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Winter Weather Preparation

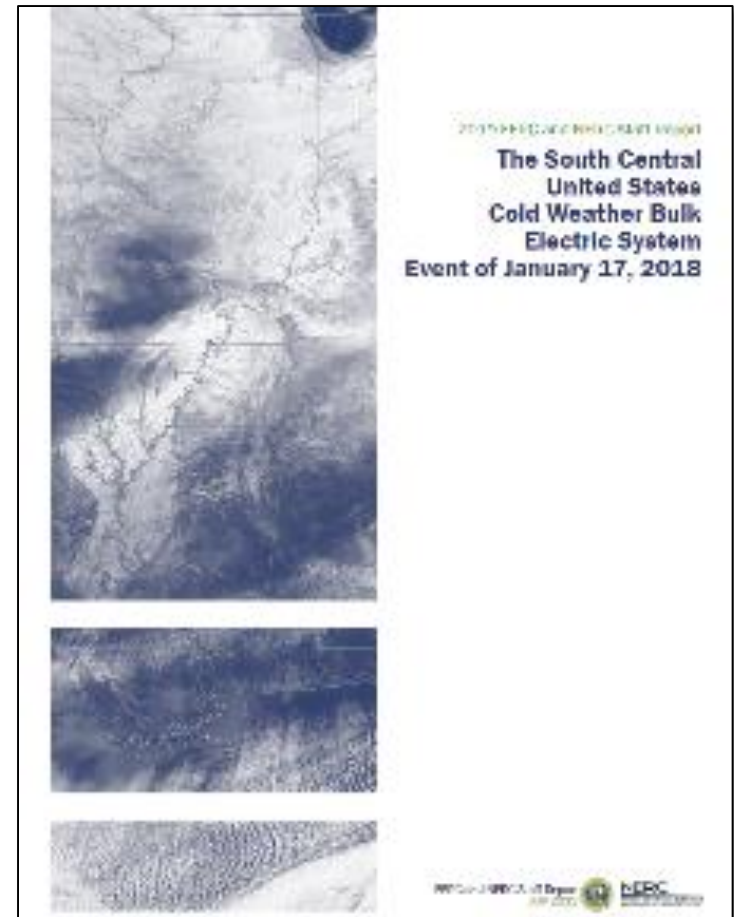
2019 Webinar

Richard Hackman, Sr. Event Analysis Advisor
September 5, 2019

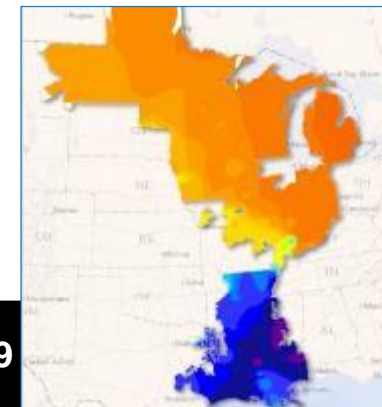
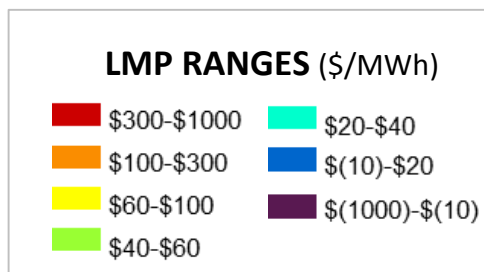
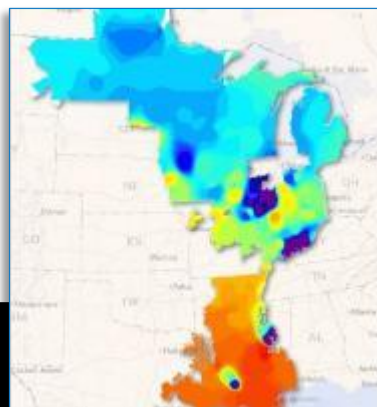
RELIABILITY | RESILIENCE | SECURITY



- January 30-31, 2019 – Extreme Cold Across North Central U.S.
- January 17, 2018 – Extreme Cold Across South Central U.S.
 - Note - There will be a webinar covering the FERC/NERC report on October 10, 2019 from 2:00-3:00 p.m. Eastern.



MISO North/Central region experienced extreme cold weather this January, similar to the extreme cold weather in the MISO South region last year



January 17, 2018
South Region

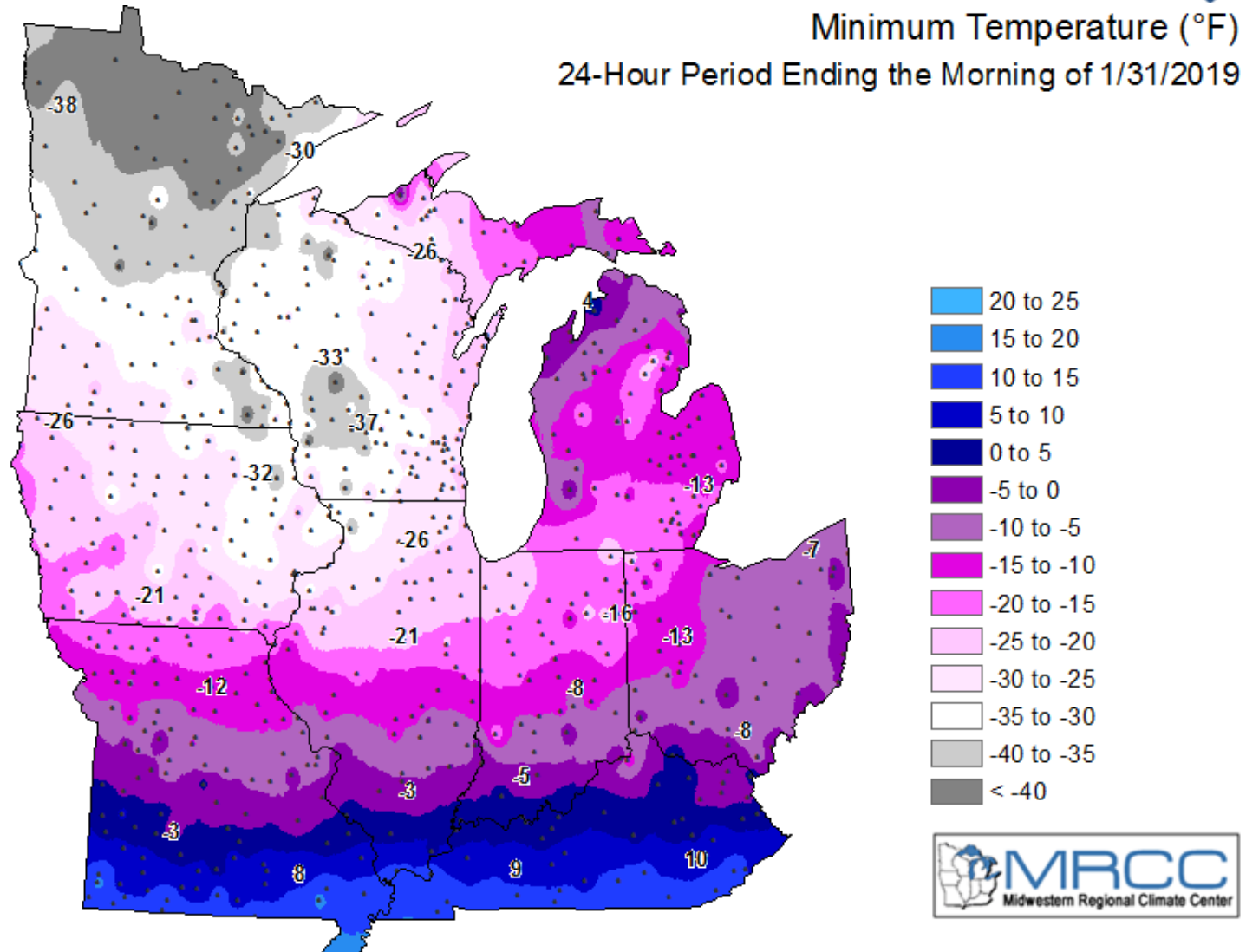
Minimum Temperature	13°F
System Peak Load	106 GW
Unplanned Outages	13 GW
Scheduled LMRs*	0.9 GW
Emergency Purchases	1.2 GW
RDT** Flow & Direction	3.9 GW N-S

January 30-31, 2019
North/Central Region

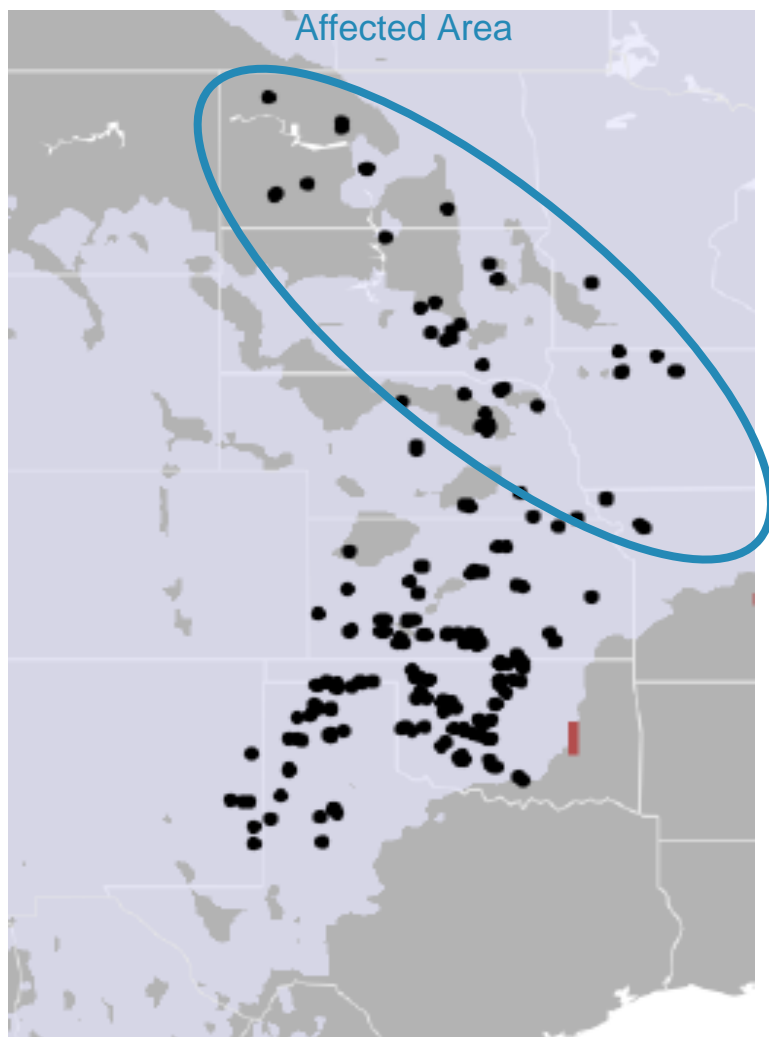
Minimum Temperature	-26°F
System Peak Load	101 GW
Unplanned Outages	29 GW
Scheduled LMRs*	2.5 GW
Emergency Purchases	Not Needed
RDT** Flow & Direction	2.2 GW S-N

*LMRs = Load Modifying Resources
**RDT = Regional Dispatch Transfer Maximum Unit Dispatch System

January 30-31, 2019 – Extreme Cold Across North Central U.S.



SPP Wind Farms (2011)



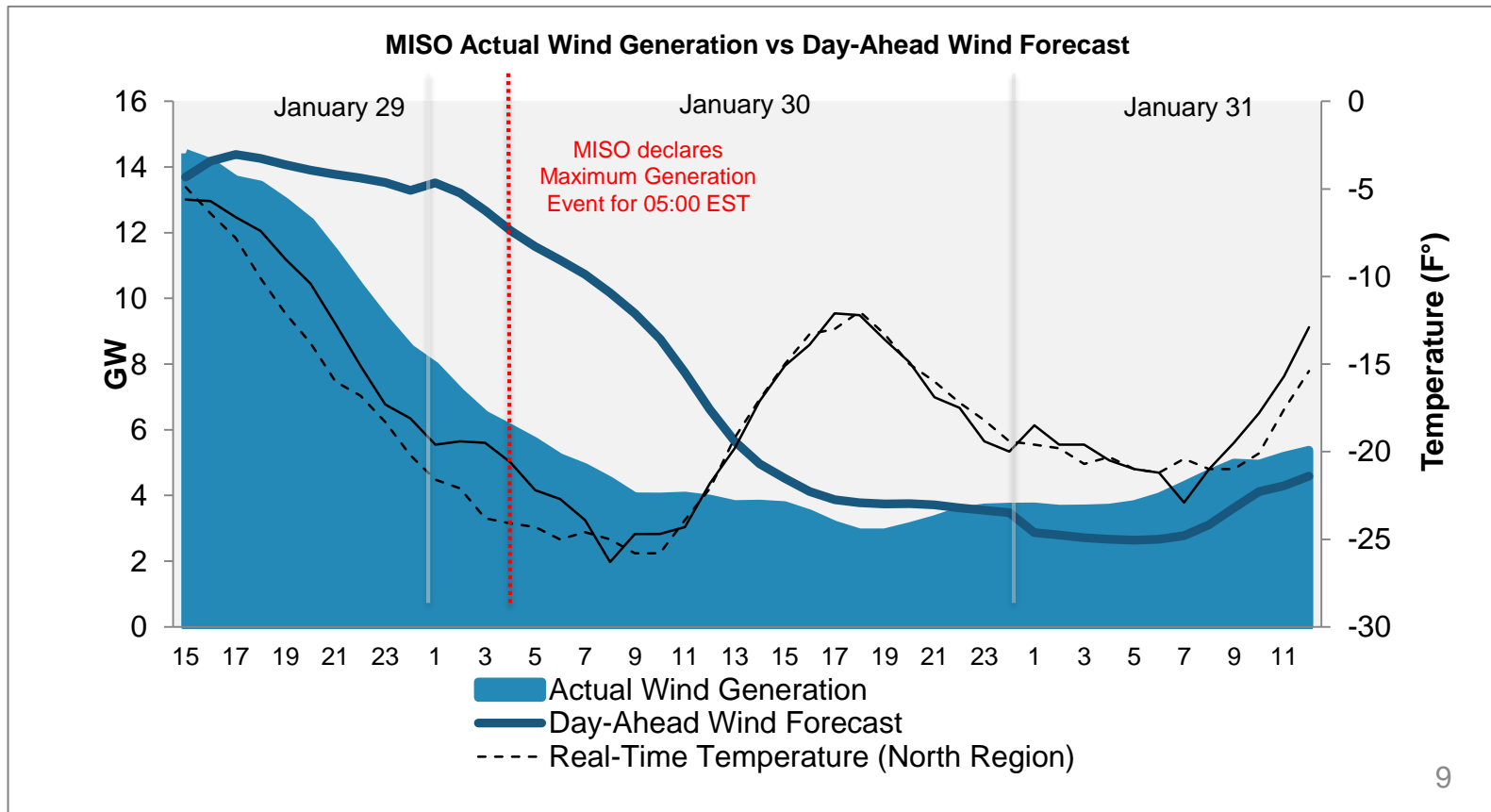
- **Temperature at which SPP Turbines Turn Off**
 - -40°C (-40°F) only 320MW are able to run
 - -30°C (-22°F) 10GW are able to run
 - -20°C (-4°F) 17GW are able to run
 - $>-10^{\circ}\text{C}$ ($+14^{\circ}\text{F}$) All 21.6GW are able to run
 - @ -10°C 1.6GW will shut down in SPP South, Texas/Oklahoma

- Some Wind Turbine temperature limits are based on greases and other lubricants, but these are generally specified for the expected temperature range the device should see in its location.
- Most Wind Turbines have both installed heaters and low temperature protective shutdown features.
- Below their shutdown temperature, Wind Turbines become load.
- Thumb rule - Roughly 2MW load for 100MW capacity

- Most of the more common inverters are able to operate down to -25°C (-13°F).
- Most can be exposed to temperatures down to -40°C (-40°F). Below that, damage will occur. The primary concern is the oil within large electrolytic capacitors freezes below -40°C .
- This means active measures must be taken to keep the inverters above -40°C to prevent damage, or above -25°C to operate. These measures include enclosures designed with heat and snow drift abatement for most of the U.S. and Canada.

- Typical uninterruptible power supplies (UPS) in support systems for wind turbines or other outdoor installations have somewhat more restrictive cold temperature limits than inverters do.
- They are generally limited by the battery technology used. Few function below -10°C ($+14^{\circ}\text{F}$), some cannot handle $<0^{\circ}\text{C}$ (32°F), and most are damaged below -25°C (-13°F).
- Cabinet heaters or other temperature controls are necessary support across most of the U.S. and Canada.

An earlier than expected drop in wind output increased insufficiency risk early on the morning of January 30 for MISO

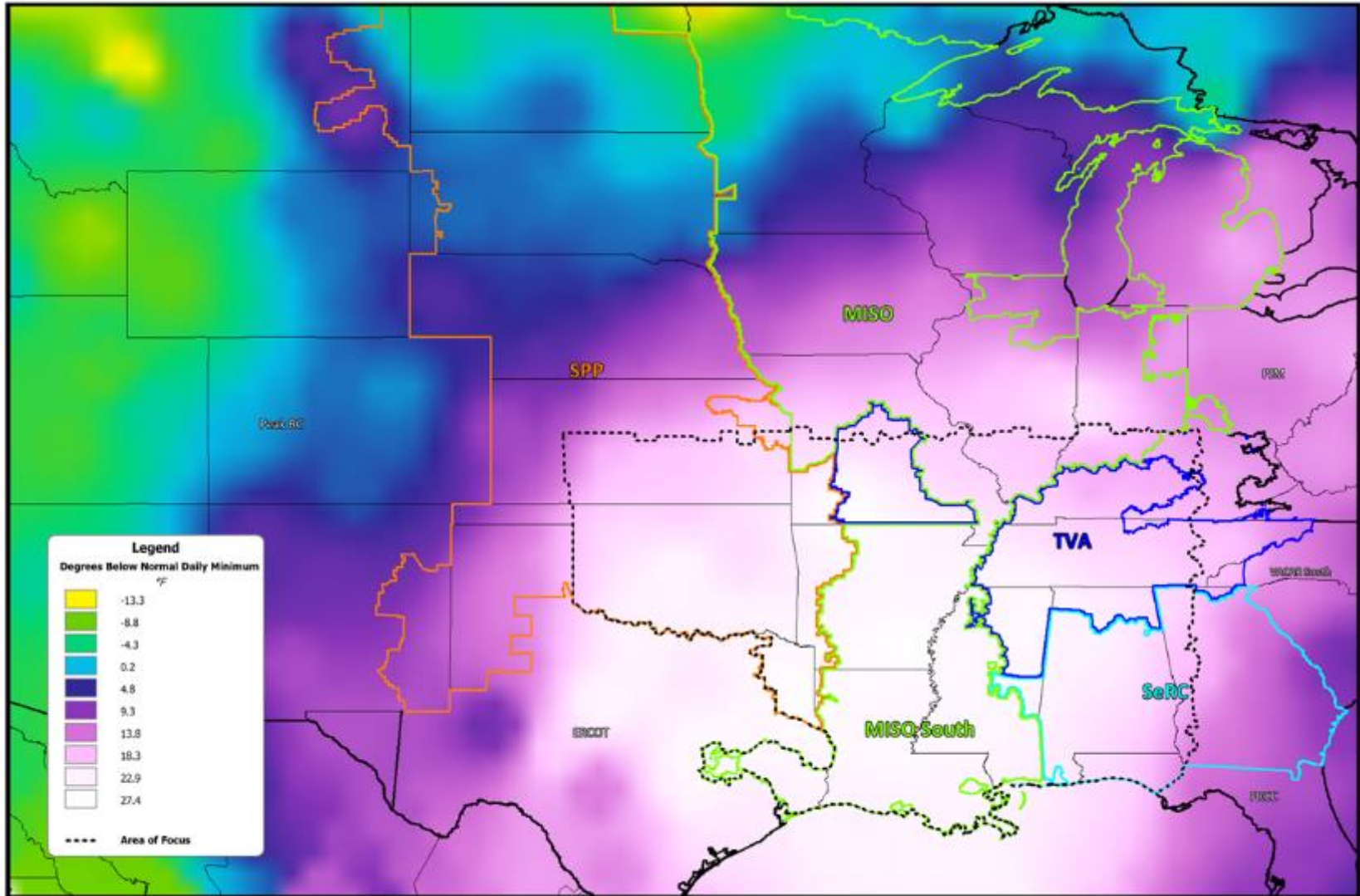


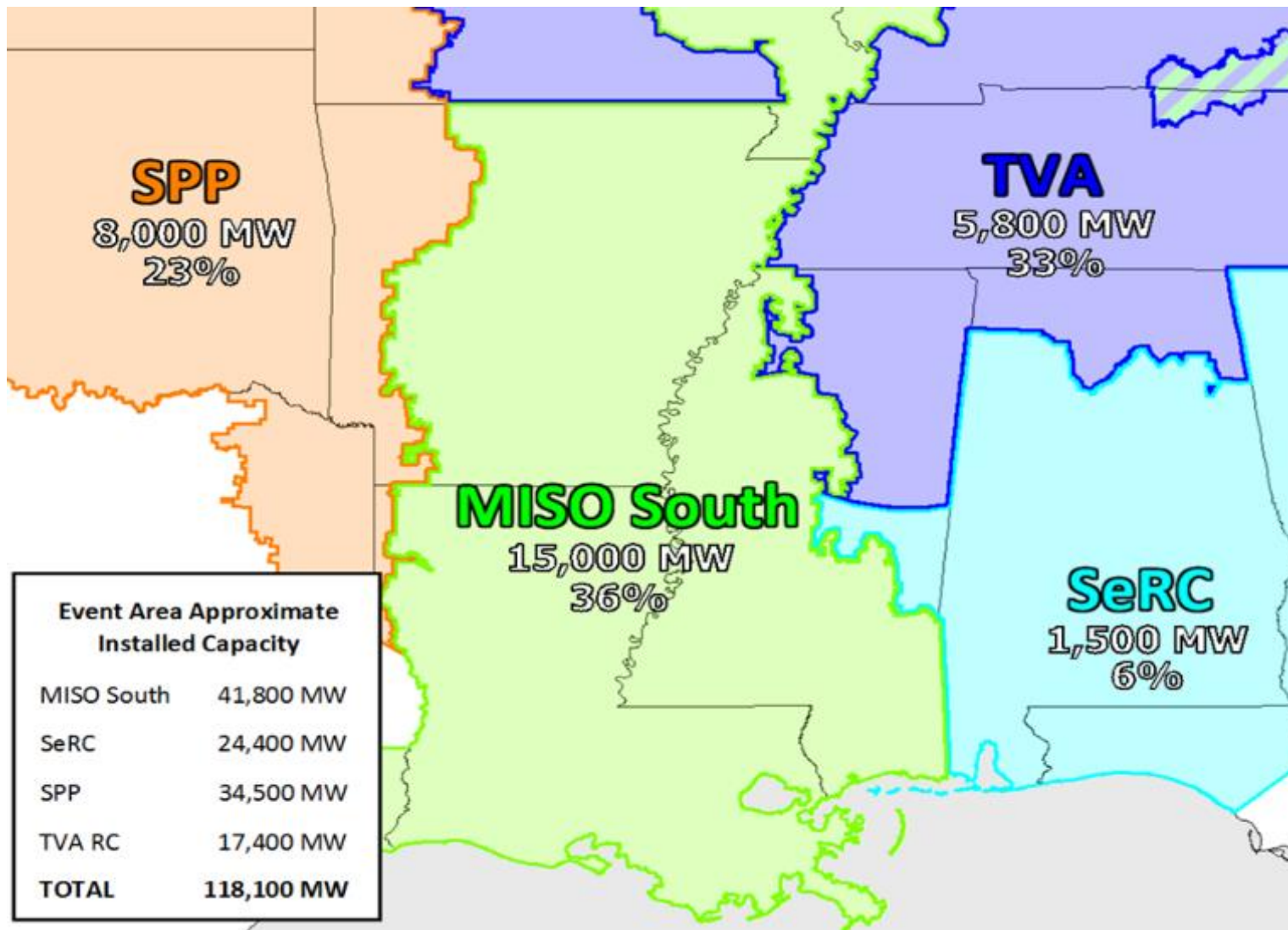
MISO North/Central Region Unplanned* Outages (GW)

	Coal	Gas	Wind	Other	Total
Installed Capacity	48.4	31.9	14.2	18.2	112.7
January 29	10.3 (21%)	6.3 (20%)	1.3 (9%)	2.2 (12%)	20.1 (18%)
January 30	10.3 (21%)	10.8 (34%)	4.0 (28%)	4.5 (25%)	29.6 (26%)
January 31	9.3 (19%)	11.9 (37%)	2.7 (19%)	5.0 (28%)	28.9 (26%)

*Unplanned = Forced plus derates

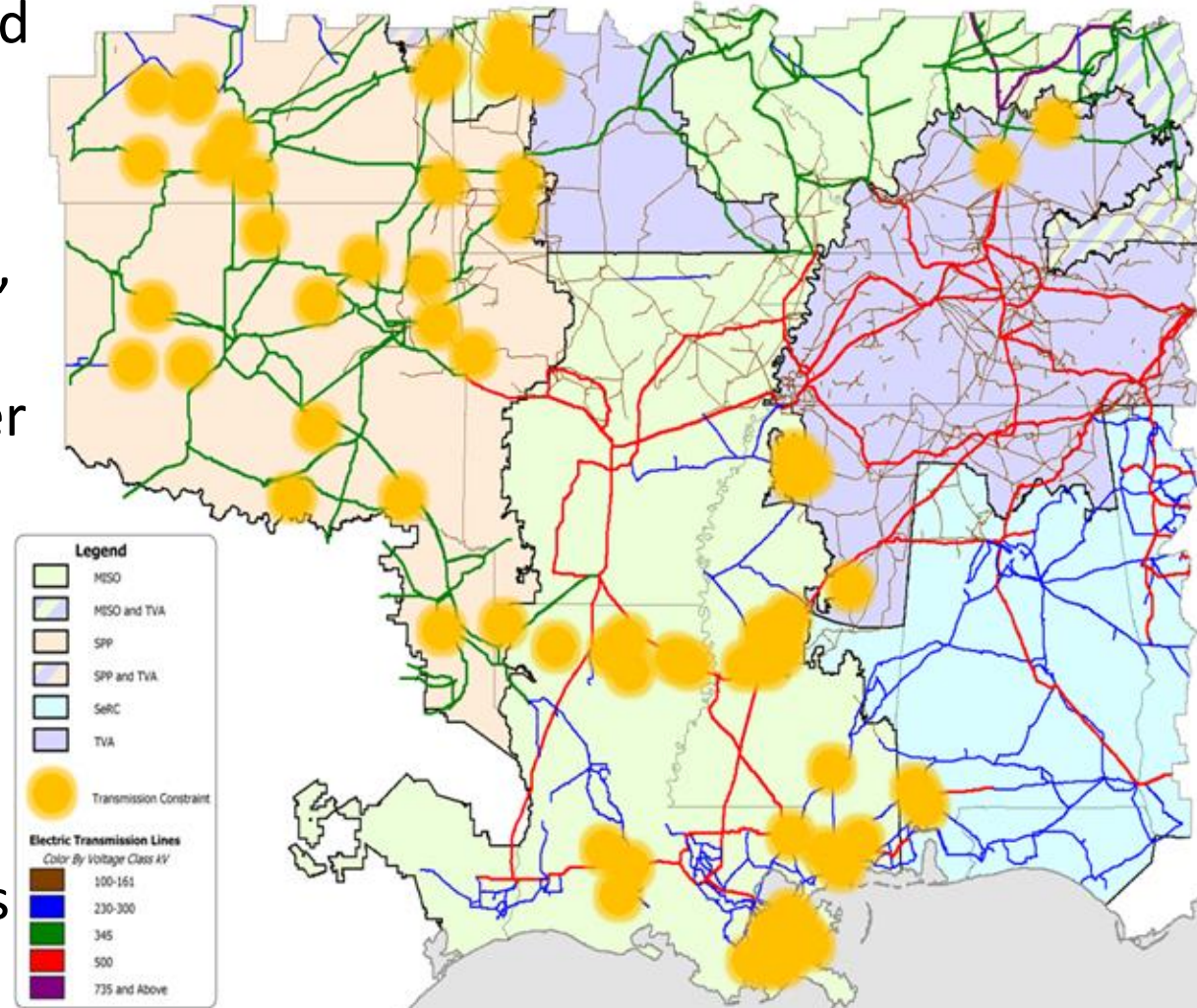
January 17, 2018 – Extreme Cold Across South Central U.S.



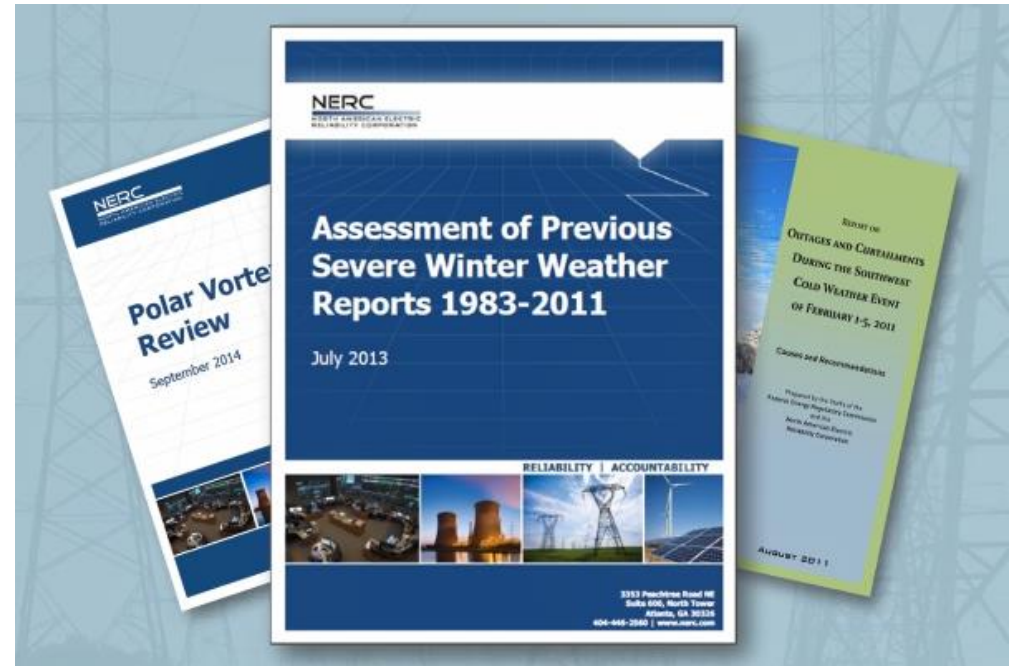


- As temperatures decreased, unplanned outages increased
- 44% of outages were directly attributed to, or likely related to, extreme cold weather
- Gas supply issues contributed to the event
- Frozen moisture in control air and instrumentation lines still occurs

Constrained Transmission Conditions



- One-third of Generator Owner/Operators who had outages/derates/failures to start did not have winterization procedures
- This should not be the case given the number of prior cold weather events that have been analyzed, lessons learned, and preventive actions reported to the industry.



<https://www.nerc.com/pa/rrm/Pages/Webinars.aspx>

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Webinars/Training and Outreach Videos

Webinars

Title/Summary	Webinar Date
2019 Webinars (3)	
2018 Webinars (6)	
2017 Webinars (6)	
2016 Webinars (3)	
2015 Webinars (6)	
2014 Webinars (6)	
2013 Webinars (4)	
2012 Webinars (1)	
(More Items...)	

Training and Outreach Videos

<https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx>



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Major Event Analysis Reports

Major Event Analysis Reports

- January 2018 South Central Cold Weather Event
- April and May 2018 Fault Induced Solar Photovoltaic Resource Interruption Disturbances Report
- September 2017 Hurricane Irma Event Analysis Report
- August 2017 Hurricane Harvey Event Analysis Report
- October 2017 Canyon 2 Fire Disturbance Report
- August 2016 1200 MW Fault Induced Solar Photovoltaic Resources Interruption Disturbance Report
- April 2015 Washington D.C. Area Low-Voltage Disturbance Event
- Cold Weather Training Materials
- January 2014 Polar Vortex Review
- October 2012 Hurricane Sandy Event Analysis Report
- October 2011 Northeast Snowstorm Event
- September 2011 Southwest Blackout Event
- February 2011 Southwest Cold Weather Event

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

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Lessons Learned

Disclaimer for Lessons Learned: These documents are not intended to establish new requirements or amend existing Reliability Standards. Compliance with Reliability Standards as they may be amended from time to time is required to meet requirements in NERC's Reliability Standards.

For a brief summary of the lessons learned, click on the link below. Guide.

Lessons Learned

Type	LL#
Lessons Learned 2019	(10)
Lessons Learned 2018	(15)
Lessons Learned 2017	(9)
Lessons Learned 2016	(13)
Lessons Learned 2015	(16)
Lessons Learned 2014	(19)
Lessons Learned 2013	(14)
Lessons Learned 2012	(18)
Lessons Learned 2011	(22)

Lesson Learned
Preparing Circuit Breakers for Operation in Cold Weather

Lesson Learned
Plant Operator Training to Prepare for Weather Event

Lesson Learned
Transmission Facilities and Winter Storm

Primary Interest Groups
Generator Owners (GO) | Generator Operators (GOP) | Transmission Owners (TO) | Transmission Operators (TOP)

Problem Statement
Unit 1 at a 1700 Mw plant was forced off line during a severe winter storm during a disconnect "B" phase switch.

Details
After a winter storm at a generating plant, the "B" phase of the plant switchyard. The Control Room was notified immediately and took the generator off line. It was found that the disconnect switch just inside the contact region. The disconnect switch was found to be in an open position. Once electricians removed the disconnect switch arm in the contact region, it was found that the disconnect switch arm, froze during the cold weather, causing the current carrying capabilities of the arm. This caused an arc.

Corrective Actions
To prevent recurrence, all three disconnect switch arms were replaced on the "B" phase connection as well as the insulators and the bottom corona ring. Each contact was replaced with a new contact. The insulators on the "B" phase transformer on the center pivot, which supports the switch arm, were replaced with new insulators. Research of available industry technical documentation was conducted. The manufacturer was contacted and reported that the manufacturer recommended drilling holes into the switch arm. The manufacturer recommended that the switch arm be replaced. The manufacturer was contacted and reported that the manufacturer recommended that the switch arm be replaced. The manufacturer recommended that the switch arm be replaced. Other disconnect switches but did not experience the same issues. They followed the manufacturer recommendations.

Lessons Learned
All plant and transmission electrical disconnect equipment should be inspected and maintained - especially in geographic areas not accustomed to cold weather.

Lesson Learned
Winter Storm Inlet Air Duct Icing

Lesson Learned
Wind Farm Winter Storm Issues

Lesson Learned
Plant Fuel Switching and Cold Weather

Lesson Learned
Plant Onsite Material and Personnel Needed for a Winter Weather Event

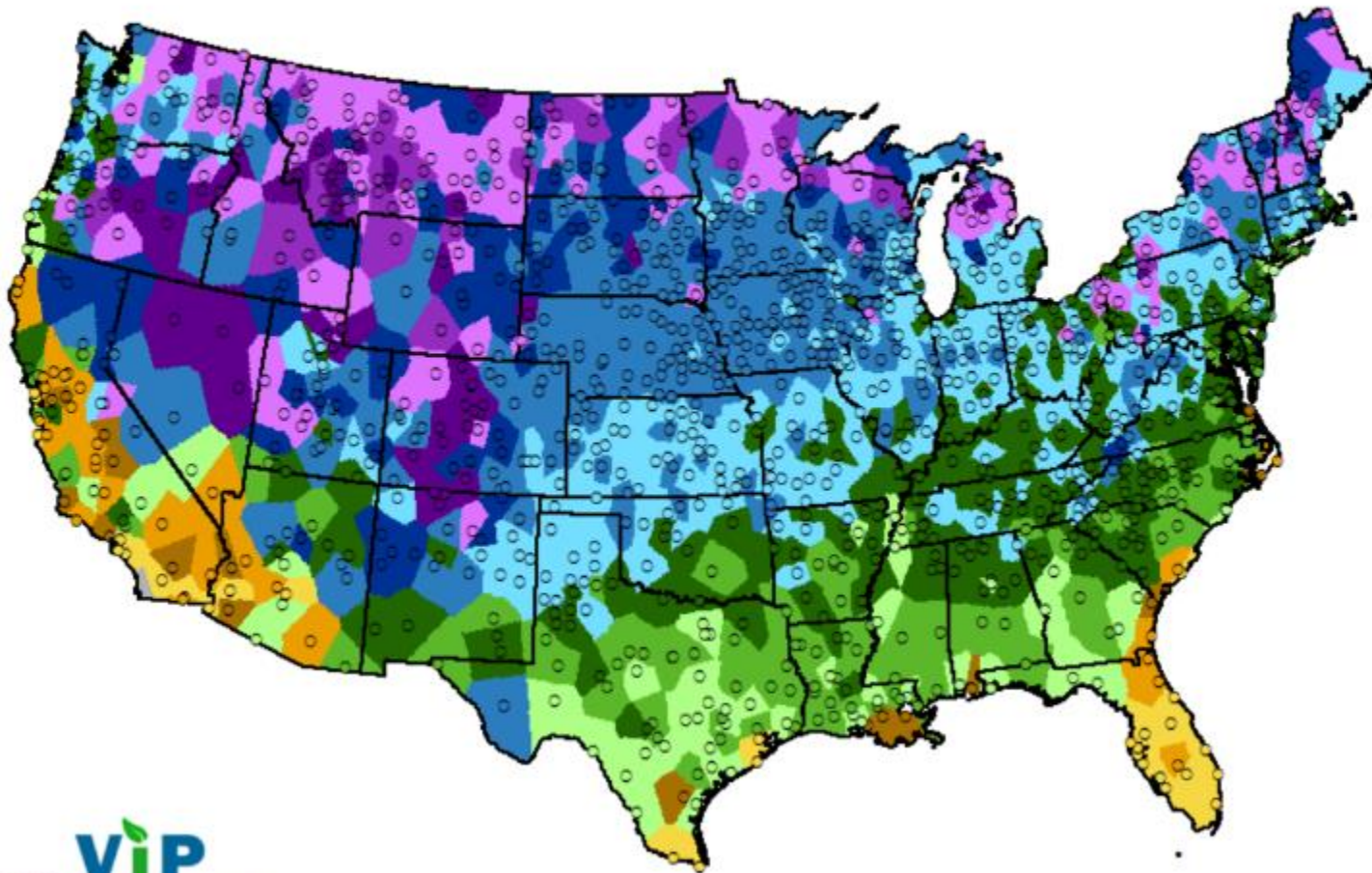
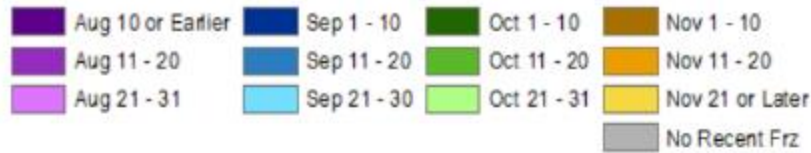
Primary Interest Groups
Generator Owners | Generator Operators

Problem Statement
A 700 Mw generating plant, despite having installed new freeze protection to maintain the plant's operability to 40 degrees F during 0 degrees F conditions, contributed to a BA having to implement load sheds because it could not keep generation online during 0 degrees F conditions because of critical components freezing.

Details
Before a cold weather event, the plant personnel discussed the forecast for the on-coming cold weather during plant staff meetings, advising everyone to remind their teams to prepare for the cold weather of longer duration than the plant had experienced before. Temporary enclosures were constructed in areas subject to wind. Portable heaters and tarps were placed where critical equipment, instrumentation and/or piping was located. The fuel level in the kerosene heaters was checked and fuel was added as needed. Heat tracing panels were checked and heat tracing was verified to be functional. A "tools down" order was communicated to all plant personnel to prevent any problems associated with non-emergency maintenance work. This order included no changes or tuning to be done on the plant control system. The "Work Force Disruption Policy" was initiated and essential maintenance and operations personnel were confirmed and scheduled for day and night shifts staying at the plant site to avoid delays.

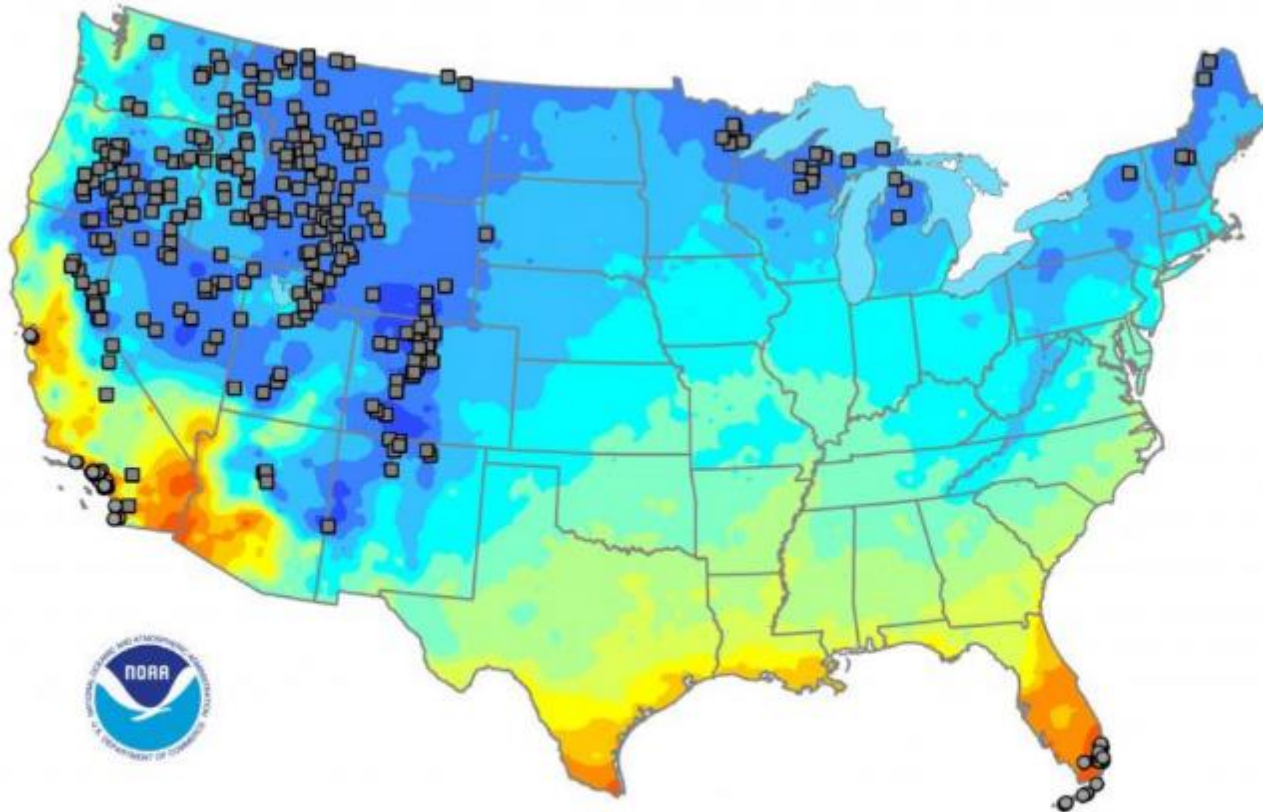
What is your Winterization Procedure Schedule Date?

Climatological Date of Earliest First 32°F Freeze
For the years from 1980-81 to 2009-10
Earliest freeze within the 30-year POR



Day of the Last Spring Freeze

from the 1981–2010 U.S. Climate Normals



- Too Cold to Compute
- Too Warm to Compute

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NERC Winter Reliability Assessment

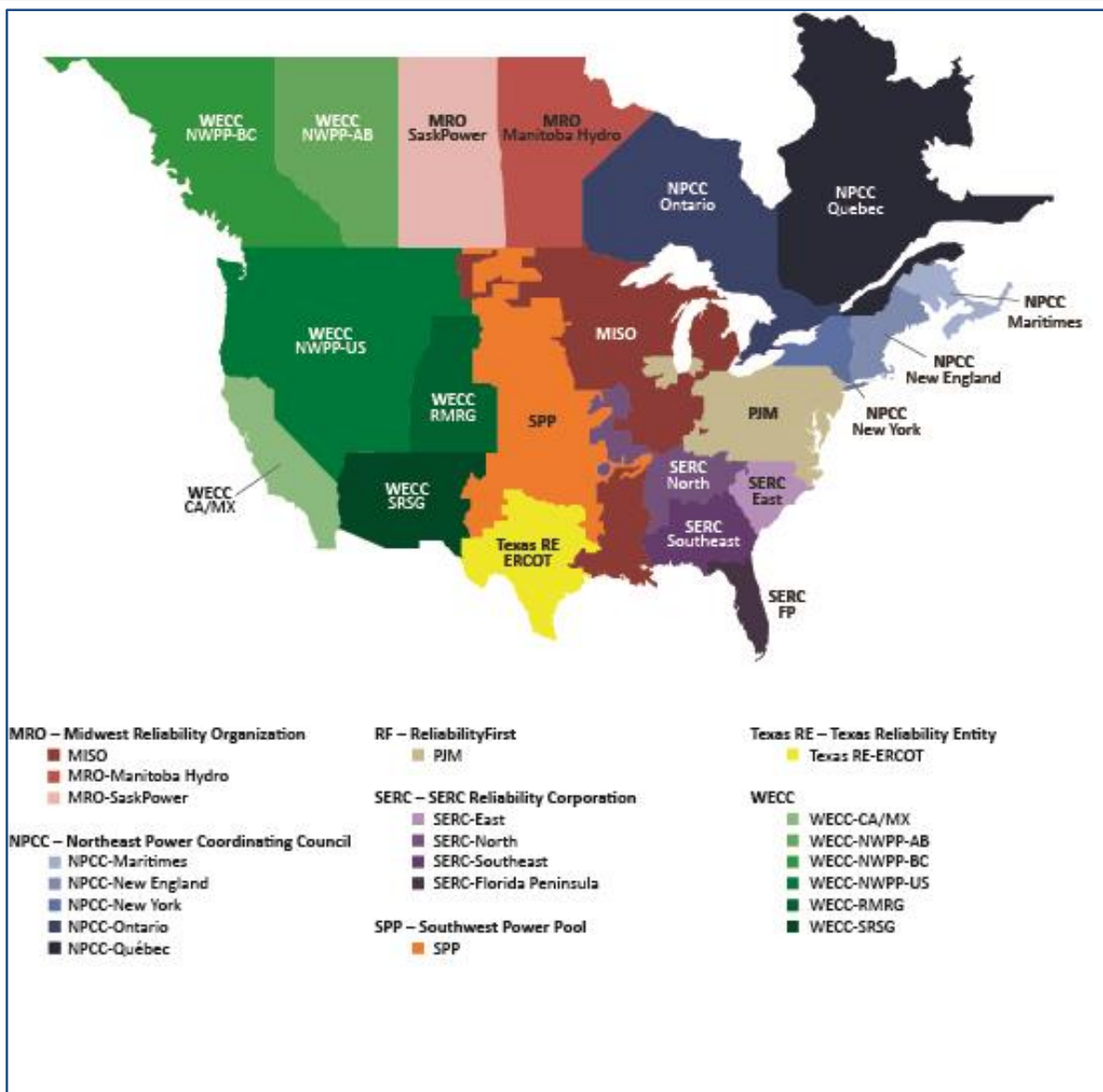
Mark Olson, Senior Engineer Reliability Assessments
Winter Readiness Webinar
September 5, 2019

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- NERC's Winter Reliability Assessment (WRA) examines potential regional resource deficiencies and operating reliability concerns
 - Describes industry preparations to manage seasonal risks
- Developed with the Reliability Assessment Subcommittee (RAS) and reviewed by the NERC technical committees
- Published annually

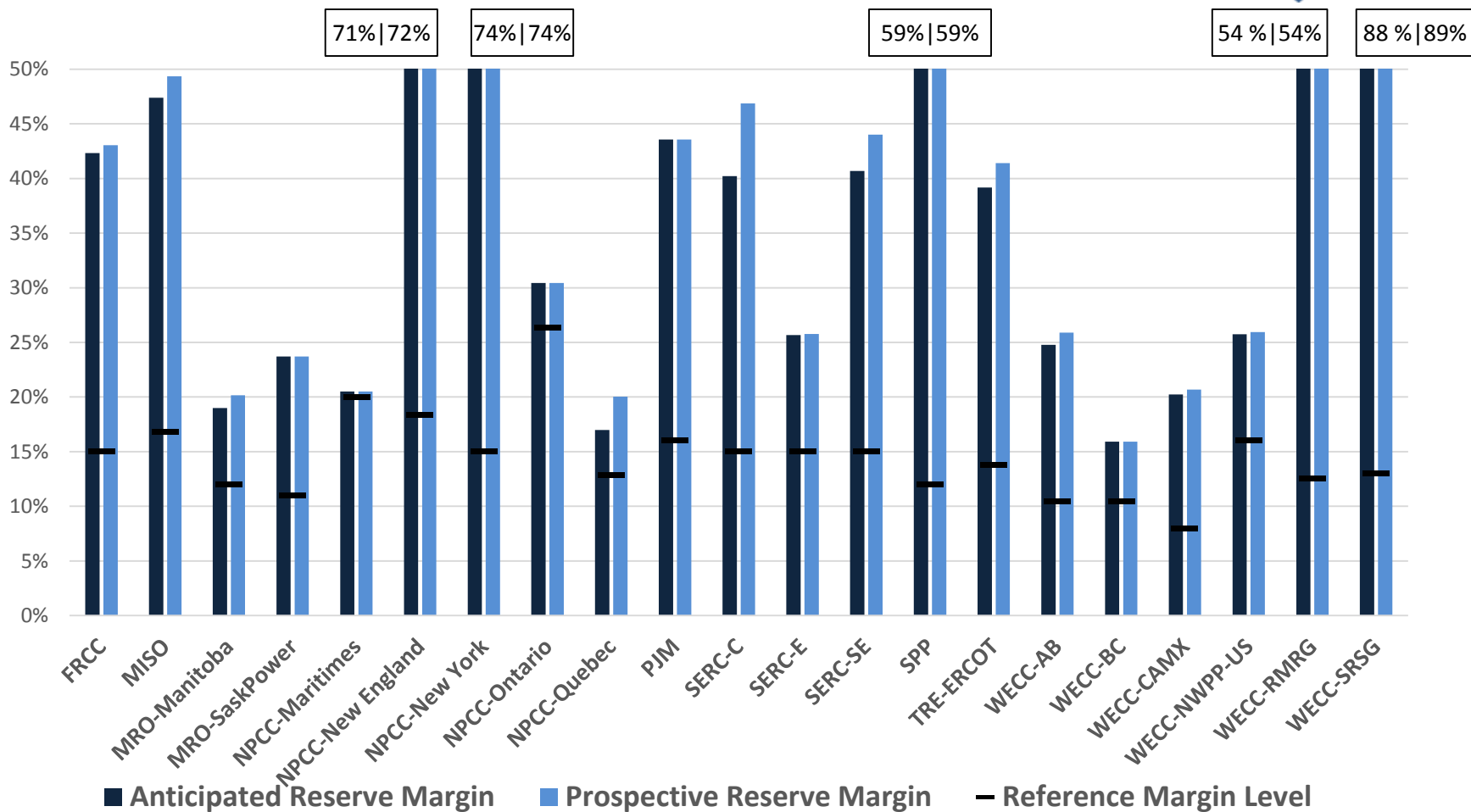




Released December 12, 2018

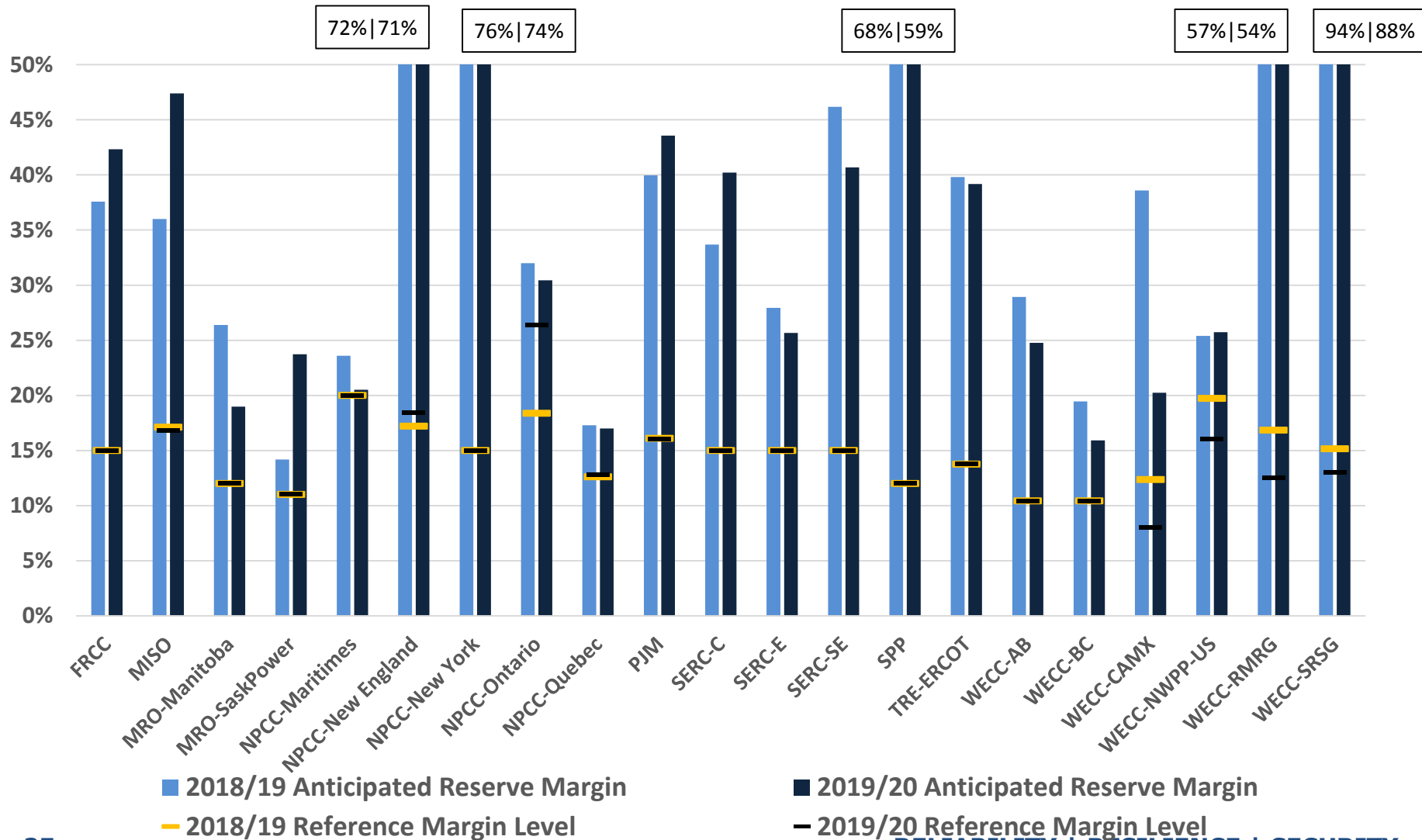
- All assessment areas had adequate resources for December 2018-19 winter season
- Incentives for generator performance in market areas are aimed at mitigating winter reliability risks
 - PJM Capacity Performance Initiative
 - ISO-NE Pay for Performance
- Entities are implementing processes and strategies to reduce risks of generator fuel supply issues
- Continuing natural gas storage and transportation limitations associated with Aliso Canyon could impact Southern California generators

2019-20 Winter Reserve Margins

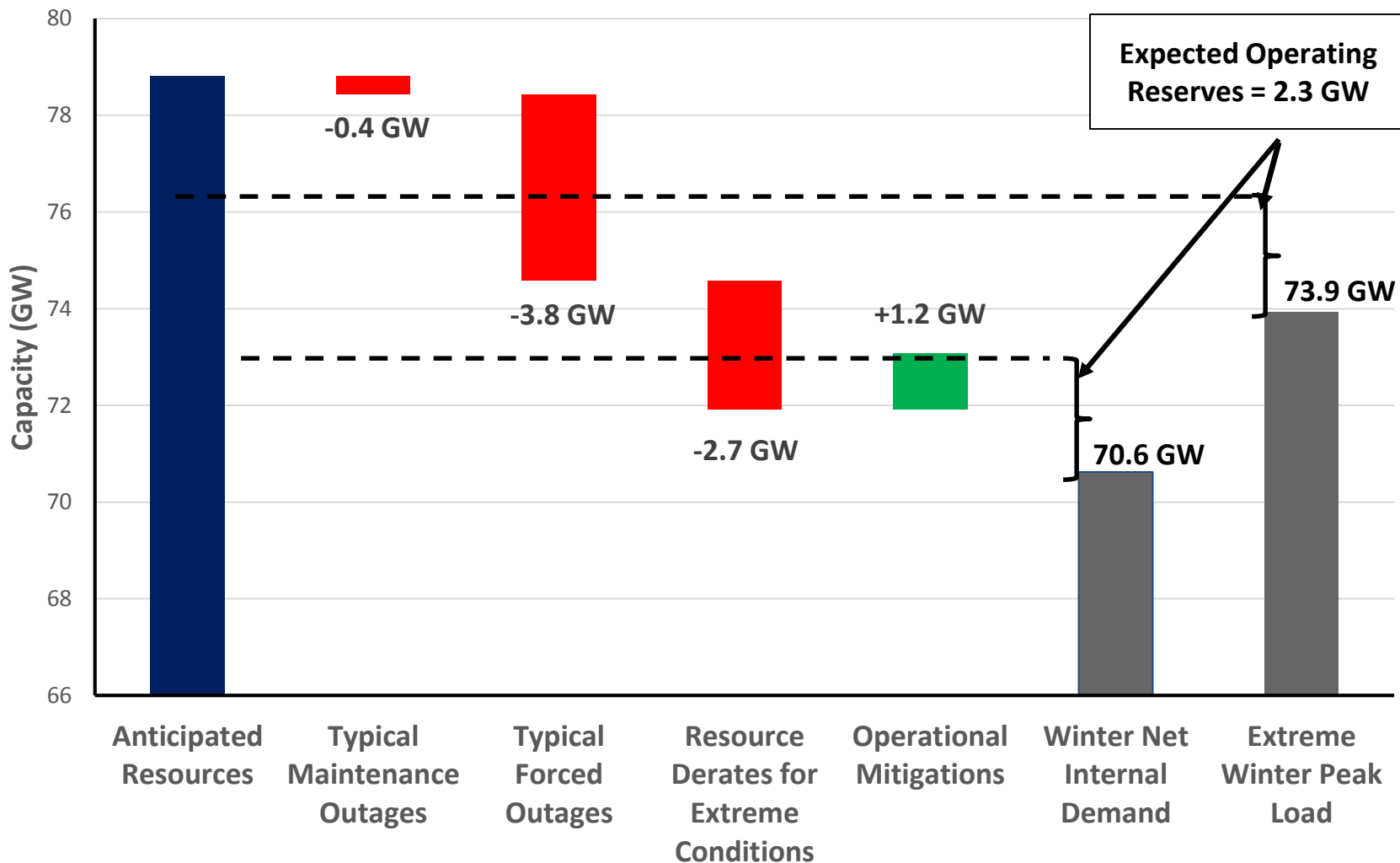


Preliminary Data Shows Capacity Resources are Adequate for Winter

Preliminary Reserve Margin Year-on-Year Comparison



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





Questions and Answers