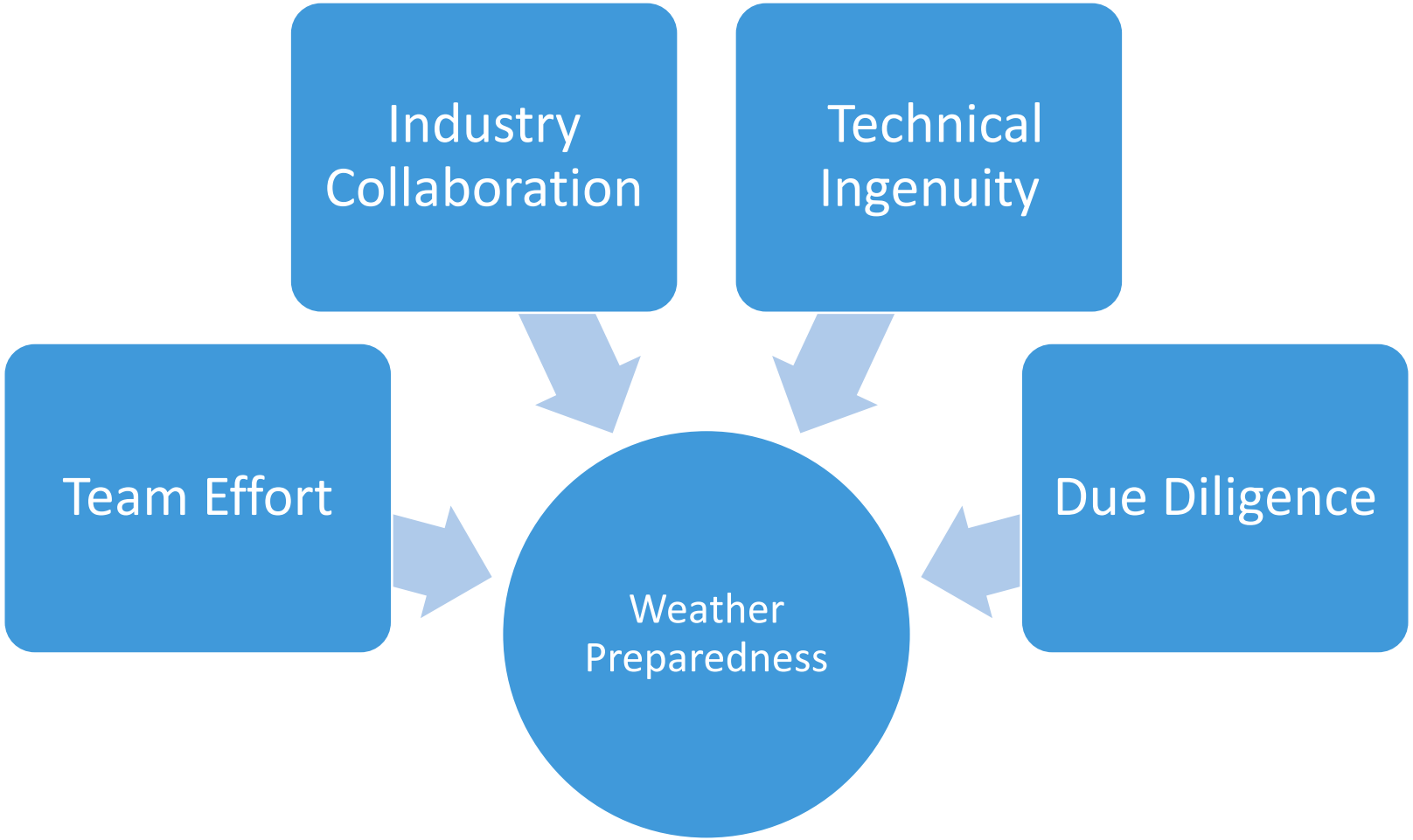
Site Preparation

- [ ] Preparation checklist
- [ ] Backup generators
- [ ] Alarm review
- [ ] Staffing confirmation

Real-time Communication

- [ ] Increased awareness
- [ ] Monitoring for derates
- [ ] Notifications and submissions

Weatherization Lessons Learned



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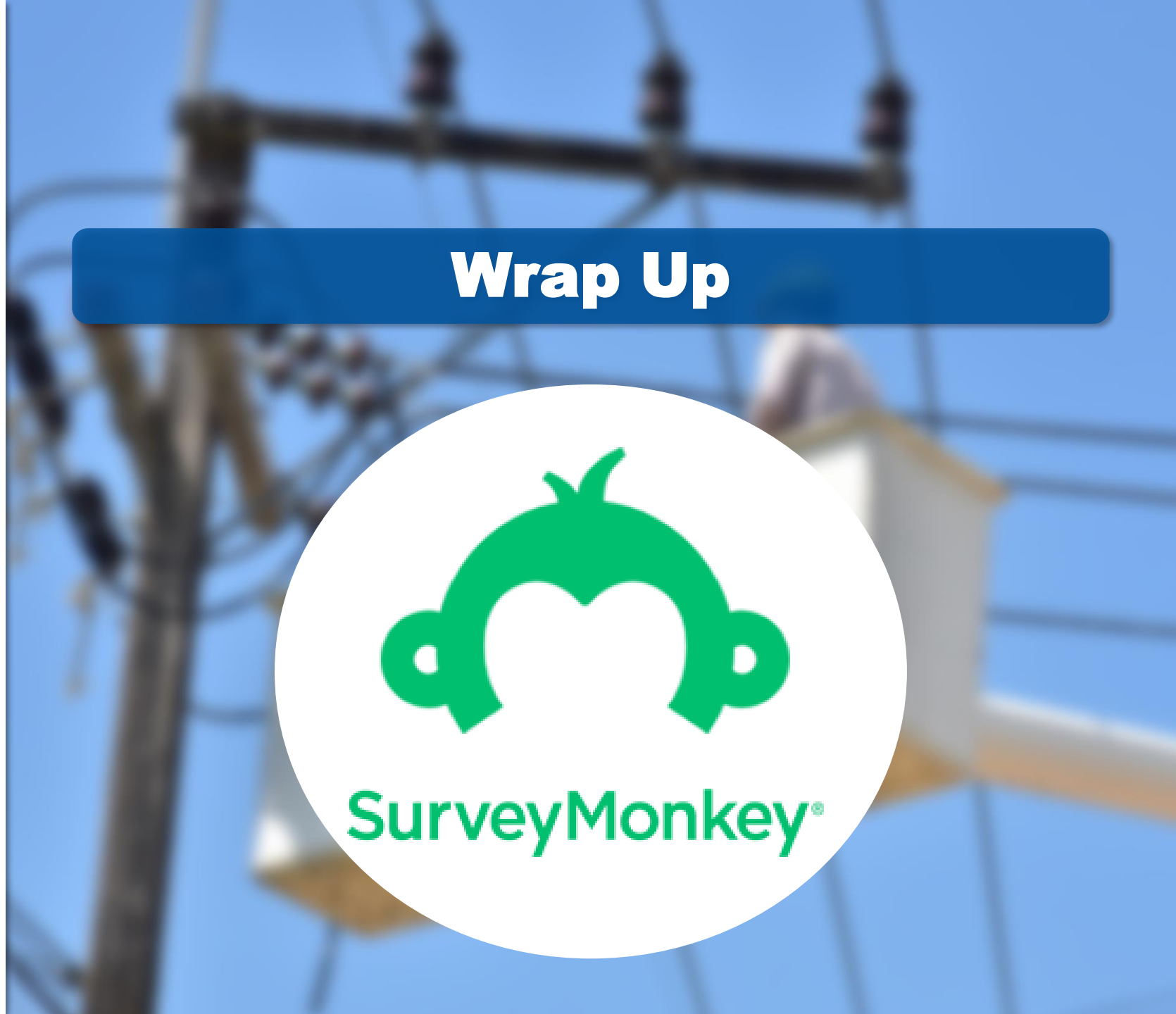
Thank you!

Wrap Up



Fall Standards, Security, & Reliability Workshop

October 27, 2022

TEXAS RE

Energy Industry Vendors Summit

November 9, 2022