TEXAS RE
Ensuring electric reliability for Texans

2019 ERCOT and Texas RE Generator Weatherization Workshop

September 5, 2019

TEXAS RE
Ensuring electric reliability for Texans

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Attendee Information

- Bathroom locations
- In the event of a fire
- Medical emergency

Agenda

Beginning Time	End Time	Description	Presenter
08:00	08:15	Regulatory review of winterization activities.	Mark Henry Director, Reliability Services Texas Reliability Entity, Inc. Mark.Henry@TEXASRE.org
08:15	08:45	Causes of frozen instrumentation from the last two winters and actions to prevent reoccurrence.	Patrick Jackson Plant Engineer Tenaska Kiamichi Generating Station PJackson@TENASKA.com
08:45	09:15	Improvements to Deer Park Energy Center winter readiness and lessons learned from GT1 trip.	Jacob Frahm Plant Engineer, Deer Park Energy Center Jacob.Frahm@Calpine.com
09:15	09:25	Break	
09:25	09:55	Improvements and lessons learned to Lamar Power Partners winter readiness.	Steven Harper Lamar Power Partners Steven.Harper@Luminant.com
09:55	10:25	Correct testing of heat trace.	Patrick Bartell, Valin Corporation PBartell@valin.com
10:25	10:35	Break	
10:35	11:05	Understanding critical components within a series heat trace circuit.	Jeff Klier, Plant Manager Wolf Hollow Generating Station Jeffery.Klier@constellation.com
11:05	11:20	ERCOT update.	Alan H. Allgower Operations Analyst, Senior, ERCOT alan.allgower@ercot.com
11:20	12:00	Preliminary winter 2019/2020 outlook.	Chris Coleman, Meteorologist Sr, Load Forecasting & Analysis, ERCOT Chris.Coleman@ercot.com
12:00	12:05	Closing comments.	Alan Allgower, ERCOT

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Regulatory Review of Winterization Activities

Mark Henry
Reliability Services, Texas Reliability Entity

September 5, 2019

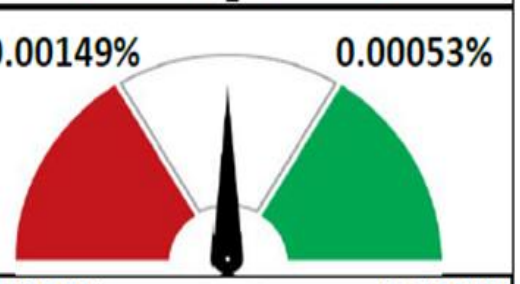
NERC Industry Metric on Events Caused by Gas-Fired Unit Forced Outages Due to Cold Weather or Gas Unavailability

Why is it important?:

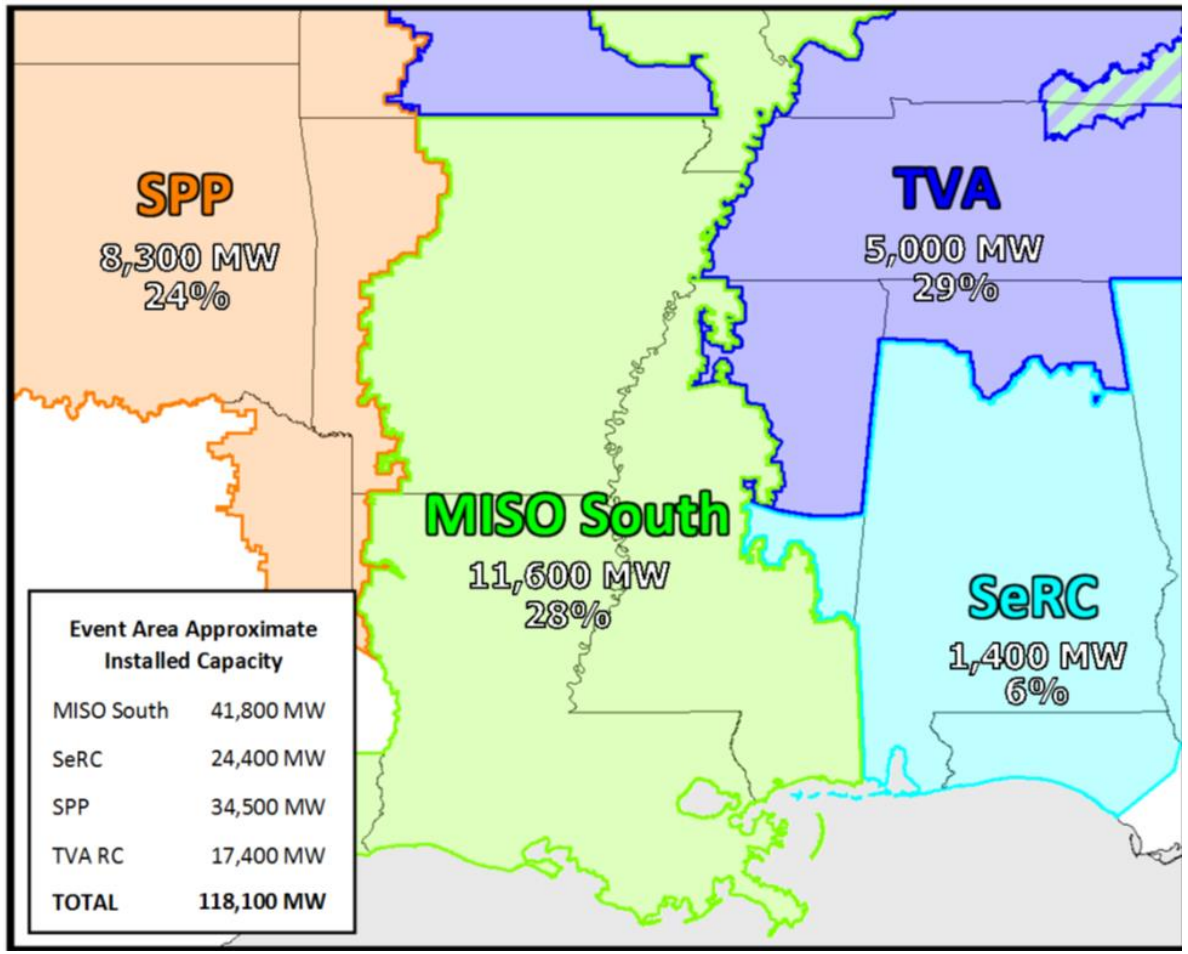
- Reduce risk to BPS reliability due to gas-fired unit outages during cold weather or gas unavailability

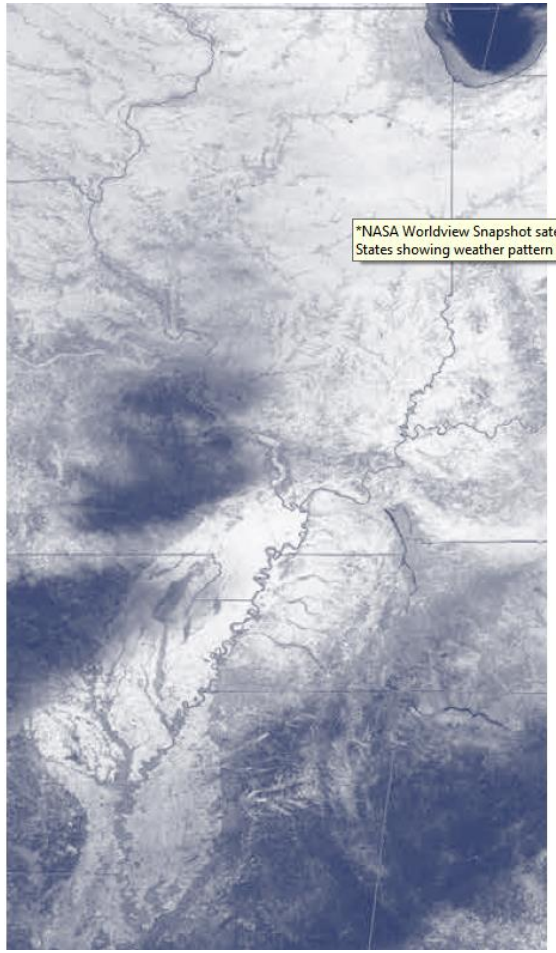
How is it measured?:

- Firm load loss due to cold weather or gas unavailability
- MWh of potential production lost initiated by cold weather and gas unavailability

Data (Annual Measurement) ▪ No firm load loss due to gas-fired unit outages during cold weather: *Zero is green, else is red* (Cold weather months: January – March and December of the same calendar year) ***As of 4/1/2019, Metric status is Green.***	**2019 Status** 
Data (Annual Measurement) (Match with 4.4, year defined as Q3-Q2) ▪ No firm load loss due to gas unavailability: *Zero is green, else is red* ***As of 4/1/2019, Metric status is Green.***	
Data (Compared to a 5-year rolling average) ▪ Percentage of winter period net MWh of potential production lost due to gas-fired unit outages during cold weather (Cold weather months: January – March and December of the same calendar year) ▪ **Five-year average: 0.0068%**	
Data (Compared to a 5-year rolling average) ▪ Percentage of annual net MWh of potential production lost due gas unavailability compared to a 5-year rolling average (Due to data availability, year defined as Q3-Q2) ▪ **Five-year average: 0.1312%**	

Joint NERC/FERC Inquiry and Report



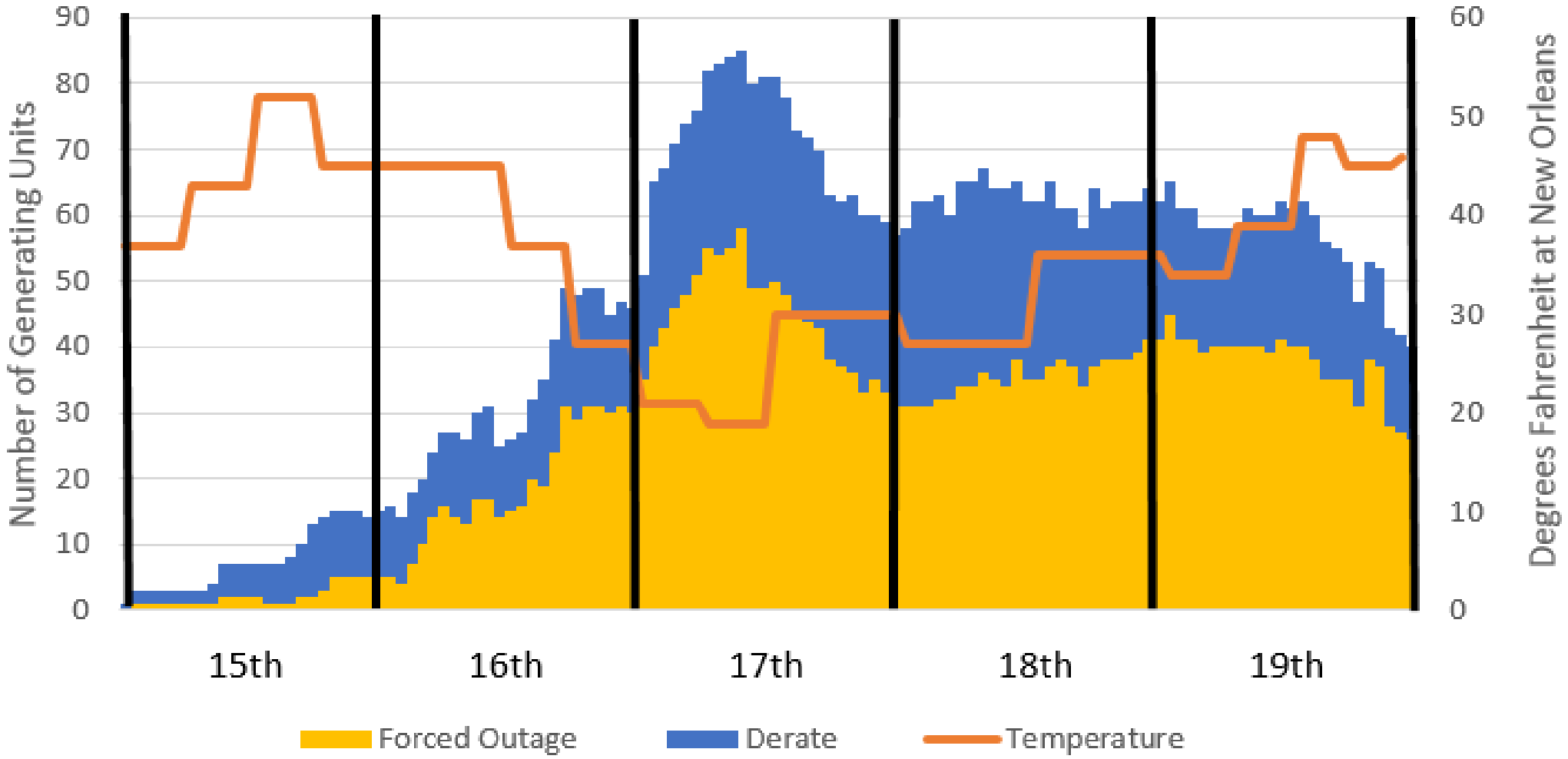


*NASA Worldview Snapshot satellite image of The United States showing weather pattern for January 18, 2018.

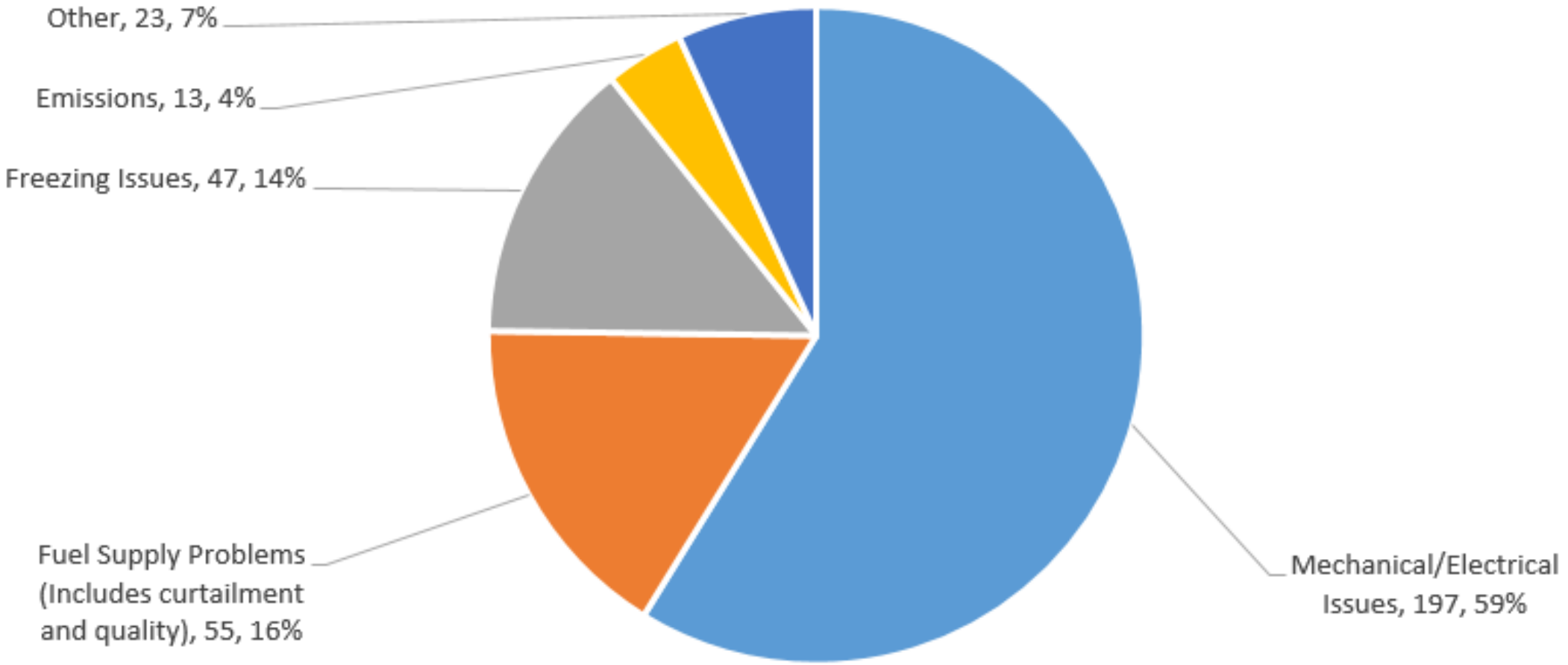
2019 FERC and NERC Staff Report

The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018

January 15-19, 2018 – Number of Generation Unit Outages and Derates Versus Temperature, by Hour, for Event Area



January 15-19, 2018 - Causes of Unplanned Generation Outages and Derates for Southeast US Event Area



Findings and Recommendations from the Report

Generator Cold Weather Reliability:

Finding: The South Central U.S. Cold Weather BES Event of January 17, 2018, was caused by failure to properly prepare or "winterize" the generation facilities for cold temperatures.

Finding: Gas supply issues contributed to the Event, and natural gas-fired units represented at least 70% of the unplanned generation outages and derates.

Recommendation 1 from the Report

The Team recommends a three-pronged approach to ensure Generator Owners/Generator Operators, Reliability Coordinators, and Balancing Authorities prepare for cold weather conditions:

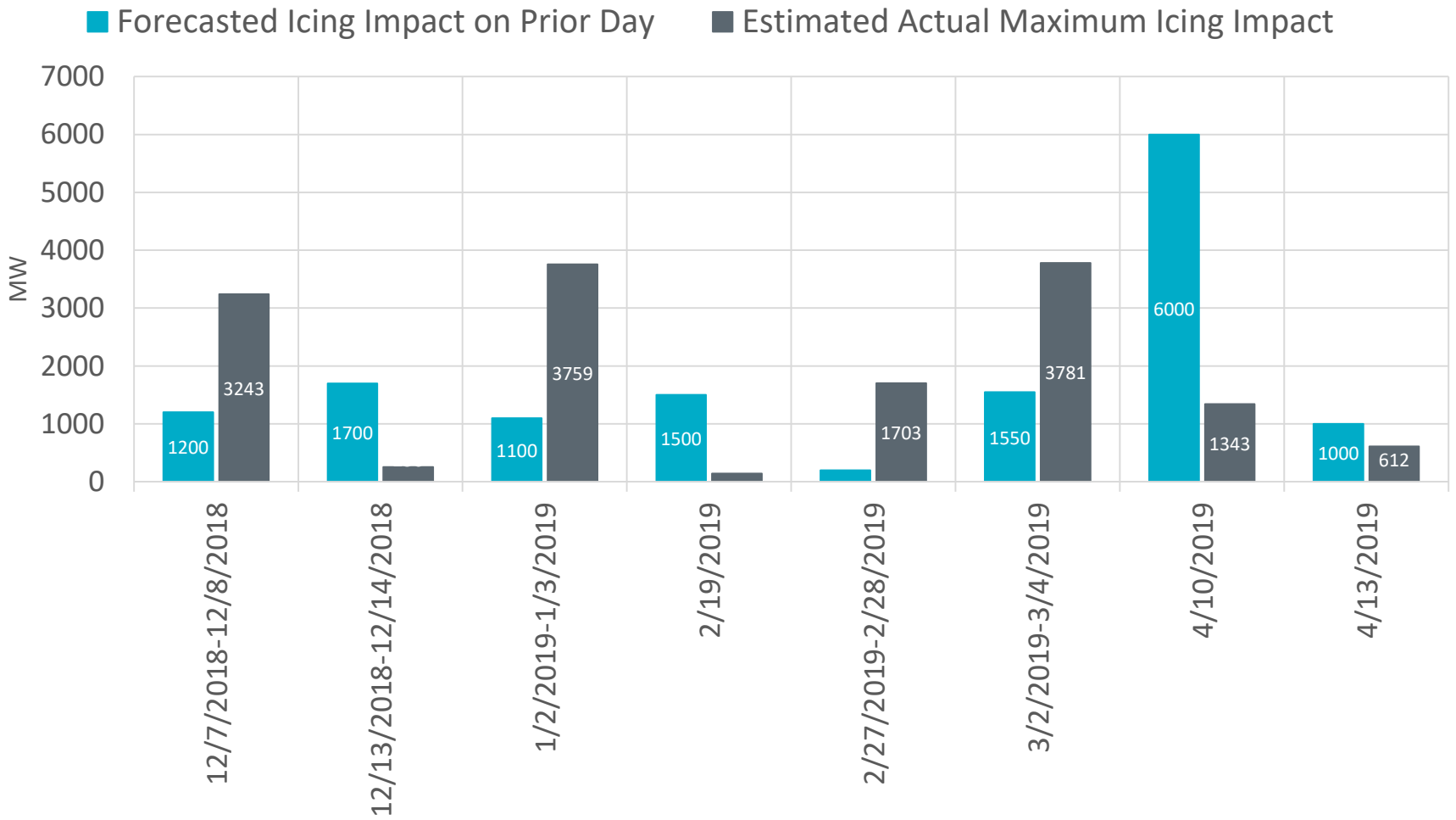
1) **Development or enhancement of one or more NERC Reliability Standards**

2) **Enhanced outreach to Generator Owners/Generator Operators**

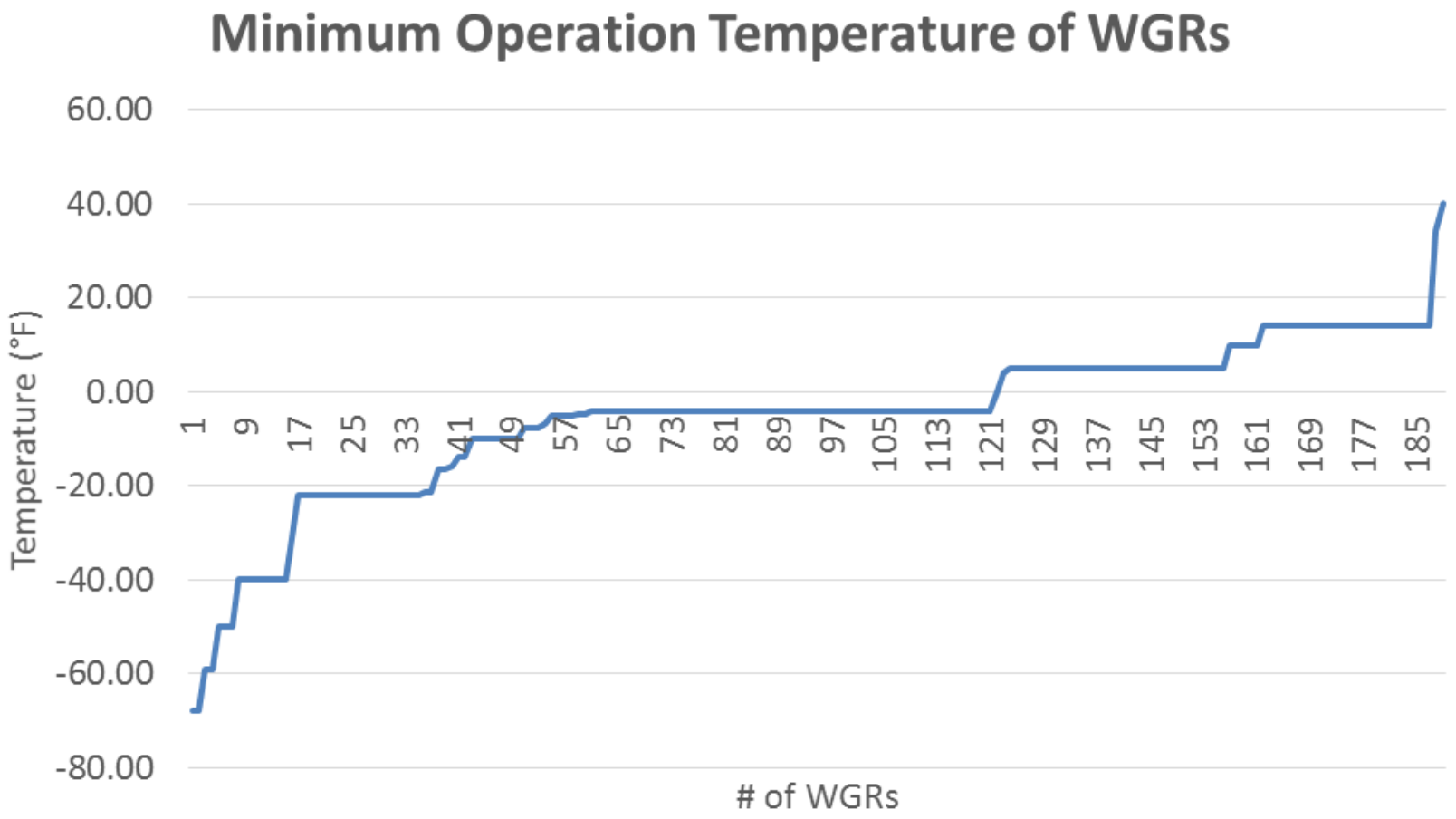
3) **Market (Independent System Operators/Regional Transmission Organizations) rules where appropriate**

ERCOT Wind Generation Icing Events in Winter 2018 - 2019

There were 8 distinct cold weather-related icing events wherein the estimated icing related wind generation impact varied from 140 MW to 3,700 MW. In all cases Icing Impact was forecasted in the days prior.



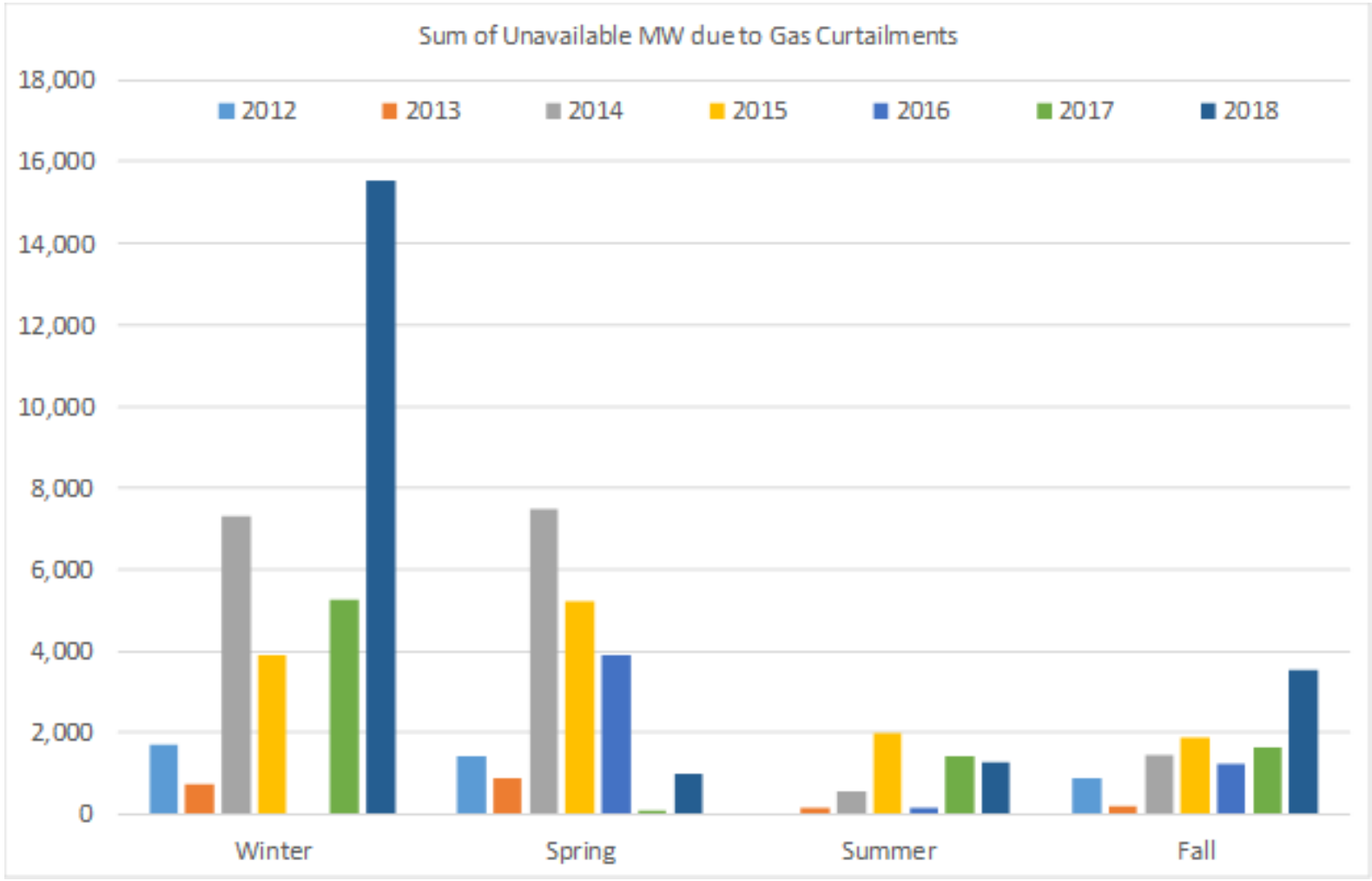
ERCOT Operation Limits of WGRs (as of early 2018)



Source: N. Mago, ERCOT

ERCOT Natural Gas Curtailments from GADS

- **Significant increase in gas curtailments in 2018**
- **Continuing to monitor as resource mix changes to more gas generation**



Questions?

For further information:
Bob Collins (512-583-4986)
Mark Henry (512-583-4988)

Email:
rapa@texasre.org

Appendix: Generation Sound Practices from the NERC/FERC Report

1) Southern Company (in the SeRC footprint), performed numerous generator fuel switches, using alternative fuel sources to help prevent a fuel supply emergency. Fuel-switching is especially important during cold weather. During extreme cold weather events, natural gas limitations can be predicted/expected to occur as residential and commercial gas heating needs compete with electric generation needs, and gas pipeline entities can be expected to limit pipeline use to sustain gas pressure throughout the cold weather demand.

2) **Continuous monitoring of heat tracing systems** complete with a display panel and indicator lights.

3) **Inspection of heat tracing circuits**, including power supplies, prior to winter.

4) Having regular, **periodic operational checks of heat tracing** circuits.

5) **Annual update of winter preparation checklist**, incorporating lessons learned from previous winter.

6) **Completion of freeze protection-related maintenance prior** to winter weather.

7) **Increased operator rounds/increased staffing** prior to, and during winter weather to check for proper operation of plant equipment susceptible to freezing conditions.

8) Addition of a “freeze protection operator,” during adverse weather who is responsible for inspecting critical equipment, and ensuring appropriate protection is in place.

Appendix: Generation Sound Practices from the NERC/FERC Report

9) Firing of dual fuel units that have not fired on their secondary fuel source during the previous year, prior to a forecast cold weather event.

10) RTO or RC conducting a survey of GO/GOP to determine winter preparedness activities have been completed, and fuel switching testing has been performed.

11) Sharing lessons learned by GO/GOP from extreme events, including through the NERC Events Analysis lessons learned program, or through Regional processes.

12) Developing procedures and training for Generator Operators on when to call for fuel switchable resources.

13) Maintaining **inventory of pre-arranged supplies** and equipment for extreme weather events by Generator Owners and Operators.

14) Generator Owners and Operators conducting **readiness drills** on extreme weather preparation.

15) Generators connecting to multiple pipelines when possible to allow for obtaining gas supply during tight market conditions if one or more pipelines has operational issues or high utilization that forces cuts to interruptible supply.

16) Generators keeping close contact with natural gas pipeline companies during events to keep abreast of timely public postings of operational details such as operationally available capacity and unexpected outages, which allows generators to make more flexible and timely decisions.

Appendix: NERC Generator Winter Weather "Lessons Learned"

- LL20110902 Adequate Maintenance and Inspection of Generation Freeze Protection
- LL20110903 Gen. Unit Temperature Design Parameters & Extreme Winter Conditions
- LL20111001 Plant Instrument & Sensing Eqpt Freezing Due to Heat Trace/Insulation Failures
- LL20111002 Plant Fuel Switching and Cold Weather
- LL20120101 Plant Onsite Material and Personnel Needed for a Winter Weather Event
- LL20120102 Plant Operator Training to Prepare for a Winter Event
- LL20120103 Transmission Facilities and Winter 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
- LL20140503 Improved Contractor Oversight Needed
- LL20180702 Preparing Circuit Breakers for Operation in Cold Weather

https://www.nerc.com/pa/rrm/ea/Pages/Lessons-Learned.aspx

https://www.nerc.com/pa/rrm/ea/Pages/February-2011-Southwest-Cold-Weather-Event.aspx

Winterization at Kiamichi

Patrick Jackson, Plant Engineer at Tenaska Kiamichi Generating Station

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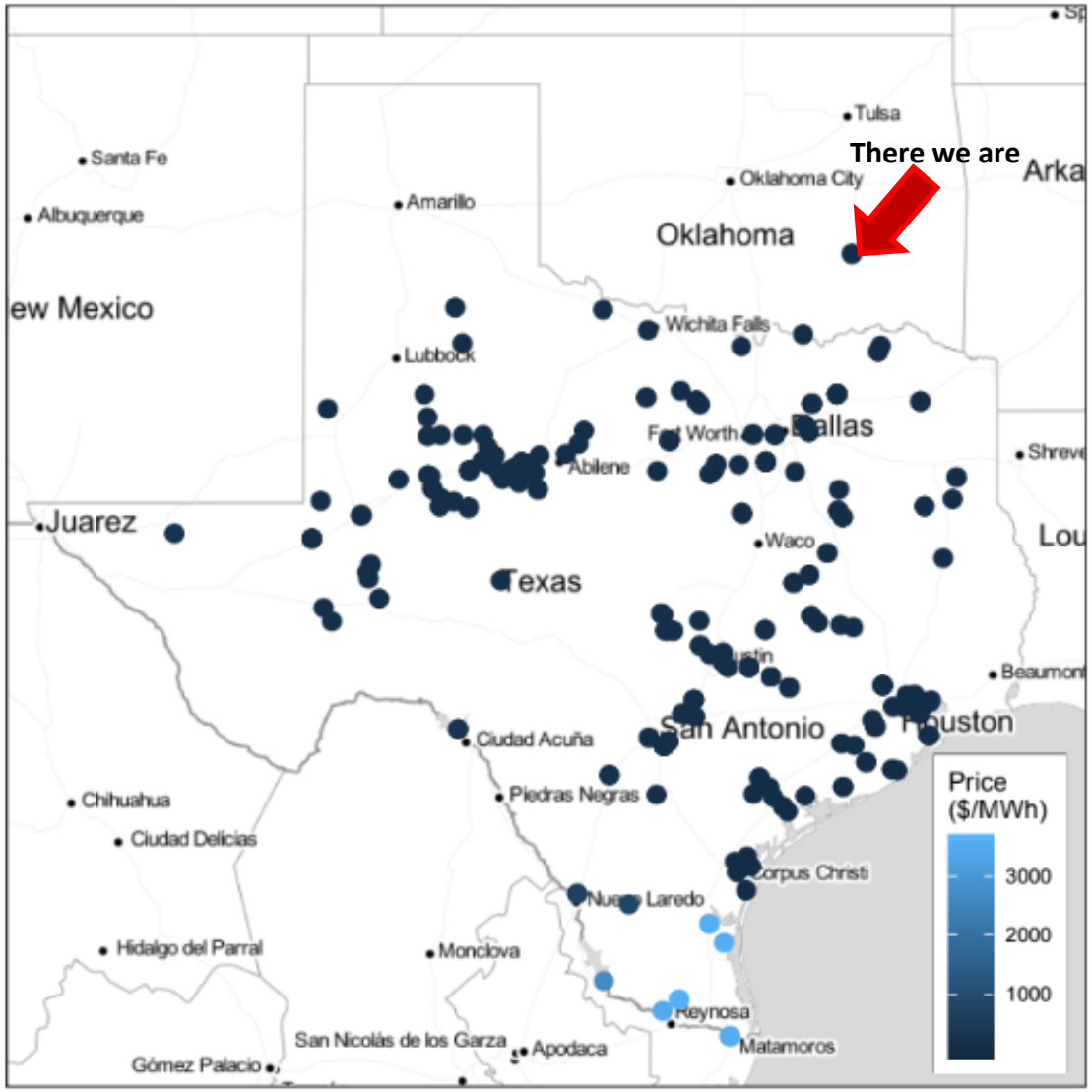
Agenda

- About the facility
- Previous problems
- Measures taken to correct previous problems
- Measures yet to be implemented



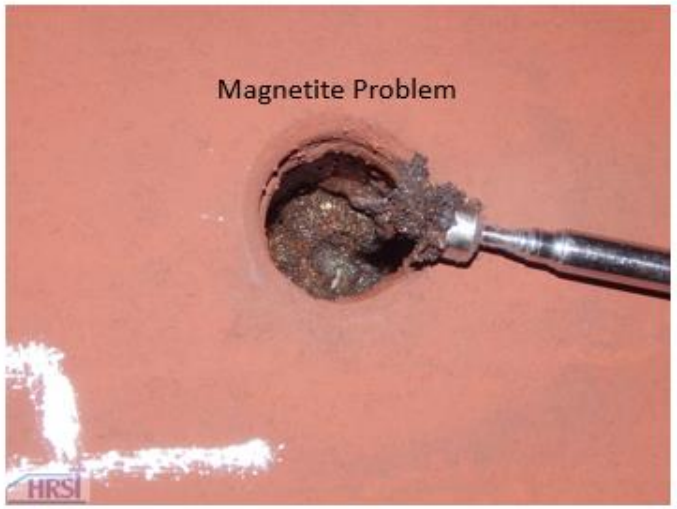
Tenaska Kiamichi Generating Station

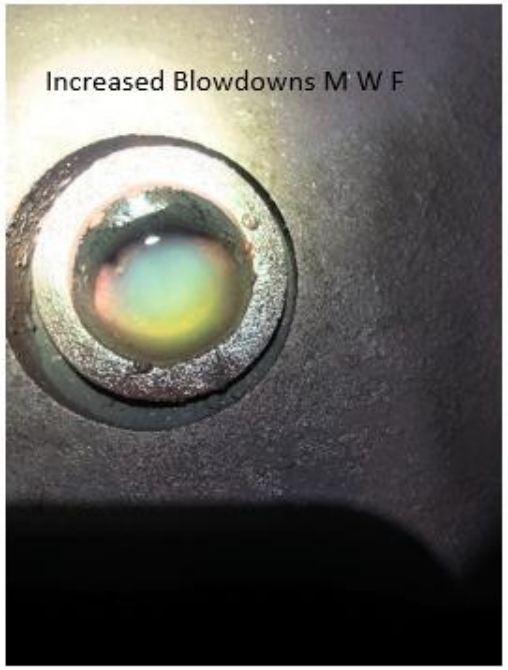
- 1220 MW facility; two 2x1 setup 610 MW per block
- GE-7FA gas turbines; GE-D11 steam turbines
- Switchable generating resource (SPP & ERCOT)
- Commissioned in 2003
- Plant design rating for 20 degree weather*
- Located near Kiowa, OK

Notable Weather events

- 2016 – Unit trip in startup from forced drum level indicator – failed start and restart required.
- 2018 – HP Drum level indicator froze, manually selected one for repair 3,427 MWh loss.
- 2019 – bypass valve received false indication of high pressure in the HP drum. Unit tripped on low drum level. Blown fuse caused heat trace to fail.

Drum Level Indicator Corrections





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Wind Break

Indicator Lights and Obrien boxes

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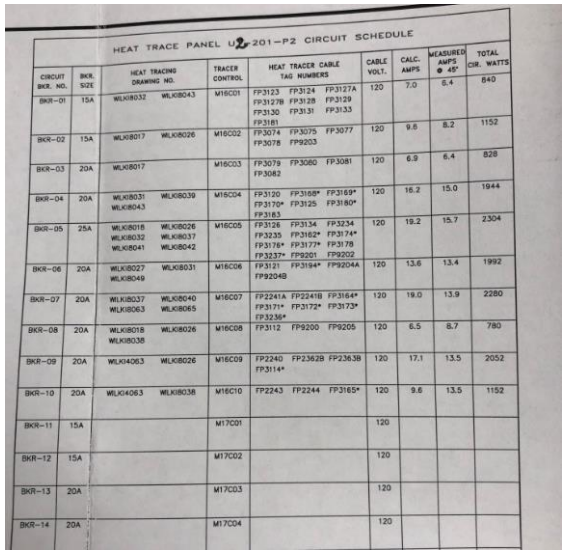
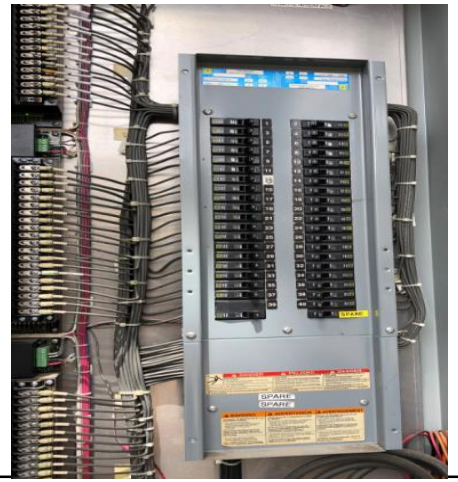
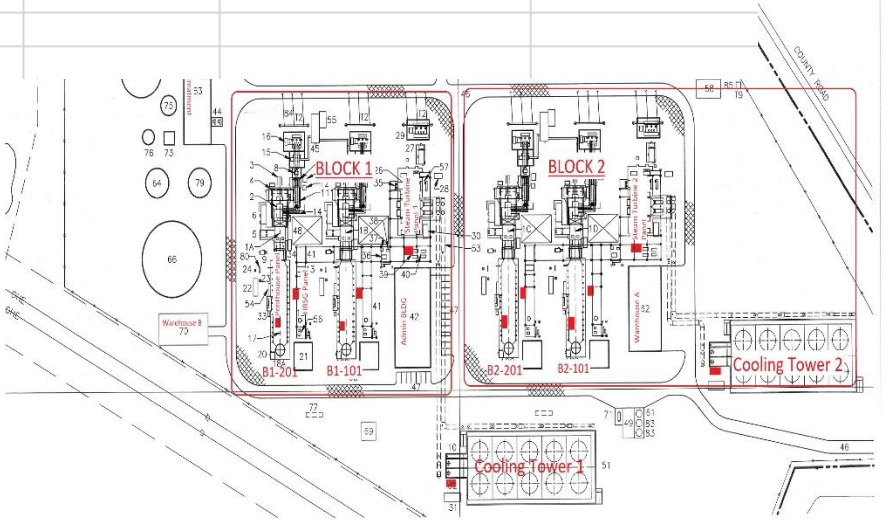
List of Critical Equipment

Unit 3 (AKA: 2-201)						
Equipment	**Description**	**Equipment**	**Panel**	**Breaker #**	**Circuit #**	**Drawing #**
B2-201 Drum Level Transmitters	B2-201 HP Drum Level Transmitter	B2-SGA-LT-203A	2-201-P2	5	16-5	WILKI-8037-R2
	B2-201 HP Drum Level Transmitter	B2-SGA-LT-203B	2-201-P2	7	16-7	WILKI-8037-R2
	B2-201 HP Drum Level Transmitter	B2-SGA-LT-203C	2-201-P2	19	17-9	WILKI-8037-R2
	B2-201 IP Drum Level Transmitter	B2-SGA-LT-202A	2-201-P2	2, 5, 8, 9, 19	16-2, 16-5, 16-8, 16-9, 17-9	WILKI-8026-R2
	B2-201 IP Drum Level Transmitter	B2-SGA-LT-202B	2-201-P2	2, 5, 8, 9, 19	16-2, 16-5, 16-8, 16-9, 17-9	WILKI-8026-R2
	B2-201 IP Drum Level Transmitter	B2-SGA-LT-202C	2-201-P2	2, 5, 8, 9, 19	16-2, 16-5, 16-8, 16-9, 17-9	WILKI-8026-R2
	B2-201 LP Drum Level Transmitter	B2-SGA-LT-201A	2-201-P2	10	16-10	WILKI-8038-R2
	B2-201 LP Drum Level Transmitter	B2-SGA-LT-201B	2-201-P2	10	16-10	WILKI-8038-R2
	B2-201 LP Drum Level Transmitter	B2-SGA-LT-201C	2-201-P2	20	17-10	WILKI-8038-R2
B2 BFP 201 Suction Strainer Diff Pressure Transmitters	B2 BFP P-201A Suction Strainer Diff Pressure Transmitter	B2-FWA-PT-203				
	B2 BFP P-201B Suction Strainer Diff Pressure Transmitter	B2-FWA-PT-204				
B2-201 Deluge Shack Heater	B2-201 Deluge Shack Heater		Deluge Panel			
B2-201 Duct Burner Regulators	B2-201 Duct Burner Reg VLV E5 Actuator and Air Supply Heat Trace	FGA-ACV-E5				
	B2-201 Duct Burner REG VLVS Shack Heater	FGA				


HEAT TRACE PANEL U2-201-P2 CIRCUIT SCHEDULE

CIRCUIT BKR. NO.	BKR. SIZE	HEAT TRACING DRAWING NO.	TRACER CONTROL	HEAT TRACER CABLE TAG NUMBERS	CABLE VOLT.	CALC. AMPS	MEASURED AMPS @ 45°	TOTAL CIR. WATTS
BKR-01	15A	WLKI8032 WLKI8043	M16C01	FP3123 FP3124 FP3127A FP3127B FP3128 FP3129 FP3130 FP3131 FP3133 FP3181	120	7.0	6.4	840
BKR-02	15A	WLKI8017 WLKI8026	M16C02	FP3074 FP3075 FP3077 FP3078 FP9203	120	9.6	8.2	1152
BKR-03	20A	WLKI8017	M16C03	FP3079 FP3080 FP3081 FP3082	120	6.9	6.4	828
BKR-04	20A	WLKI8031 WLKI8039 WLKI8043	M16C04	FP3120 FP3168* FP3169* FP3170* FP3125 FP3180* FP3183	120	16.2	15.0	1944
BKR-05	25A	WLKI8018 WLKI8026 WLKI8032 WLKI8037 WLKI8041 WLKI8042	M16C05	FP3126 FP3134 FP3234 FP3235 FP3162* FP3174* FP3176* FP3172* FP3178 FP3237* FP9201 FP9202	120	19.2	15.7	2304
BKR-06	20A	WLKI8027 WLKI8031 WLKI8049	M16C06	FP3121 FP3194* FP9204A FP9204B	120	13.6	13.4	1992
BKR-07	20A	WLKI8037 WLKI8040 WLKI8063 WLKI8065	M16C07	FP2241A FP2241B FP3164* FP3171* FP3172* FP3173* FP3236*	120	19.0	13.9	2280
BKR-08	20A	WLKI8018 WLKI8026 WLKI8038	M16C08	FP3112 FP9200 FP9205	120	6.5	8.7	780
BKR-09	20A	WLKI4063 WLKI8026	M16C09	FP2240 FP2362B FP2363B FP3114*	120	17.1	13.5	2052
BKR-10	20A	WLKI4063 WLKI8038	M16C10	FP2243 FP2244 FP3165*	120	9.6	13.5	1152
BKR-11	15A		M17C01		120			
BKR-12	15A		M17C02		120			
BKR-13	20A		M17C03		120			
BKR-14	20A		M17C04		120			





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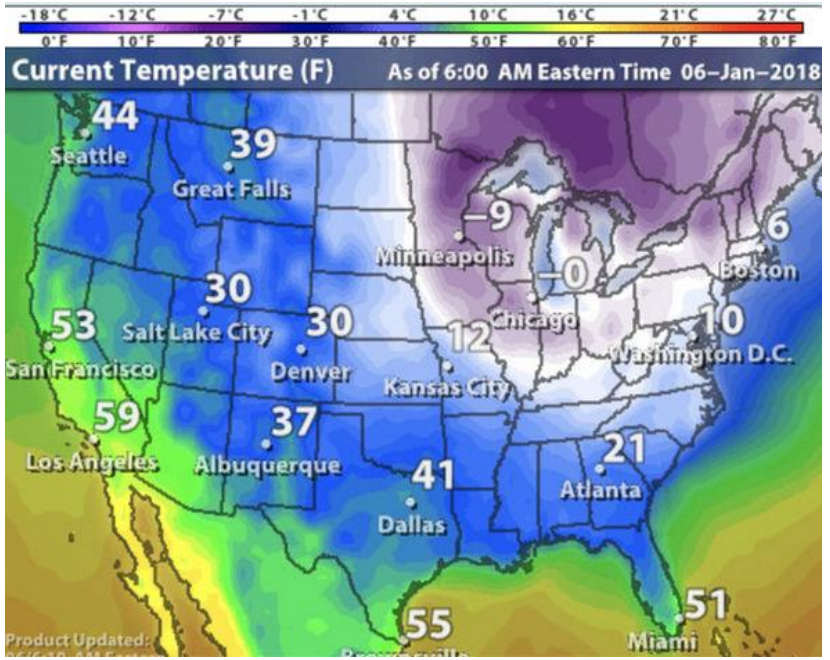
Kiowa a Day Ahead for the Cold



	Kiowa, OK	Dallas, TX	Austin, TX
January 1, 2019	42° / 29°	45° / 36°	46° / 39°
February 8, 2019	32° / 19°	38° / 25°	39° / 33°

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Actions Taken

- Initiated the inclusion of annual budget line item for winterization, heat trace installations / repairs, insulation additions / repairs and formal inspection program for all winterization items.
- Improved drum level indicators for improved reliability.
- Installed wind breaks in troublesome areas.
- Included manual checks for heat trace; turkey thermometers.
- Request QSE to schedule units to be on-line ahead of cold weather projections in Kiowa, OK. (Best practice)

Future Action Items Planned

- Update heat trace indicators to provide external light for visual indication of when circuits are off. This modification prevents a normal-off status from masking a loss of power to the heat tracing due to a circuit failure. Partially completed.
- Duct burners fail to read correctly sometimes because air/moisture gets caught in the sensing line.
- Heat trace panels alarm indicators to the DCS. Working towards this based on available economics.
- Modify installation methods for insulation to minimize damage to heat trace.

Questions?

Deer Park Energy Center ERCOT Winter Prep 2019

Our mission is to guide employees in a team environment that allows us to work toward a shared goal of best in class operations. Through our stewardship we will strive to accomplish the goals set forth by management while adhering to the highest principles in our industry.

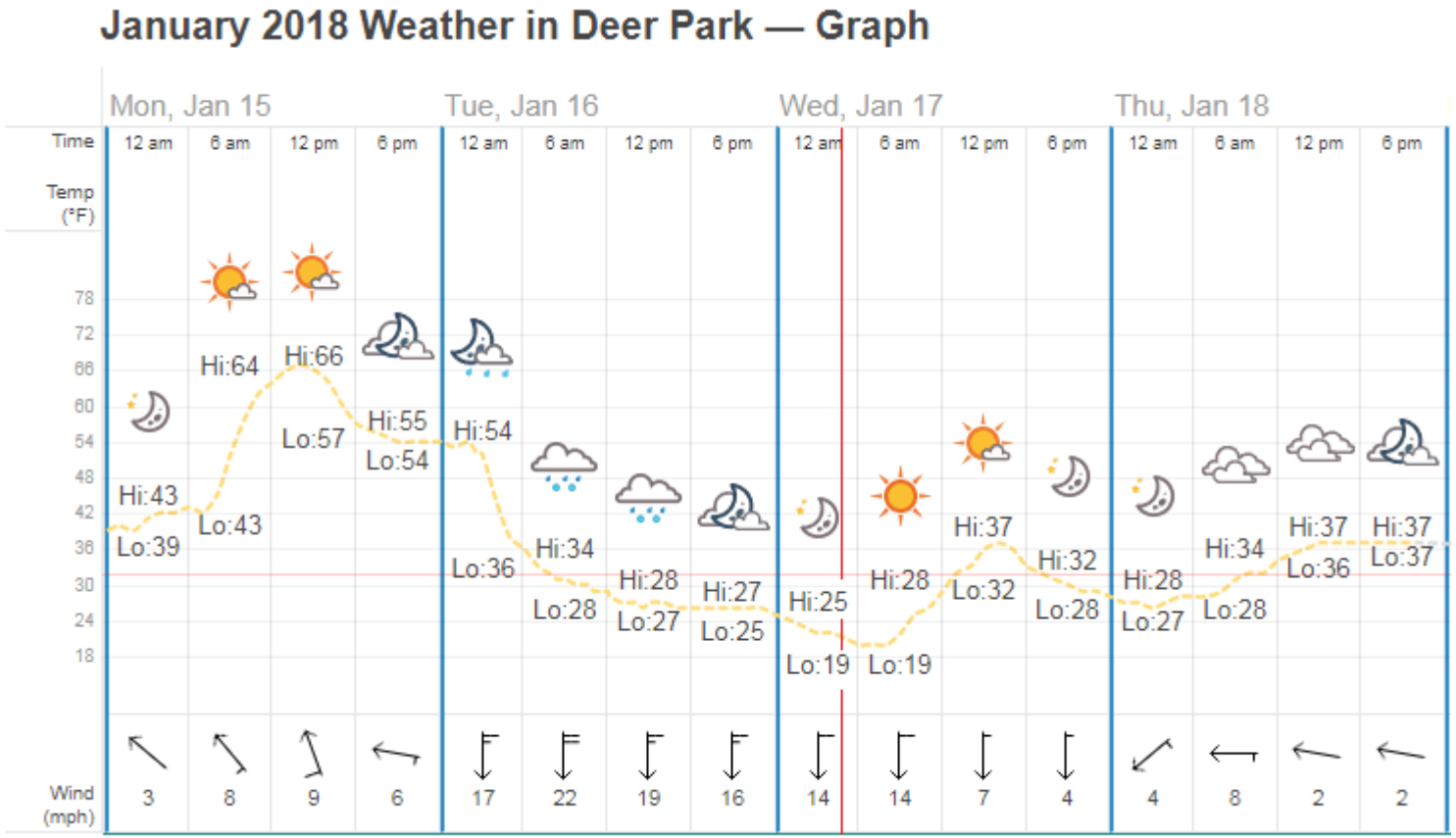
9/5/2019

DEER PARK ENERGY CENTER

Location:	Deer Park, TX
Commercial Operation Date:	June 2003
Calpine Net Interest Baseload (MW):	1103 megawatts
Calpine Net Interest With Peaking (MW):	1204 megawatts
Ownership:	Calpine 100%
Technology:	Natural gas-fired, combined-cycle cogeneration
Turbines:	Siemens Westinghouse combustion and Toshiba steam
NERC Region:	Texas RE

January 17th 2018 Plant Conditions

- Ambient temperature 24 degrees F and decreasing
- Below freezing temperatures sustained for 20+ hours
- Slight wind from the North at 14mph
- Plant Design Temp of 20 degrees F (dry Bulb) 18 degrees F (wet bulb)
- All 5 units were online and base loaded
- Winter Rounds and Readings were in effect
- Winter system checkouts had already been completed for the season



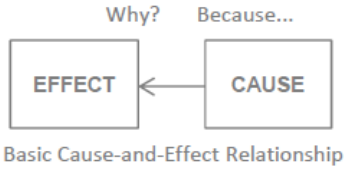

Cursor-lines Information: 01/17/2018 04:43:47.550 01/17/2018 05:12:35.850 0:28:48.3
1 (A) 1-LOAD-SELECT.UNIT1@OVATION Auto Historian Actual LOAD SELECT 3.4 MW -1 215 0.0 3.7 3.7
2 (A) 1-GEN-BRKR-CLOSED.UNIT1@OVATION Auto Historian Actual GEN BREAKER CLOSED CLOSED 1 OPEN CLOSED OPEN 0 CLOSED 1 1.000
3 (A) 1-SPD-SELECT.UNIT1@OVATION Auto Historian Actual SELECTED SPEED 3600.6 RPM -1 3700 3395.5 3600.6 205.1
4 (A) 01CNS-LT1073A.UNIT1@OVATION Auto Historian Actual LP FW TO KETTLE BOILER LVL-A 3.78 INCH -12 12 8.31 3.78 -4.53
5 (A) 01CNS-LT1073B.UNIT1@OVATION Auto Historian Actual LP FW TO KETTLE BOILER LVL-B 3.91 INCH -12 12 -10.04 4.15 14.18
6 (A) 01CNS-LT1073S-SEL.UNIT1@OVATION Auto Historian Actual H1 LP FW TO KTL BLR LVL SEL 3.776 INCH -12 12 -10.123 3.776 13.899
7 (A) 01CNS-LT1073S-LL.UNIT1@OVATION Auto Historian Actual H1 LP FW TO KTL BLR LVL LO LO FALSE 0 FALSE TRUE TRUE 1 FALSE 0 -1.000
Graph
Table View
Summary View
Radar View
Kettle Boiler Transmitter "A" Going Bad Quality
Kettle Boiler Transmitter "B" thawed
Kettle Boiler Transmitter "B" Freezes.
Breaker Open 04:43:47
Operations restarted 04:52:13
Breaker Closed 05:12:35
CLOSED
OPEN
TRUE
FALSE
04:38:00
04:40:04
04:42:07
04:44:11
04:46:14
04:48:18
04:50:21
04:52:25
04:54:28
04:56:32
04:58:35
05:00:39
05:02:42
05:04:46
05:06:49
05:08:53
05:10:56
05:13:00

Unit 1 Trip Root Cause Analysis

Unit 1 trip from load due to 01-CNS-LT-1073B freezing

Step 2. Analysis

Cause Map



Basic Cause-and-Effect Relationship

Problem

Unit 1 tripped from load

With a level of < -5.5" the logic tripped the turbine

LT1073A is automatically excluded from the average

Level Transmitter 1073A went bad quality

Level Transmitter A rose to 9+ inches

Level control valve opened to compensate

LCV control loop averages the 2 transmitters

LT1073B froze and was measuring -10inches

RAC#1 is without instrument block heaters

Possible solution:Install instrument block heaters

Evidence: RAC#2-4 have ins. heater blocks

RAC#1 was built under a different contract than RAC#2-4

Freezing temperatures sustained for >20 hours

Temperature was 24 degrees and decreasing

Unit 1 Trip Follow-up Actions

DPEC Winter Prep Procedure Highlights

- Pre-Winter Season Checklists
  - Verify operation of portable heaters (liquid fuel and electric)
  - Verify operation and current draw of heat trace circuits
  - Install temporary wind breaks and “hooches”.
  - Instrument enclosure checkouts.
  - Rotor Air Cooler heater block checkout (added to critical component list after Unit 1 trip event).
  - Verify that critical component measures to prevent freezing has been completed
  - Stores and winter inventory check sheet.
  - Provide training refresher on winter procedures to staff.

DPEC Winter Prep Procedure Highlights

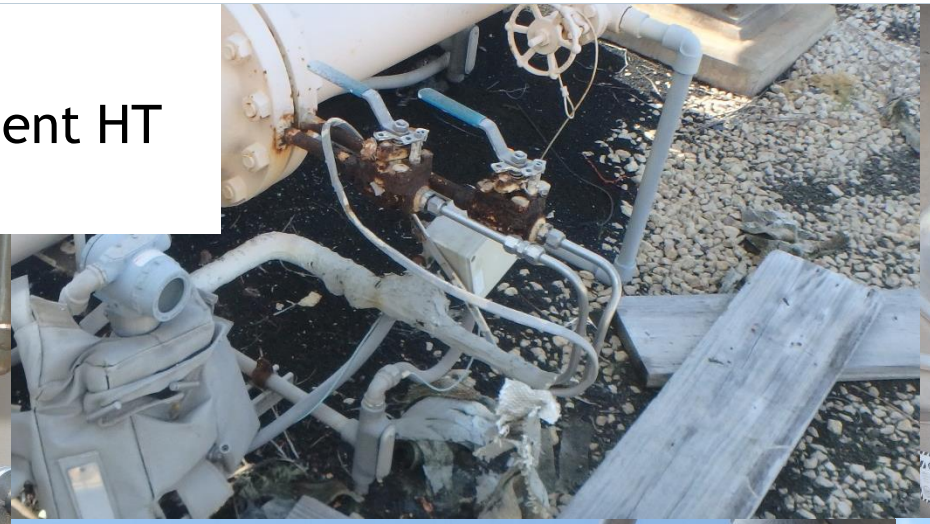
- Cold Weather Readiness Procedure
  - Activated during the winter cold weather season.
  - Activities pick up once temperatures are 35 degrees decreasing and predicted to go below 32 degrees (Plant enters **“Cold Weather Operations”** conditions).
    - Verify all heaters operating and on.
    - Walk down all exposed equipment focusing on instrumentation.
    - Verify chemical inventories are sufficient.
    - Verify fuel supplies are sufficient.
    - Verify sufficient food, blankets, cots, drinking water, etc… is available at the plant should roads become impassable due to inclement weather.
    - Suspend all discretionary maintenance that could affect plant availability.
    - Verify all susceptible Out-Of-Service equipment drained or protected.
    - Verify all susceptible In-Service equipment is protected.
    - CT Inlet Air Fogging System drained and dried.

DPEC Winter Prep Procedure Highlights

- Cold Weather Operations Rounds and Readings
  - Daily Checks
    - Temporary windbreaks and hooches inspections
  - Every 4 hours
    - Instrument enclosure inspections
    - Buildings and Permanent shelter inspections
  - Every Hour
    - Freeze Protection Panel inspections

2018/2019 Winter Improvements

- Insulation Survey
  - Identified and remedied deficient HT insulation

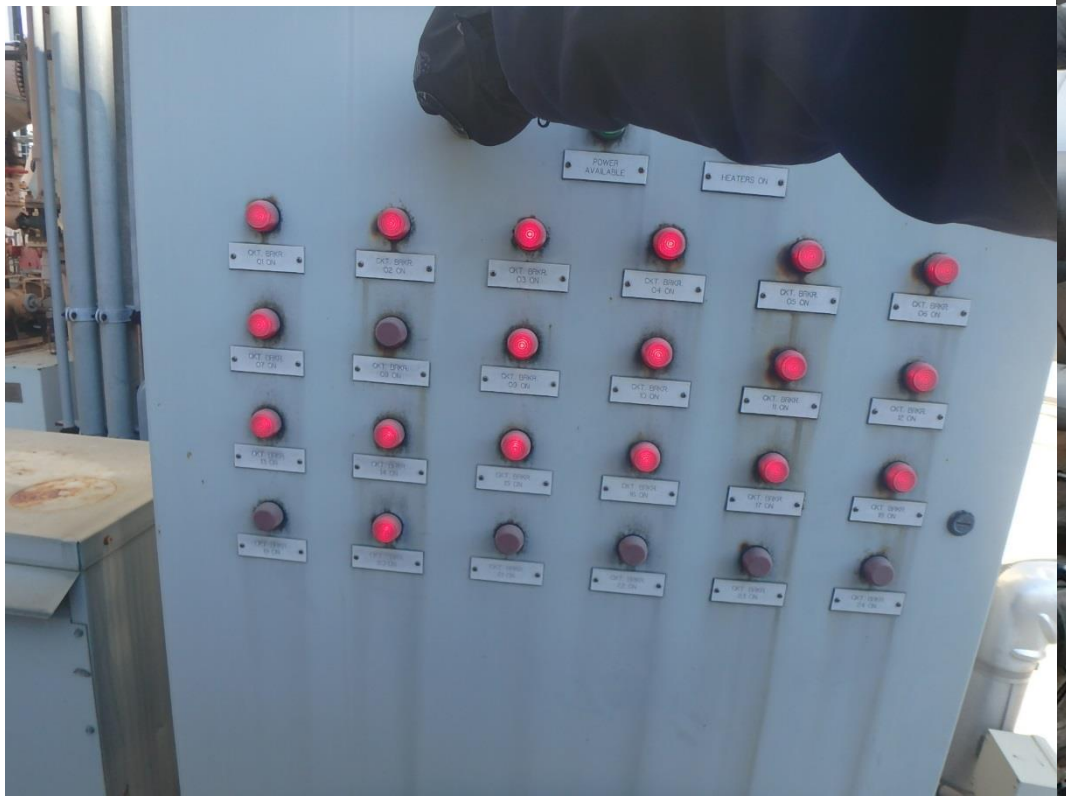


2018/2019 Winter Improvements

- Converting scaffold windbreaks over to rolling curtain style windbreaks

2018/2019 Winter Improvements

- Heat Trace Panel Survey
  - Troubleshot 100% of the faulty circuits
  - Eliminated unhealthy circuits
  - Made temporary corrections to critical unhealthy circuits
  - Created WO to follow up after temporary repairs had been made



2018/2019 Winter Improvements

- Heat Trace Panel Survey Troubleshooting Process
  - Measure Current through the heat trace.
  - If current is near zero, lift wires and measure resistance to ground and resistance across the HT bus bars.
  - If a short or a ground was discovered, we removed that portion of that circuit from the overall circuit.
  - We also identified the circuit on the associated drawing with notes regarding troubleshooting efforts and discoveries.
  - We then created a corrective maintenance work order to track the repair of circuit that was removed.

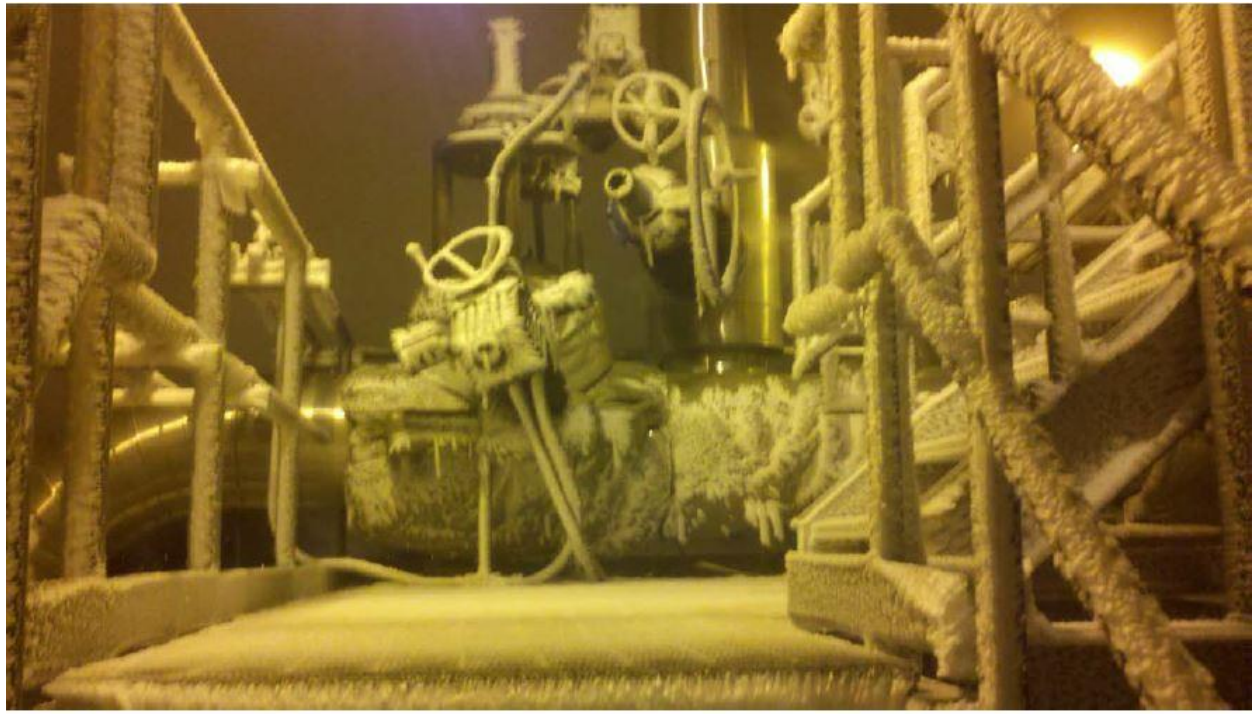
Break

Winter Readiness Improvements
&
Lessons Learned

Lamar Power Plant

Luminant

February 2011



February 8, 2011

- On February 8th 2011 after being in planned outage for 4 days ERCOT requested that we bring the plant back out of outage.
- It took 3 days to bring block 1 back out of outage. Not because maintenance or equipment reassembly. It took 3 days to thaw equipment so the plant could be started
- It took a large amount of propane bottles, weed burners, bullet heaters, heat lamps, portable heat trace, and miles of extension cords.
- But, there was a cost:

Lamar Block 2 Trip on January 6, 2014

- At 0900 on January 5, 2014 the ambient temperature dropped below freezing and the overnight low reached 14 degrees.
- 15 – 20 mph winds combined with low overnight temperature resulted in a trip of block 2 steam turbine due to loss of condenser vacuum.
- The trip was due to the steam seal pressure transmitter freezing and therefore providing false feedback to the steam seal pressure control valve.
- The trip resulted in a 550 MW loss for 4 hours, 5 minutes.
- At the time of the event Lamar Power Plant was not owned by Luminant.
- The total cost of the event due to loss generation was $2.2M.
- The root cause was contractor error when installing heat trace on the transmitter sensing line.

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Proactive vs. Reactive

Discussion Topic: What proactive measures could have been take to prevent this?

Access to equipment after the fact can be very difficult.

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Condition Variables

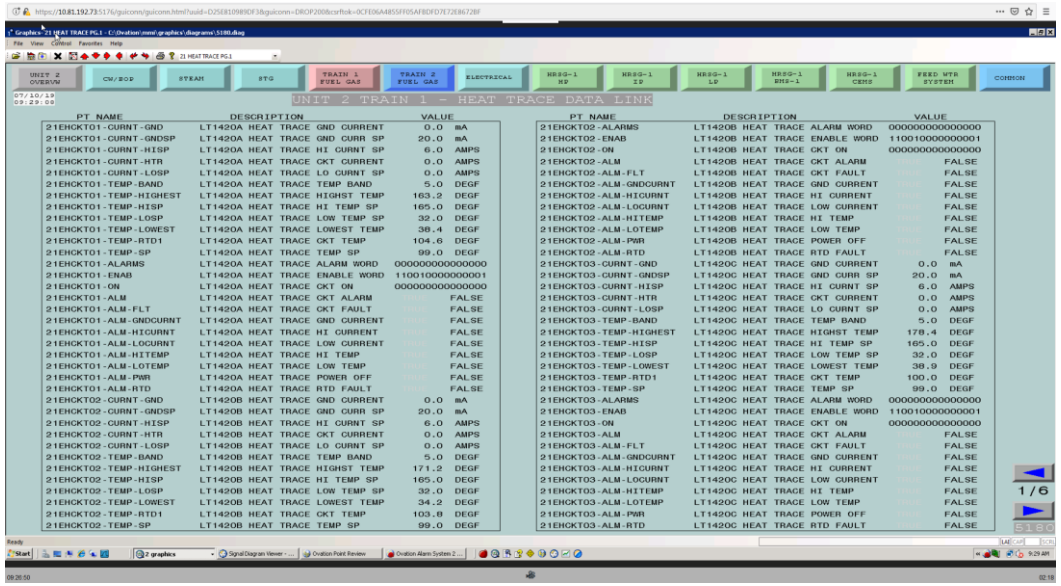
Frozen Valves:
Inspect and maintain thermal insulation on all units.

Removal of insulating blanket in summer, failure to reinstall for winter.

We were excited to be able to help NERC out with their "Cold Weather Presentation"…

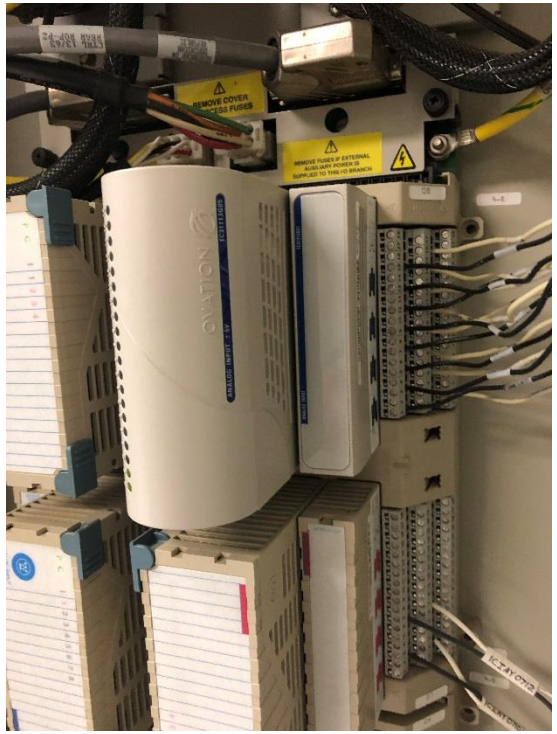
It was time to develop a more robust winter readiness plan & improve the plant’s winter reliability.

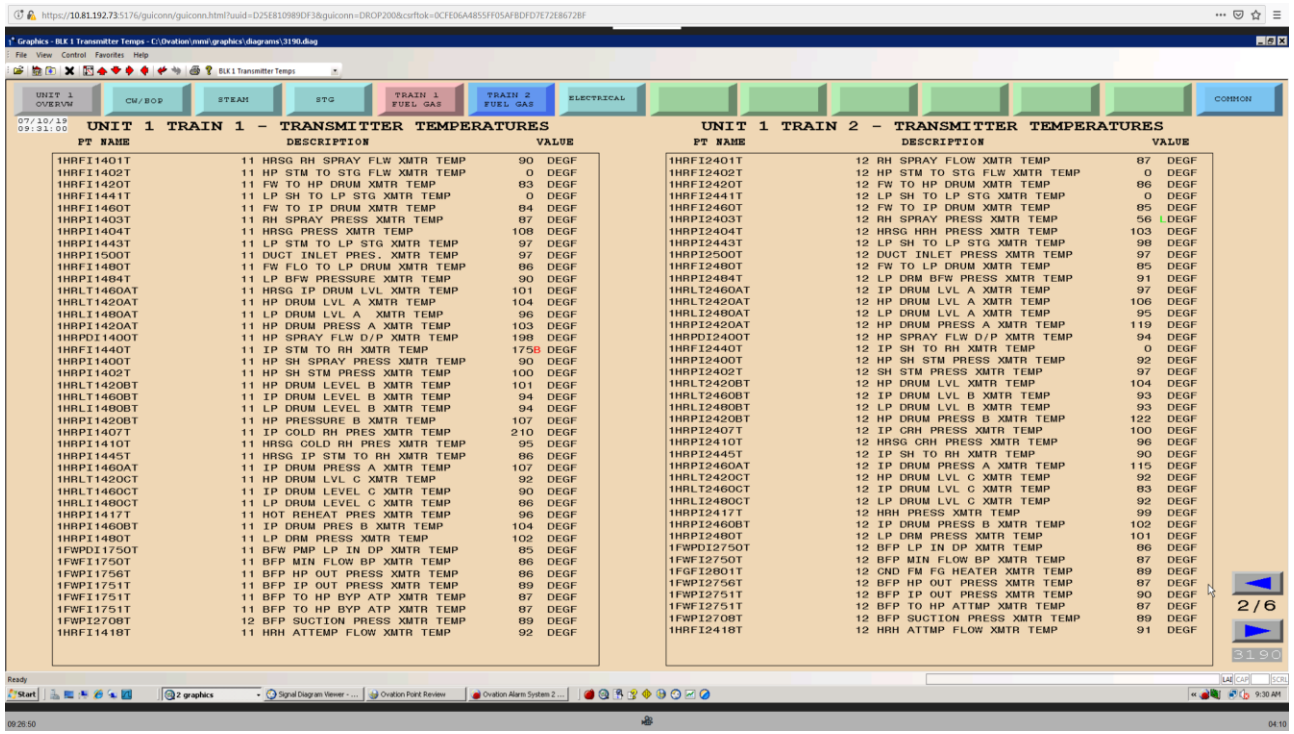
Equipment Upgrades For Reliability & Equipment Monitoring



Thermon heat trace control panels were installed on the top of each HRSG. These panels provide heat trace control and circuit monitoring for all critical equipment. The system is monitored through Ovation DCS by the control room operator. Alarms are generated for faulty circuits and low temperature circuits.

Equipment Upgrades For Reliability & Equipment Monitoring





UNIT 1 TRAIN 1 - TRANSMITTER TEMPERATURES

PT NAME	DESCRIPTION	VALUE
1HRFI1401T	11 HRSG RH SPRAY FLW XMTR TEMP	90 DEGF
1HRFI1402T	11 HP STM TO STG FLW XMTR TEMP	0 DEGF
1HRFI1420T	11 FW TO HP DRUM XMTR TEMP	83 DEGF
1HRFI1441T	11 LP SH TO LP STG XMTR TEMP	0 DEGF
1HRFI1460T	11 FW TO IP DRUM XMTR TEMP	84 DEGF
1HRPI1403T	11 RH SPRAY PRESS XMTR TEMP	87 DEGF
1HRPI1404T	11 HRSG PRESS XMTR TEMP	108 DEGF
1HRPI1443T	11 LP STM TO LP STG XMTR TEMP	97 DEGF
1HRPI1500T	11 DUCT INLET PRES. XMTR TEMP	97 DEGF
1HRFI1480T	11 FW FLO TO LP DRUM XMTR TEMP	86 DEGF
1HRPI1484T	11 LP BFW PRESSURE XMTR TEMP	90 DEGF
1HRLT1460AT	11 HRSG IP DRUM LVL XMTR TEMP	101 DEGF
1HRLT1420AT	11 HP DRUM LVL A XMTR TEMP	104 DEGF
1HRLI1480AT	11 LP DRUM LVL A XMTR TEMP	96 DEGF
1HRPI1420AT	11 HP DRUM PRESS A XMTR TEMP	103 DEGF
1HRPDI1400T	11 HP SPRAY FLW D/P XMTR TEMP	198 DEGF
1HRFI1440T	11 IP STM TO RH XMTR TEMP	175B DEGF
1HRPI1400T	11 HP SH SPRAY PRESS XMTR TEMP	90 DEGF
1HRPI1402T	11 HP SH STM PRESS XMTR TEMP	100 DEGF
1HRLT1420BT	11 HP DRUM LEVEL B XMTR TEMP	101 DEGF
1HRLT1460BT	11 IP DRUM LEVEL B XMTR TEMP	94 DEGF
1HRLI1480BT	11 LP DRUM LEVEL B XMTR TEMP	94 DEGF
1HRPI1420BT	11 HP PRESSURE B XMTR TEMP	107 DEGF
1HRPI1407T	11 IP COLD RH PRES XMTR TEMP	210 DEGF
1HRPI1410T	11 HRSG COLD RH PRES XMTR TEMP	95 DEGF
1HRPI1445T	11 HRSG IP STM TO RH XMTR TEMP	86 DEGF
1HRPI1460AT	11 IP DRUM PRESS A XMTR TEMP	107 DEGF
1HRLT1420CT	11 HP DRUM LVL C XMTR TEMP	92 DEGF
1HRLT1460CT	11 IP DRUM LEVEL C XMTR TEMP	90 DEGF
1HRLI1480CT	11 LP DRUM LEVEL C XMTR TEMP	86 DEGF
1HRPI1417T	11 HOT REHEAT PRES XMTR TEMP	96 DEGF
1HRPI1460BT	11 IP DRUM PRES B XMTR TEMP	104 DEGF
1HRPI1480T	11 LP DRM PRESS XMTR TEMP	102 DEGF
1FWPDI1750T	11 BFW PMP LP IN DP XMTR TEMP	85 DEGF
1FWFI1750T	11 BFP MIN FLOW BP XMTR TEMP	86 DEGF
1FWPI1756T	11 BFP HP OUT PRESS XMTR TEMP	86 DEGF
1FWPI1751T	11 BFP IP OUT PRESS XMTR TEMP	89 DEGF
1FWFI1751T	11 BFP TO HP BYP ATP XMTR TEMP	87 DEGF
1FWFI1751T	11 BFP TO HP BYP ATP XMTR TEMP	87 DEGF
1FWPI2708T	12 BFP SUCTION PRESS XMTR TEMP	89 DEGF
1HRFI1418T	11 HRH ATTEMP FLOW XMTR TEMP	92 DEGF

UNIT 1 TRAIN 2 - TRANSMITTER TEMPERATURES

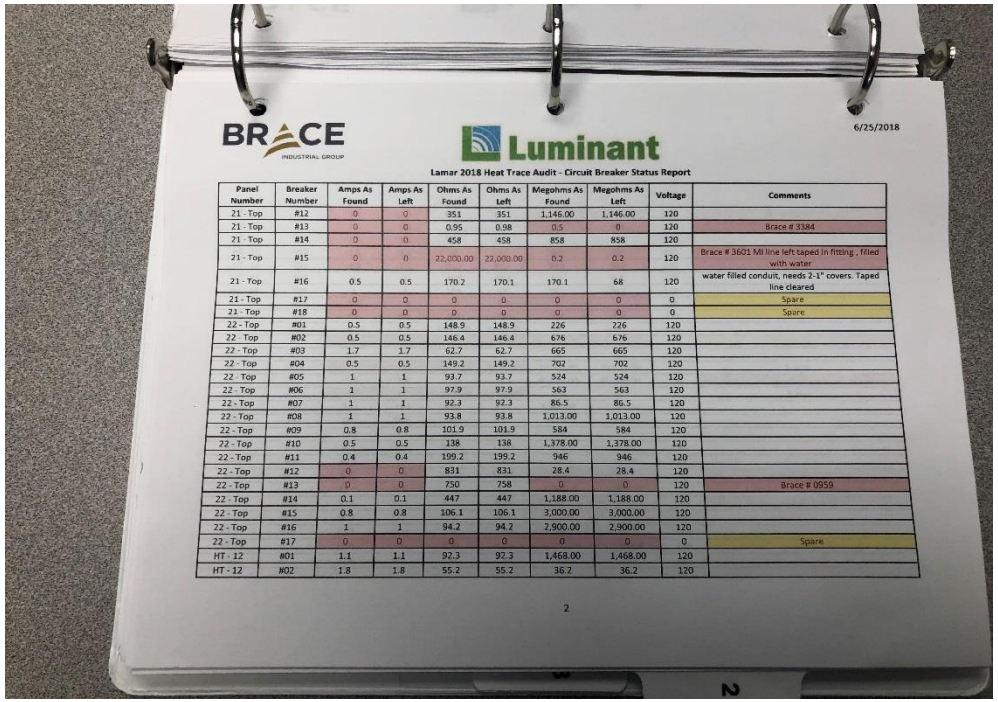
PT NAME	DESCRIPTION	VALUE
1HRFI2401T	12 RH SPRAY FLOW XMTR TEMP	87 DEGF
1HRFI2402T	12 HP STM TO STG FLW XMTR TEMP	0 DEGF
1HRFI2420T	12 FW TO HP DRUM XMTR TEMP	86 DEGF
1HRFI2441T	12 LP SH TO LP STG XMTR TEMP	0 DEGF
1HRFI2460T	12 FW TO IP DRUM XMTR TEMP	85 DEGF
1HRPI2403T	12 RH SPRAY PRESS XMTR TEMP	56 LDEGF
1HRPI2404T	12 HRSG HRH PRESS XMTR TEMP	103 DEGF
1HRPI2443T	12 LP SH TO LP STG XMTR TEMP	98 DEGF
1HRPI2500T	12 DUCT INLET PRESS XMTR TEMP	97 DEGF
1HRFI2480T	12 FW TO LP DRUM XMTR TEMP	85 DEGF
1HRPI2484T	12 LP DRM BFW PRESS XMTR TEMP	91 DEGF
1HRLT2460AT	12 IP DRUM LVL A XMTR TEMP	97 DEGF
1HRLT2420AT	12 HP DRUM LVL A XMTR TEMP	106 DEGF
1HRLI2480AT	12 LP DRUM LVL A XMTR TEMP	95 DEGF
1HRPI2420AT	12 HP DRUM PRESS A XMTR TEMP	119 DEGF
1HRPDI2400T	12 HP SPRAY FLW D/P XMTR TEMP	94 DEGF
1HRFI2440T	12 IP SH TO RH XMTR TEMP	0 DEGF
1HRPI2400T	12 HP SH STM PRESS XMTR TEMP	92 DEGF
1HRPI2402T	12 SH STM PRESS XMTR TEMP	97 DEGF
1HRLT2420BT	12 HP DRUM LVL XMTR TEMP	104 DEGF
1HRLT2460BT	12 IP DRUM LVL B XMTR TEMP	93 DEGF
1HRLI2480BT	12 LP DRUM LVL B XMTR TEMP	93 DEGF
1HRPI2420BT	12 HP DRUM PRESS B XMTR TEMP	122 DEGF
1HRPI2407T	12 IP CRH PRESS XMTR TEMP	100 DEGF
1HRPI2410T	12 HRSG CRH PRESS XMTR TEMP	96 DEGF
1HRPI2445T	12 IP SH TO RH XMTR TEMP	90 DEGF
1HRPI2460AT	12 IP DRUM PRESS A XMTR TEMP	115 DEGF
1HRLT2420CT	12 HP DRUM LVL C XMTR TEMP	92 DEGF
1HRLT2460CT	12 IP DRUM LVL C XMTR TEMP	83 DEGF
1HRLI2480CT	12 LP DRUM LVL C XMTR TEMP	92 DEGF
1HRPI2417T	12 HRH PRESS XMTR TEMP	99 DEGF
1HRPI2460BT	12 IP DRUM PRESS B XMTR TEMP	102 DEGF
1HRPI2480T	12 LP DRM PRESS XMTR TEMP	101 DEGF
1FWPDI2750T	12 BFP LP IN DP XMTR TEMP	86 DEGF
1FWFI2750T	12 BFP MIN FLOW BP XMTR TEMP	87 DEGF
1FGFI2801T	12 CND FM FG HEATER XMTR TEMP	89 DEGF
1FWPI2756T	12 BFP HP OUT PRESS XMTR TEMP	87 DEGF
1FWPI2751T	12 BFP IP OUT PRESS XMTR TEMP	90 DEGF
1FWFI2751T	12 BFP TO HP ATTMP XMTR TEMP	87 DEGF
1FWPI2708T	12 BFP SUCTION PRESS XMTR TEMP	89 DEGF
1HRFI2418T	12 HRH ATTMP FLOW XMTR TEMP	91 DEGF

All Ovation DCS analog input cards were upgraded to the Hart protocol analog input cards. The new analog input cards enable the temperature monitoring function for all Rosemount transmitters. During cold weather, transmitter temperatures are monitored by the control room operator and alarms are generated in the event of a low transmitter temperature.

Equipment Upgrades For Reliability & Equipment Monitoring

Exposed transmitters were installed in a heated enclosure with tube-trace for the sensing line.

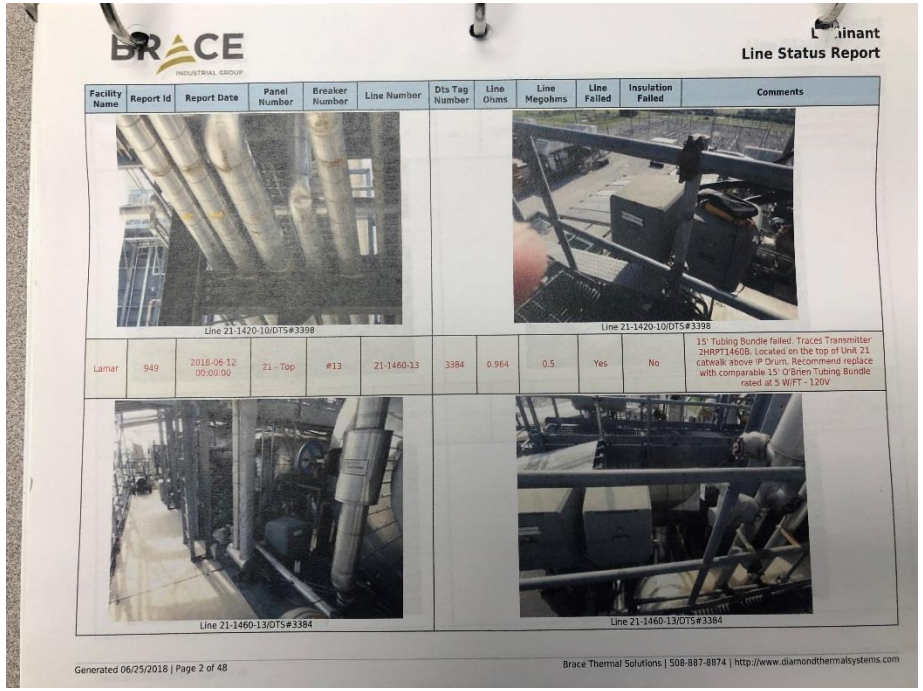
Heat Trace Audit



Panel Number	Breaker Number	Amps As Found	Amps As Left	Ohms As Found	Ohms As Left	Megohms As Found	Megohms As Left	Voltage	Comments
21 - Top	#12	0	0	351	351	1,146.00	1,146.00	120	
21 - Top	#13	0	0	0.95	0.98	0.5	0	120	Brace # 3384
21 - Top	#14	0	0	458	458	858	858	120	
21 - Top	#15	0	0	22,000.00	22,000.00	0.2	0.2	120	Brace # 3601 MI line left taped in fitting , filled with water
21 - Top	#16	0.5	0.5	170.2	170.1	170.1	68	120	water filled conduit, needs 2-1" covers. Taped line cleared
21 - Top	#17	0	0	0	0	0	0	0	Spare
21 - Top	#18	0	0	0	0	0	0	0	Spare
22 - Top	#01	0.5	0.5	148.9	148.9	226	226	120	
22 - Top	#02	0.5	0.5	146.4	146.4	676	676	120	
22 - Top	#03	1.7	1.7	62.7	62.7	665	665	120	
22 - Top	#04	0.5	0.5	149.2	149.2	702	702	120	
22 - Top	#05	1	1	93.7	93.7	524	524	120	
22 - Top	#06	1	1	97.9	97.9	563	563	120	
22 - Top	#07	1	1	92.3	92.3	86.5	86.5	120	
22 - Top	#08	1	1	93.8	93.8	1,013.00	1,013.00	120	
22 - Top	#09	0.8	0.8	101.9	101.9	584	584	120	
22 - Top	#10	0.5	0.5	138	138	1,378.00	1,378.00	120	
22 - Top	#11	0.4	0.4	199.2	199.2	946	946	120	
22 - Top	#12	0	0	831	831	28.4	28.4	120	
22 - Top	#13	0	0	750	758	0	0	120	Brace # 0959
22 - Top	#14	0.1	0.1	447	447	1,188.00	1,188.00	120	
22 - Top	#15	0.8	0.8	106.1	106.1	3,000.00	3,000.00	120	
22 - Top	#16	1	1	94.2	94.2	2,900.00	2,900.00	120	
22 - Top	#17	0	0	0	0	0	0	0	Spare
HT - 12	#01	1.1	1.1	92.3	92.3	1,468.00	1,468.00	120	
HT - 12	#02	1.8	1.8	55.2	55.2	36.2	36.2	120	

Winter readiness begins in August. A contractor is brought to conduct a full plant heat trace audit. 4 people usually take about 5-7 days to complete the audit. A full report is provided to the plant documenting the condition of each heat trace circuit as well as the corresponding control panel.

Heat Trace Audit


BRACE INDUSTRIAL GROUP

Luminant

Line Status Report

Facility Name	Report Id	Report Date	Panel Number	Breaker Number	Line Number	Dts Tag Number	Line Ohms	Line Megohms	Line Failed	Insulation Failed	Comments
Lamar	949	2018-06-12 00:00:00	21 - Top	#13	21-1460-13	3384	0.964	0.5	Yes	No	15' Tubing Bundle failed. Traces Transmitter 2HRPT1460B. Located on the top of Unit 21 catwalk above IP Drum. Recommend replace with comparable 15' O'Brien Tubing Bundle rated at 5 W/FT - 120V

Line 21-1420-10/DTS#3398

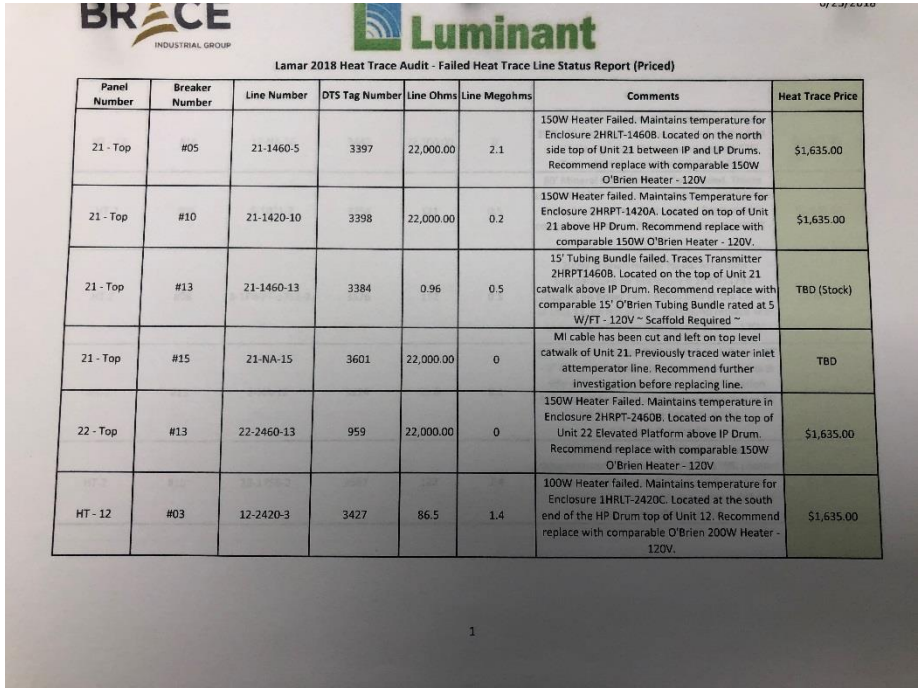
Line 21-1420-10/DTS#3398

Line 21-1460-13/DTS#3384

Line 21-1460-13/DTS#3384

Generated 06/25/2018 | Page 2 of 48

Brace Thermal Solutions | 508-887-8874 | http://www.diamondthermalsystems.com


BRACE INDUSTRIAL GROUP

Luminant

Lamar 2018 Heat Trace Audit - Failed Heat Trace Line Status Report (Priced)

Panel Number	Breaker Number	Line Number	DTS Tag Number	Line Ohms	Line Megohms	Comments	Heat Trace Price
21 - Top	#05	21-1460-5	3397	22,000.00	2.1	150W Heater Failed. Maintains temperature for Enclosure 2HRLT-1460B. Located on the north side top of Unit 21 between IP and LP Drums. Recommend replace with comparable 150W O'Brien Heater - 120V	$1,635.00
21 - Top	#10	21-1420-10	3398	22,000.00	0.2	150W Heater failed. Maintains Temperature for Enclosure 2HRPT-1420A. Located on top of Unit 21 above HP Drum. Recommend replace with comparable 150W O'Brien Heater - 120V.	$1,635.00
21 - Top	#13	21-1460-13	3384	0.96	0.5	15' Tubing Bundle failed. Traces Transmitter 2HRPT1460B. Located on the top of Unit 21 catwalk above IP Drum. Recommend replace with comparable 15' O'Brien Tubing Bundle rated at 5 W/FT - 120V ~ Scaffold Required ~	TBD (Stock)
21 - Top	#15	21-NA-15	3601	22,000.00	0	MI cable has been cut and left on top level catwalk of Unit 21. Previously traced water inlet attemperator line. Recommend further investigation before replacing line.	TBD
22 - Top	#13	22-2460-13	959	22,000.00	0	150W Heater Failed. Maintains temperature in Enclosure 2HRPT-2460B. Located on the top of Unit 22 Elevated Platform above IP Drum. Recommend replace with comparable 150W O'Brien Heater - 120V	$1,635.00
HT - 12	#03	12-2420-3	3427	86.5	1.4	100W Heater failed. Maintains temperature for Enclosure 1HRLT-2420C. Located at the south end of the HP Drum top of Unit 12. Recommend replace with comparable O'Brien 200W Heater - 120V.	$1,635.00

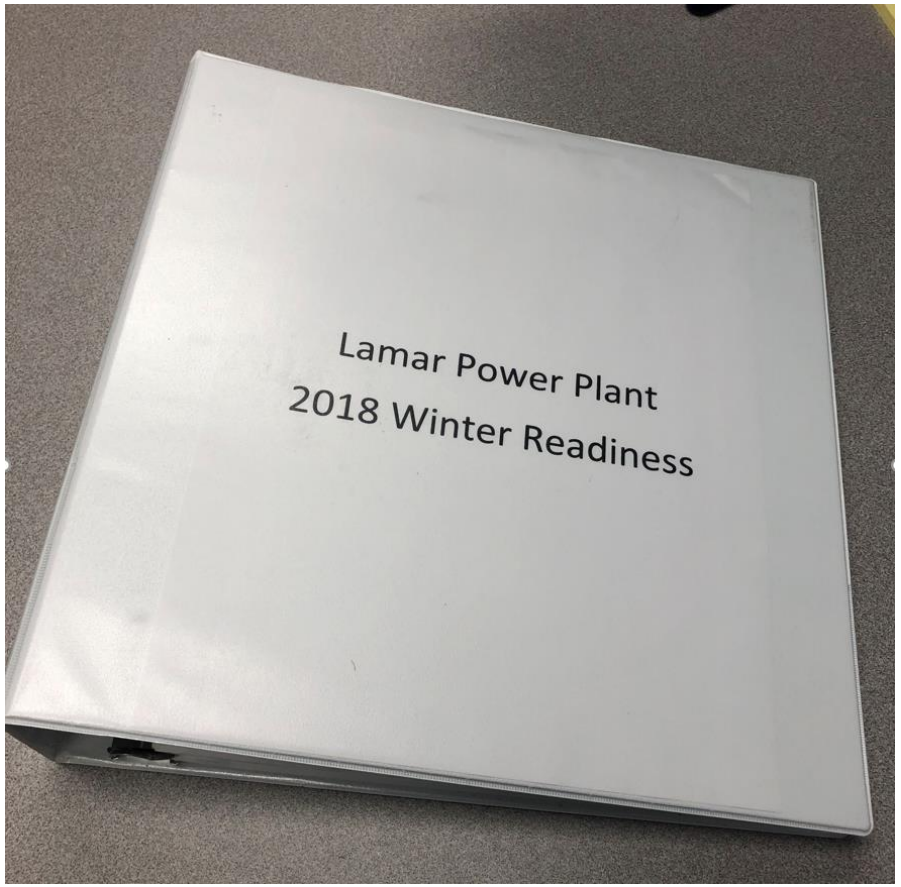
1

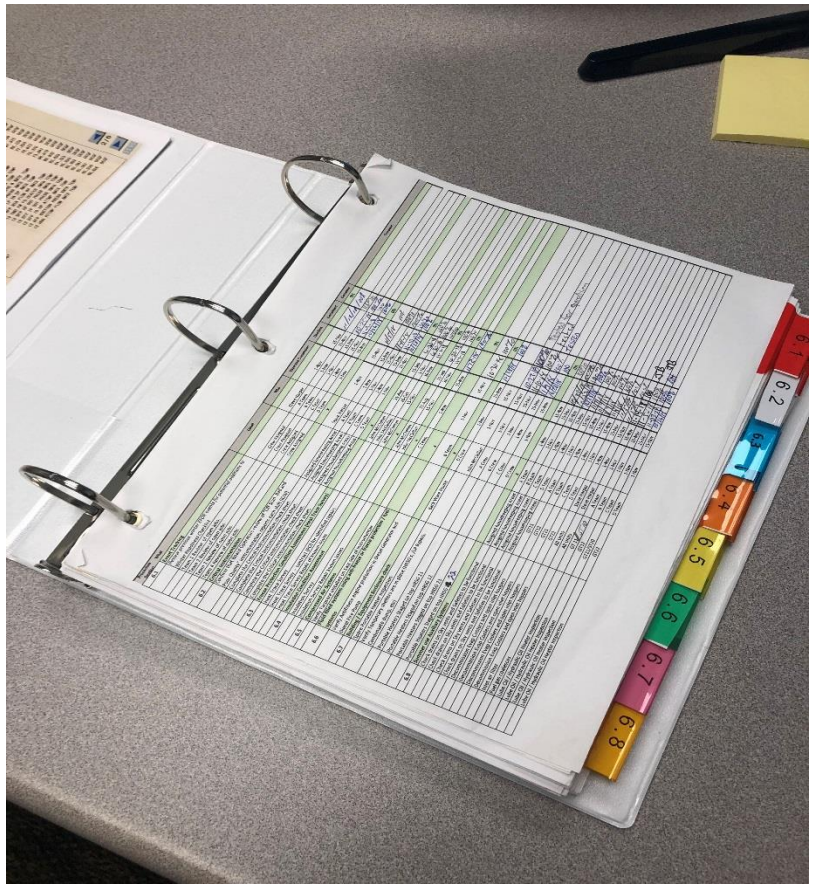
Pictures are provided to document the location and failure mode for each failed heat trace circuit. In addition to circuit health documentation, individual cost estimates are provided for repair of each failed circuit.

The report is reviewed by the plant lead team. Items are ranked by risk (likelihood vs. cost of failure) and a repair plan is generated.

A heat trace specialty contractor is brought to execute the repair plan.

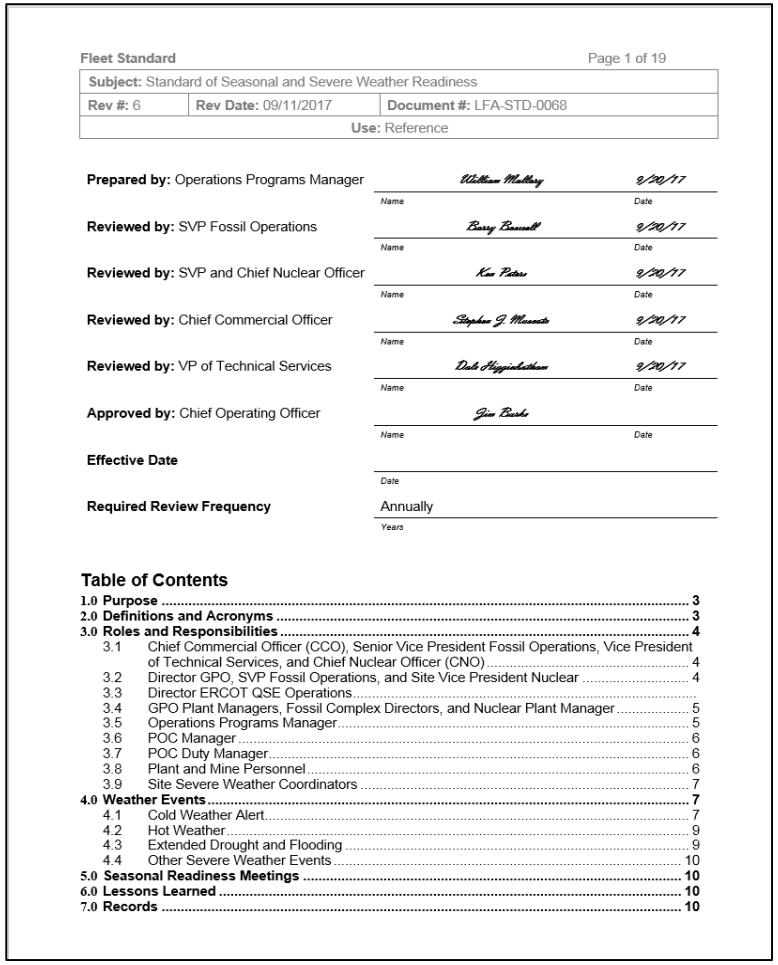
Winter Readiness





Each year at the first of October a winter readiness book is created and placed in the control. The book contains all winter readiness assignments, required training material, sign-off, and task tracking sheet. Each crew/individual is assigned a specific task that must be completed by a specific date.

Winter Readiness Task – Operator Training



Fleet Standard — Page 1 of 19

Subject: Standard of Seasonal and Severe Weather Readiness		
Rev #: 6	Rev Date: 09/11/2017	Document #: LFA-STD-0068
Use: Reference		

	Name	Date
Prepared by: Operations Programs Manager	William Mallory	9/20/17
Reviewed by: SVP Fossil Operations	Barry Bassett	9/20/17
Reviewed by: SVP and Chief Nuclear Officer	Ken Peters	9/20/17
Reviewed by: Chief Commercial Officer	Stephen J. Masonis	9/20/17
Reviewed by: VP of Technical Services	Dale Higginbotham	9/20/17
Approved by: Chief Operating Officer	Jim Burke	
Effective Date		
Required Review Frequency	Annually (Years)	

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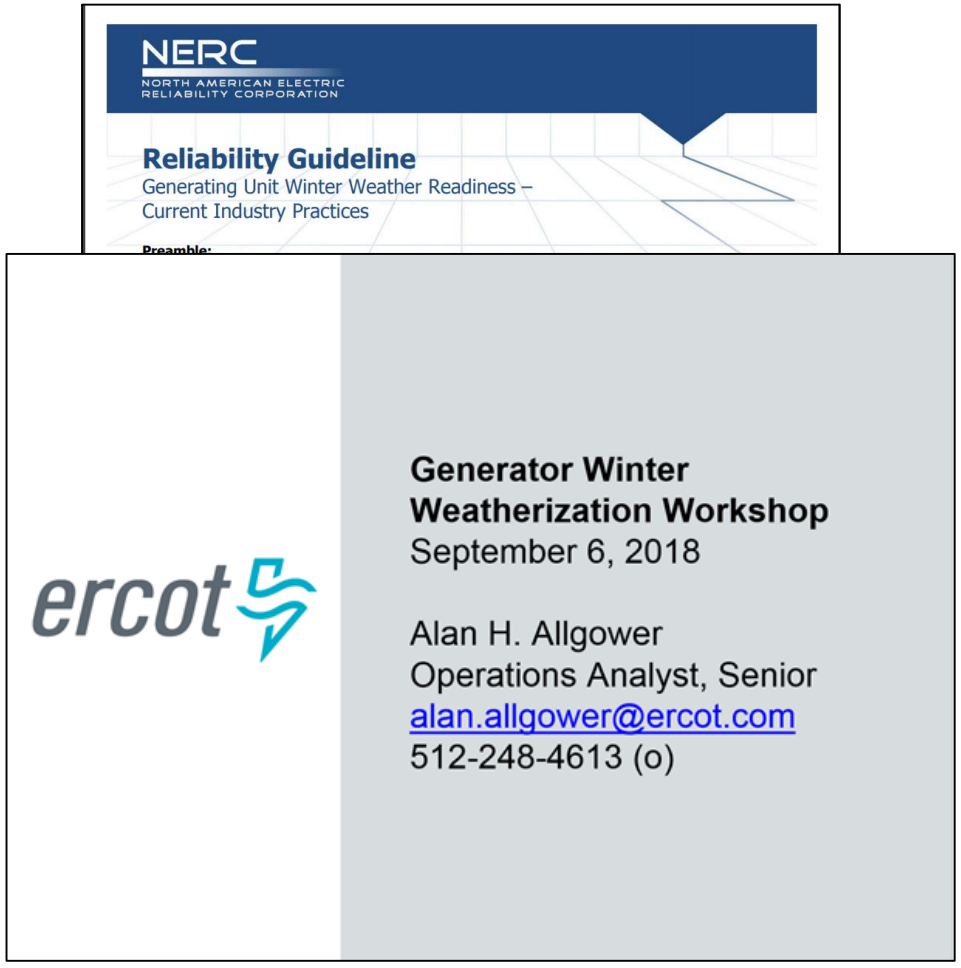

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Reliability Guideline
Generating Unit Winter Weather Readiness – Current Industry Practices

Preamble:

ercot

Generator Winter Weatherization Workshop
September 6, 2018

Alan H. Allgower
Operations Analyst, Senior
alan.allgower@ercot.com
512-248-4613 (o)

Operator training includes procedure review, past winter event review, off-normal procedure review, and review of ERCOT & NERC training material.

Winter Readiness Task

Inspection Criteria for Junction Boxes:
Inspect for water intrusion
Inspect condition of wiring
Verify door seal/gasket integrity

Location	Junction Box	Initial of Verifyer
CEMS 11	Analog Signal J-Box	
	Descrete Signal J-Box	
Bottom of North Side of HRSG 11	1-JB-1101	
	1-JB-1100	
	1-JB-1104	
	1-JB-1502	
	1-JB-1500	
	1-JB-1501	
	1-JB-1505	
	Lighting Panel 1ES-PL-BB	
	PWR Panel 1ES-PL-BK	
	PWR Panel 1ES-PL-BL	
	MOV Power Panel 1EP-PL-BP	
	J-Box @ LP Recirc Pump	
	J-Box @ LP Non-Return	
	Duct Burner Panel	
	Duct Burner Scanner J-box	
	Duct Burner Element J-box	
	J-Box @ West side of Scanner Blowers	
BFW P 11	BFWP Lube Oil Instrumentation J-Box	
	BFWP J-Box 1 Temperature Instruments	
	BFWP J-Box 2 Vibration Instruments	
Top of HRSG 11	J-Box 1 @ HV-1404	
	J-Box 2 @ HV-1404	
	Heat Trace Control Panel	
	1-JB-1102	
	1-JB-1103	
	1-JB-1504	
Gas Turbine 11	JB19A @ Fuel Gas Block	
	JB19B @ Fuel Gas Block	
	JB19C @ Fuel Gas Block	
	JB19D @ Fuel Gas Block	
	JB20A @ Fuel Module Door	
	JB20B @ Fuel Module Door	
	77G @ East Side Of LO Tank	
	130A @ East Side Of LO Tank	
	133 @ East Side Of LO Tank	
	317 @ East Side Of LO Tank	
	132B @ East Side Of LO Tank	
	77L @ East Side Of LO Tank	
	132C @ East Side Of LO Tank	
	132A @ East Side Of LO Tank	
	J-Box @ South of Eyewash Station West Side Of PEECC	
	Mark Vie Mashalling Panel	
	GEC-11 JB @ East Side OF GEECC	
	North Tuning Kit	
	South Tuning Kit	
	Ignition Exciter J-Box	
	Ignition Alarm/Control J-Box	
	JB34A @ Turbine Mid-level South Side	
	JB169 on Turbine Roof	
	JB34 on Turbine Roof	
	JB37 on Turbine Roof	
	J-Box by CCW on S Side of Generator	
	J-Box Under Collector Cab Stairs	
	JB 77T South JB on East Wall of Exhaust Frame Area	
	JB 21A North JB on East Wall of Exhaust Frame Area	
	Small JB South of JB 20G on West Wall of Exhaust Frame Area	
	JB 20G North JB on West Wall of Exhaust Frame Area	
GSU	GSU Control Panel/J-Box	
Inlet	J-Box @ Inlet (2 Total)	
	Evap Cooler Conductivity panel	

Completed By:_____ as indicated by_____ Date_____

Also Worked On By:_____ as indicated by_____ Date_____

Also Worked On By:_____ as indicated by_____ Date_____

Also Worked On By:_____ as indicated by_____ Date_____

Team	C
Production Leader	Vincent
Inspection	
Inspection	

Complete every block - No Blanks
Persons Initials indicates the check was completed
N/A indicates not applicable
Comment on repair. Include work order number if the task was not completed when found
Production Leader please sign completed sheet

HRSG-21 Instrument Tag	Description	Location	Critical	Single Point Failure	Tube Trace Installed	Panel #	Circuit #	DCS Point Quality	O'Brien Box	Block Heater	Sensing Lines	Root Piping	Secondary Heating	Conduit	Date Checked	Comments
HRPT1500	HRSG DUCT INLET PRESS	HRSG Ground Level	Y	Y	Y											
HRPT1403	HRSG RH SPRAY PRESS	HRSG Ground Level	N	N	Y											
HRPT1404	HOT RH PRESS	HRSG Ground Level	N	N	Y											
HRFT1401	HRSG RH SPRAY FLOW	HRSG Ground Level	N	N	Y											
FWFT1400	HRSG HP SH SPRAY FLOW	HRSG Ground Level	N	N	Y											
FWPT1756	HP/IP BFW PUMP HP OUT PRESS	HRSG Ground Level	Y	Y	Y											
FWFT1751	HP/IP BFW TO HP BYD ATTEMP FLOW	HRSG Ground Level	Y	Y	Y											
FWFT1750	BFW PUMP MIN FLOW BP	HRSG Ground Level	Y	Y	Y											
HRFT1420	FW TO HP DRUM	HRSG Ground Level	N	N	Y											
HRFT1460	FW TO IP DRUM	HRSG Ground Level	N	N	Y											
HRPT1404	HRSG LP DRM BFW PRESS	HRSG Ground Level	N	N	Y											
HRFT1480	FW TO LP DRUM FLOW	HRSG Ground Level	N	N	Y											
HRPT1443	HRSG LP SH STM TO LP STG	HRSG Ground Level	N	N	Y											
HRFT1441	HRSG LP SH STM TO LP STG TRI-LOOP	HRSG Ground Level	N	N	Y											
HRFT1402	HP STEAM TO STG FLOW TRI-LOOP	HRSG Ground Level	N	N	Y											
CCPT0354	CCW LOOP SUPPLY PRESSURE	HRSG Ground Level	N	N	Y											
FGFT1801	CND FM FG PREHEATER	HRSG Support Area	N	N	Y											
FWPT1751	HP/IP BFW PMP IP OUT PRESS	HRSG Support Area	N	Y	Y											
FWPDT1750	HP/IP BFW PMP LP IN DP	HRSG Support Area	Y	Y	Y											
FWPT1708	HP/IP BFW PMP SUCTION PRESS	HRSG Support Area	Y	Y	Y											
HRPT1402	HP SH STEAM PRESS	HRSG Top Level	Y	Y	Y											
HRFT1440	HRSG IP SH STM TO REHEAT TRI-LOOP	HRSG Top Level	N	N	Y											
HRPT1400	HRSG HP SH SPRAY PRESS	HRSG Top Level	N	N	Y											
HRPT1445	HRSG IP SH STM TO REHEAT PRESS	HRSG Top Level	N	N	Y											
HRPT1410	HRSG COLD REHEAT PRESS	HRSG Top Level	N	N	Y											
HRPT1407	IP COLD RH PRESS	HRSG Top Level	N	N	Y											
HRPT1420A	HP DRUM PRESS	HRSG Top Level	Y	N	Y											
HRPT1420B	HP DRUM PRESS	HRSG Top Level	Y	N	Y											
HRLT1420A	HP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1420B	HP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1420C	HP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRPT1460A	IP DRUM PRESS	HRSG Top Level	Y	N	Y											
HRPT1460B	IP DRUM PRESS	HRSG Top Level	Y	N	Y											
HRLT1460A	IP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1460B	IP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1460C	IP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRPT1480	LP DRUM PRESS	HRSG Top Level	N	N	Y											
HRLT1480A	LP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1480B	LP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
HRLT1480C	LP DRUM LEVEL INDICATION	HRSG Top Level	Y	N	Y											
	GT Bearing Temperature, Vibration and Fire Protection	Gas Turbine														

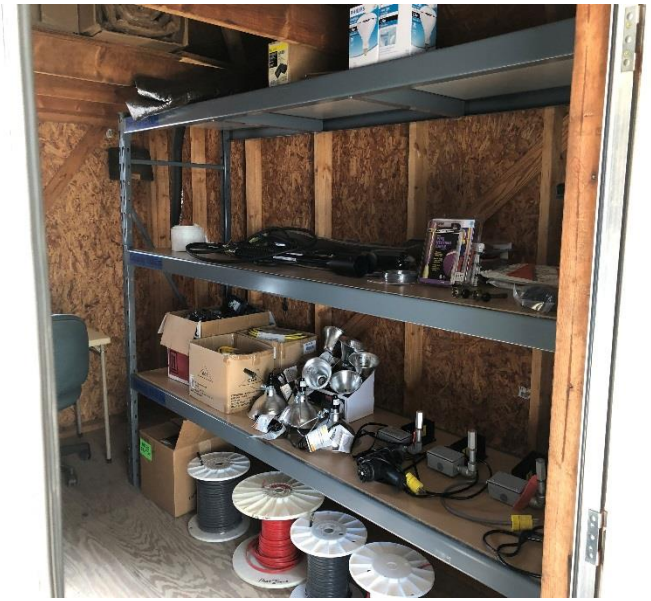
All electrical junction boxes are inspected for signs of water intrusion other obvious

All instrumentation deemed “critical” is inspected.

Winter Readiness Task

Temporary shelters are erected around critical equipment that has caused issues in the past.

Winter Readiness Task



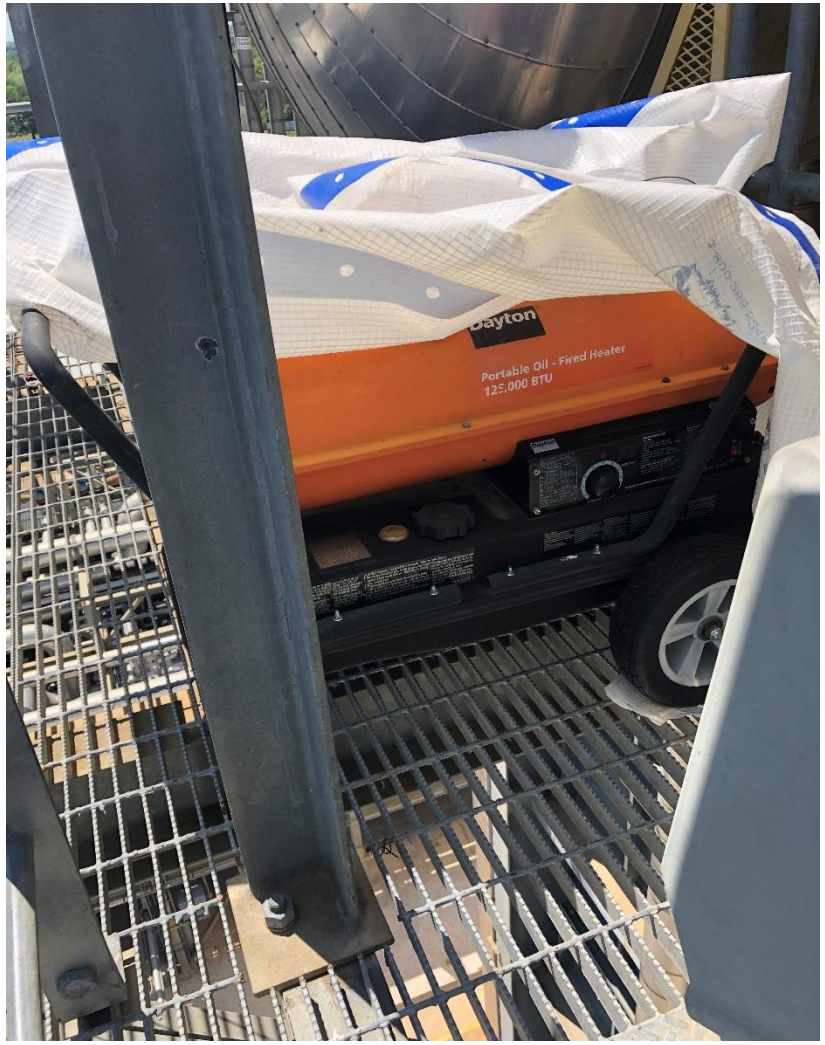
Item	On Hand	Minimum	Unit	Reorder (Y/N)	Comments
Hand Warmers		20	ea	N	
Ice Creeper for Boots		18	pair		
Sand		1	pallet		
Salt		1	pallet		
Sand / Salt spreader		1	ea		
Extension Cords		24	ea		
Temp Heat Trace 6'		12	ea		
120v Pigtails		0	ea		
Heat Light Bulbs		15	ea		
Heat Light Housings		10	ea		
Large - Propane Cylinders		5	ea		
Small - Propane Cylinders		25	ea		
R19 Pink Panther Insulation		6	pack		
Pipe Insulation Tubes		10	tube		
Tie Wire		1	roll		
String		1	roll		
1/4" Rope		500	ft		
Duct Tape		8	roll		
Ground Fault Detectors		3	ea		
2x4x8 boards		0.5	bundle		
Plywood		5	Sheet		
Nails		2	lbs		
Kerosene		10	barrel		
Small propane torches		5	ea		
Weed burners		5	ea		
Zip Ties		100	ea		

Name _____

Date Checked

Adequate quantities of winter supplies are verified.

Winter Readiness Task



Temporary heating equipment is inspected/tested and quantity of fuel is verified and staged.

Winter Readiness Task

Other Winter Readiness Tasks/Checks

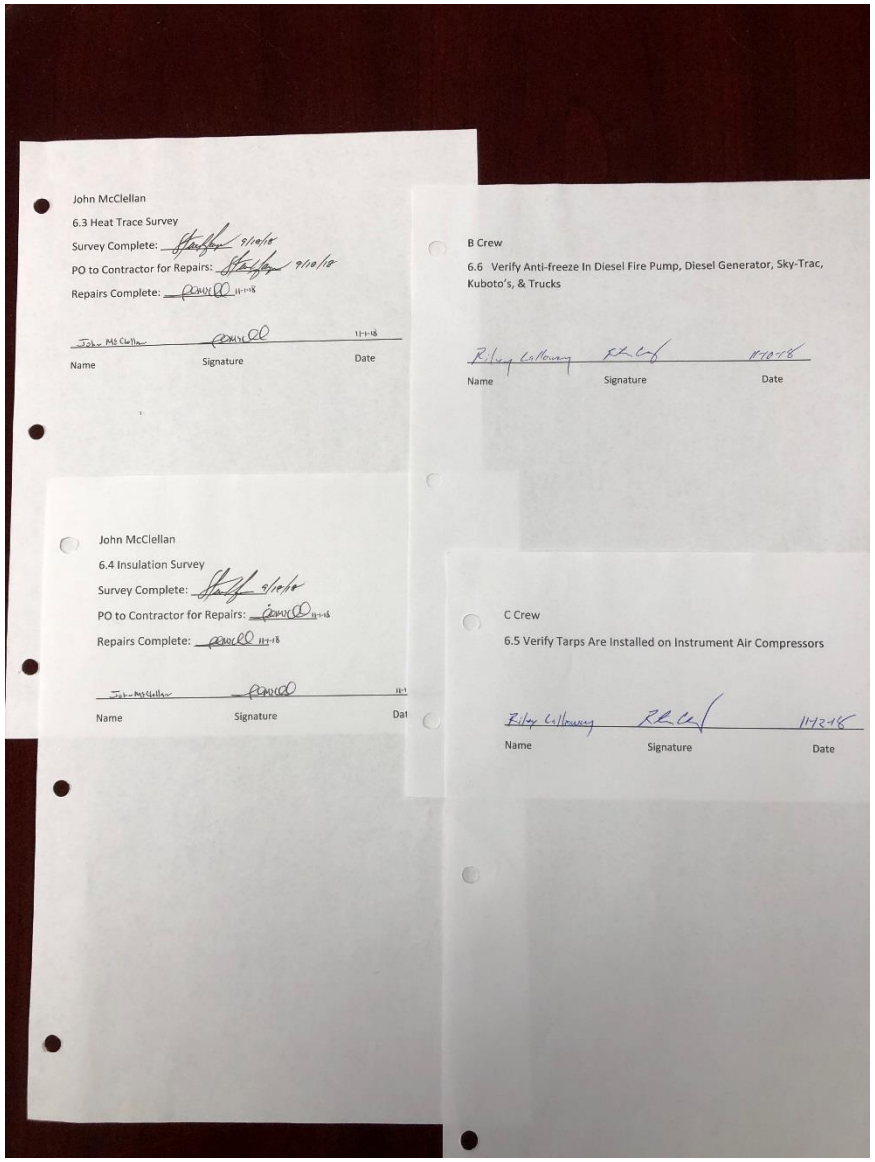
- Insulation Survey (Insulation Contractor)
- Compressed air system checks (dew point meter calibration & tarps)
- Verify antifreeze engine protection in diesel generator and diesel fire pump
- Spare portable heater inspection
- Portable heaters staged
- Lube oil / hydraulic oil heater inspection
- Fire pump/deluge house heater inspection
- Fuel gas filters
- Inlet air filters
- PO in place for contractor winter support
- Check operation of sand/salt spreader
- Check drains on sky vents and safeties to be functional
- Identified heat trace deficiencies corrected
- Insulation repairs complete

Winter Readiness Preparation

							% Complete	Green - Documented in Book	
							0.00%	Yellow - Need document for book	
Procedu Sectio	What	Detail	Who	Expected Completi	Deadlir	Complete	Comple	Comment	
6.1	**Event Tracking**						0%		
	Review previous winter EFOR events for potential additions to Winter Readiness Checklist		Steve Harper	1-Nov	15-Nov				
	Team 1 Review of open jobs.	Crew Assigned	A Team	1-Nov	15-Nov				
	Team 2 Review of open jobs.	Crew Assigned	B Team	1-Nov	15-Nov				
	Team 3 Review of open jobs.	Crew Assigned	C Team	1-Nov	15-Nov				
	Team 4 Review of open jobs.	Crew Assigned	D Team	1-Nov	15-Nov				
6.2	**Critical Instrumentation**		x						
	Confirm that Board Operators review of "Off Scan. Bad and Poor Quality" instrumentation reports each shift (IOW)		Steve Harper	1-Nov	15-Nov				
	Complete the Critical Instrumentation check sheet.	Assigned housekeeping Areas	A Team	1-Nov	15-Nov				
	Complete the Critical Instrumentation check sheet.	Assigned housekeeping Areas	B Team	1-Nov	15-Nov				
	Complete the Critical Instrumentation check sheet.	Assigned housekeeping Areas	C Team	1-Nov	15-Nov				
	Complete the Critical Instrumentation check sheet.	Assigned housekeeping Areas	D Team	1-Nov	15-Nov				
6.3	**Freeze Protection Condition Assessment (Heat Trace Survey)**		x						
	Heat Trace Survey		John McClellan	31-Aug	15-Sep				
	Heat Trace Survey - contract (PO) for identified repairs		John McClellan	20-Oct	1-Nov				
	Heat Trace Survey Repair of known issues		John McClellan	15-Nov	30-Nov				
6.4	**Insulation Condition Assessment**		x						
	Insulation Survey		John McClellan	31-Aug	15-Sep				
	Insulation Survey Repair known issues		John McClellan	15-Nov	30-Nov				
6.5	**Compressed Air Systems**		x						
	compressors		C Team	1-Nov	15-Nov				
6.6	**Fluid filled systems using anti-freeze or freeze protection / fuel systems**		x						
	Verify Antifreeze engine protection in Diesel Generator and Diesel Fire Pump		B Team	1-Nov	15-Nov				
6.7	**Building / Equipment Enclosure check**		x						
	Spare Portable Heater Inspection	Back Ware House	D Crew	1-Nov	15-Nov				
	Verify Temporary shelters are in place (HRSG's, /LP Bypass, Condensate dump, etc)		John McClellan	1-Nov	15-Nov				
	Portable Heaters Staged on top HRSG 11		A Crew	1-Nov	15-Nov				
	Portable Heaters Staged on top HRSG 12		B Crew	1-Nov	15-Nov				
	Portable Heaters Staged on top HRSG 21		C Crew	1-Nov	15-Nov				
	Portable Heaters Staged on top HRSG 22		D Crew	1-Nov	15-Nov				
6.8	**Summer use Auxiliary Systems**		x						
	Check drains on Sky vents and Safeties to be functional	Assigned housekeeping Areas	A Team	1-Nov	15-Nov				
	Check drains on Sky vents and Safeties to be functional	Assigned housekeeping Areas	B Team	1-Nov	15-Nov				
	Check drains on Sky vents and Safeties to be functional	Assigned housekeeping Areas	C Team	1-Nov	15-Nov				
	Check drains on Sky vents and Safeties to be functional	Assigned housekeeping Areas	D Team	1-Nov	15-Nov				
	Decommission Evap Coolers and open inlet hoppers	GT11	A Team	1-Nov	15-Nov				
	Decommission Evap Coolers and open inlet hoppers	GT12	B Team	1-Nov	15-Nov				
	Decommission Evap Coolers and open inlet hoppers	GT21	C Team	1-Nov	15-Nov				
	Decommission Evap Coolers and open inlet hoppers	GT22	D Team	1-Nov	15-Nov				
	Inlet air filter	All Units	Steve Harper	1-Nov	15-Nov				
	Fuel gas coalesces	All Units	Steve Harper	1-Nov	15-Nov				
	Lube Oil / Hydraulic Oil Heater Inspection	GT11/ST10	A Team	1-Nov	15-Nov				

Task completion is tracked to ensure timely completion.

Winter Readiness Preparation



John McClellan
6.3 Heat Trace Survey
Survey Complete: 9/10/18
PO to Contractor for Repairs: 9/10/18
Repairs Complete: 11-1-18
Name Signature Date

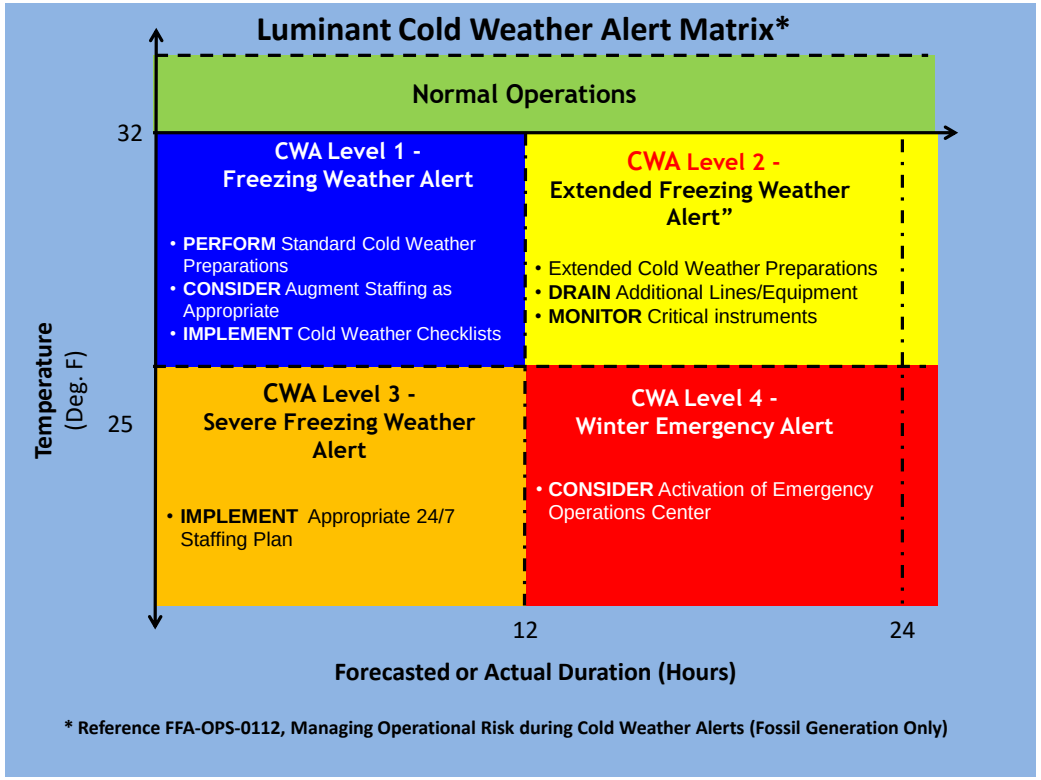
B Crew
6.6 Verify Anti-freeze In Diesel Fire Pump, Diesel Generator, Sky-Trac, Kuboto's, & Trucks
Name Signature Date

John McClellan
6.4 Insulation Survey
Survey Complete: 9/10/18
PO to Contractor for Repairs: 11-1-18
Repairs Complete: 11-1-18
Name Signature Dat

C Crew
6.5 Verify Tarps Are Installed on Instrument Air Compressors
Name Signature Date

Task completion is signed off and sign off sheets are audited by management to verify completion by deadline date.

Cold Weather Operations



COLD WEATHER ALERT (CWA) LEVEL 1 (Freezing Weather Alert) - Alert level to be entered when actual or forecasted external temperature expected to be less than or equal to 32˚ F, but greater than 25˚ F for less than 12 hours.

CWA Level 2 (Extended Freezing Weather Alert) – Alert level to be entered when actual or forecasted external temperature expected to be less than or equal to 32˚ F, but greater than 25˚ F for greater than 12 hours.

CWA Level 3 (Severe Freezing Weather Alert) - Alert level to be entered when actual or forecasted external temperature expected to be less than or equal to 25˚ F for less than 12 hours. – Staff to full complement and/or request additional contractor staffing

CWA Level 4 (Winter Emergency Alert) - Alert level to be entered when actual or forecasted external temperature expected to be less than or equal to 25˚ F for greater than 12 hours. Staff to full complement and/or request additional contractor staffing. Lead team member on site 24/7.

Cold Weather Operations

Freeze Protection Equipment Cycling

Rev 03-28-2017

Every 2 hours if temperature has been below freezing for more than 6 hours

Block 1 Run both CST & DST transfer pumps

Crack open water box 2" vent valves.

PV-1402 (ensure that HV-1410 & TV-1411 open as well)
PV-2402 (ensure that HV-2410 & TV-2411 open as well)
PV-1417 (ensure that HV-1413 & TV-1418 open as well)
PV-2417 (ensure that HV-2413 & TV-2418 open as well)
PV-0042 (ensure that HV-0040 & TV-0043 open as well)
TV-1404 (ensure HV-1400 opens)
TV-2404 (ensure HV-2400 opens)
TV-1408 (ensure HV-1405 opens)
TV-2408 (ensure HV-2405 opens)
TV-0800 (BD sump quench water)

Cycle hv-1425 &1426 hp evap drains & IP evap drains 1465 & 1466 every 2 hrs

Cycle hv-2425 & 2426 hp evap drains & IP evap drains 2465 & 2466 every 2 hrs

Start BFWP's 11 & 12 check flow on HP De-superheater attemp & HP letdown PV-1402
When running BFWPs insure hrsg start up drains & tattle tale drains are open.

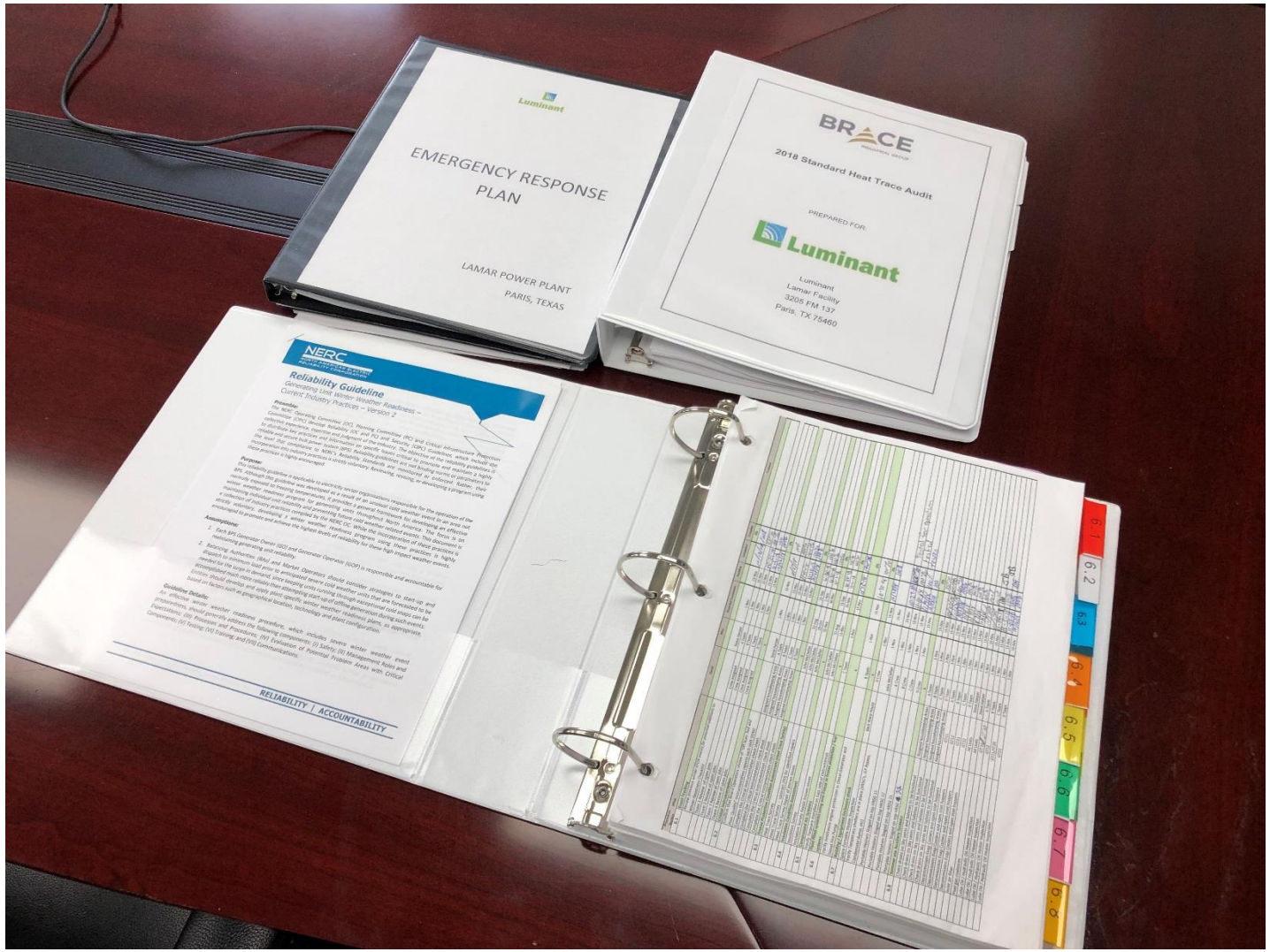
If the cooling tower plume is blowing across block visualy inspect the compartment / exhaust frame fans for

Swap Vacuum Condensate Pumps
Swap Closed Cooling Water Pumps
Swap Aux. Cooling Water Pumps

*Watch condenser level. If the level falls check the status of the dump valve back to the condensate storage tank.

Bypass Aux cooling water coolers to maintain 70F temperature

ERCOT Winter Readiness Audit



All documentation of winter readiness is made available during a winter readiness audit by ERCOT.

Questions?

-Winter Weatherization Workshop Very few do this right...

Valin Houston

Suggested Topics:

- How to properly test heat trace
- Best way to define a failing circuit
- Suggested maintenance interval

When Do You Test Heat Trace?

- Heat Trace

When should you meg electric heat trace?

When:

Meg in the box

Meg after cut and installed-pre insulation

Meg after insulation

Meg at Commissioning

As a PM punch list item annually

Heat Trace Meg

How:

Disconnect all wires/t stats etc
Connect (-neg) lead to trace braid
Connect (+pos) lead to both cable bus wires
Set meter to 500 Vdc. Test for 1 min
Record values
Repeat at 1000 and 2500 Vdc and record

Megohmeters- Acceptable Limits

@1000 VDC =10 megOhms Minimum

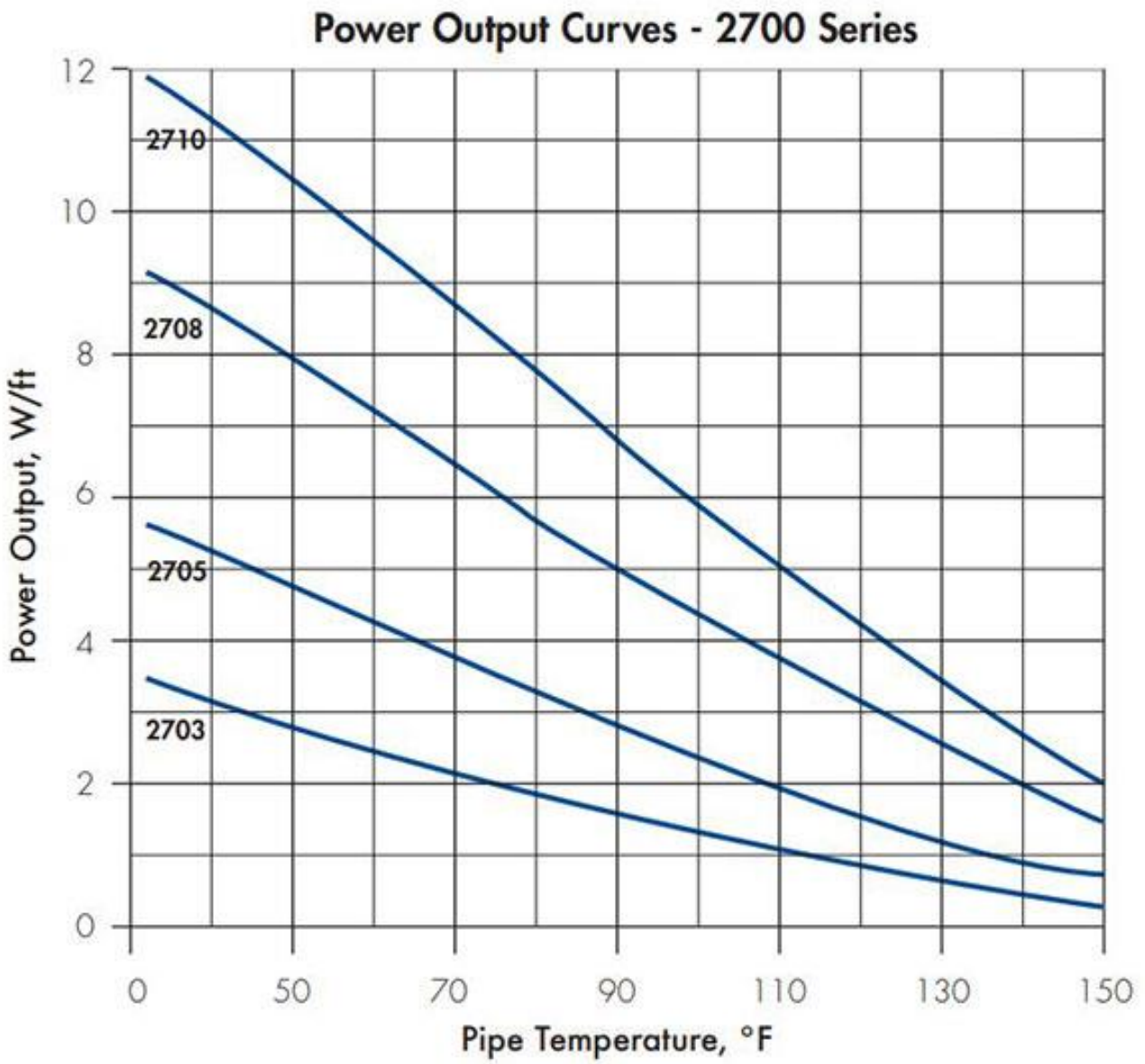
Testing Heat Trace-Common Misses

Do individual runs- no Tees
Remove and test power wire
Check box for
- moisture and bad terminals
- grommets
- over braid fuzz

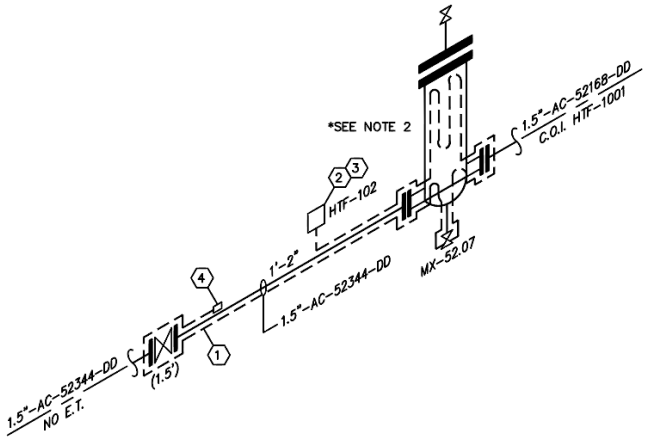
AMPS-A Great Backup

- Note amps @ start up
- After 15 min
- Note current ambient temp and pipe temp

Establish a baseline


Power Output Curves - 2700 Series
Power Output, W/ft
12
10
8
6
4
2
0
2710
2708
2705
2703
0
50
70
90
110
130
150
Pipe Temperature, °F

DRAWING NUMBER	INSULATION		MIN. MAINT. TEMP.	MIN. AMB. TEMP.	MAX. EXP. TEMP.	HEATER CABLE TYPE	PIPE LENGTH	CABLE LENGTH	VOLTS	CURRENT		TRANSFORMER LOAD (W)	CONTROL PANEL & BREAKER NUMBER	HTR. CABLE	CABLE W/FT	HEAT LOSS W/FT	SAFETY FACTOR	ELECTRICAL CLASSIFICATION		
	THK.	CODE								OPER.	COLD	OPER.						AREA	IGN. TEMP.	HI-LIMIT SET POINT
HTF-102	2"	EP	100°F	10°F	450°F	20CMH120	1'	15'	120	2.5	2.5	304	TBD	CMH	NOTE 1	NOTE 1	NOTE 1	C1D2	N/A	N/A



BILL OF MATERIAL

ITEM	QTY.	CATALOG NO.	DESCRIPTION
1	15'	20CMH120	HIGH TEMP. HEATING CABLE
2	1	HP-FG-JB	POWER JUNCTION BOX
3	1	CMH-PWR	POWER CONNECTION KIT
4	1	CMH-LP-E	LOW PROFILE END SEAL
5			
6			
7			
8			
9			
10			
11			
12			

NOTES

1.) HEAT CALCULATIONS:

FOR INLET PIPING: HEAT LOSS W/FT= 5.3
CABLE W/FT= 20
SAFETY FACTOR= 277%

FOR MIXER: HEAT LOSS W/FT= 20.8
CABLE W/FT= 20
SAFETY FACTOR= 92%

2.) APPLY APPROXIMATELY 8' OF CABLE TO MX-52.07.

3.) LINE SENSOR PROVIDED BY CLIENT.

LINE NUMBERS	EQUIPMENT & TAG NUMBERS
1.5"-AC-52344-DD	MX-52.07

REV.	DESCRIPTION	DRWN BY	CHKD BY	APPD BY	DATE	ISOMETRIC DWG NO. REF	REV.	ISOMETRIC DWG NO. REF	REV.	P&ID NO. REFERENCE	REV.
A	ISSUED FOR APPROVAL	JD	JU	JG	02/25/19	C-AC 52344-DD-1	0	.	.	50015236	13

CLIENT LOGO

CLIENT NAME
CLIENT ADDRESS
CLIENT ADDRESS #2

VALIN THERMAL SOLUTIONS & AUTOMATION
4822 N SAM HOUSTON PKWY, STE 200
HOUSTON, TX 77086

PURCHASE ORDER NUMBER: 4510059013 | DRAWING NUMBER: HTF-102 | REVISION: A

Inadequate Control Systems

Heat Trace Low Meg-

- **What should you do?**
  - Roll out cable and inspect for damage
  - Cut damaged cable off and re meg
  - Order a replacement roll and send it back

Break

Wolf Hollow II

Combined Cycle Facility

Granbury, Texas

Jeff Klier
Plant Manager

Exelon Generation®

Overview

- Introduction
- Critical components
  - Isometric View
  - Field View
- Heat trace circuits
- Heat trace panel breaker resets – human performance
- Real-time monitoring heat trace panels
- Construction lessoned learned
  - Uni-strut Stand-off protection & Insulation installation
  - Transmitter location pros and cons
  - Over protection
  - Contingency planning
- Winter readiness

Introduction to Exelon and Wolf Hollow 2

Exelon Generation

Exelon Generation is one of the nation's leading competitive power generators with a balanced (and growing) portfolio of zero-carbon nuclear, natural gas, hydro, wind, solar and more. It's among the largest, cleanest, lowest-cost power generation fleets in America. It includes the nation’s largest and, globally, the third largest nuclear fleet.

Asset Info: Wolf Hollow 2 is a 2 x 1 combined cycle power plant with a June 2017 COD

Technology

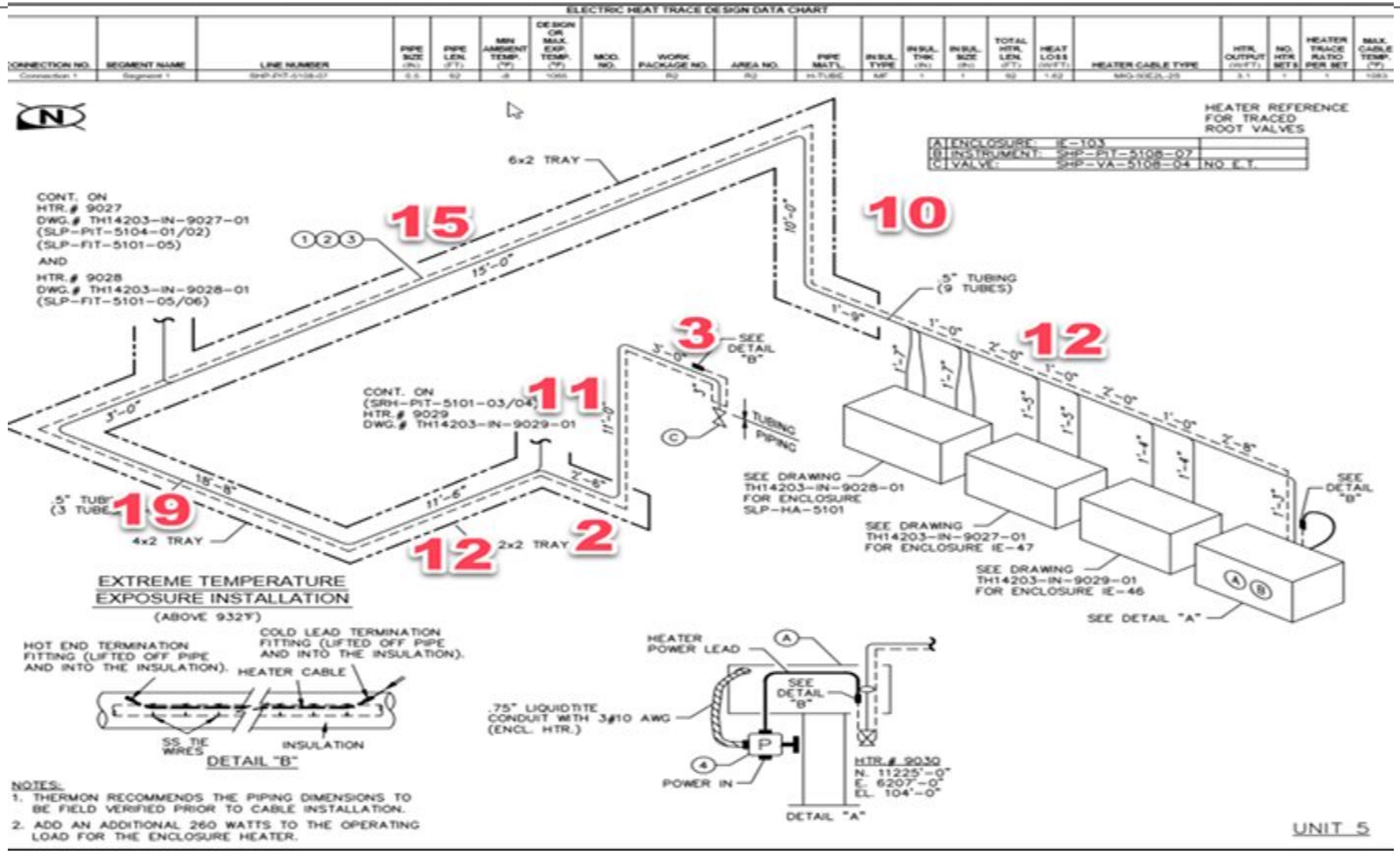
- Gas Turbines - GE 7HA.02
- Steam Turbine - GE D600
- Generators - Model H65 and H84
- DCS - Mark VIe & Ovation
- HRSG - Alstom triple pressure
- Air Cooled Condenser - Evapco

Critical Components

- Example of a Critical Circuit
  - Process controls requirements
  - Identifying single point failures
  - Circuit connections

Circuit Breaker	Equipment ID #	Instrument	Critical Component	Reference Drawings	Instrument Details / Line #
CB-14	SRH-PIT-5101-04	HRSG 5 Reheat Steam Pressure Transmitter	Critical	M004645-FPSC00088 S01	REHEAT STEAM PRESS
CB-14	SHP-PIT-5104-01	HRSG 5 HP Steam Pressure Transmitter	Critical	M004645-FPSC00059 S01	HP STEAM PRESS
CB-14	SHP-PIT-5104-02	HRSG 5 HP Steam Pressure Transmitter	Critical	M004645-FPSC00059 S01	HP STEAM PRESS
CB-14	SLP-FIT-5101-05	HRSG 5 LP Steam Flow Transmitter	Critical	M004645-FPSC00060 S01	LP STEAM FLOW
CB-14	SLP-FIT-5101-06	HRSG 5 LP Steam Flow Transmitter	Critical	M004645-FPSC00060 S01	LP STEAM FLOW
CB-14	HEATER	HTRs 9027, 9028, 9029, 9030	Heating/Piping	M004645-FPSC00059, 060, 088, 089	CNS-FIT-5100-04 SRH-PIT-5101-03/04

Isometric View

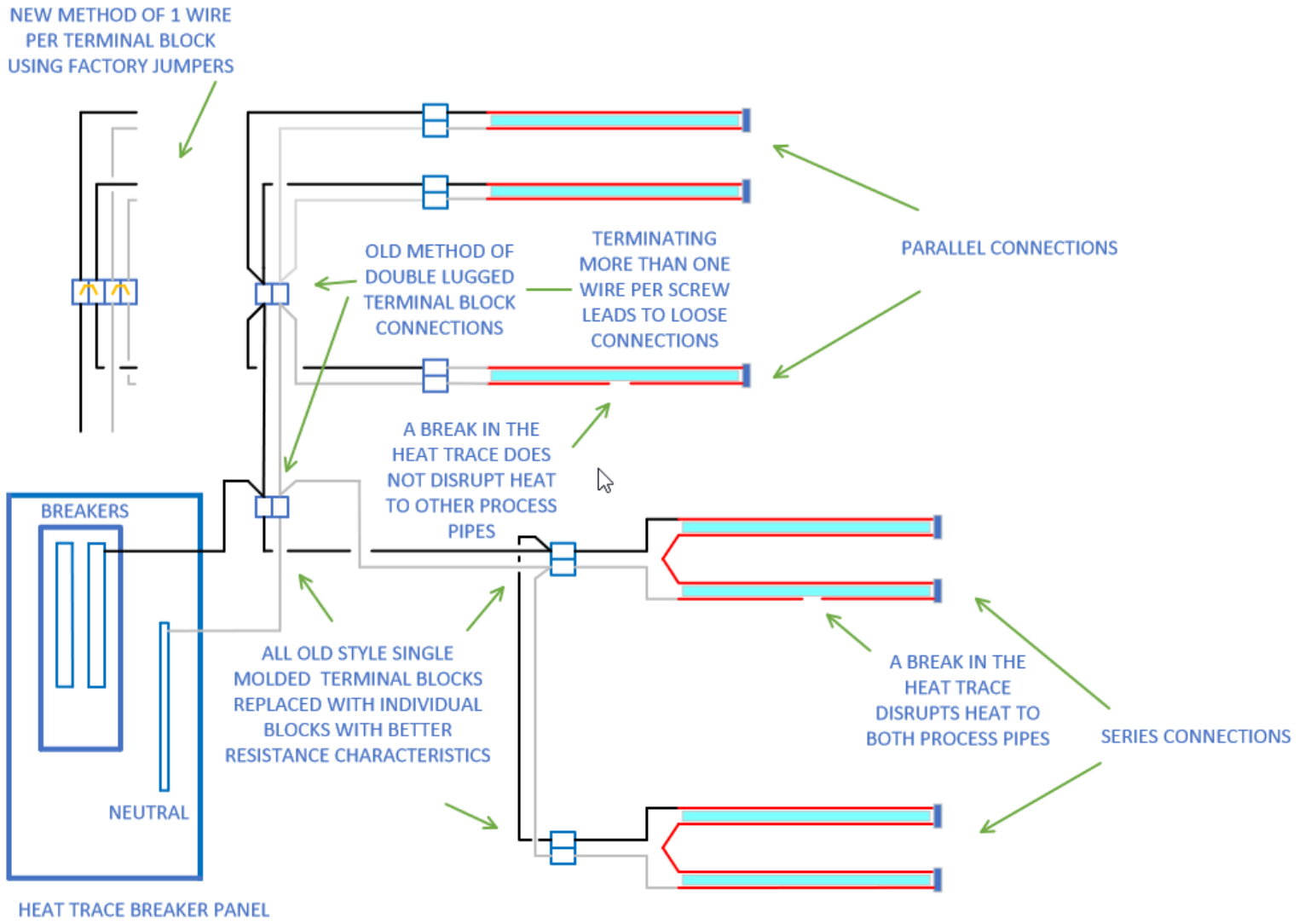


Exelon Generation

Field View


Electrical Connection
Sensing Line
Sensing Line
Transmitter Box
Heat Trace Panel

Heat Trace Circuits



Heat Trace Panel Breaker Resets

- Three Reasons Why Circuit Breakers Keep Tripping
  - Circuit Overloads
  - Short Circuits
  - Ground Fault Surges

- Breaker Resets
  - Risk vs Reward
  - Process heating demands
  - Current conditions
  - Current support

Real-Time Monitoring Heat Trace Panels

- HMI Screen Features
- Circuit Dashboard
- Live Amp readings
- Instant Alarms
- Circuit Isometric Drawings
- Circuit Baseline History For Trending
- DCS network features

Lessons Learned

Proper Application

- Heating cable selection
  - Select heating cable family
  - Select heating cable
  - Determine heating cable length
- Electrical Design
  - Determine heating cable length
  - Select protection rating
- Components and accessories selection

Sensing Line Standoffs

Terminal Block Connections

Installation Standards

ERCOT Winter Readiness

- Annual heat trace testing
- Thermal insulation inspections
  - The value of properly installed and well-maintained thermal insulation cannot be overemphasized. Without the insulation the heat loss is generally too high to be offset by heat tracing
- Ongoing preventative maintenances
  - Post outage system checks – Heat Trace & Insulation
  - Year-round post maintenance testing
  - Every day system vigilances
- Temporary vs Permanent structures and wind breaks
- Contingency planning
  - Rapid response kits
  - Appropriate Staffing
  - Targeted Training

Generator Winter Weatherization Workshop

September 5, 2019

Alan H. Allgower
Operations Analyst, Senior
alan.allgower@ercot.com
512-248-4613 (o)

February 2011 Headlines….

Austin American-Statesman

FARMERS LIST SPOTS TO EAT LOCAL FOOD

WHOLE FOODS TEAMS WITH GREENLING

Financial adviser indicted by grand jury

Money laundering, fraud among charges brought in Triton case

Testimony: System unprepared for cold

'I want confidence that you are making every effort. Who's going to be sure everything is being done?'

Austin American-Statesman WORLD & NATION Wednesday, February 9, 2011

Small percentage bore brunt of outages

By Marty Toohey

Austin Energy outages

Circuits that experienced outages

Circuits that were exempt from outages because they serve large, power-intensive industries whose facilities could be damaged by a shutdown*

Circuits serving customers that were deemed too important to shut off

Circuits that could not be turned off because doing so would destabilize the grid*

Downtown, a grid-within-a-grid that would have to be entirely shut down, putting the electrical systems of some large, power-intensive buildings at risk for damage*

POWER: Homes endure the majority of rolling blackouts in Austin

Continued from A1

Power plant problems

About ERCOT

CENTRAL TEXAS • WEATHER

'I want to ensure that this never happens again.'

LT. GOV. DAVID DEWHURST

QUESTIONS LOOM ABOUT OUTAGES

ROLLING BLACKOUTS BLAMED ON POOR COMMUNICATION

STATE PREPARES FOR SLICK, MESSY MORNING COMMUTE

The monument to fallen World War I troops at the University of Texas, Littlefield Fountain, was frozen in ice as well as preserved in granite as temperatures in Austin hovered around the 27-degree mark Thursday.

Lawmakers to investigate what caused power cutoffs

By Laylan Copelin, Marty Toohey and Kirk Ladendorf

ROSS BALDICK
LOCAL CONTRIBUTOR

ERCOT and the historic failure of electric generators

TEXAS • ENERGY

Natural gas shortage to plants was business decision, expert says

Some power generators allowed cuts to service amid cold, panel is told

By Laylan Copelin

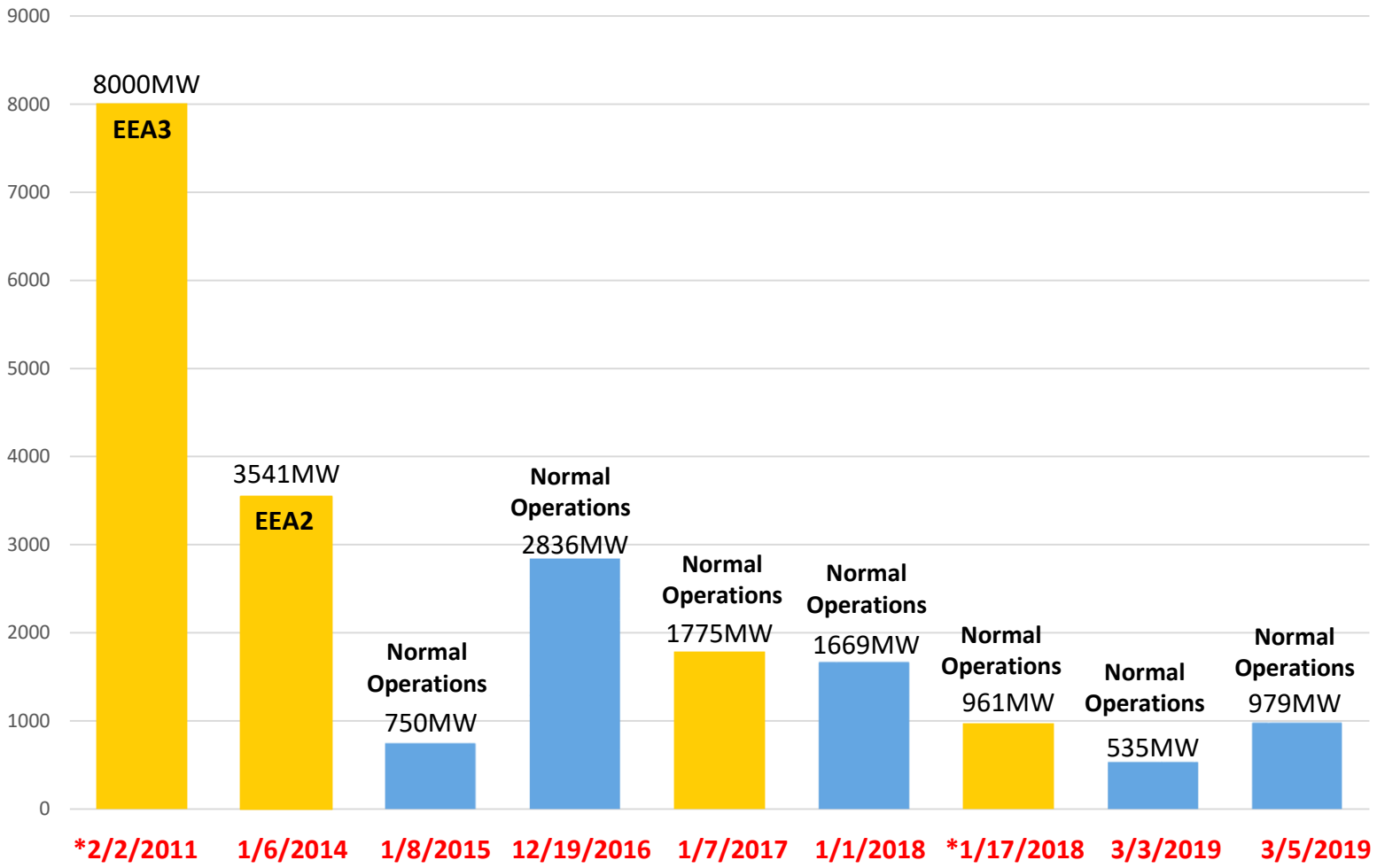
Data show where Austin-area power outages were concentrated, A6

Central Texas may see sleet in cold burst coming through today, B1

PUCT Regulatory Requirements for Generator Preparedness

- §25.53. Electric Service Emergency Operations Plans.
  - (c)(1)(H) A plan for the inventory of pre-arranged supplies for emergencies.
  - (c)(1)(I) A plan that addresses staffing during severe weather events.
  - (c)(2)(A) A plan that addresses severely cold and severely hot weather.
  - (c)(2)(B) A plan that addresses any known critical failure points, including any effects of weather design limits.
  - (c)(2)(G) Checklists for generating facility personnel to address emergency events.
  - (c)(2)(H) A summary of alternate fuel and storage capacity.
  - (c)(2)(I) A plan for alternative fuel testing if the facility has the ability to utilize alternative fuels.
  - (c)(2)(d) A Market entity shall conduct or participate in one or more drills annually to test its emergency procedures if its emergency procedures have not been implemented in response to an actual event within the last 12 months.

Generation MW tripped due to frozen instrumentation



Salmon colored reflects four coldest days in ERCOT in last eight years

* 2/2/2011 and 1/17/2108 were the two coldest days this decade

Plant spot checks winter season 2018/2019 results

- 97 units spot checked
  - ✓The purpose of spot checks is to verify plant personnel are following their weatherization plan.
  - ✓As necessary, plant personnel are left with a recommendation based on lessons learned or best practices observed.
  - ✓Company senior management is emailed results.
- Fuel types
    - 4 coal units
    - 93 gas fired units (conventional and combined cycle)
  - ➢33 units agreed to improve preparations and/or records management and will be scheduled early in 2019 to verify improvements.
  - ➢64 units had no observed deficiencies in their plan or records management.

Common causes of transmitter manifolds and/or sensing lines freezing

- Tripped heat trace circuit breaker.
- Blown fuse in heat trace panel.
- Contractor error when terminating heat trace after testing.
- Insulating contractor damage to heat trace.
- Section of heat trace not functioning.
- Incorrect heat trace for application.
- Heat trace open ended and not grounded.
- Transmitter cabinet heater not functioning.
- Poor or lack of wind break measures.
- Transmitter(s) exposed to the elements.
- Gaps in insulation.

What have we learned since February 2011?

- ✓ Identify critical components if frozen, will derate, trip or fail to start the unit and incorporate the measures to prevent from freezing into weatherization plan.
- ✓ Heat trace failure rates in Texas on average are 10-15% from previous season.
- ✓ Detailed testing of heat trace is necessary, identifying critical circuits. Repair at minimum, critical circuits.
- ✓ Verify critical heat trace circuits are functioning prior to every extreme cold weather event.
- ✓ Insulation inspections, focusing on critical components.
- ✓ As an additional measure, install wind breaks and/or space heaters protecting critical components, focusing on the N and NE sides of unit. Avoid off the shelf tarps.

What have we learned since February 2011? (continued)

- ✓ Review scope of contractor work and verify acceptable completion.
- ✓ Verify instrument air dryers, dew point monitoring, blow downs are all operating correctly.
- ✓ Conduct a refresher training drill in the fall with operators on extreme cold weather procedures.
- ✓ Ensure critical transmitters are in a heated enclosure and inspect integrity of transmitter enclosures in the fall as part of weatherization plans.
- ✓ Test critical components transmitter cabinet thermostat and heater as part of heat trace testing.
- ✓ Weatherization plan portion of EOP should be updated annually as lessons are learned and sent to ERCOT at EOP@ercot.com.

Closing comments……

- ✓ ERCOT assists generators in preparing for winter operations with spot checks, sharing lessons learned, best practices, recommendations and the annual fall workshop.
- ✓ Recent history has shown us that for every extreme cold weather event, a small amount of generation will experience freeze related derates or trips.
- ✓ Overall, ERCOT was pleased with the performance of generators during this past winter.
- ✓ For winter 2019/2020, spot checks will begin November 15, 2019 and will conclude February 28, 2020.

Thank you generator owners, operators and plant staff for your efforts on winter weatherization!

2019-20 Preliminary Winter Weather Outlook

Chris Coleman
ERCOT Sr. Meteorologist

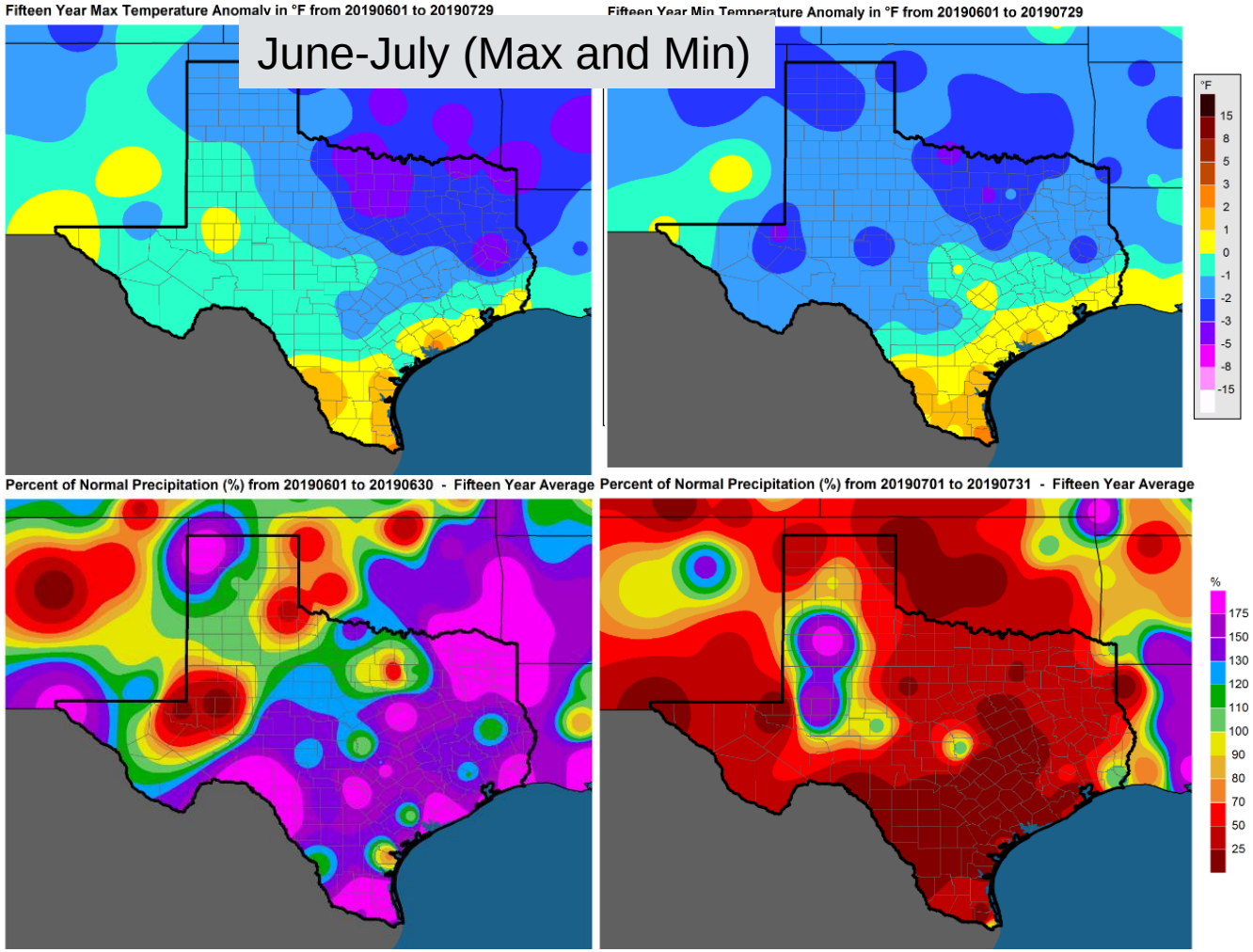
Generator Weatherization Workshop
Sep 5, 2019

Agenda

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

Updating Summer 2019

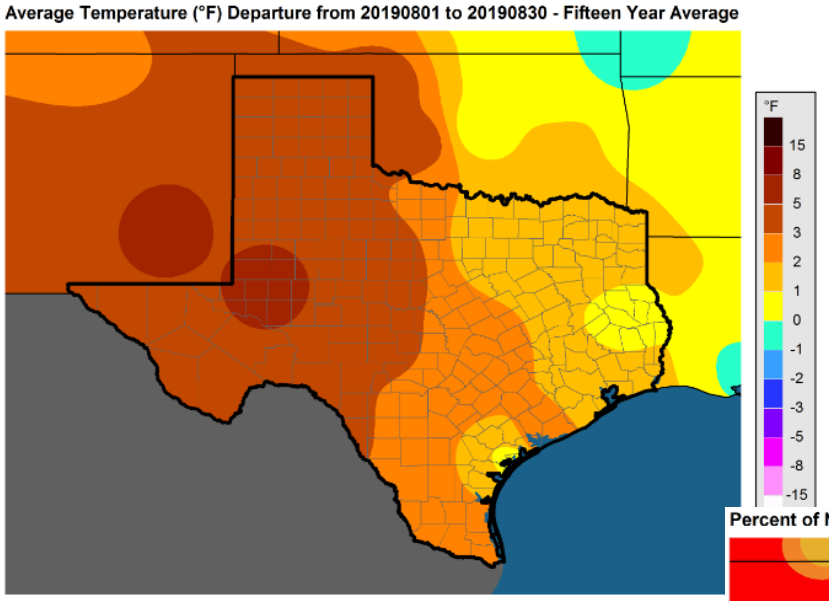
- June 2019 was the coolest for the state of Texas since June 2007. July was the coolest since 2014. **Jun-Jul combined was the coolest since 2007**
- Dallas-Fort Worth recorded its first 100° day on 7/30 – the latest first 100 since 2007
- June 2019 was the wettest for the state of Texas since June 2007
- The back half of the summer was forecast to be hotter than the front half (like August, September has above normal potential)

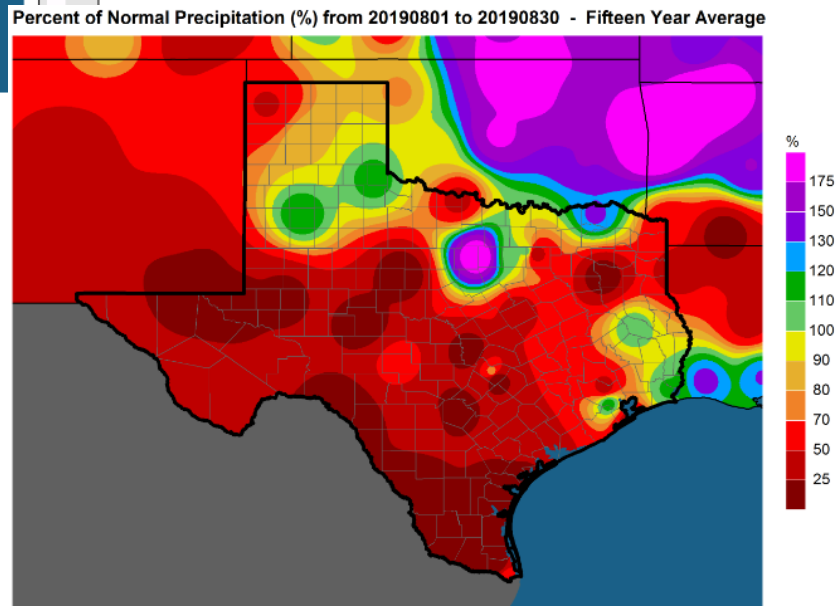


July trended much drier – driest since 2011 – which resulted in a significantly hotter August

Updating Summer 2019

- The dry trend that started in July continued through August
- This resulted in a very hot August, likely the hottest since August 2011
- After very few 100 degree days in June and July, August has made up a large chunk of the deficit
- September is likely to see August's hotter-than-normal trend continue

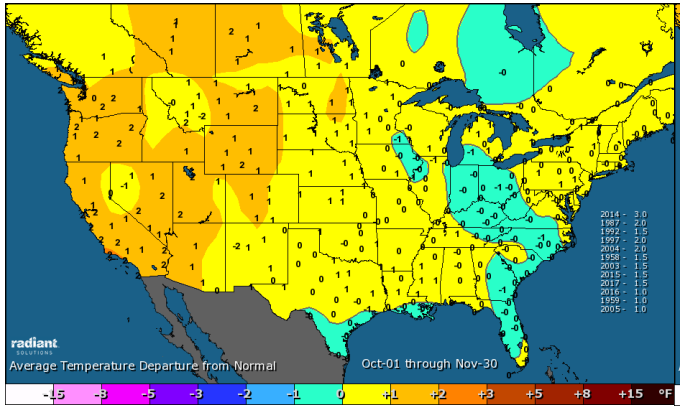


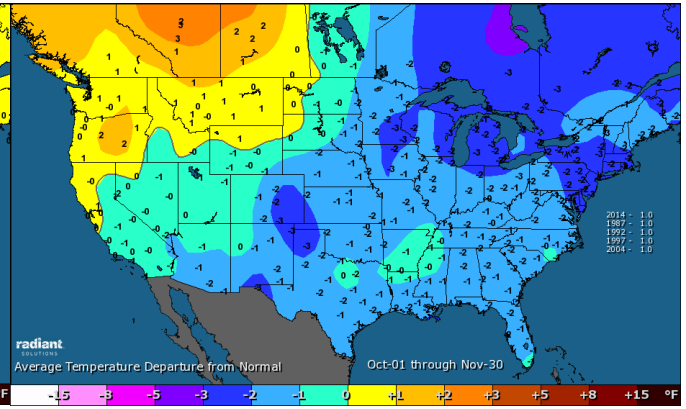


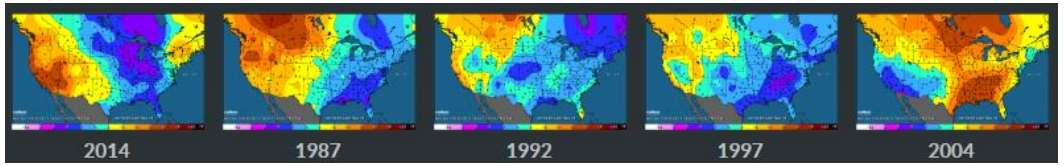
August 2019 – hotter and drier than normal

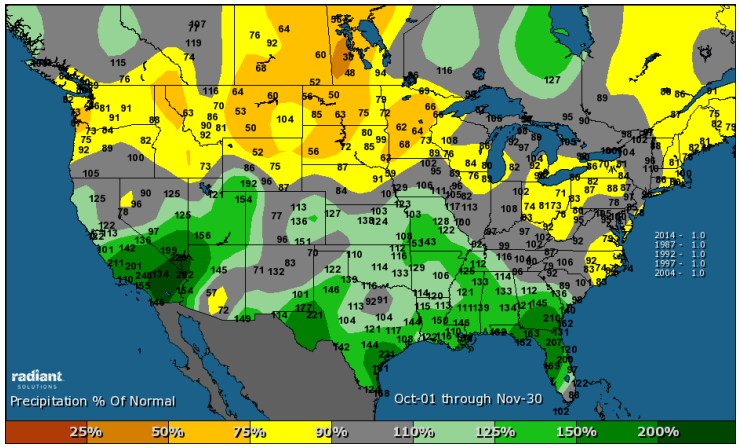
Fall 2019 Weather Outlook

- Late-summer/early-fall indicates warmer than normal conditions
- **October** shows **above normal** temperature potential
- Potential to turn significantly **cooler** in **November** – but not necessarily a precursor to the winter
- Possible early-season ice/snow event in West Texas in November
- After a dry period this summer, indications of a wetter pattern developing in the fall

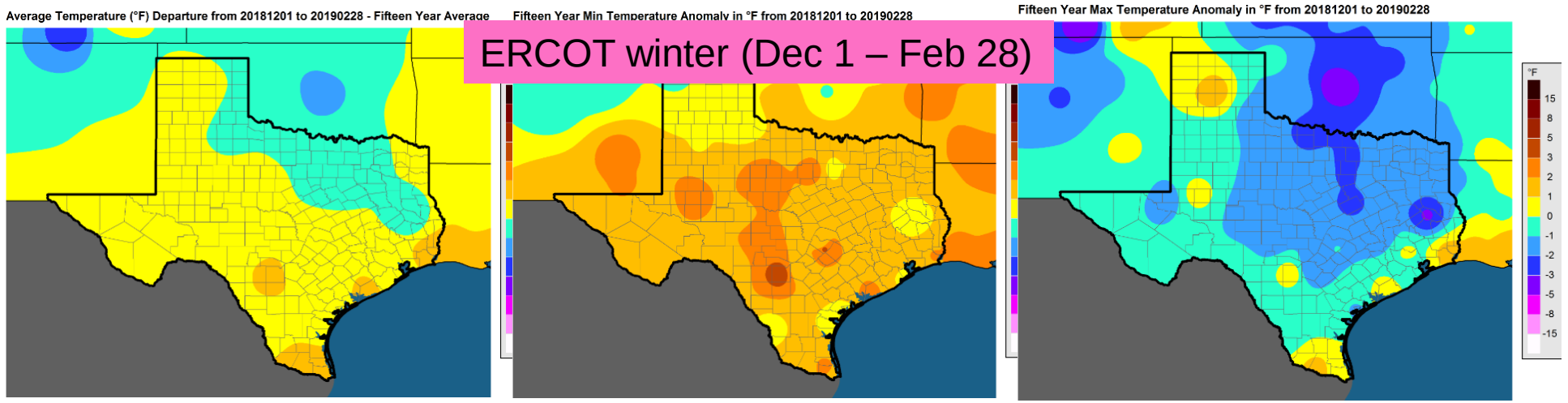








Reviewing Last Winter

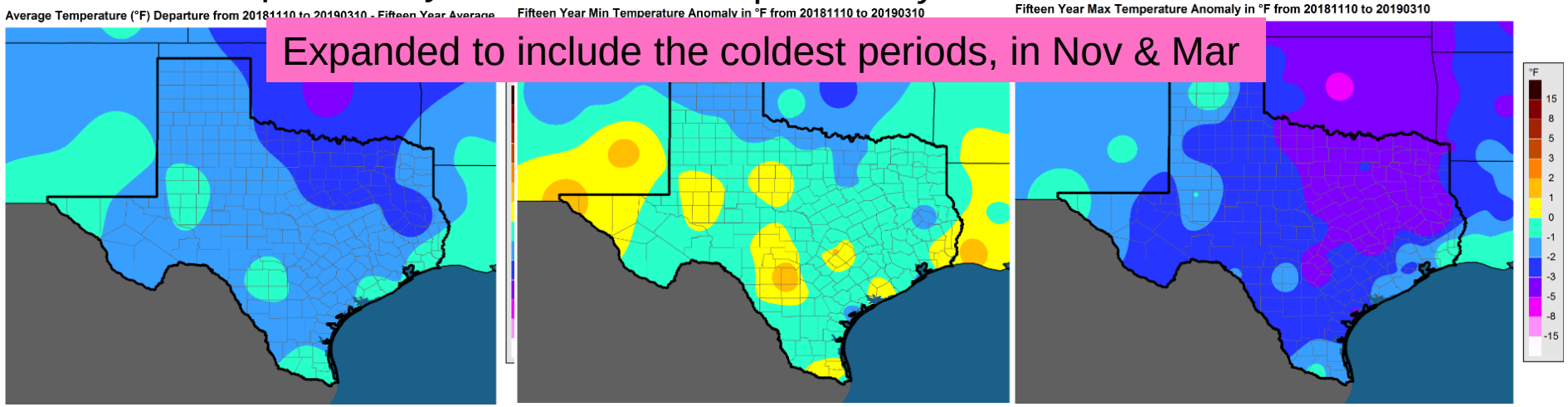


ERCOT winter (Dec 1 – Feb 28)

Mean temp anomaly

Min temp anomaly

Max temp anomaly



Expanded to include the coldest periods, in Nov & Mar

November 14, 2018
March 5, 2019

Mean Temperature Ranking of Recent Texas Winters (124 historical winters)

2018-19	93rd coldest
2017-18	75th
2016-17	**124th** coldest (warmest winter on record)
2015-16	**116th**
2014-15	67th
2013-14	30th
2012-13	**109th**
2011-12	98th
2010-11	67th
2009-10	**8th**
2008-09	**111th**

Since 2001, only two winters have ranked in the coldest third (1-41) of historical winters

Last winter's two coldest periods were technically just outside of the ERCOT winter (Dec 1-Feb 28). The coldest periods were in mid-November and early-March (11/14/18 & 3/5/19)

Seasonal Rankings

- 125 years of data, 1895-2019
- Chart shows the ranking within that set of years, by season
- 1 = warmest, 125 = coldest
- 38 total seasons thus far this decade
- Of the 38, **23** have ranked in the **warmest** third (1-42; indicated by red-shaded cells)
- **12** have ranked in the **middle** third (43-83; indicated by no shade)
- **3** have ranked in the **coldest** third (84-125; indicated by blue-shaded cells)

- What does this tell you?
  - You'd better have strong supporting evidence if forecasting a colder-than-normal season

spring 2019	72
winter 2018-19	31
fall 2018	103
summer 2018	6
spring 2018	7
winter 17-18	48
fall 2017	8
summer 2017	50
spring 2017	9
winter 16-17	1
fall 2016	1
summer 2016	21
spring 2016	21
winter 15-16	8
fall 2015	8
summer 2015	17
spring 2015	58
winter 2014-15	54
fall 2014	65
summer 2014	50
spring 2014	81
winter 13-14	93
fall 2013	83
summer 2013	21
spring 2013	76
winter 2012-13	15
fall 2012	17
summer 2012	12
spring 2012	1
winter 2011-12	25
fall 2011	32
summer 2011	1
spring 2011	3
winter 2010-11	54
fall 2010	32
summer 2010	10
spring 2010	68
winter 2009-10	114

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 literally be 20,000 MW or more higher 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 impacts 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).

Seasonal versus Extremes

*****Mild winters can have very cold periods*****

- February 2, 2011:
  - **Dallas**: 13° (20MPH wind)
  - **Houston**: 21° (16MPH wind)
  - **San Antonio**: 19° (25MPH wind)
  - **Austin**: 18° (26MPH wind)
  - **Brownsville**: 32° (26MPH wind)
  - **Abilene**: 7° (16MPH wind)
  - **Midland**: 6° (16MPH wind)

Winter of 2010-11: 67th coldest in TX weather history

Remains the winter peak record (65,915 MW)

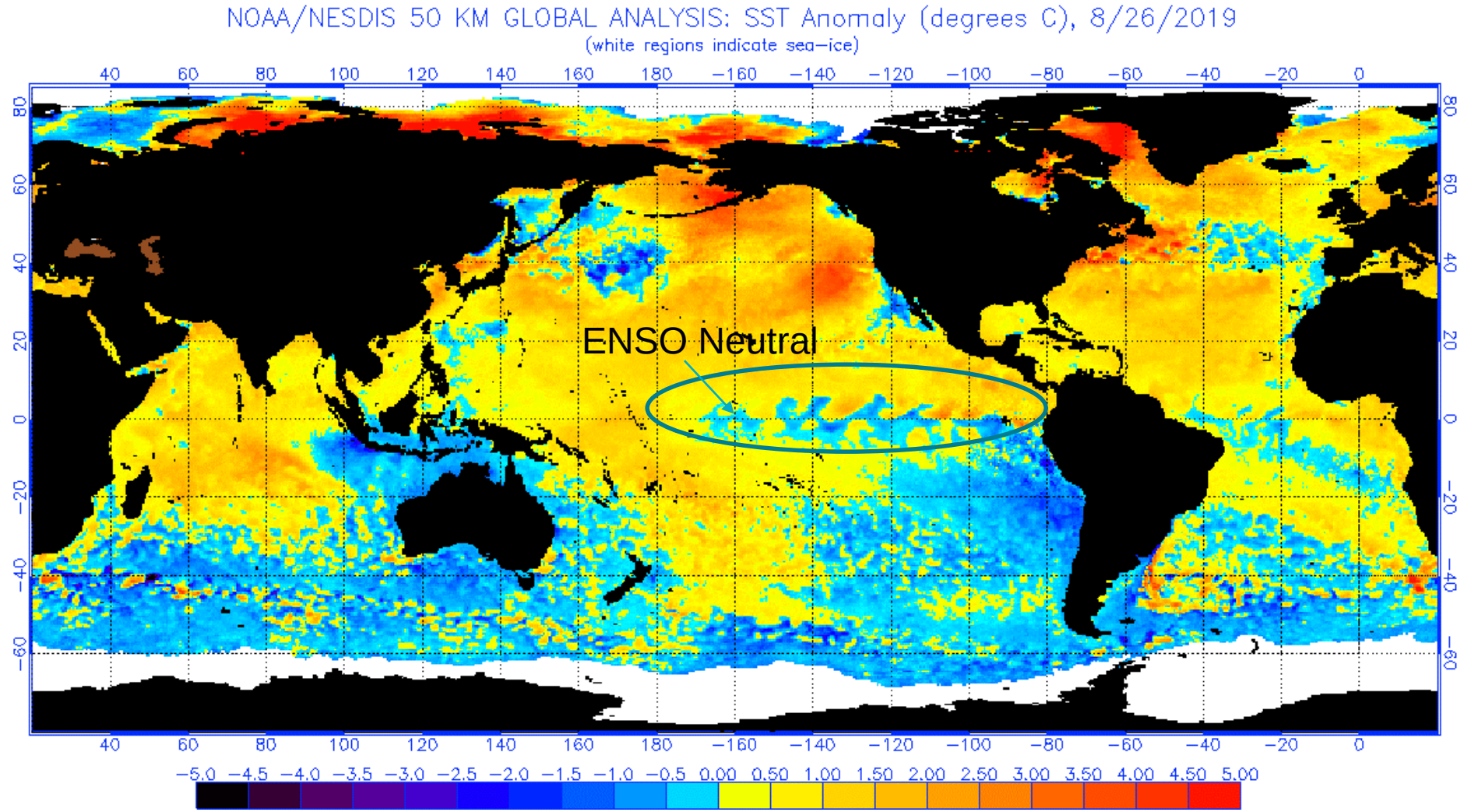
- January 17, 2018:
  - **Dallas**:13° (5MPH wind)
  - **Houston**: 19° (13MPH wind)
  - **San Antonio**: 23° (10MPH wind)
  - **Austin**: 18° (10MPH wind)
  - **Brownsville**: 30° (14MPH wind)
  - **Abilene**: 8° (5MPH wind)
  - **Midland**:28° (7MPH wind)

Winter of 2017-18: 75th coldest in TX weather history
*****Including the Coldest day since February 2011*****
All-time winter peak load on this date: 65,750 MW

Those were the **two coldest days** this decade

Winter 2013-14 was the coldest this decade (polar vortex winter) – but no single day that winter approached the cold extremes of 2/2/11 or 1/17/18

Ocean Temperatures

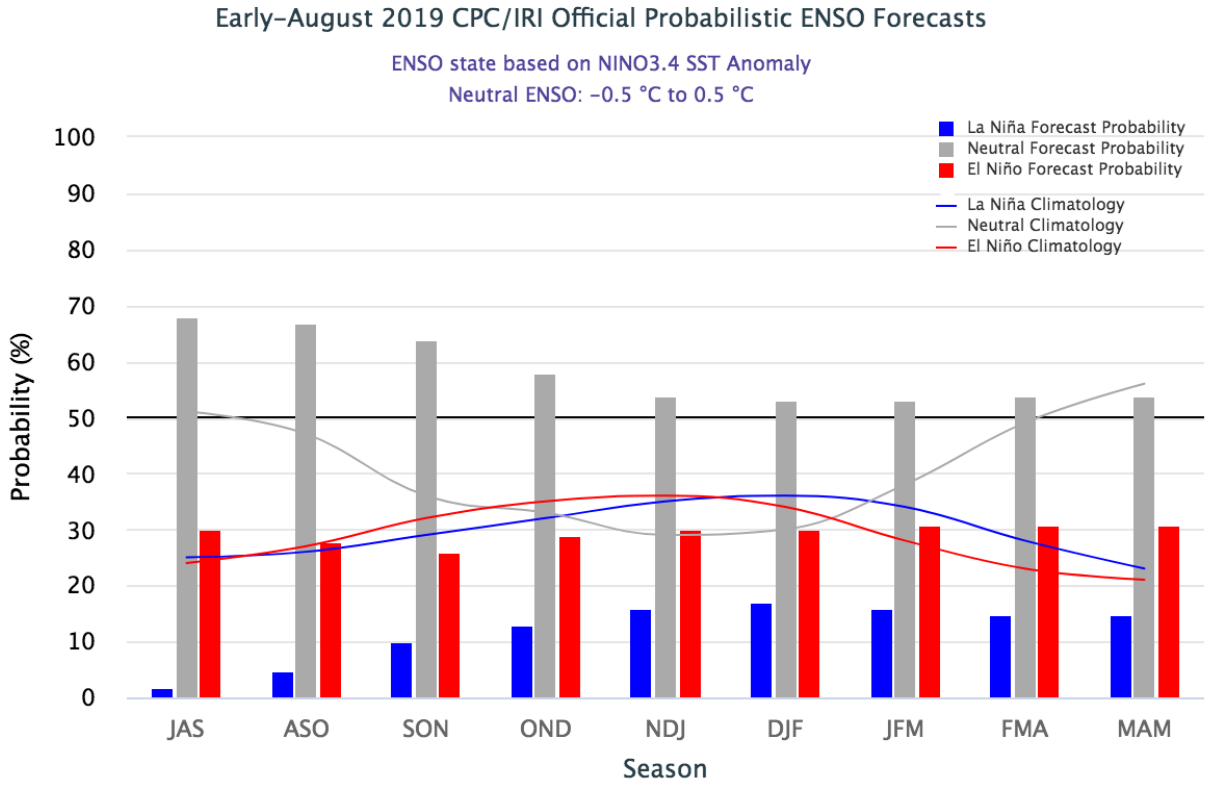


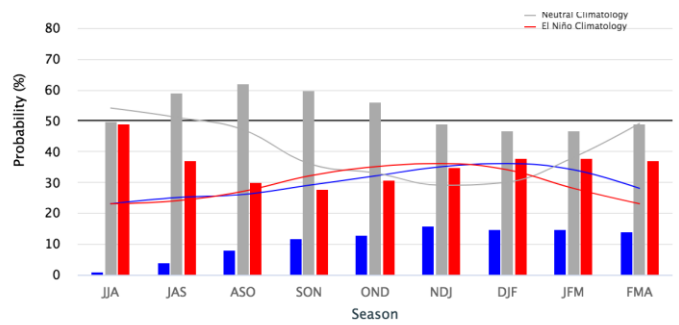
ENSO (El Niño Southern Oscillation)

A Weak El Niño event started last fall. It's transitioned to a **neutral** state this summer

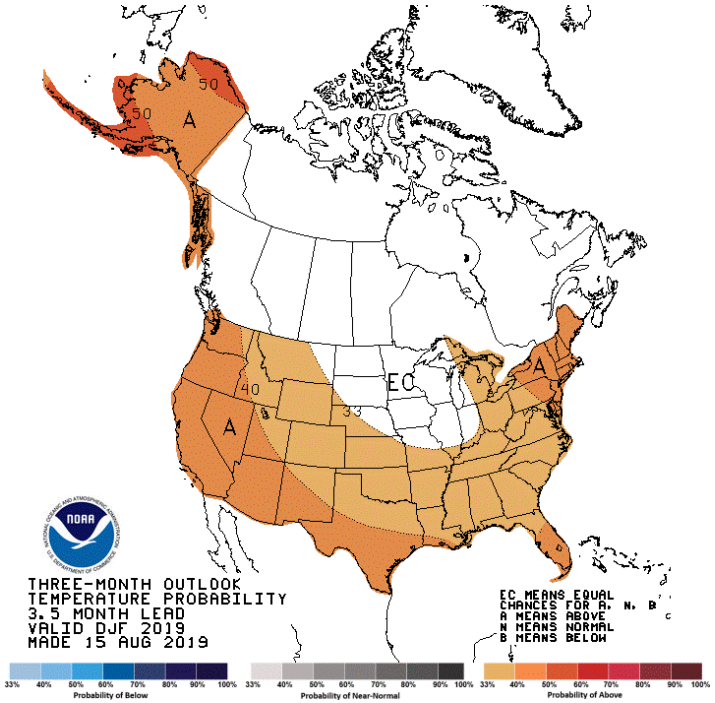
ENSO models are poorest performing in the summer (when ENSO is typically weak – so less for models to initialize)

Neutral (neither El Niño nor La Niña) is the most likely scenario through fall and winter. El Niño has more support than La Niña, with a very warm Pacific Ocean

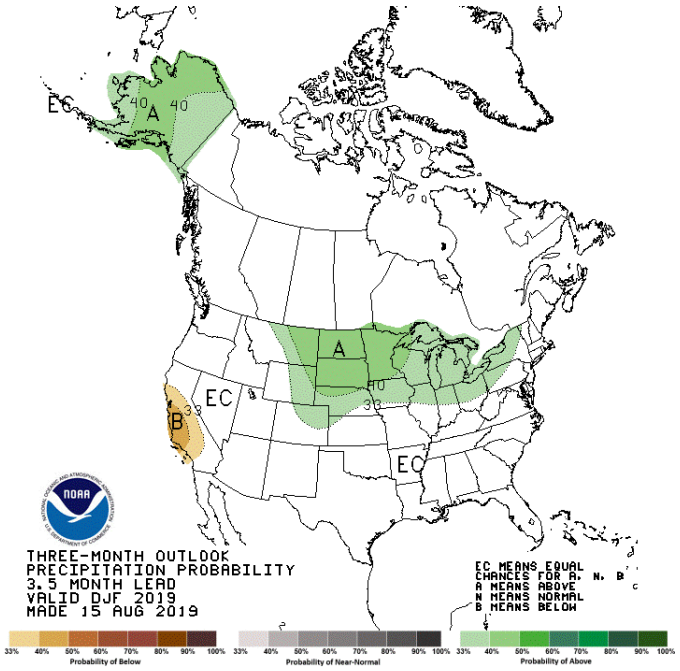


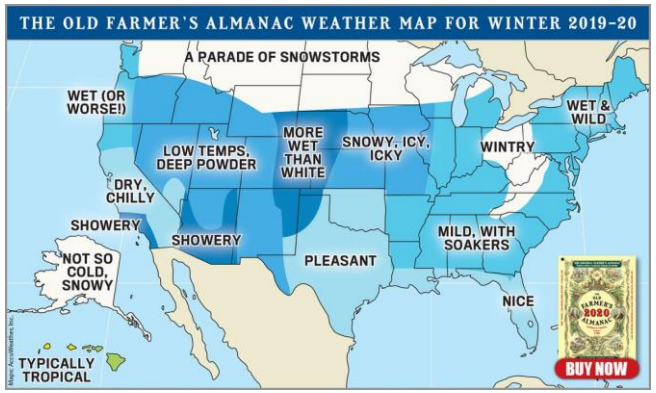


Other Winter Outlooks Currently Available



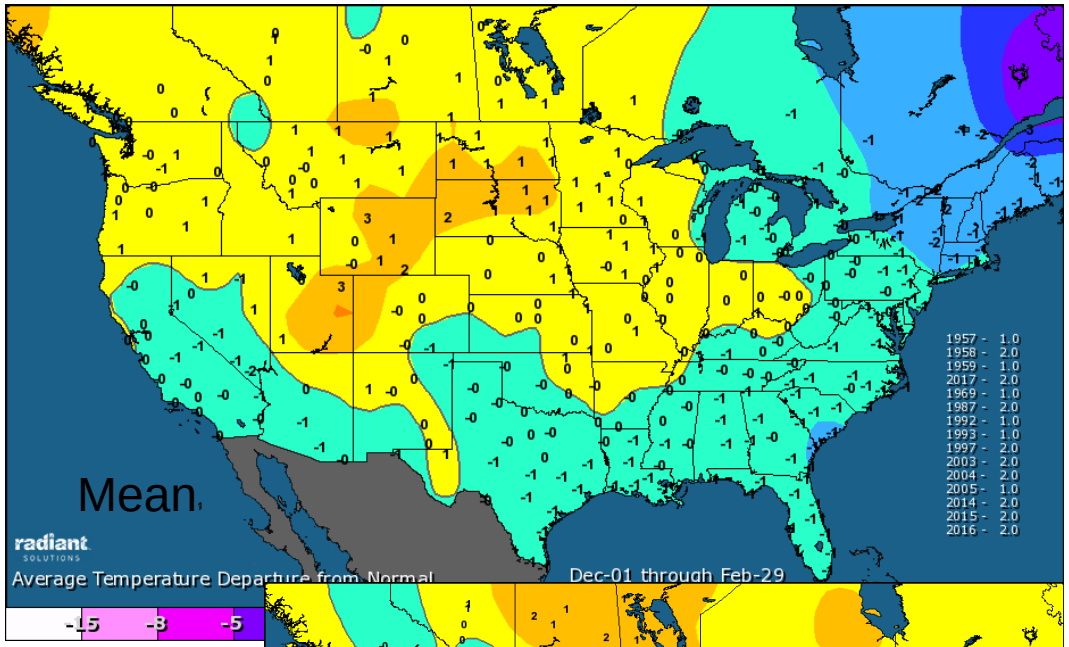
(All based on 30-year normal)

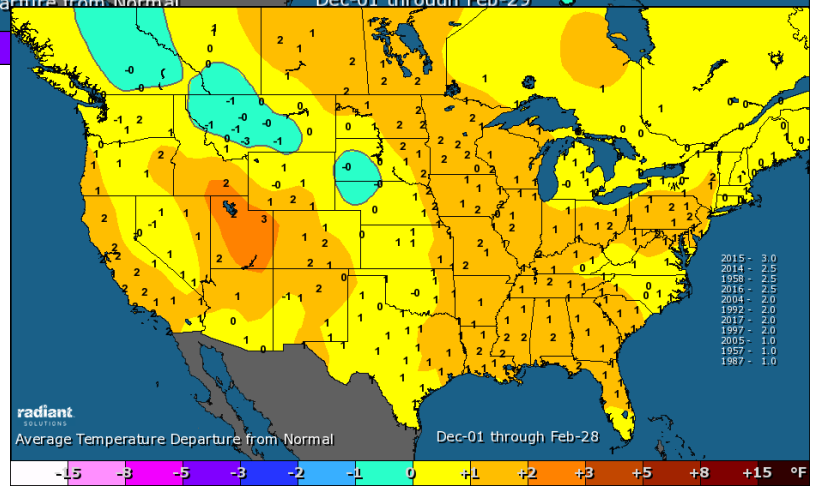


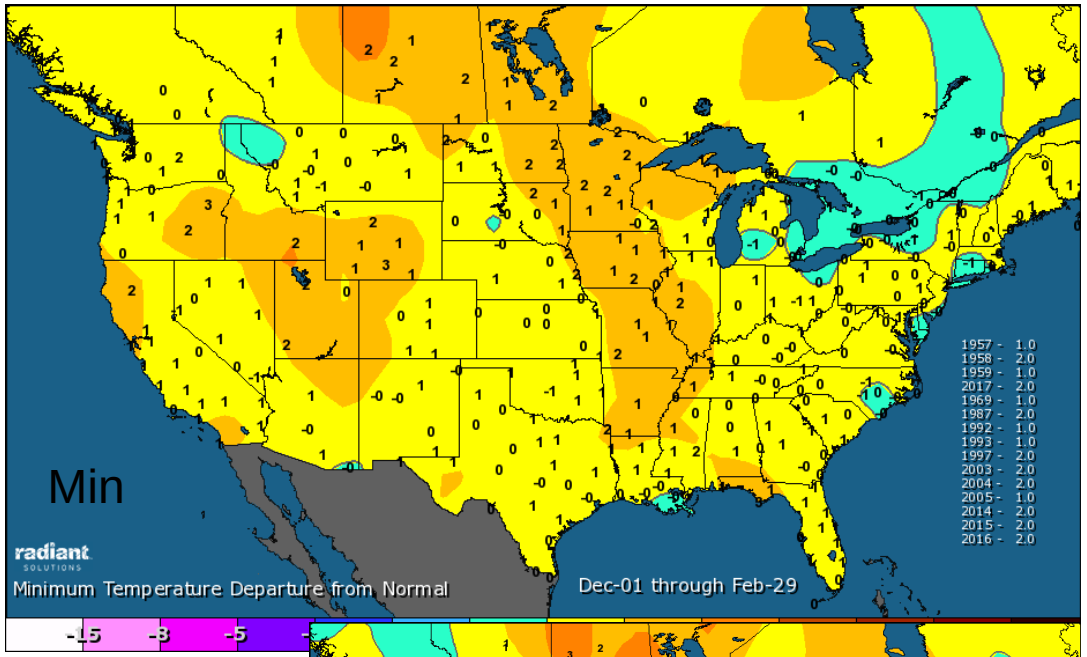


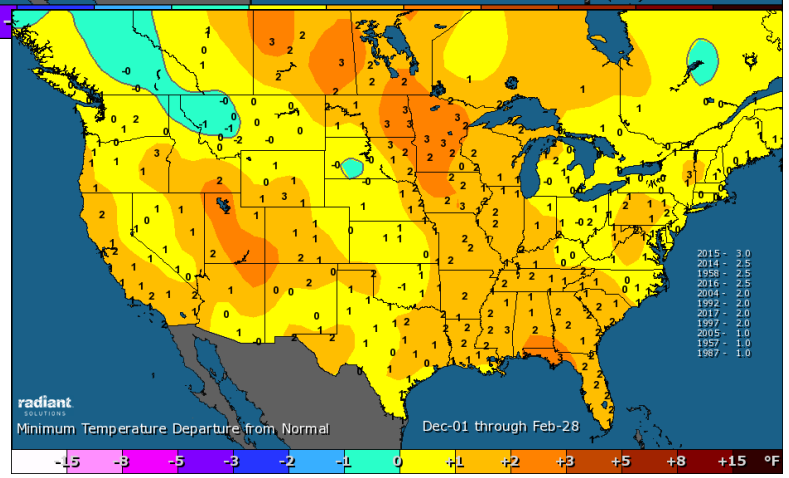
Preliminary Winter 2019-20 Temperature Outlook

Analog weighted consensus:



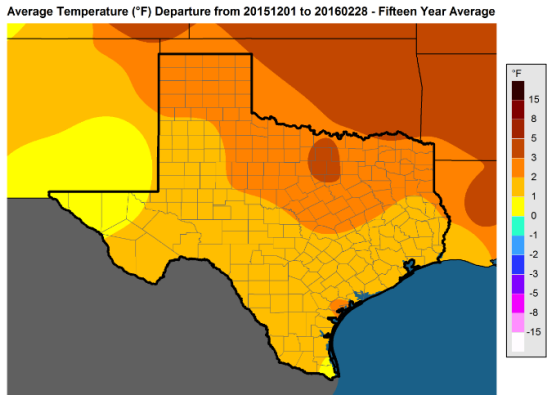




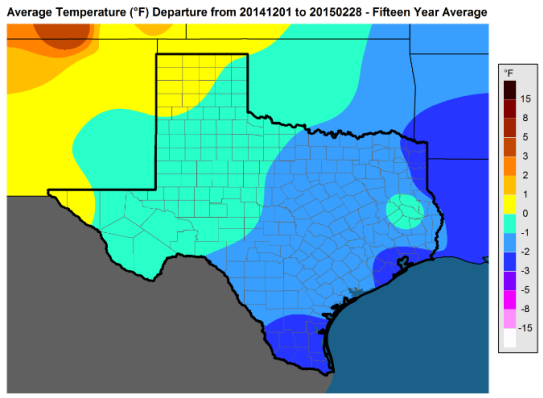


Updates are trending warmer

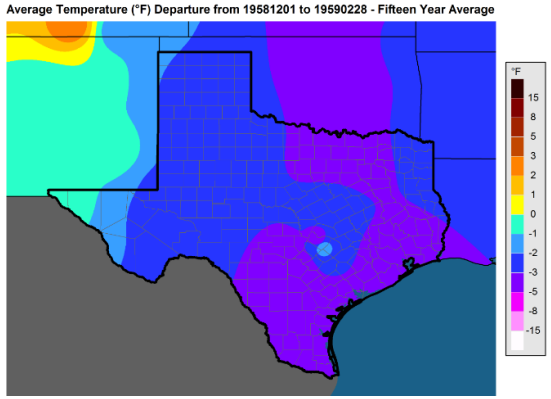
Historical Matches (Analogs)



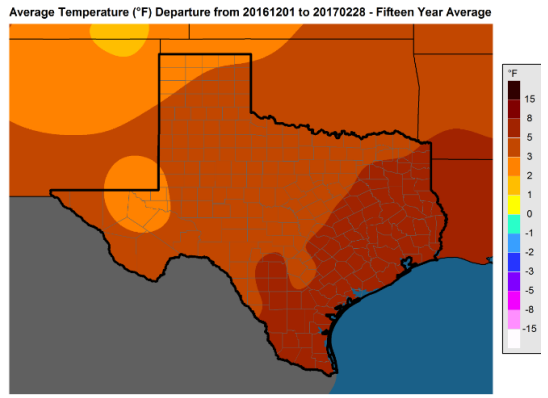
2015-16 (116th/106th coldest)



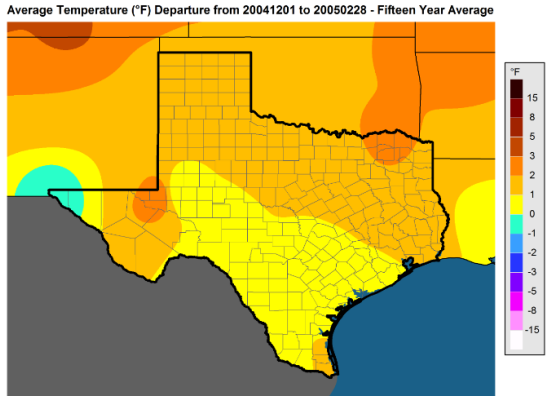
2014-15 (67th/101st)



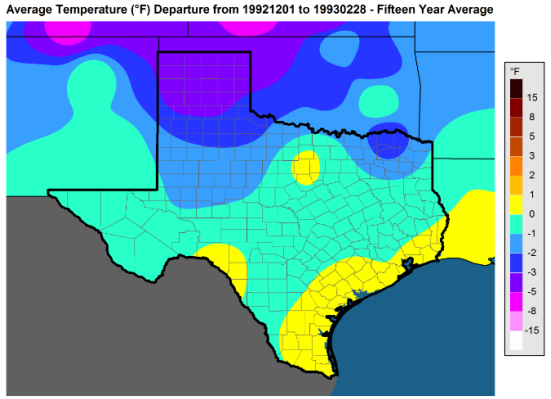
1958-59 (35th/22nd)



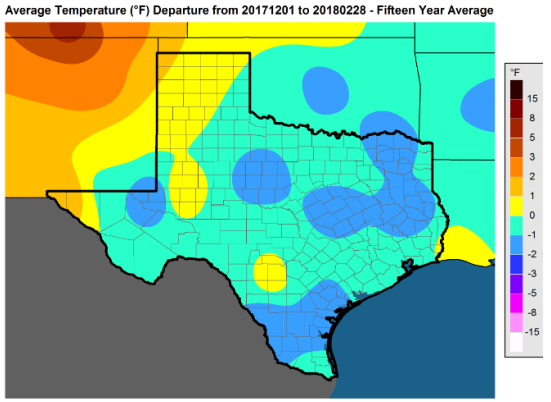
2016-17 (124th/124th)



2004-05 (107th/119th)

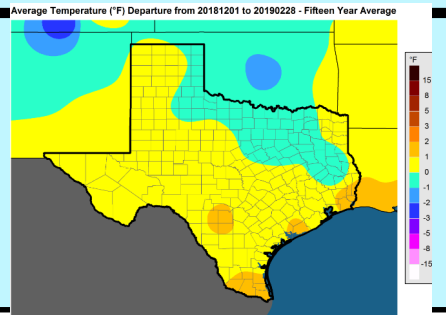


1992-93 (71st/101st)



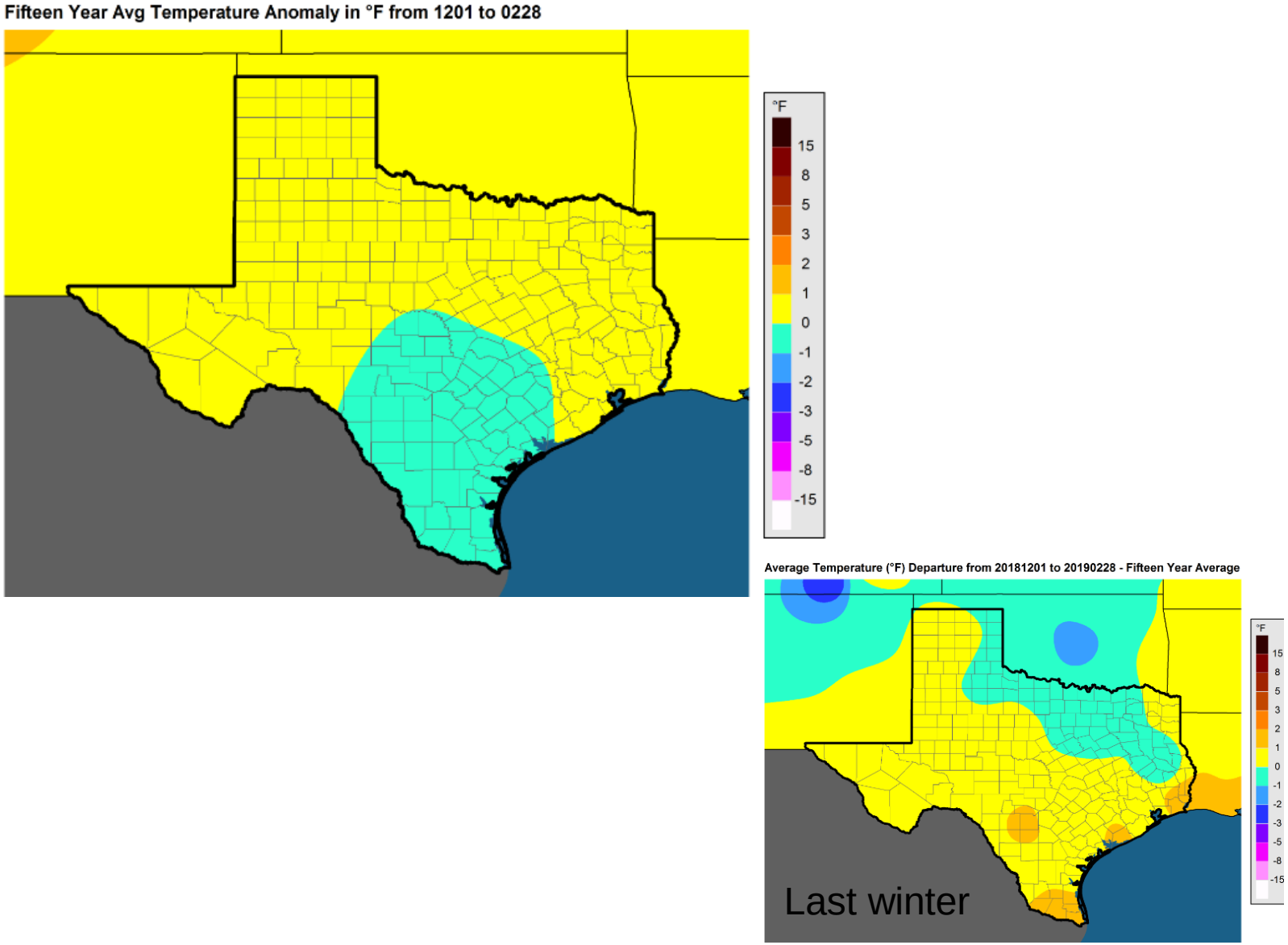
2017-18 (75th/67th)

Last winter ranked 93rd/109th **(mean/min)** coldest; this winter could be similar.



Preliminary Winter 2019-20 Temperature Outlook

- **Unlikely to see a winter that ranks among the top third coldest** of all-time (2013-14 is the most recent winter that ranked that cold)
- Can't yet rule out a finalized, colder forecast (1987-88), which would be on the cusp of the coldest third and colder than last winter
- Preliminary forecast has been trending warmer/milder
- **Mild winters can – and oftentimes do – have very cold periods!**



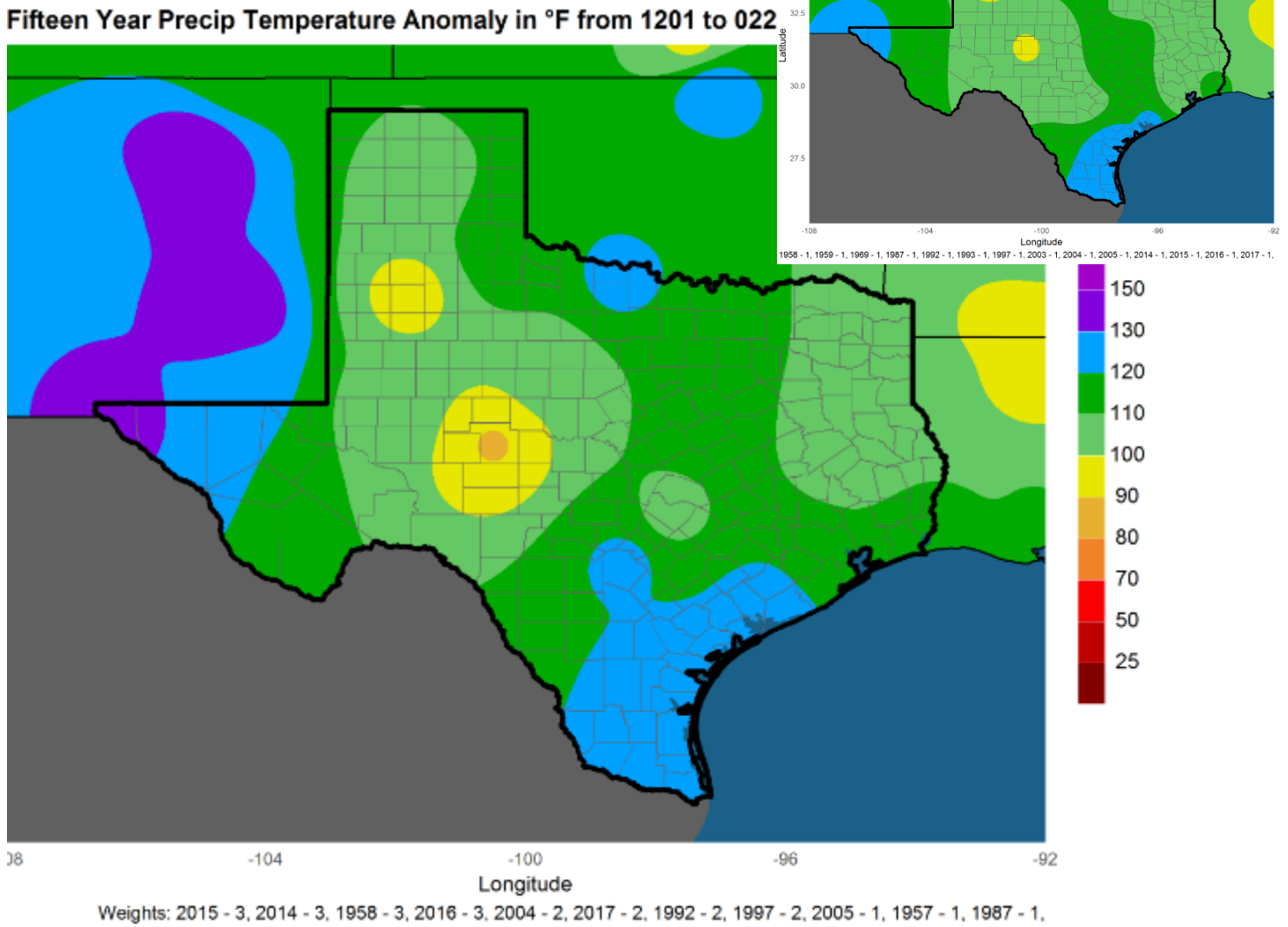
Precipitation Ranking of Recent Winters (Texas)

2018-19	**87th driest (out of 124)**
2017-18	71st
2016-17	**94th**
2015-16	56thth
2014-15	70th
2013-14	**11th**
2012-13	60th
2011-12	**114th**
2010-11	**17th**
2009-10	**113th**
2008-09	**1st driest**

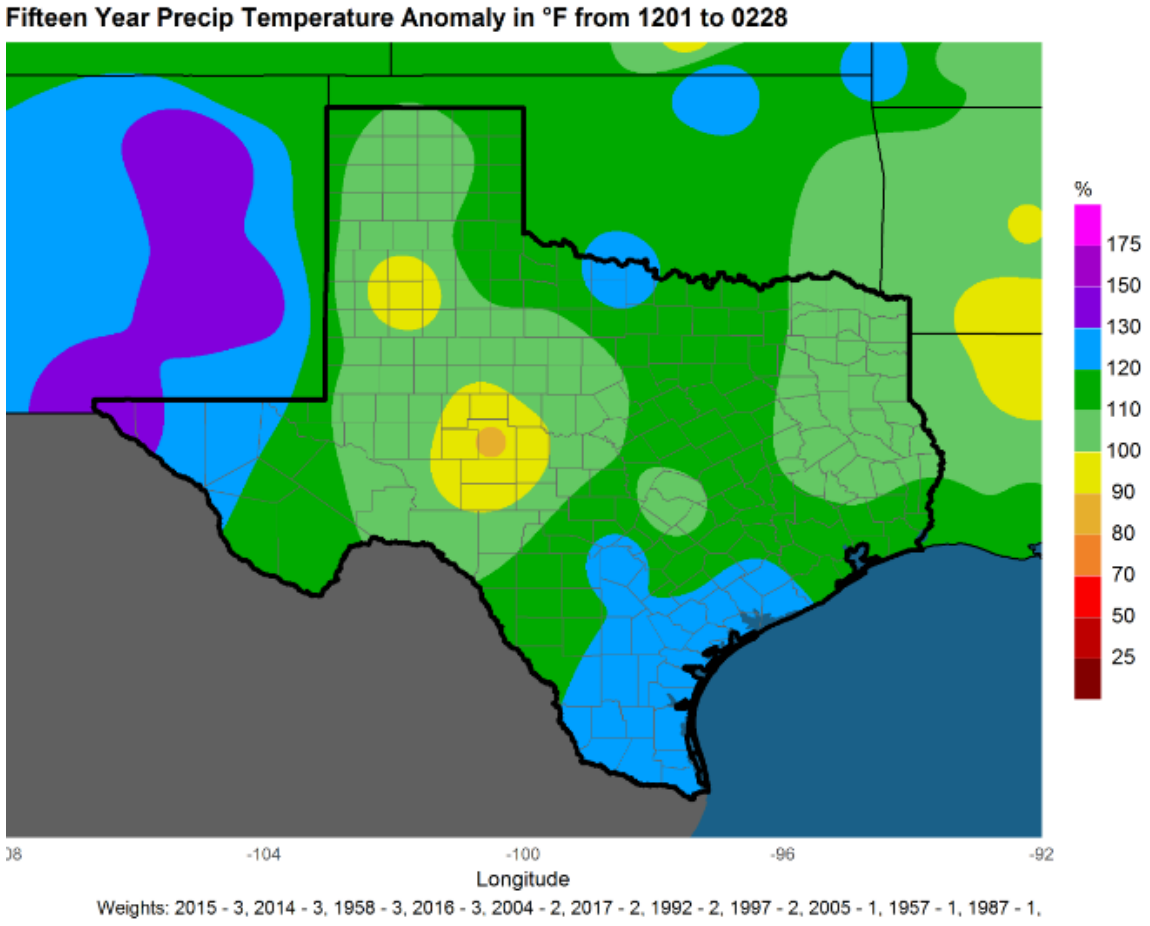
Last dry winter was 2013-14 (during long-term drought)

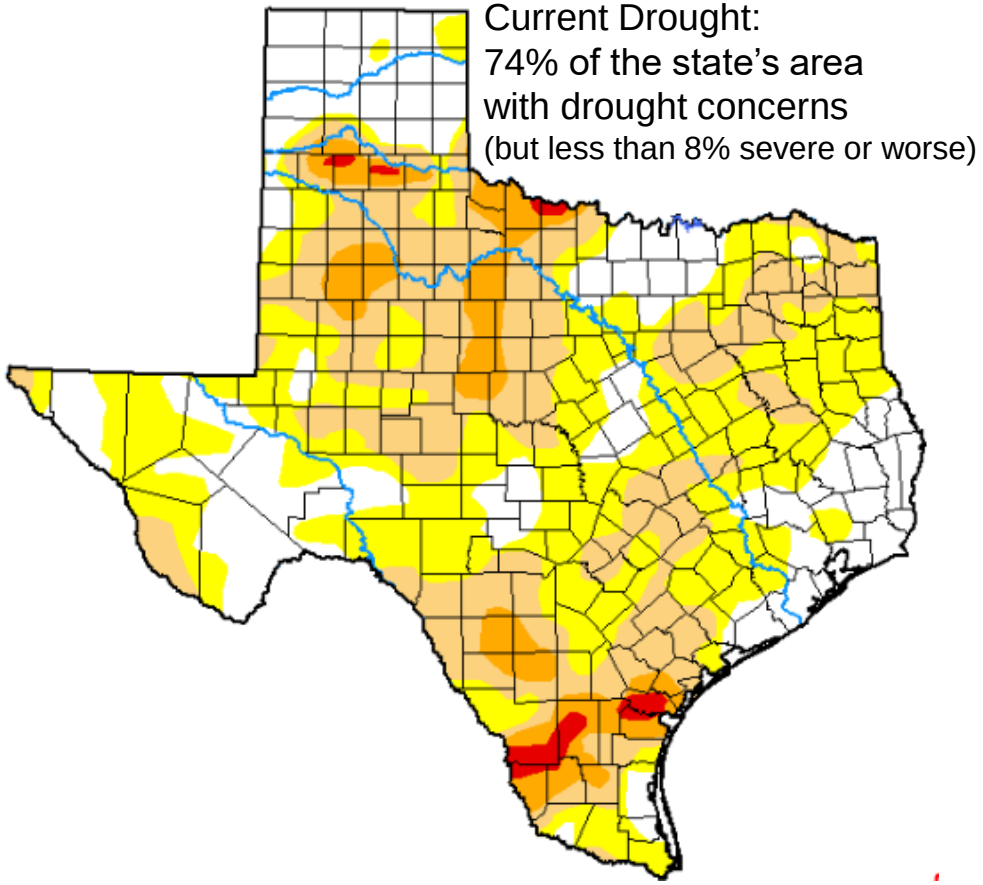
Winter 2019-20 Precipitation Outlook

- We are still in a pattern that supports wet winters over dry
- I wouldn't expect widespread, severe drought conditions to continue to expand and intensify late in the year and extend into the start of 2020 (even given the current summertime drier conditions)



Winter 2019-20 Precipitation Outlook vs Drought





Current Drought:
74% of the state's area
with drought concerns
(but less than 8% severe or worse)

General improvements to drought are expected late in 2019, early in 2020

Winter Weather Outlook Summary

- This is preliminary. The winter forecast will be finalized by November
- At this time, mixed messages if this coming winter will be warmer or colder than last winter – but current forecast trend is warmer
- The 2019-20 winter is most likely to either fall in the warmest third or middle third of winter rankings. Least likely is the coldest third
- Current pattern supports daytime high temperatures to be more anomalously cold than nighttime/morning low temperatures
- Continued opportunities for a relatively wet pattern with decreasing drought concerns
- 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 month out forecasts