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ERCOT and Texas RE 2015-2016 Generator Winter Weatherization Workshop  
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## ERCOT's Authority for Spot Checks

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- PUCT Substantive Rule 25.362 (i) (2)

No later than January 15 of each year, ERCOT shall file an operations report and plan. The report and plan shall contain the following information:

An assessment of the reliability and adequacy of the ERCOT system during extremely cold or extremely hot weather conditions, or drought, for which purpose ERCOT has the right, upon reasonable notice, to conduct generator site visits to review compliance with weatherization plans and has the right to obtain from generators any information concerning water supplies for generation purposes, including contracts, water rights, and other information.

## What does a spot check entail?

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- Objective is to build a working relationship with generators operators so that they are comfortable sharing information and are receptive to recommendations.
- Lessons learned from previous winter, observations, best practices and NERC lessons learned are all shared at each site.
- Generators are spot checked that they are following their weatherization plan.
- The spot check is NOT a comprehensive review of all plant equipment.
- ***ERCOT does not certify a generator is prepared for winter operations.***
- Every plant is left with recommendations to improve reliability.

## Criteria for selection of spot checks

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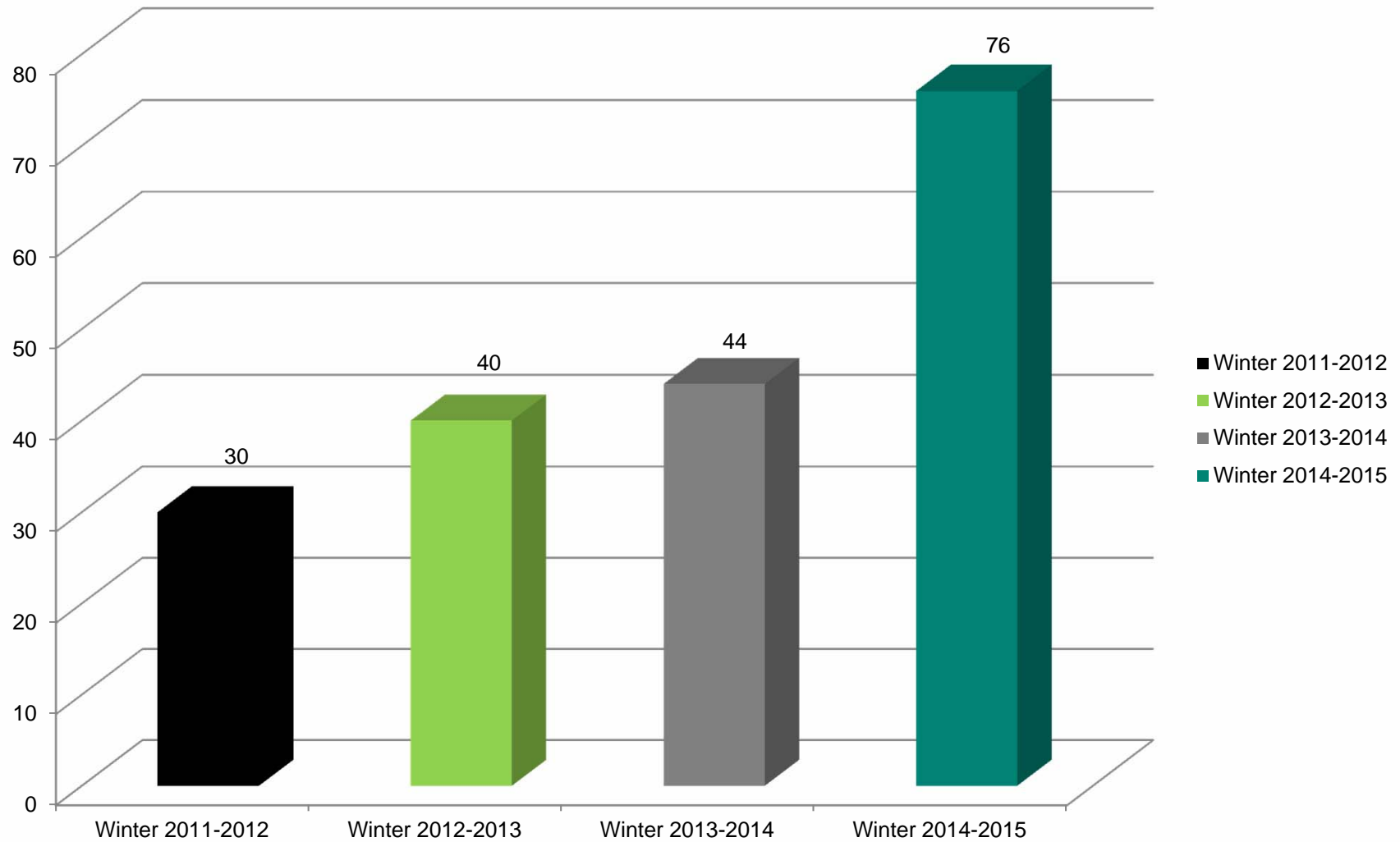
- ✓ New generator resources commissioned start by December 1.
- ✓ Generator resources that experienced freezing equipment from previous winter.
- ✓ Generators that notified ERCOT improvements were planned from previous winter.
- ✓ Randomly selected generators, including black start or next start resources.

## History of Spot Checks

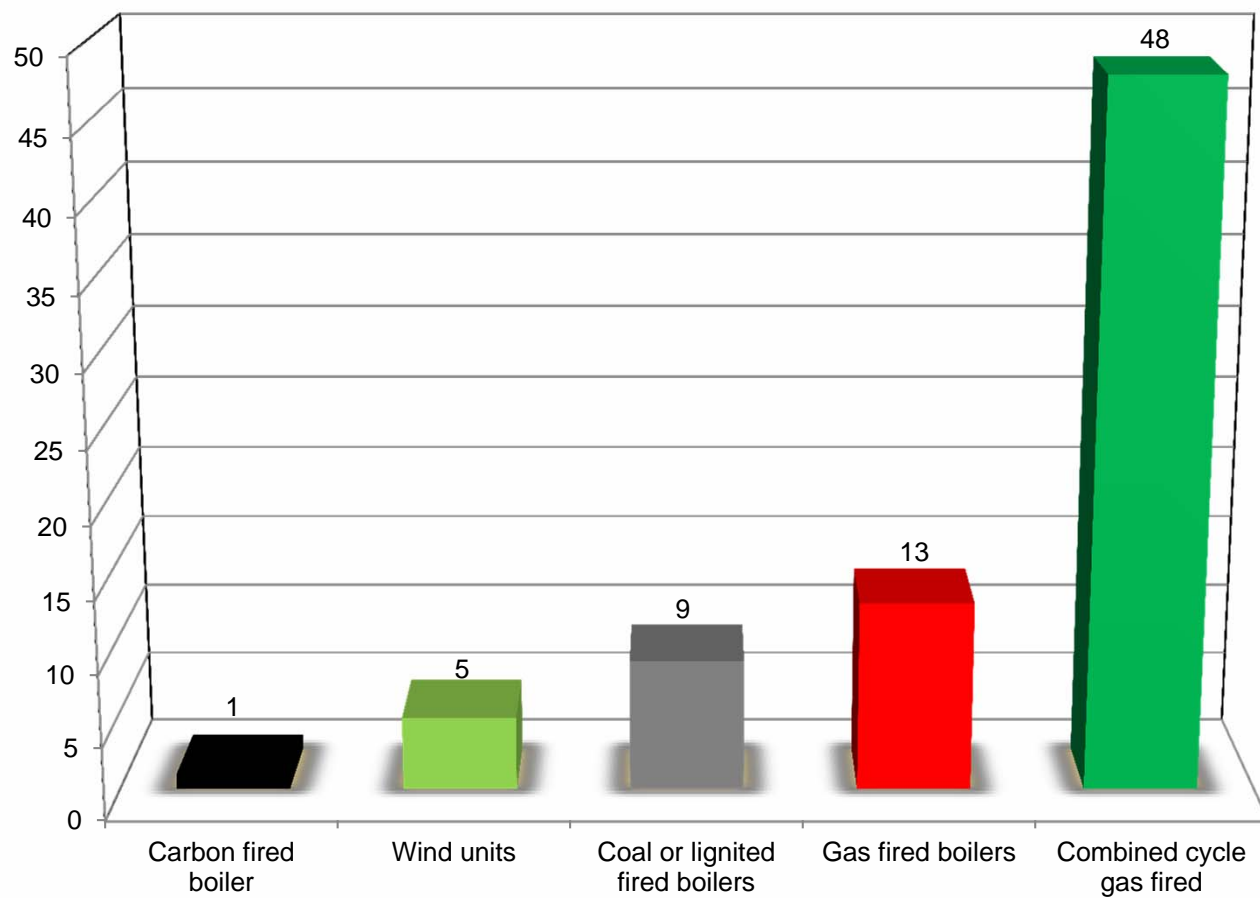
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- A check list was developed due to equipment or instrumentation freezing from February 2011, which has been updated as new issues are found. ERCOT uses the check list to cross check weatherization plans to determine if best practices and lessons learned are included.
- Spot checks start as early as November 15 and end February 28.
- There are approximately 550 generators in ERCOT, which includes conventional, wind and hydro.

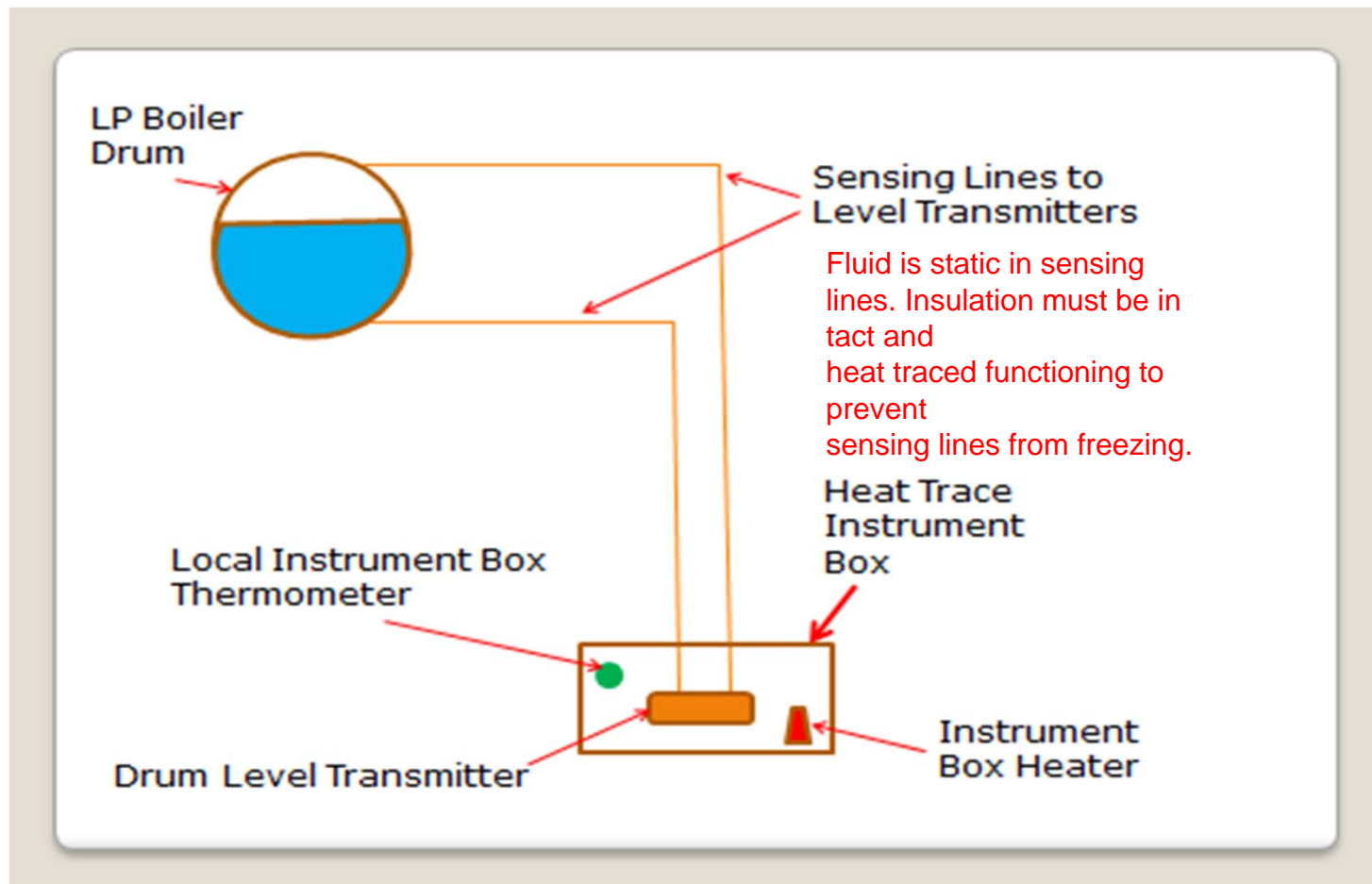
## Total units spot checked by winter



## Units spot checked by type for winter 2014-2015



## Drum level transmitter manifolds and sensing lines freezing are the leading cause of a unit trip or derate





## Insulated heated enclosure for transmitters – best practice

Insulated  
heated  
enclosure  
for  
transmitters



Outside  
temperature  
gauge to  
monitor  
inside  
temperature

## Three phase monitor on heat trace panel – best practice

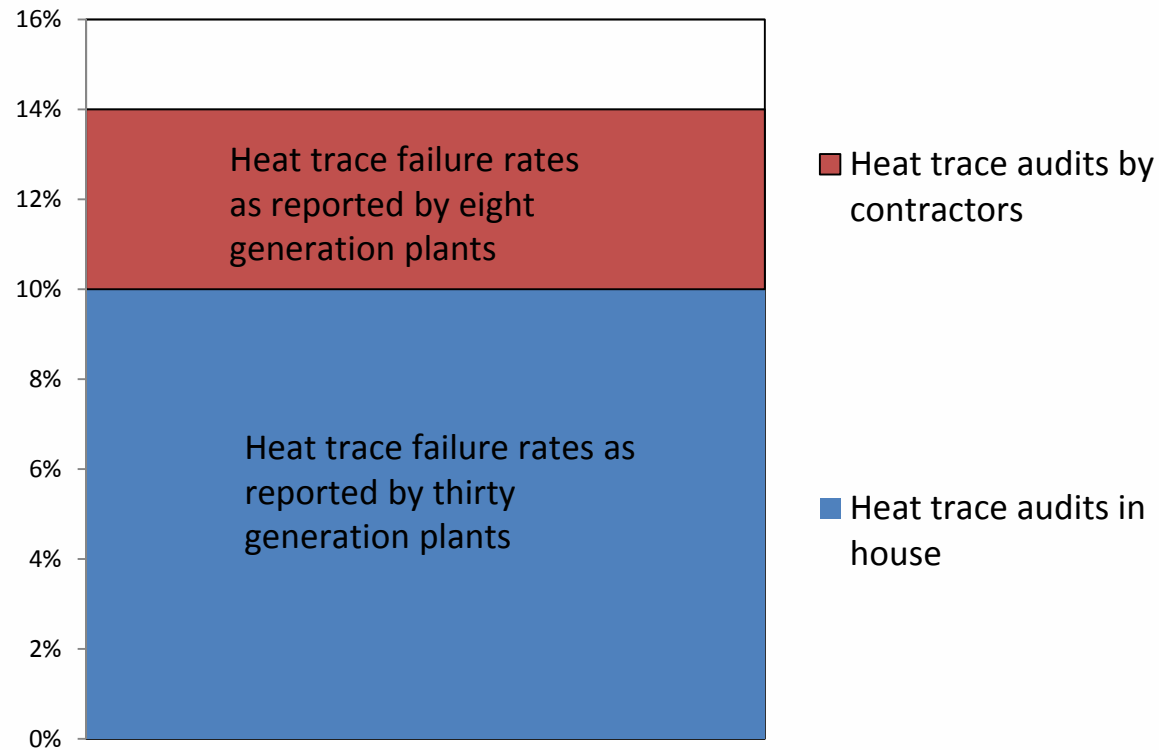


# Heat Trace Maintenance – Best Practice

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- Heat trace maintenance testing should include meggar, voltage, amperage testing and comparing to design criteria, if known or previous season.
- Thirty eight plants spot checked report annual testing of their heat trace circuits.
  - ✓ ***Recommendations given to continue annual audit on heat trace systems.***
- Six plants spot checked report they do not perform annual testing their heat trace circuits.
  - ✓ ***Recommendations given to start annual audit on heat trace systems.***
- ***Because heat trace circuits worked last winter doesn't mean they're working this year. Annual maintenance testing is necessary.***

## Heat trace annual maintenance testing results – winter 2014/2015



Six plants reported they do not test their heat trace.

# Sample spreadsheet for recording heat trace testing

Panel 001 Circuit breaker	Circuit description	Reference drawing number	Heat Trace type	Design amperage or previous/first year readings	2013/2014 amperage winter readings	2014/2015 amperage winter readings	2015/2016 amperage winter readings
1	LP drum level transmitter/sensing line	XXX-XXX-XXX	Series constant wattage	10A	9.5A	9.7A	
2	LP drum level transmitter/sensing line	XXX-XXX-XXX	Series constant wattage	7A	7.1A	6.8A	
3	LP drum level transmitter/sensing line	XXX-XXX-XXX	Series constant wattage	14A	10A	6A	
4	IP drum level transmitter/sensing line	XXX-XXX-XXX	Mineral insulated	11A	10.5A	11.2A	
5	IP drum level transmitter/sensing line	XXX-XXX-XXX	Mineral insulated	12A	11A	11.5A	
6	IP drum level transmitter/sensing line	XXX-XXX-XXX	Mineral insulated	5A	7A	6.5A	
7	HP drum level transmitter/sensing line	XXX-XXX-XXX	Parallel constant wattage	7A	7.5A	7.2A	
8	HP drum level transmitter/sensing line	XXX-XXX-XXX	Parallel constant wattage	12A	10.9A	11.1A	
9	HP drum level transmitter/sensing line	XXX-XXX-XXX	Parallel constant wattage	5A	4.1A	4.5A	
10	Boiler feed water pump flow	XXX-XXX-XXX	Self regulating	10A	5A	1A	

## Insulation and wind breaks – winter 2014/2015

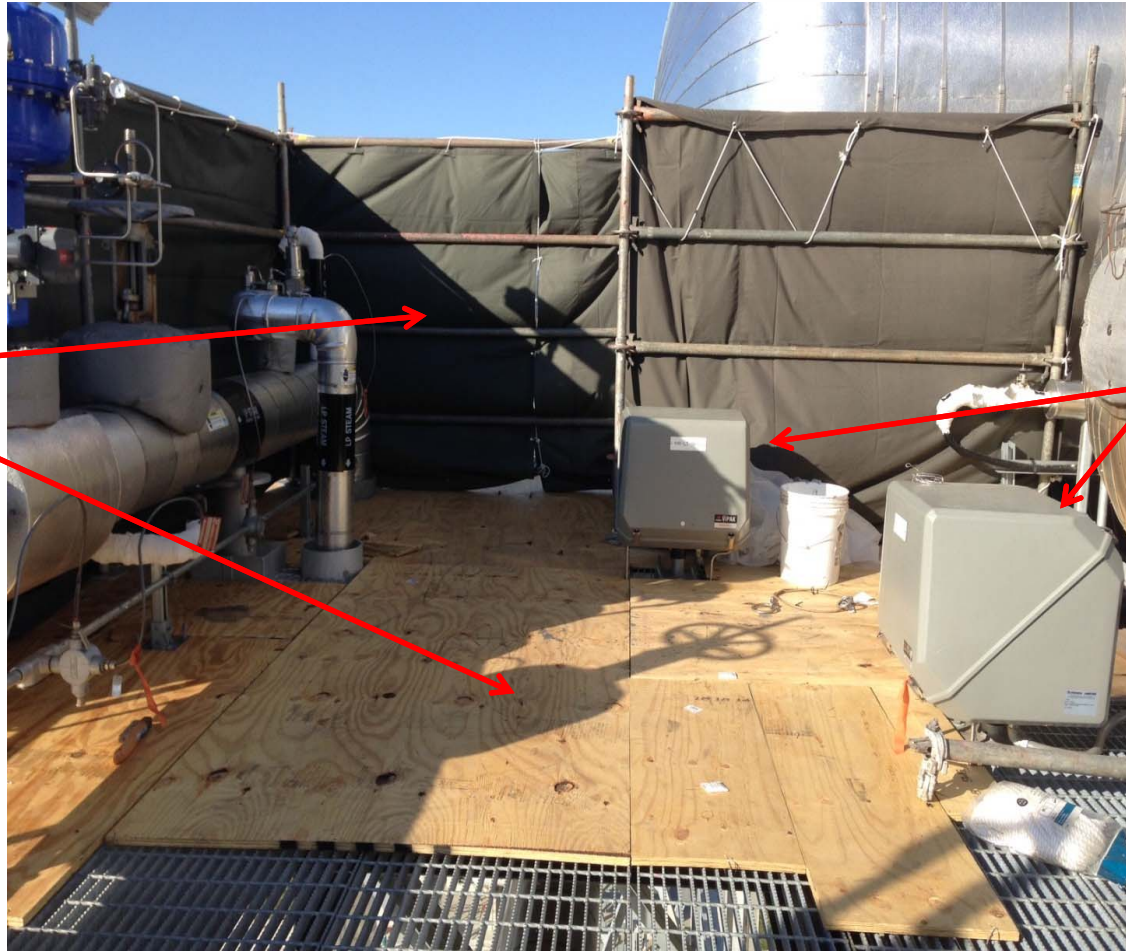
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- Insulation audit by plants was observed at 91% (40 of 44)
  - ✓ 5 plants not performing this type of audit.
  - ✓ All were given recommendation to start doing so.
- Wind Breaks
  - ✓ Plants are using wind breaks that are either plywood, heavy duty tarps, reinforced plastic or permanent structures.
  - ✓ Two plants were observed using off the shelf blue tarps as wind breaks.
  - ✓ Both plants were left with recommendation to use another heavy duty material as a wind break.



# Best Practice

Best practice wind break and flooring to prevent tunneling effect.



Insulated transmitter boxes

# Best Practice





## New plant findings – winter 2014/2015

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- Four new conventional plants visited
  - Plants heat trace audit found 10%-50% of the circuits not functioning or installed incorrectly.
  - Additional wind breaks used as a precaution.
  - Some transmitter cabinet heaters not terminated to potential.

## New wind plant findings – winter 2014/2015

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- Four plants visited
  - Cold weather package part of design.
  - Icing remains a concern that could impact generation. ERCOT emphasized the need to notify QSE when ice conditions are forecasted or if turbines trips due to icing for reporting to ERCOT.
  - Stressed the importance to keep plan current.

# Comparing Feb 2, 2011 to Jan 6, 2014

8000MW of capacity tripped, failed to start or derated that was freeze related.

ERCOT declared EEA3 – 4000MW firm load shed

## 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)

3541MW of capacity tripped that was freeze related.

ERCOT declared EEA2

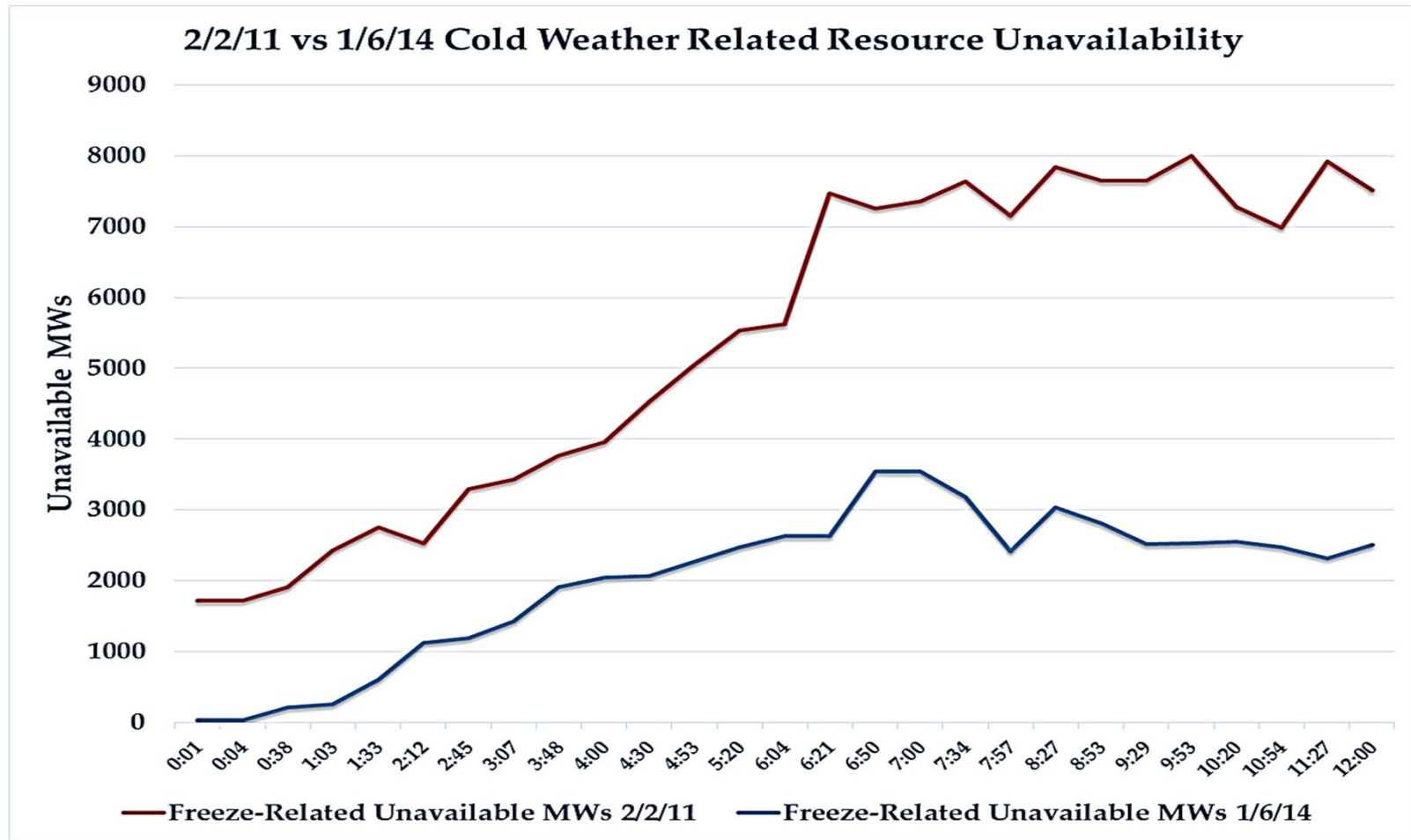
## January 6, 2014

**Dallas:** 15° (9MPH wind)  
**Houston:** 27° (16MPH wind)  
**San Antonio:** 27° (15MPH wind)  
**Austin:** 20° (13MPH wind)  
**Brownsville:** 37° (17MPH wind)  
**Abilene:** 11° (5MPH wind)  
**Midland:** 14° (12MPH wind)



Weather Source: Chris Coleman, ERCOT

# Comparing February 2, 2011 to January 6, 2014



# Comparing Jan 6, 2014 to Jan 8, 2015

3541MW of capacity tripped  
that was freeze related.

ERCOT declared EEA2

## January 6, 2014

**Dallas:** 15° (9MPH wind)  
**Houston:** 27° (16MPH wind)  
**San Antonio:** 27° (15MPH wind)  
**Austin:** 20° (13MPH wind)  
**Brownsville:** 37° (17MPH wind)  
**Abilene:** 11° (5MPH wind)  
**Midland:** 14° (12MPH wind)

750 MW of capacity tripped  
that was freeze related.

Normal Operations in ERCOT

## January 8, 2015

**Dallas:** 16° (5MPH wind)  
**Houston:** 28° (6MPH wind)  
**San Antonio:** 28° (8MPH wind)  
**Austin:** 21° (7MPH wind)  
**Brownsville:** 39° (16MPH wind)  
**Abilene:** 16° (8MPH wind)  
**Midland:** 20° (7MPH wind)



Weather Source: Chris Coleman, ERCOT

## January 6, 2014 EEA2 event follow up

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Units that experienced freezing equipment on 1/6/14 were visited within days of the event.

- ✓ Plant 1 – Lessons Learned Event
- ✓ Plant 2 – Lessons Learned Event
- ✓ Plant 3 – Lessons Learned Event
- ✓ Plant 4 – Lessons Learned Event
- ✓ Plant 5 – Lessons Learned Event
- ✓ Plant 6 – Lessons Learned Event
  - Three of six plants were deemed preventable

## Plant 1 - wind break measure after 1/6/14 event

Steam seal line froze delaying startup – **first** occurrence, lessons learned





## Plant 2 – contractor error – lessons learned

January 6, 2014 derate.  
Heat trace left exposed by  
insulating contractor on steam seal  
pressure regulator transmitter.



Mitigation action for remainder  
of winter 2014.

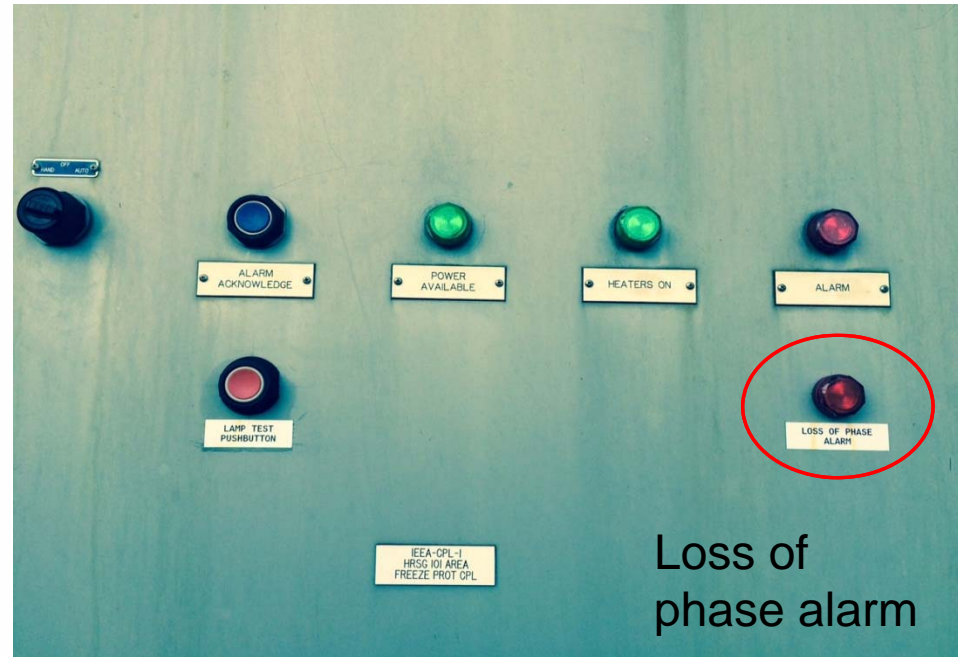
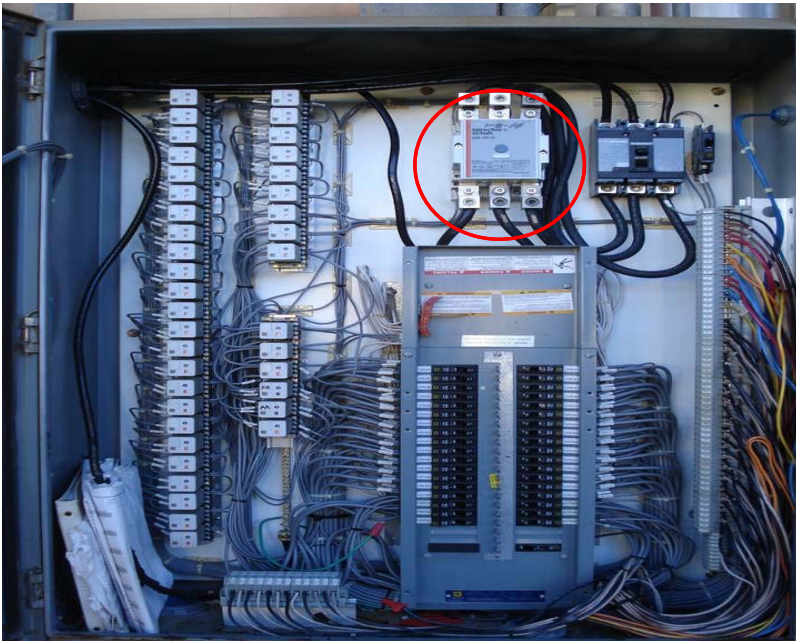




## Plant 3 – heat trace panel, three phase contactor – lessons learned and best practice

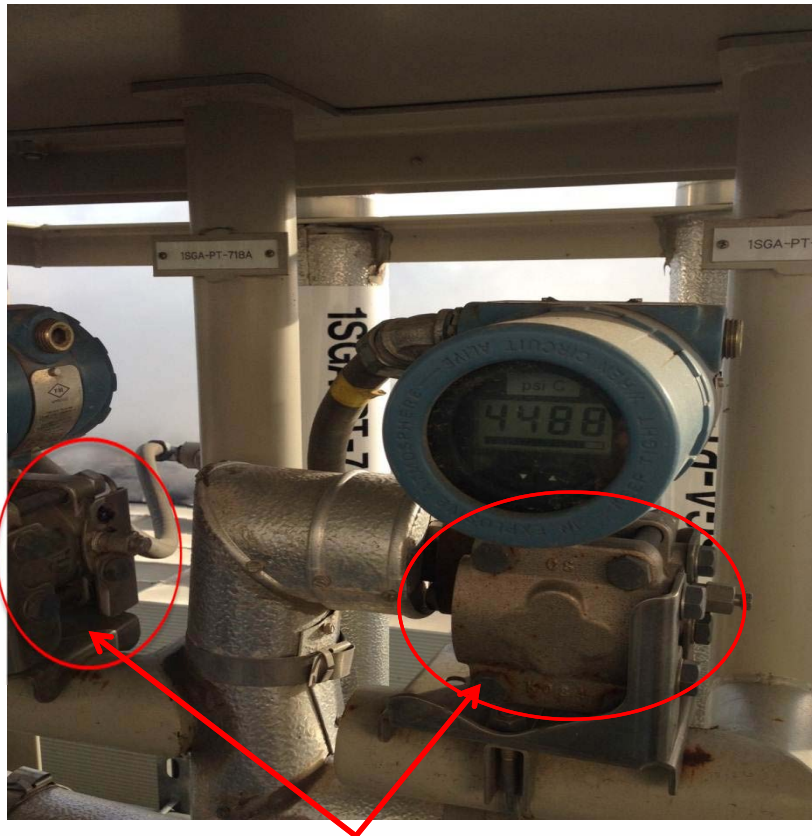
Spot check after 1/6/14 event. One phase failed to close resulting in auxiliary cooling water transmitter freezing, which tripped plant. Contactor scheduled for annual replacement.

Monitoring system installed by plant as a visual for the operators making rounds to verify three phases are energized on load side of three phase contactor. **Plant experienced no freezing equipment for winter 2014/2015.**



**Plant 4 – superheat steam transmitters that caused trip on 1/6/14 with boiler logic set to OR. Uninsulated transmitter manifolds.**

January 6, 2014 – lessons learned



Uninsulated transmitter manifolds

Mitigation for remainder of winter 2014



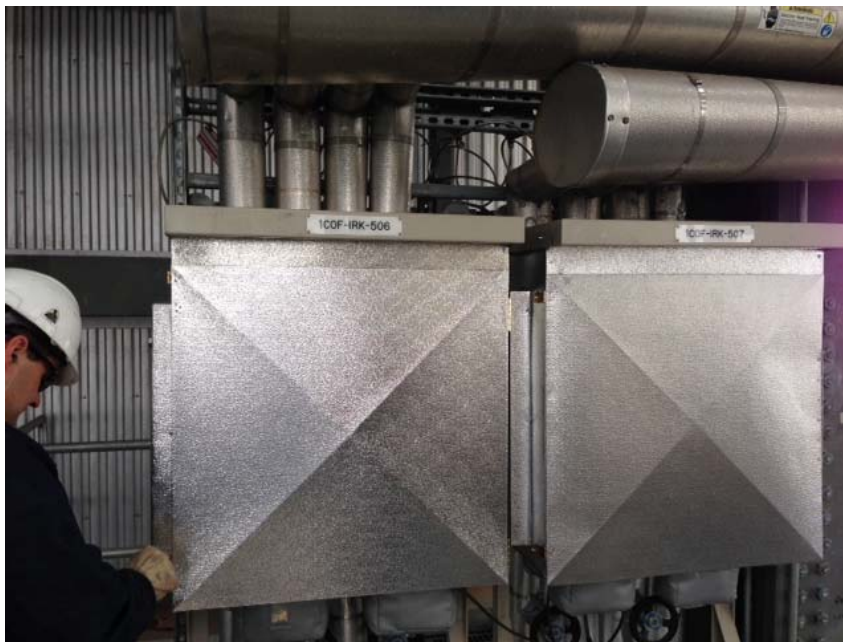
# Plant 4 (continued) superheat transmitters winter 2014/2015

- ✓ Relocated Transmitters
- ✓ New wind break
- ✓ Heated enclosure
- ✓ Transmitter manifolds are heat traced
- ✓ Boiler logic set to **AND** for transmitters





Plant 4 (continued) transmitters winter 2014/2015.  
Relocated, wind break, insulated and transmitter  
manifolds are heat traced.



Unit experienced no freezing equipment for winter  
2014/2015.

# Plant 5 – lessons learned

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Frozen equipment (**many of the same that occurred in 2/2011**)

2 – HP steam flow transmitters

1 – 1st stage pressure transmitter in steam turbine enclosure

1 – NOX steam transmitter sensing line

1 – LP drum pressure transmitter sensing line

1 – IP drum level control valve - water penetrating resulting in valve failing to regulate due to ice

LP Economizer vents lines

**Plant 5 - improvements winter 2014/2015: new heat trace smart panel, new heat trace, new critical sensing lines for transmitters.**



## Plant 5 - regulating valve improvements. Nineteen valves rebuilt with rain caps installed.

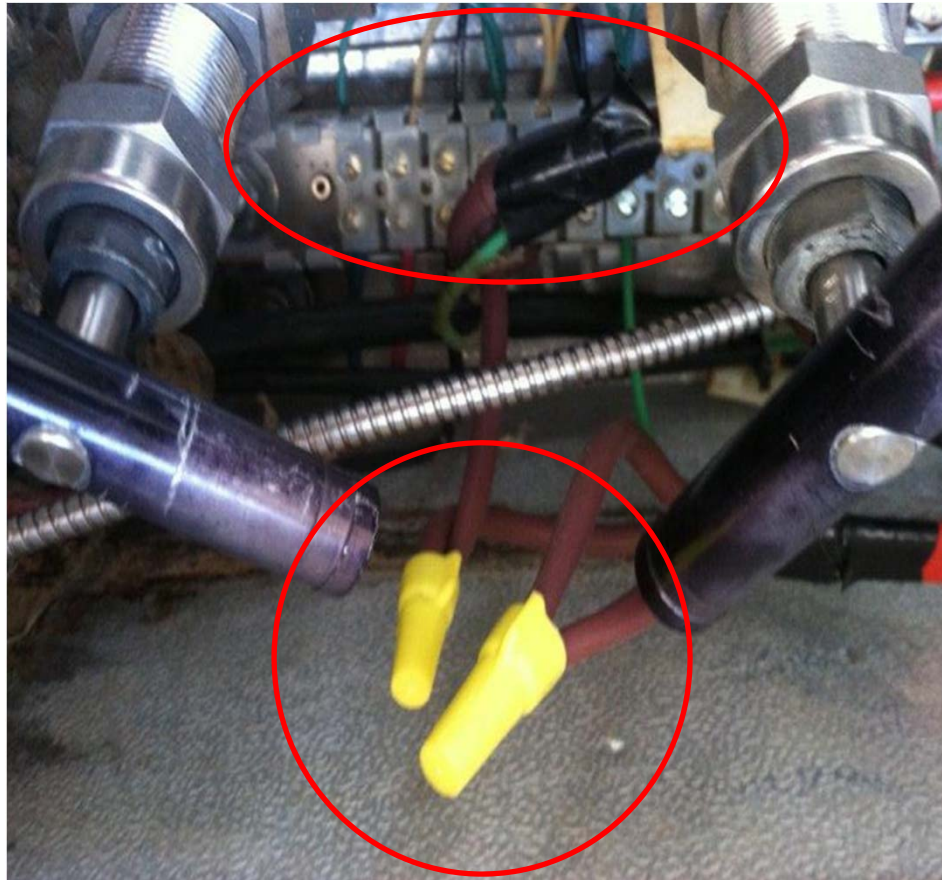
Inspection discovered valves with water that freeze up during extreme temperatures



Plant experienced no freezing equipment for winter 2014/2015



## Plant 6 - 1/6/14 unit trip. Contractor error resulting in heat trace not functioning – lessons learned



Drum level transmitter cabinet: Wires should have been connected on the terminal strip at the back of the box.

***Parallel*** constant wattage heat trace was connected in ***series***, not in ***parallel***.

Corrective action: Plant requires **contractor** to have a quality control program. Plant electrician verifies work is completed correctly by testing circuits for amperage.



### Root cause:

Snow and ice blocking the cooling air filters on the circulating pump motor #1 resulting in inadequate cooling of the stator windings. This resulted in a high temperature on the motor and a trip of the pump. When pump #1 tripped the resulting turbulence tripped pump #2 on high vibrations. This resulted in plant trip due to inadequate cooling of stator windings.

### Corrective action:

- ✓ **Added** physical inspection of the motor filters to plants cold weather rounds sheet.
- ✓ **Added** the motor temperature readings to the operator cold weather rounds.
- ✓ **Added** Spare filters to stores stock for the motors allowing for filter replacement if they start to show ice, or snow build-up.

**NOTE: First occurrence since plant was commissioned this is a lesson learned.**

### Plant Trip 2/25/15 – lesson learned



Plant experienced no other freezing equipment during the winter 2014/2015

## Weatherization plans, procedures and checklists

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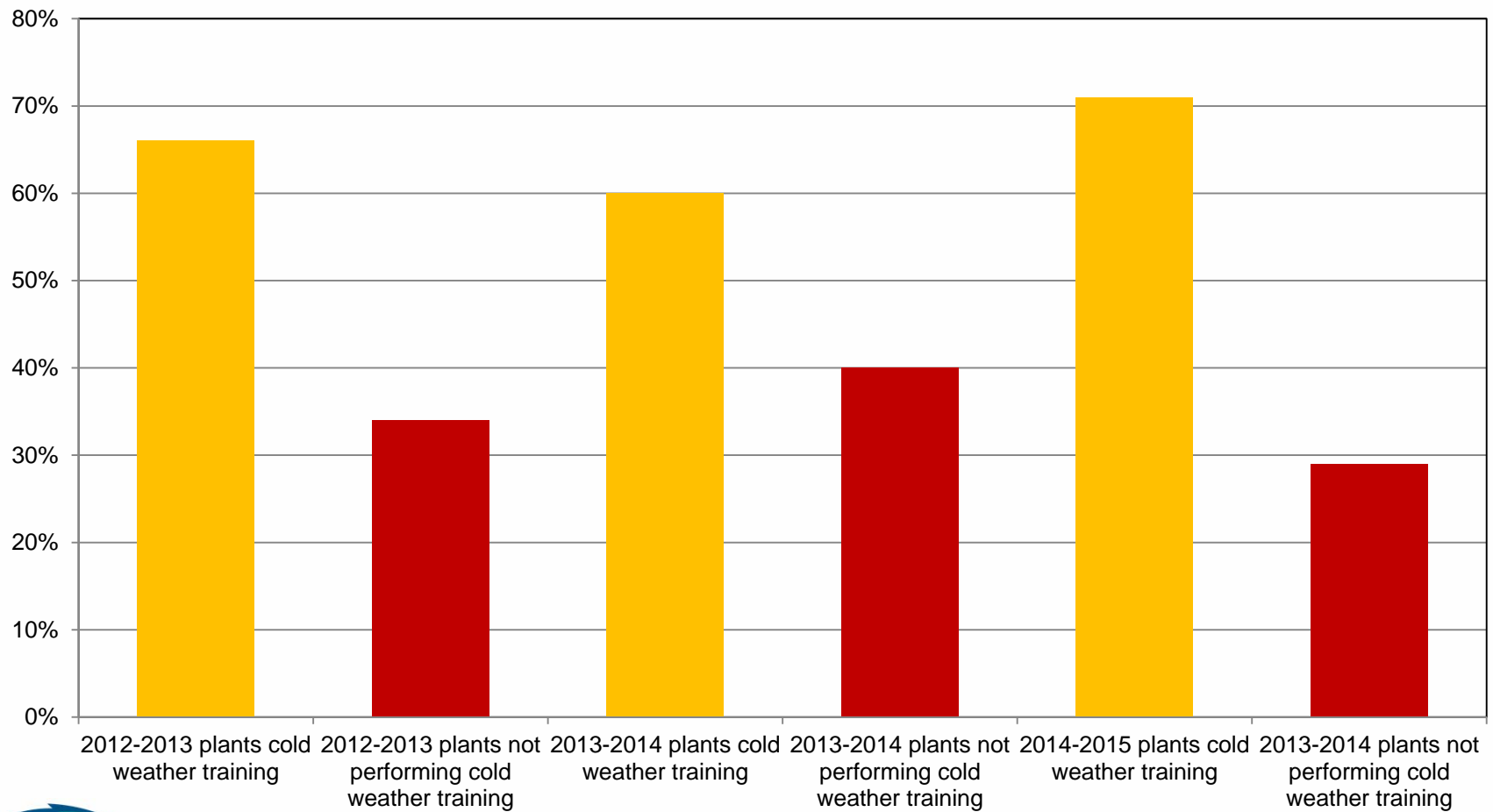
- ✓ Weatherization plans, procedures and checklists vary from detailed to general requirements.
- ✓ Plants that have detailed weatherization plans, procedures and checklists remained on line with minor problems during February 2011.
- ✓ Weatherization plans should be a living document with additions of any lessons learned.

## Instrument air maintenance and dryers

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- ✓ Most plants do maintenance bi annually.
- ✓ Moisture is removed by air dryers, dew point monitoring or periodic automatic blow downs.
- ✓ Instrument air drying is normally remotely alarmed.
- ✓ One plant during 2014-2015 winter experienced a 480V breaker failure that feeds block 2 instrument air compressor. The plant has failover capability for the other compressor and that failed to work as designed.

# Annual cold weather training



## Plant training and supplies needed for extreme cold weather event

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- ✓ *All plant personnel should train annually on extreme cold weather procedure.*
- ✓ 100% of the plants visited have cold weather supplies in inventory.

# ERCOT Recommendations

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- Continue or start annual audit of heat trace.
- Continue or start annual audit of insulation.
- Improve cold weather training focusing on the type of checks required on critical equipment.  
Recommended using NERC cold weather training as a possible guide.
- Capture lessons learned from previous season for inclusion in weatherization plan.
- Add cold weather supplies needed to weatherization plan.
- Improve details of weatherization plan.

# ERCOT Recommendations (continued)

- Develop a pre-winter checklist for preparation.
- Install thermometers on the outside of transmitter boxes to measure inside temperature.
- Install weatherproof boxes with thermometers on outside of boxes that monitors inside temperature.
- Work with Corporate to provide clarity for weatherization plan.
- Develop spreadsheet record of heat trace audit testing. Record design amperage by circuit (if known), amperage readings, identify critical circuits. Do so for each panel for comparison review. ERCOT is promoting this for companies that have many units as a standard.
- Find another reliable wind break other than a blue off the shelf tarp.

## Comments

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- Overall, ERCOT was pleased with winter 2014/2015 spot checks and plants are improving weatherization as evidenced by 2014/2015 winter weather on a few occasions.
- Purpose of this program is to ensure plants can operate to their design temperatures.
- Plants should be preparing for a one in twenty year event.
- ***It is ERCOT's expectation that for every cold weather event, some generation is going to experience freeze related derates or trips.***
- “do or do not; there is no try.” Yoda – Star Wars



## Scarcity Pricing

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System-wide Offer Cap increased to \$9000.00  
per MWh on June 1, 2015 (pursuant to  
PUCT Substantive Rule 25.505 (g)(6)(B)(iii))

***ERCOT would like to thank the generator owners, operators and plant staff for their cooperation and efforts on weatherization!***

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# Questions?