

**NERC**

NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

# Extreme Winter Weather Events Instructor's Manual

October 2013

RELIABILITY | ACCOUNTABILITY



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# Table of Contents

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Table of Contents.....	2
Introduction.....	3
Course Overview.....	4
Course Organization.....	5
Course Coordination.....	6
Target Audience.....	7
Course Goal and Outcomes.....	8
Course Goal.....	8
Course Outcomes.....	8
Training Tools and Tips.....	9
Audiovisual Equipment Requirements.....	9
Maximize the Training.....	9
How Do I Customize Course?.....	9
Printed Materials prior to class.....	11
Housekeeping Items.....	12
The Parking Lot.....	12
After the Event.....	12
Presentation Deck.....	13
Icebreaker: Fact or Fiction.....	14
Icebreaker: Group Résumé.....	15
Slides.....	16

## Introduction

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While extreme cold weather events are not common in the Southwest, they do occur every few years. These events create significant impact in terms of dollars and human hardship. Many utilities have already undertaken improvements in light of their experiences during the February 1–5, 2011 event. The report makes a number of recommendations the task force believes are both reasonable economically and which would substantially reduce the risk of blackouts and natural gas curtailments during extreme cold weather in the Southwest. Those recommendations are highlighted in this training packet.

This document was created as a tool to assist in the delivery of the training for preparation for cold weather in non-traditional cold weather locations. This document provides a guide to recommendations, steps and process for the participants to review, discuss and apply to their respective entities.

## Course Overview

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The course is designed to highlight the event findings. From those findings recommendations have been made to improve reliability. Those recommendations are arranged as practical activities to generate discussion on targeted recommendations and how they can be implemented in respective entities.

## Course Organization

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Lesson #	Lesson Title & Description
1	Introduction – Objectives – Purpose – Audience
2	February 2011- Overview of the Severe Cold Weather Event
3	FERC & NERC
4	Precedents – Previous Events
5	Winter Readiness
6	Elements of Winter Weather Preparations
7	Lessons Learned
8	Question & Answer / Supplemental Photos

## Course Coordination

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Each entity will be responsible for the coordination and delivery of courses in their local geography.

This includes:

- Schedule and confirm times for instructors and training delivery.
- Room preparation and set-up
- Review course materials and create necessary handouts
- Create and retain sign-in sheets
- If continued education hours (CEH) are sought:
  - Prepare Individual Learning Activities (ILA) with added training materials
  - Enhance content with local materials
  - Present to NERC for verification and approval of training CEH

## Target Audience

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It is in the public's interest for NERC to develop guidelines that are useful for maintaining and enhancing the reliability of the Bulk Electric System (BES).

This presentation provides suggested guidance on preparations for cold weather events for BES users, owners, and operators according to each entity's circumstances.

# Course Goal and Outcomes

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## Course Goal

- Provide timely, relevant information to assist registered entities prepare for extreme winter weather events.
- Identify key outputs and causes that led to significant loss of capacity.
- Outline importance of maintaining thorough winterization practices.
  - February 2011 cold weather event
  - Comparison between 1989 and 2011 events
- Discuss guidelines for winter weather preparedness.
- Prevent future events related to extreme winter weather.

## Course Outcomes

At the conclusion of this session, attendees will be able to:

- Identify the contributing factors that caused the event and the consequences, as described in the event report.
- Discuss potential cold weather vulnerabilities in their respective work environments.
- Identify preventative actions that can be taken when faced with infrequent cold weather disturbances.

# Training Tools and Tips

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## Audiovisual Equipment Requirements

Visual aids for this course consist of PowerPoint slides and participant handouts.

The following audiovisual equipment is necessary for delivery of this course:

- LCD projector compatible with a notebook computer and cables for proper connection (e.g., InFocus or similar make)
- Electronic remote device to advance slides in PowerPoint presentation, if available
- Projection screen or smooth wall surface
- Flip chart with markers
- Large black markers for participant tent cards (at least one for every two participants should be placed at their workspace)
- Yellow sticky index cards for “Parking Lot” questions

## Maximize the Training

Understanding that not all individuals presenting this course are experienced trainers. Listed below are some general guidelines on how to improve the delivery of this course. These tips should help to improve the learner experience and make for a more energized session.

- **Make it customized.** By tailoring the course to your current processes, the participants will find the information more relevant and become more engaged.
  - Use examples, case studies, and stories that are relevant to the entity.
  - Identify whether your participants work in different areas or work together in the same departments. Tailor your approach to suite your audience.
  - Different people learn in different ways, so use different types of activities to balance it all out. (For example, some people learn by reading, while others learn by talking about it, while still others need a hands-on approach)
    - This packet is designed from some lecture, some open discussion and there are 5 practical activities that should lead to group discussion.
- **Make it relevant.** Participants are much more receptive to learning if they understand why they are learning and how they can apply it in their daily lives. Most importantly, they want to know how it will benefit them and make their lives easier. Take every opportunity to tie what you are teaching back to real life experiences and work activities.

## How Do I Customize Course?

Customizing your course is easy. To edit text, just click and type as you would with any document. This is particularly convenient if you want to add customized statistics for your region, or special examples for your audience. Also it is recommended that where necessary, add additional information. You can use all of your word processing and other features, including text formatting and editing tools. The training presentation will remain in PowerPoint form and the instructor notes in Word.

### Optional:

Each of the practical activities has been taken directly from the report. To make the training more impactful and relevant, it is recommended that the instructor incorporate materials from their respective entity to be reviewed and discussed during the practical activities. By using local procedures and process participants will be able to see where there are opportunities for improvement and areas of strength.

**Instructor: Presentation Requirements**

**Before the Training Event: Confirm the training dates, location, and number of participants.  
(For a new instructor – 20-25 participants should be maximum)**

**Day of training event**

- Ensure you have the following materials:
  - Instructor guide, one copy for each instructor
  - PowerPoint presentation
  - Participant workbook (Practical Activities 1-5)
  - Attendance sign-in sheets
  - A computer loaded with PowerPoint capabilities
  - An LCD projector
  - Flip chart
  - Large markers
  - Index sized post-it notes for “Parking Lot”
  - Cables necessary to connect projector to computer
  - Learning Assessment (If CEH hours are being sought)
  - Course Evaluation – link will be provided by NERC
    - Review and study the instructor guide, PowerPoint presentation, and any local documentation pertaining to the materials, the activities and local procedures.
- Prepare the agenda (below) on a PowerPoint slide or flip chart page. Review at the kick-off of the training event. A good training habit is to write the agenda on a sheet of flip chart paper and “check-off” segments as they are completed.

<b>Agenda</b>	
<b>Lesson #</b>	<b>Lesson Title &amp; Description</b>
1	Introduction – Objectives – Purpose – Audience
2	February 2011 – Overview of the Severe Cold Weather Event
3	FERC & NERC
4	Precedents – Previous Events
5	Winter Readiness
6	Elements of Winter Weather Preparations
7	Lessons Learned
8	Question & Answer / Supplemental Photos
9	Wrap-up / Q&A
10	Course Review and Assessment
11	Evaluation
<b>Breaks as appropriate</b>	

- Prepare the following ground rules on a flip chart page. (Cover the ground rules with the flip chart pad's cover or a blank flip chart page, and leave it covered until you review it during the training event. Then post it on the wall so it is visible during the entire event.) If time permits, solicit the ground rules from the participants and write them in class.
  - Ground Rules
    - Participate.
    - Be on time.
    - Stay on task.
    - Share responsibility for training.
    - Listen when others talk.
    - Respect the opinions and attitudes of others.
    - Place cell phones on vibrate/if you must take a call, step outside
    - Use flip chart parking lot.
- Ensure the room is set-up properly (i.e., tables and chairs are arranged to maximize interaction, projectors do not block participants' lines of sight, flip charts are convenient to you and visible to participants, etc.).
- Test the equipment.
- Arrange materials so they are convenient for you and the participants. Ensure each participant's place has:
  - One copy of the participant workbook
  - One name tent – optional
  - Index sized post-It stickers placed around tables for easy access

#### Printed Materials prior to class

- Participant workbook with the practical activities 1-5
- Sign in sheet(s)
- Quiz/Assessment
- Few Copies of the **“Report on Outages and Curtailments During the Southwest Cold Weather Event of February 1-5, 2011”**
- Applicable Lessons Learned
- Reliability Guideline:
  - Winter Weather Readiness – Current Industry Practices w/ Attachment 1
- FERC/NERC Recommendations (26 Electrical and 6 Gas)

#### Instructor Reminders

- Arrive early. Give yourself plenty of time to get organized.
- Circulate the attendance sign-in sheet each session. Be sure all participants sign-in. Start on time and stay on track. Always start on time, even if only one participant is in the room. Keep exercises within their time limits. End discussions when they cease to be productive. Lead participants away from digressions and tangents and back to the lesson - if necessary recommend a topic for the “Parking Lot” to discuss later.
- Be available during breaks and after class for any follow-up or clarifying questions.

- Monitor participants during the activities. Walk among groups in class while they work on their activities, and answer questions and offer guidance as appropriate. Ensure participants are on track as they work. Give constructive feedback during the presentations and discussions.
- Review Questions: Review the content of each lesson throughout the course to reinforce the learning outcomes for that lesson and to connect to upcoming material. Try to avoid YES or NO questions and try to use open-ended questions to draw participants into the material.
  - Sample review questions are available in the Instructor's guide; however, you can also develop additional questions, as appropriate. Make sure all questions directly relate to and support the learning outcomes.

**Tips:**

Be sure to cover the topics below at the start of each class:

**Housekeeping Items**

Take a few moments to cover basic housekeeping items:

- Let participants know where they can find bathrooms, break facilities, and fire exits.
- Ask participants to turn off their cell phones or at least turn them to vibrate. If they must take a call, request that they do it outside.
- Take this time to encourage the group to ask questions and make this an interactive workshop.

**The Parking Lot**

Explain the concept of the Parking Lot to participants.

- The Parking Lot is a visible place where you will “park” ideas that arise which are not on the agenda, may be off topic, or are better addressed outside of the training session.
  - In this instance have the participant place the topic/concern on the index sized sticky note and place in the parking lot for review and or response later.
- At the end of the session, will review parked ideas and follow up, or make suggestions for participants’ own investigation once back at work.

**Suggestions for the instructor:**

- If you are working with a large group of participants, you may wish to nominate a scribe to park items as you are facilitating.
- Items noted on the Parking Lot can be useful to you later as you plan future training sessions.
- For any item that you committed to “finding” an answer or response, make sure you follow-up after the conclusion of the class. Recommended sending the response to the entire group attending the session.

**After the Event**

Have participants complete Learning Assessments and Course Evaluations. Collect the assessments and evaluations for your records. Also, provide a link to the online survey that will feed back to the NERC data base.

# Presentation Deck

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## Review Questions/Examples:

- Identify the contributing factors that caused the event, as described in the event report.
  - List the weather conditions that contributed to the loss of generation during the February 2011 SW cold weather event.
  - Approximately how many generating units and how much load was shed as a result of cold weather?
  - Explain why previous experience with severe cold weather did not help prevent the loss of generation experienced during the February 2011 SW cold weather event.
  - Why did cold weather have such a significant impact on so many generating units during the February 2011 event?
- Discuss potential *threats* in their respective work environments.
  - List typical generating unit equipment or components that can be affected by cold weather that contributed to reduced generation.
  - What components at stations in your system could be susceptible to cold weather effects?
  - Discuss how your system could be affected by a period of unusually cold weather.
  - What are some of the key lessons learned from this event?
  - What areas of your facility are most susceptible to cold weather?
- Describe programmatic actions to prevent such occurrences from taking place in the future at their facility using local procedures.
  - What processes are in place at your facility to prevent adverse affects of cold weather?
  - What activities or programs does your facility use to ensure it is ready for the cold weather season?
  - Describe the main components of the Cold Weather Reliability Guideline.
- Identify preventative actions that can be taken when faced with a cold weather disturbance.
  - You hear on local news forecast that three days from now your area will experience three days with very windy conditions and maximum temps of 28 degrees (F). What actions would your facility take to prepare? (Your normal lowest temperature is typically 42 degrees).
  - What are you or your crew's responsibilities for an impending cold weather event?
  - Identify key locations and components to check for impending cold weather protection requirements.
- Organizational Ideas:
  - What communications/reports should be made within our system?
  - What coordination is appropriate to ensure system reliability?

# Icebreaker: Fact or Fiction

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## **Purpose**

To help participants get acquainted and start talking to each other.

## **Materials Required**

None

## **Preparation**

None

## **Activity**

If larger than 20 participants - Divide the participants into groups of three or four (depending on the number of participants).

Explain to the groups that each person must write down three statements about themselves. Two of these statements must be fact and one fiction. Each participant will have a chance to present his / her statements to the group. It is up to the group to pick which of the three statements is not true.

Bring the smaller groups together to form the larger group and ask three or four participants to share their statements and have the class select the statement that is false.

This teambuilding icebreaker takes 10 – 15 minutes, depending on the number of groups.

## **Debrief**

There are many fact and also fictions around properly preparing for cold weather. This session is designed to illustrate some of identified ways in which we can successfully do so and increase reliability.

# Icebreaker: Group Résumé

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## **Purpose**

To help participants get acquainted and start talking to each other.

## **Materials Required**

- Name card for each person
- Markers

## **Preparation**

Have participants fill out their name card. Divide participants into groups of four to six.

## **Activity**

Ask participants to create a composite résumé for their group. They might include such things as:

- Total years of experience
- Outside interests
- What do you hope to gain from the class?
- Positions held
- Education
- Skills

Ask each group to present its résumé to the rest of the participants.

## **Debrief**

Instructor capture the ideas around “what do you hope to gain” document these and refer back to them during and at the completion of the session to insure that all expectations were met.

# Slides

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## Slide 1



## Instructions

**WELCOME**



1

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### Key Message:

Welcome to the Extreme Winter Weather Events Training, developed by the NERC Training Team. This package offers you top-quality training materials that are customizable, user-friendly, educational, and ready to use instantly. We provide your course materials, instructor's guide and recommended materials to assist in the facilitation of the class. Also included are PowerPoint slides and a take-home reference sheet (Single Point Lessons or "SPL" for the student and worksheets for the practical activities. You simply need to prepare by reviewing the materials, and adding any entity specific content you would like to align with this material and begin training.

Best of all, this package is created in Microsoft Office products thus allowing customization in almost any version of Word and PowerPoint. Therefore, feel free to customize the content, add your logo, change the color scheme, and print and e-mail training materials to your audiences.

The purpose for this training is not to discuss compliance or standards issues. This training provides additional information on how to better prepare for future cold weather events.

Slide 2



- This package offers you top-quality training materials that are customizable, user-friendly, educational, and ready to use instantly. We provide your materials, materials for the student, PowerPoint slides, and a take-home reference sheet (Single Point Lessons – SPL’s) for the student. You simply need to prepare and train!
- Best of all, this package is created in Microsoft Office and can be opened using any version of Word and PowerPoint. This means that you can customize the content, add your logo, change the color scheme, and easily print and e-mail training materials.

2

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**Key Message:**

You can hide this slide, from the audience- it is part of the instructors tool kit. If you have any questions go to the [NERC website](#) and submit it to the NERC Training email link. Someone will promptly respond to your inquires.

To gain the most from the training, it is recommended that you tailor the materials to specific examples in your entity. When going through the practical activities, focus examples and follow-up to items that are specific to your locations.

## Slide 3

- Housekeeping
- The Parking Lot
- Workshop Objectives
- Pre-Assignments (if any)
- Action Plans
- Evaluations



3

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**Key Message:**

As part of the introduction, cover the house keeping items some of the individuals may not be aware of where bathrooms and break rooms are designated smoking areas are located. This time will also provide an opportunity to conduct a safety brief and point out exists and discuss with the group what actions to take in the event of an emergency.

Also, emphasis the Parking Lot concept. During the course of your training some topics may be discussed that are not related to materials designated for presentation. The Parking Lot is a location where you can have the, items reside and get back to them at the end of the session if there is time or send an email out to the attendees with proper responses after the training has been completed and they are back in their respective work areas.

After the general overview if it is a group that is not familiar with each other or you just want to create some early interactions – conduct one of the pre-selected ice-breakers to take the group through.

Slide 4

The slide features a blue background with a white grid pattern. At the top left is the NERC logo: "NERC" in a large font, with "NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION" in smaller text below it. The main title "Extreme Winter Weather Events" is centered in a large, bold, white font. Below the title, the subtitle "Recommendations and Guidelines" and "Month XX, 20XX" are displayed in a smaller white font. A horizontal line separates the text from a row of four images. Above the images, the text "RELIABILITY | ACCOUNTABILITY" is centered. The images from left to right are: a control room with multiple monitors, two large industrial cooling towers at night, a high-voltage power transmission tower, and a wind turbine next to solar panels.

**Key Message:**

Before the class take the time to read up on the reports sited and used for the majority of the training to follow. The reports can be found in the [Cold Weather Event](#) folder on the [NERC website](#).

Prior to the class, distribute any printed materials (from the recommended list above) this will save time during the training.

## Slide 5

While extreme cold weather events are not common in the Southwest, they do occur every few years. These events create significant impact in terms of dollars and human hardship. Many utilities have already undertaken improvements in light of their experiences during the February 1–5, 2011 event.

This report makes a number of recommendations that are reasonable economically and the risk of blackouts and natural gas curtailments during extreme cold weather in the Southwest.\*

*\*Source: Outages and Curtailments during the Southwest Cold Weather Event of February 1–5, 2011*

**Key Message:**

If possible, have a leader of the entity “Kick-off” this session of the training. Provide background on the event and high-level on the report.

## Slide 6

## Purpose

- Provide timely, relevant information to assist registered entities prepare for extreme winter weather events.
- Identify key outputs and causes that led to significant loss of capacity.
- Outline importance of maintaining thorough winterization practices.
  - February 2011 cold weather event
  - Comparison between 1989 and 2011 events
- Discuss guidelines for winter weather preparedness.
- Prevent future events related to extreme winter weather.



6

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**Key Message:**

Read aloud the purpose of this workshop. Let the group know that the purpose of this training is not to discuss Compliance or Standards issues. This training provides additional information on how to better prepare for future cold weather events.

This training is also to share findings from a previous event, share Lessons Learned and make recommendations on how to improve reliability in areas that are not typically used to the effects of extreme cold weather.

## Slide 7

At the conclusion of this session, attendees will be able to:

- Identify the contributing factors that caused the event and the consequences, as described in the event report.
- Discuss potential cold weather vulnerabilities in their respective work environments.
- Identify preventative actions that can be taken when faced with infrequent cold weather disturbances.



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7

**Key Message:**

Here are our learning objectives for today:

At the conclusion of this session, attendees will be able to:

- Identify the contributing factors that caused the event and the consequences, as described in the event report.
- Discuss potential cold weather vulnerabilities in their respective work environments.
- Identify preventative actions that can be taken when faced with infrequent cold weather disturbances.

## Slide 8



## Audience

It is in the public's interest for NERC to develop guidelines that are useful for maintaining and enhancing the reliability of the Bulk Electric System (BES).\*

This presentation provides suggested guidance on preparations for cold weather events for BES users, owners, and operators according to each entity's circumstances.

\*Source: Reliability Guidelines ([Appendix 3 of NERC Operating Committee Charter](#))



8

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**Key Message:**

This training is not intended for a specific type of audience, but intended as an overview and preparation guidelines for entities that typically don't face severe cold weather on a regular basis. This packet is designed to provide additional guidance and recommendations on developing immediate, mid-range and long term goals to combat the potential impacts of severe cold weather.

Slide 9 – Transition to discuss the actual event



## February 2011

9

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**Key Message:**

Review Introduction from the [Report on Outages and Curtailments During the Southwest Cold Weather Event of February 1-5, 2011](#).

## Slide 10



## February 2011 Event Background

Between February 1 and 5, a significant winter storm caused a loss of power in the southwestern United States that resulted in a loss of 56,344 MW and left 1.3 million customers without power and 225 tripped generators.

On February 14, the Federal Energy Regulatory Commission (FERC) initiated an inquiry into the Southwest outages and service disruptions.

The inquiry had two objectives:

1. Identify the causes of the disruptions.
2. Identify any appropriate actions for preventing recurrence of the disruptions.



10

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**Key Message:**

It is important to set the foundations of the event at this point by discussing the background based on the data placed in the report. This provides a comprehensive overview of the purpose and results of this major event. Discuss the finding of the report. This report was not created to place blame, but to accomplish two higher order objectives:

- Identify the causes of the disruptions.
- Identify any appropriate actions for preventing recurrence of the disruptions.

## Slide 11



## Event Analysis

On August 16, 2011, FERC and NERC released a staff report that made recommendations to help prevent a recurrence of the events experienced by customers in the Southwest during February 2011.

At the conclusion of a six-month inquiry, Recommendations and Lessons Learned were published for review and implementation where appropriate.

11

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**Key Message:**

Summarize points in the overall events analysis:

- On August 16, 2011, FERC and NERC released a staff report making recommendations to help prevent a recurrence of rolling blackouts and natural gas curtailments experienced by customers in the Southwest during extreme cold weather the first week of February 2011. Concluding a six-month inquiry, the task force found a majority of the electric outages and gas shortages were due to weather-related causes. In total, approximately 1.3 million electric customers were out of service at the peak of the event on February 2, and a total of 4.4 million were affected over the course of the event from February 2 through February 4.
- Natural gas customers also experienced extensive curtailments of service during the event. These curtailments were longer in duration than the electric outages because relighting customers' equipment has to be accomplished manually at each customer's location. Local distribution companies (LDCs) interrupted gas service to more than 50,000 customers in New Mexico, Arizona, and Texas; New Mexico was the hardest hit with outages of over 30,000 customers. On May 9, 2011, FERC and NERC announced that their staffs would create a joint task force to combine their separate inquiries. This report is a product of that effort.

## Slide 12

The next section provides an opportunity to review the findings from the six-month inquiry into the cold weather event from February 2011.

**Report Content:**

- High-level overview of the six-month inquiry
- Precedents
- Lessons Learned guide



12

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**Key Message:**

Prepare to discuss some of the major findings in the overall report.

Slide 13



Event Report Findings

Condition	Consequences
Coldest Texas weather since 1989	Single-digit sub-freezing temperatures for more than 100 hours with sustained winds of 30–40 mph
New ERCOT winter peak demand record	56,344 MW (with a second record set the following week)
ERCOT capacity affected	17.6 percent of total ERCOT winter 2011 capacity out at February 2 peak
225 units tripped, derated, or failed to start (February 1–3)	Except for nuclear facilities, all power plant types including coal/lignite, simple-cycle gas, combined-cycle gas, and wind resources experienced problems.

The front was not unexpected. About a week prior to the event, long-range forecasts predicted an outbreak of very cold temperatures for the first week of February, with wind, ice, and snow from Texas to Mississippi.

**Key Message:**

During the second record-setting peak demand period, no problems were encountered as generators had made some immediate corrections to their plant winterization in the previous event.

The front was not unexpected. About a week prior to the event, long-range forecasts predicted an outbreak of very cold temperatures for the first week of February, with wind, ice, and snow from Texas to Mississippi.

Slide 14



## Conditions Leading to the Event

The February 2, 2011 event was caused by insufficient or ineffective preparation of generating facilities for prolonged freezing weather.

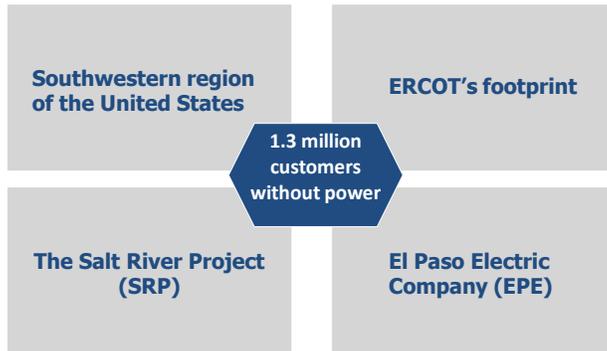
Observations	Effects
<p>Many plants had rigorous plans, controls, and safeguards in place to address winter weather conditions; however, many plants weren't prepared to withstand levels of severe winter weather.</p>	<p>In some cases, maintenance issues impacted the ability to withstand the prolonged, freezing conditions, including:</p> <ul style="list-style-type: none"> <li>• Failed or inadequate heat trace</li> <li>• Missing or inadequate wind breaks</li> <li>• Inadequate or missing insulation</li> <li>• Failure to have or maintain heating elements and heat lamps in instrument cabinets</li> </ul>

Source: *Outages and Curtailments During the Southwest Cold Weather Event of February 1–5, 2011*

**Key Message:**

For many plants there were plans in place to combat cold weather, but necessary steps for preparation were not taken. Also, the duration of the severe cold weather over a prolonged period left many entities unable to combat/maintain and or sustain the activities that were in place.

## Slide 15



15

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**Key Message:**

The quadrant is a depiction of the four major areas that were noted in the final report. Each of the areas represents the primary stakeholders affected by the event. In the proceeding slides, we will discuss each of the four highlighted areas in specific detail.

The southwestern region of the United States experienced unusually cold and windy weather during the first week of February 2011, leading to temperatures well below freezing for four days straight, with winds gust up to 30 mph or more.

- Between February 1 and 4, 2011, a total of 210 individual generating units within ERCOT's footprint experienced either an outage, a derate, or a failure to start, leading to total load shed on February 4 of 4,000 MW.
- The Salt River Project (SRP) Balancing Authority (BA) in the Western Interconnection, located in Arizona, lost 1,050 MW of generation on February 1 through February 2, and shed load of 300 MW, affecting some 65,000 customers.
- El Paso Electric Company (EPE), another BA in the Western Interconnection, lost approximately 646 MW of local generation over four days beginning February 1 and was forced to implement rotating load shedding on each of the days from February 2 through February 4, totaling over 1,000 MW and affecting some 253,000 customers.
- In total, approximately 1.3 million electric customers were out of service at the peak of the event on February 2, and a total of 4.4 million were affected over the course of the event from February 2 through February 4, 2011.

NOTE: This represents the primary stakeholders affected by the event. there were other contributing causes within these big segments

## Slide 16

## Southwestern Region

The southwestern region of the United States experienced unusually cold and windy weather during the first week of February 2011, leading to temperatures well below freezing for four days straight, with winds gusting up to 30 to 40 mph.



16

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**Key Message:**

The Southwest region of the United States typically does not receive severe cold weather on a regular basis. This region had not seen temperatures at these levels since the 1989 event of a similar magnitude.

## Slide 17



## ERCOT's Footprint

Between February 1 and 4, 2011, a total of 210 individual generating units within ERCOT's footprint experienced either an outage, a derate, or a failure to start, leading to total load shed of 4,000 MW on February 4.



17

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**Key Message:**

The load shed affected 3.2 million customers on February 2. It shed another 300 MW on February 3, affecting 180,000 customers. In comparison SRP shed 300 MW of load affecting 65,000 customers and EPE shed a little over 1,000 MW of load affecting 253,000 customers.

## Slide 18



## The Salt River Project

The Salt River Project (SRP) Balancing Authority (BA) in the Western Interconnection, located in Arizona, lost 1,050 MW of generation from February 1 through February 2 and shed 300 MW of load, affecting some 65,000 customers.



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18

**Key Message:**

SRP did not issue a cold weather alert in advance of the storm. SRP reports that management at the Navajo Generating Station did inform its operators at the beginning of the shifts that cold weather was approaching and inquired if there was anything the employees needed to help them with their jobs. SRP does not employ a formal checklist of activities that should be carried out prior to a winter storm and the company reports that the group did not take any formal actions to prepare the station for the anticipated severe weather.

## Slide 19



## El Paso Electric Company

El Paso Electric Company (EPE), another BA in the Western Interconnection, lost approximately 646 MW of local generation over four days beginning February 1.

It was forced to implement rotating load shedding from February 2 through February 4, totaling over 1,000 MW and affecting some 253,000 customers.



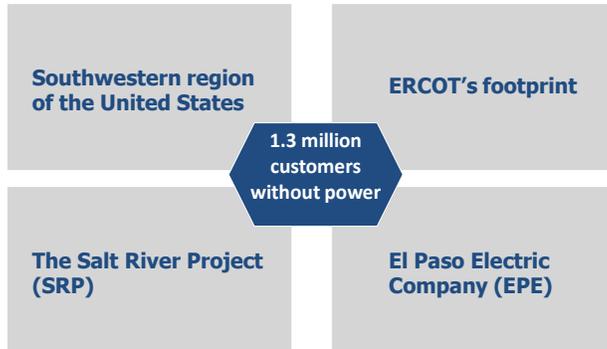
19

**Key Message:**

Reported that it took steps to winterize its generating as it does every year. This included verifying that heat tracing was properly functioning, as well as making sure insulation was properly installed. Also stated that it verified that the equipment in its substations, the part of the transmission and distribution system most susceptible to cold temperatures extremes, could withstand the expected cold temperatures.

## Slide 20

In total, approximately 1.3 million electric customers were out of service at the peak of the event on February 2, and a total of 4.4 million were affected over the course of the event from February 2 through February 4, 2011.



20

RELIABILITY | ACCOUNTABILITY

**Key Message:**

In summary – sum up the findings from the overall impact from the four areas that were reviewed and discussed.

## Slide 21



## Key Report – Staff Findings

- During the February event, temperatures were considerably lower (15 degrees or more) than average winter temperatures and represented the longest sustained cold spell in 25 years.
- While load forecasts fell short of actual load, the forecasts were not a factor in the loss of load.
- Generators could better coordinate generator-scheduled outages in terms of the total amount of scheduled outages at a given time and their location.
- Fast action in initiating rolling blackouts prevented more widespread, less-controlled blackouts.
- BAs, Reliability Coordinators (RCs), and generators often lacked adequate knowledge of plant temperature design limits, and thus did not realize the extent to which generation would be lost when temperatures dropped.
- Generators were generally reactive, as opposed to being proactive, in their approach to winterization and preparedness.

21

RELIABILITY | ACCOUNTABILITY

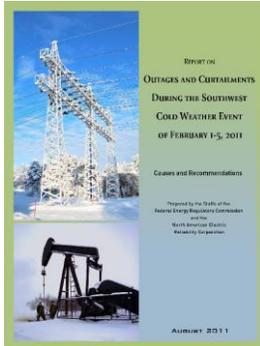
**Key Message:**

Use this summary page to generate discussion around the results of the extreme cold weather. As you begin the discussion, ensure that you direct the discussions so they are relevant to your entity and not generalizations. Very high-level begin to think about how you impact reliability in your entity.

## Slide 22 - Transition to Discuss FERC NERC Report



## FERC & NERC



22

RELIABILITY | ACCOUNTABILITY

### Key Message:

Based on all of the facts that came to light in the course of the joint inquiry conducted by the staff of FERC and NERC, as well as the conclusions formed from them, have been presented throughout the entire packet. Based on the complexity of the matters examined, this training is only a summary of the key findings from the task force. Following are some of the recommendations that the task force believes, if implemented, could significantly contribute to preventing a recurrence of the rolling blackouts and natural gas curtailments experienced in the Southwest during the February 2011 cold weather events.

### Key Findings:

During the February event, temperatures were considerably lower (15 degrees plus) than the average winter temperatures. Coldest sustained spell in 25 years. The Southwest experienced similar cold spells in December 1989. Less extreme cold weather events occurred in 2003 and 2010. Many generators failed to adequately apply and institutionalize knowledge and recommendations from the previous severe winter events. Especially as to winterizations of generation and plant auxiliary equipment.

While load forecast fell short, the forecasts were not a factor in the loss of load. ERCOT manually increased its February 1 and 2 forecast by 4,000 MW

ERCOT and generators within ERCOT could better coordinate generator scheduled outages, in terms of total amount of scheduled outages at a given time and their locations

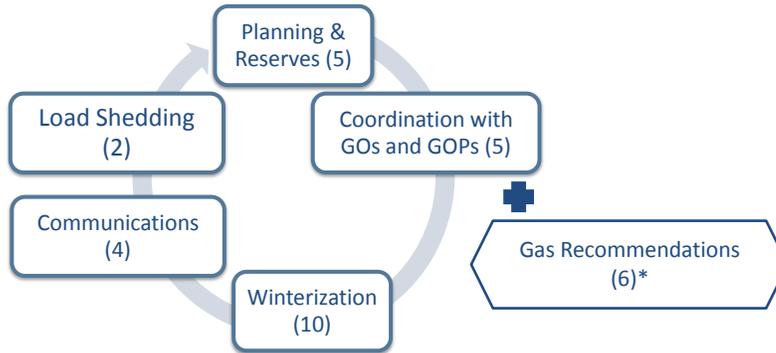
ERCOT's fast action in initiating rolling blackouts prevented more widespread and less controlled ERCOT-wide blackouts. Had ERCOT not initiated manual load shed, load shedding relays would have instantaneously dropped approximately 2,600 MW creating further loss and disturbances.

Lack of any state, regional or Reliability Standards that directly require generators to perform winterization left winter-readiness dependent on plant or corporate choices. While Reliability Standard EOR-001 R.4 and R.5 refer to winterization as a consideration in emergency plans, these requirements apply only to balancing authorities, transmission owners and transmission operators.

## Slide 23

**FERC and NERC Recommendations**

On August 15, 2011, 26 Electrical Recommendations and 6 Gas Recommendations were issued.



Source: *Outages and Curtailments During Southwest Cold Weather Event February 1–5, 2011*

**Key Message:**

This information is located on pages 197–217 of the joint report. Print off copies for the participants for review and discussion.

August 15, 2011 – Joint FERC/NERC report released

- There were a total of 26 electric recommendations issued:
  - Planning and reserves (5);
  - Coordination with generator owners/operators (GOs/GOPs) (5);
  - Winterization (10);
  - Communications (4); and
  - Load Shedding (2)
- There were also six gas recommendations.

\* For additional discussion, there can be talks about the gas interdependencies discussed in the recommendations.

**Practical Activity:**

Before this activity, the instructor should review the recommendations based on the findings and highlight the ones that are applicable to their entity. During the discussion activity, these should be the recommendations that are discussed and ideas focused on how you can use these recommendations to increase/improve reliability in particular entity.

**Practical Activity 1**

**26 Electrical Recommendations**

<b>Estimated Time</b>	30 minutes
<b>Lesson Objective</b>	Participants will identify areas in their entity where the recommendations can be reviewed and possibly implemented to improve reliability.
<b>Lesson Summary</b>	There are many ways to ensure reliability, by taking a critical look back on prior incidents and make changes based on the findings you stand a greater chance of improved future reliability.
<b>Materials Required</b>	<ul style="list-style-type: none"> <li>• Recommendations based on the FERC/NERC final report. (p.197-217)</li> <li>• Practical Activity Handout 1 – 26 Electrical Recommendations</li> <li>• Flip chart to capture thoughts and ideas</li> </ul>
<b>Recommended Activity</b>	<ul style="list-style-type: none"> <li>• Tell the participants to review the selected recommendations from the report and compare them to current practices</li> <li>• Discuss ways in which to implement/activate recommendations from the report</li> <li>• Capture ideas on flipchart</li> </ul>
<b>Delivery Tips</b>	<ul style="list-style-type: none"> <li>• Be sure to try to cover each of the recommendations that are specific to your entity.</li> <li>• Get input and ideas from as many individuals as possible.</li> <li>• Call time even if the group was unable to determine responses for each of the designated topics. – DON'T EXCEED planned time. [if more time required, entity and plan as needed]</li> <li>• Off-topic or detailed comments can be added to the parking lot – encourage this process.</li> </ul>

**Print Handout located on the Cold Weather Training site for this activity**

[FERC/NERC 26 Recommendations for Activity 1](#)

## Slide 24

**FERC and NERC Recommendations****Review & Discuss Applicable Recommendations**

- Planning and Reserves
    - (5) Recommendations
  - Coordination with GO's and GOP's
    - (5) Recommendations
  - Winterization
    - (10) Recommendations
  - Communications
    - (4) Recommendations
  - Load Shedding
    - (2) Recommendations
- 
- Gas Recommendations
    - (6) Recommendations

24

RELIABILITY | ACCOUNTABILITY

**Key Message:**

The recommendations based on the joint review of FERC and NERC centered around five major areas dealing with electrical recommendations. The report also provided a sixth recommendation based on Gas interdependencies. These recommendations are located in the overall training packet and can be found on pages 197-217 in the final report.

## Slide 25 - Transition to Discuss Prior Cold Weather Events



## Precedents

25

RELIABILITY | ACCOUNTABILITY

**Key Message:**

The storm was not without precedent. There were prior severe cold weather events in the Southwest in 1983, 1989, 2003, 2006, 2008, and 2010. The worst of these in 1989, the prior event most comparable to 2011. That year marked the first time ERCOT resorted to system-wide rolling blackouts to prevent more widespread customer outages. In all of those prior years, the natural gas delivery system experienced production declines; however, curtailments to natural gas customers in the region were essentially limited to the years 1989 and 2003.

**Electric:**

Going into the February 2011 storm, neither ERCOT nor the other electric entities that initiated rolling blackouts during the event expected to have a problem meeting customer demand. They all had adequate reserves margins, based on extraordinary amount of capacity that was lost during the event from trips, derates and failures to start.

Slide 26

1989	1994	2011
<ul style="list-style-type: none"> <li>• Good analysis and reports were written</li> <li>• Development of good recommendations</li> <li>• Recommendations not institutionalized</li> <li>• ERCOT (<a href="#">December 21–13, 1989</a>)</li> <li><a href="#">Previous Cold Weather Events Analysis</a></li> </ul>	<ul style="list-style-type: none"> <li>• Record cold weather in mid-Atlantic and the Midwest</li> <li>• Resulted in rolling blackouts</li> <li>• Mid-Atlantic and the Midwest (<a href="#">January 19, 1994</a>)</li> <li>• Preparation was conducted, the problem still existed</li> <li>• Recommendations not institutionalized</li> </ul>	<ul style="list-style-type: none"> <li>• Severe cold weather event</li> <li>• Same region as 1989 event</li> <li><a href="#">Southwest Cold Weather Event 2011</a></li> </ul>

With a number of the generators, the recommendations from the 1989 event were not institutionalized and did not result in ACTIONS to prevent another event.

**Key Message:**

Discuss the other two major events prior to the 2011 event. There are also links to the reports and supporting documentation for the other events. Would recommend reviewing and printing off information prior to the workshop.

**Share this Point:** Based on information from those events, recommendations were provided and some of them were even implemented, however, none was institutionalized and the practices were not followed in a manner that would prevent outages in the event of another storm. Entities reverted to their pre-event routines and were not prepared for the next big event.

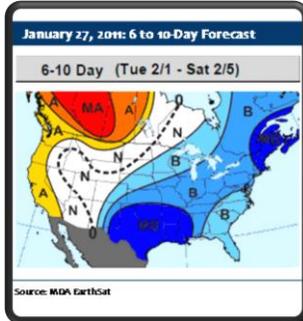
**Tip:** Recommend clicking on the links prior to class and review and take notes from the other events, be prepared to discuss briefly and explain how critical it is to reliability to not only begin a new practice based on recommendations but find ways to integrate the practice into the overall business operating processes.

Click on the hyperlinks and explore the other reports that are mentioned and stored at the Severe Weather Training site location

Prior severe cold weather in the Southwest included 1983, 1989, 2003, 2006, 2008, 2010. With the worst of these being 1989 – the storm most comparable to the 2011 event. That year marked the first time ERCOT resorted to system-wide rolling blackouts to prevent more widespread customer outages.

## Slide 27

## Not Without Warning



Color legend:  
 N = normal  
 B = below normal  
 MB = much below normal  
 SB = strong below normal

A severe arctic cold front hit the central and northeastern United States and southern Canada on February 1, 2011, and lasted for several days. It was dubbed the “Groundhog’s Day Blizzard of 2011.”

**The front was not unexpected.**

About a week prior to the event, long-range forecasts predicted an outbreak of very cold temperatures for the first week of February, with wind, ice, and snow from Texas to Mississippi. Arctic air was expected to extend southward to the Gulf by February 2, bringing daytime highs to as low as 30 degrees below normal.

Sustained winds of 20–25 mph, with higher gusts, were also anticipated.

### Key Message:

Actual weather conditions between February 1-5 turned out to be largely as predicted by the National Weather Service’s long range forecast. However, actual temperatures were a few degrees lower than forecasted, especially in Texas and New Mexico. In some places, temperatures did not rise above freezing until February 4. Low temperatures in Albuquerque ranged from -7 degrees to 7 degrees over the four day period, in midland from 6 degrees to 12 degrees, and in Dallas from 13 degrees to 19 degrees.

Houston’s temperatures started out on February 1 at 70 degrees, by 7:00 a.m. the temperature had dropped to 45 degrees.

## Slide 28

**Proper Preparations**

**“By failing to prepare, you are preparing to fail.”**

-- Benjamin Franklin

Electric:

*“ Going into the February 2011 Storm, neither ERCOT nor the other electric entities that initiated rolling blackouts during the event expected to have a problem meeting customer demand.”*

*They all had adequate reserve margins, based on anticipated generator availability. But those reserves proved insufficient for the extraordinary amount of capacity that was lost during the event from trips, derates and failures to start.”*



RELIABILITY | ACCOUNTABILITY

28

**Key Message:**

**Open Commentar:**

**Ask the group what measures can be taken to ensure proper preparations and planning before each cold weather season, during the season and after the season is officially completed.**

## Slide 29 - Transition to Discuss Reliability Guidelines



## Winter Readiness

29

RELIABILITY | ACCOUNTABILITY

**Key Message:**

*Instructors Note:* Provide hard copies of the report to participants for review.

**Introduction:**

This reliability guideline is applicable to electricity sector organizations responsible for the operation of the BES. It provides general concepts that may be considered when developing a winter weather readiness program.

This guideline provides a general framework for identifying the concepts and steps to consider for an effective program with a focus on maintaining individual unit reliability. This document, written in the form of a guideline, is a collection of industry practices compiled by the NERC Operating Committee (OC). The use of these methodologies and guidelines is strictly voluntary.

Click here for: [Reliability Guidelines](#)

## Slide 30



## Winter Readiness

Reliability Guideline: Generating Unit Winter Weather Readiness Current Industry Practices is applicable to electricity sector organizations responsible for the operation of the BES. It provides general concepts that may be considered when developing a winter weather readiness program.

These guidelines provide a general framework for identifying the concepts and steps to consider for an effective program with a focus on maintaining individual unit reliability.

The use of these methodologies and guidelines is strictly voluntary.

30

RELIABILITY | ACCOUNTABILITY

**Key Message:**

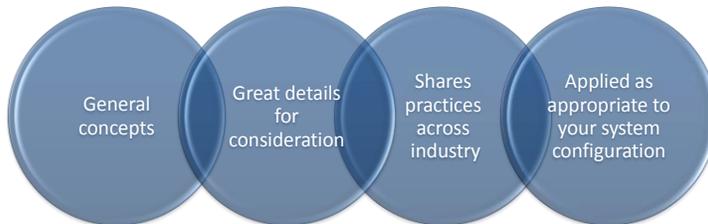
As you go through the next series of slides, you will discuss the components of the winter weather guidelines. As you lead the discussion emphasize the founding principles:

- General Concepts
- Great Details for considerations
- Share Practices
- Applied as appropriate

The Reliability Guidelines provide a suggested guidance on a particular topic for Bulk-Power System (BPS) users, owners, and operators according to each entity's circumstances. Reliability Guidelines are not to be used to provide binding norms, establish mandatory Reliability Standards, or create parameters by which compliance to standards is monitored or enforced.

## Slide 31

## Generating Unit Winter Weather Readiness Reliability Guideline:

**Key Message:**

This Reliability guide is applicable to electricity sector organizations responsible for the operation of the BOS. Although this guideline was developed as a result of an unusual cold weather event in an area not normally exposed to freezing temperatures, it provides a general framework for developing an effective winter weather readiness program for generating units throughout North America. The focus is on maintaining individual unit reliability and preventing future cold weather related events. The listed items are a collection of industry practices complied by the NERC OC. While the incorporation of these practices is strictly voluntary, developing a winter weather readiness program using these practices is highly encouraged promoting and achieving the highest levels of reliability for these high impact weather events.

**Assumptions:**

Each BPS generator owner and operator is responsible and accountable for maintaining generation unit reliability.

Entities should develop and apply plant-specific winter weather readiness plans, as appropriate, based on factors such as geographical location, technology and plant configuration.

## Slide 32

- Management must emphasize that personnel safety remains the top priority during winter weather events.
- Management ensures that job safety briefings are conducted during preparation for winter weather events as well as during response to winter weather events.



32

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Safety remains the top priority during winter weather events. Job safety briefings should be conducted during preparation for and in response to these events.

Slide 33



## II. Management Roles

Senior Management	Plant Management
<ul style="list-style-type: none"> <li>•Set expectations “top-down”</li> <li>•Ensures process exists</li> <li>•Annual winter preparations</li> <li>•Share best practices</li> <li>•Consider a fleet-wide annual winter preparation meeting and training exercise</li> <li>•Encourage sharing of insights across organizations and industry</li> </ul>	<ul style="list-style-type: none"> <li>•Ensure preparations contain processes, staffing, timelines</li> <li>•Conduct plant readiness reviews</li> <li>•Ensure completion of winter readiness</li> <li>•Encourage staff to look for risk</li> <li>•Conduct evaluation after each winter season</li> </ul>

**Key Message:**

Management plays an important role in maintaining effective winter weather programs. The management roles and expectations below provide a high-level overview of the core management responsibilities related to winter weather preparation. Each entity should tailor these roles and expectations to fit within their own corporate structure.

## Slide 34

**III. Processes and Procedures****Winter Weather Preparedness Procedures:**

34

RELIABILITY | ACCOUNTABILITY

**Key Message:**

A winter weather preparation procedure should be developed for seasonal winter preparedness, as well as severe winter weather preparedness. Components of an effective winter weather preparation procedure are included as Attachment 1 to the Reliability Guideline.

After a severe winter weather event, entities should utilize a corrective action process to formally identify Lessons Learned. Procedures should be reviewed and updated using these lessons learned after every winter event to institutionalize knowledge from guidelines (i.e., what worked well or did not work well during the event).

## Slide 35



## IV. Evaluate Potential Problem Areas

Identify and prioritize components, systems, and other areas of vulnerability which may experience freezing problems or other cold weather operational issues.

This includes components and systems that have the potential to:

- A. Initiate an automatic unit trip,
- B. Impact unit start-up,
- C. Initiate automatic unit runback schemes or cause partial outages,
- D. Cause damage to the unit,
- E. Adversely affect environmental controls that could cause full or partial outages,
- F. Adversely affect the delivery of fuel or water to the units,
- G. Cause other operational problems such as slowed or impaired field devices, or
- H. Create a safety hazard.

35

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Identify and prioritize components, systems, and other areas of vulnerability which may experience freezing problems or other cold weather operational issues.

Slide 36



**Practical Activity**

**Evaluate Potential Problem Areas (PPAs)**

In the spaces provided in the handout, list some of the systems in your facility that could potentially be affected by cold weather in the PPAs identified.

PPAs:	Local Areas of Concern:
Initiate an automatic unit trip	
Impact unit start-up	
Initiate automatic unit runback schemes and/or cause partial outages	
Cause damage to the unit	
Adversely affect environmental controls that could cause full or partial outages	
Adversely affect the delivery of fuel or water to the units	
Cause other operational problems such as slowed or impaired field devices	
Create a safety hazard	

## Practical Activity 2

### Potential Problem Areas

<b>Estimated Time</b>	15 minutes
<b>Lesson Objective</b>	Participants will identify Potential Problem Areas, based on those identified in the final report. The focus of the activity is to focus on those areas that can have a detrimental impact on reliability.
<b>Lesson Summary</b>	There are many ways to ensure reliability, by focusing on areas that were identified based on previous events allow us to begin to eliminate areas that may pose a problem in future severe cold weather instances. Being proactive and making changes based on the findings, you stand a greater chance of improved future reliability.
<b>Materials Required</b>	<ul style="list-style-type: none"> <li>• Recommendations based on Reliability Guidelines Generating Unit Winter Weather Readiness – Current Industry Practices</li> <li>• Practical Activity 2 Handout</li> <li>• Flip chart to capture thoughts and ideas</li> </ul>
<b>Recommended Activity</b>	<ul style="list-style-type: none"> <li>• Tell the participants they are the subject matter experts in the entity and you are depending on them to identify and discuss Potential Problem Areas.</li> <li>• Discuss ways in which to correct/improve reliability in these identified areas.</li> <li>• Capture ideas on flipchart</li> </ul>
<b>Delivery Tips</b>	<ul style="list-style-type: none"> <li>• Be sure to try to cover each of the areas that are specific to your environment.</li> <li>• Also, try to get input and ideas from as many individuals as possible.</li> <li>• Call time even if they were unable to determine responses for each of the designated topics. – DON'T EXCEED planned time.</li> <li>• Any additional comments and or thoughts can be added to the parking lot.</li> </ul>

Use the Handout in Packet 1-5

[Practical Activity Handout](#)

## Slide 37

## Typical Problem Areas

Based on previous cold weather events, a list of typical problem areas were identified. This is not meant to be an all inclusive list. Individuals entities should review their plant design and configuration, identify areas with potential exposure to the elements and/ or ambient temperatures, and tailor their plans to address the accordingly.

• Level transmitters	• Pressure transmitters
• Flow transmitters	• Instrument air system
• Fuel Supply and Ash Handling	• Water pipes and Fire Suppression Systems
• Motor-operated valves, valves positions and solenoid valves	• Drain lines, steam vents and intake screens

37

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Following is a listing of items that may fall into any of the categories for Typical Problem Areas. Read aloud items that may be present in your plant to generate discussion around those items on the list.

- Level Transmitters
  - Drum level transmitters and sensing lines
  - Condensate tank level transmitters and sensing lines
  - De-aerator tank level transmitters and sensing lines
- Pressure Transmitters
  - Gas turbine combustor pressure transmitters and sensing lines
  - Feed water pump pressure transmitters and sensing lines
  - Condensate pump pressure transmitter and sensing lines
- Flow Transmitters
  - Steam flow transmitters and sensing lines
  - Feed water pump flow transmitters and sensing lines
- Instrument Air System
- Motor-Operated Valves, Valve Positioners, and Solenoid Valves
- Drain Lines, Steam Vents, and Intake Screens
- Water Pipes and Fire Supperssion Systems
  - Low/no water flow piping system
- Fuel Supply and Ash Handling
  - Coal piles and coal handling equipment

## Slide 38

**Countermeasure for Critical Valves and Sensing Lines:**  
Install Insulation Blankets and Monitor Valve Performance

Insulation blankets are critical for MOVs and other control valves.

**Takeaway:** Keeping critical valves and associated actuators insulated will ensure continued reliability.

**Discussion Topic:** What local areas do you feel are currently protected properly?

38

RELIABILITY | ACCOUNTABILITY

**Key Message:**

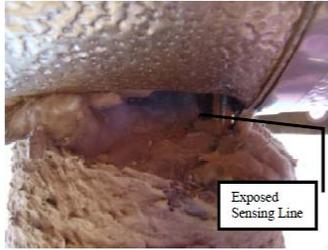
Engage your groups into discussing areas that they feel are currently protected properly. Capture these on a flipchart and display them so the group can review later. In addition, it is recommended to instruct participants to “go see” those areas and make the same type updates/improvements in areas that are less than properly protected.

Note: During the brainstorm/discussion, do not challenge any responses this is just a brainstorm!

This will allow you to get a full range of ideas on how other view the various levels of proper protection in the entity.

**Review Protected Areas List** – discussion and feedback

## Slide 39



Gap in insulation



Exposed valves emerge from thermal insulation and are not heat traced.

**Key Message:**

Review the list that has been collected based on the discussion above. Ask the question do ANY of these areas have exposure pipes, valves etc? If the answer is yes, then there is still an exposure problem in extreme cold weather.

**Share with Group:**

In addition to the pipe itself, valves, flanges, traps, and fittings should be insulated to the greatest extent possible. Non-insulated valves, like those pictured below, can cause pipes to freeze if enough surface area is exposed to freezing wind conditions.

**Activity:**

Take a look at the list to see if any of the areas have unprotected/exposed parts that can lead to the freezing of the entire unit. Debrief with the group.

Slide 40

Typical problem areas during cold weather include:

	TPAs
1	Pressure Transmitters and Sensing Lines
2	Flow Transmitters and Sensing Lines
3	Instrument Air System
4	Motor-Operated and Solenoid Valves
5	Drain Lines and Steam Vents
6	Emergency Generators
7	Water Pipes and Fire Suppression Systems
8	Fuel Supply

**Key Message:**

Based on the eight identified Typical Problem Areas, list areas that maybe impacted during a cold weather event in your plant.

Slide 41



**Practical Activity**

**Instructions:** With a partner or group, identify items on the list in your facility and locations. Create a checklist of areas to monitor based on the Typical Problem Areas identified below.

#	Local TPAs	Locations and Labeling in Your Facility to Check before Cold Weather Event
1	Pressure Transmitters and Sensing Lines	
2	Flow Transmitters and Sensing Lines	
3	Instrument Air System	
4	Motor-Operated and Solenoid Valves	
5	Drain Lines and Steam Vents	
6	Emergency Generators	
7	Water Pipes and Fire Suppression Systems	
8	Fuel Supply	

41

RELIABILITY | ACCOUNTABILITY

**Practical Activity 3:**

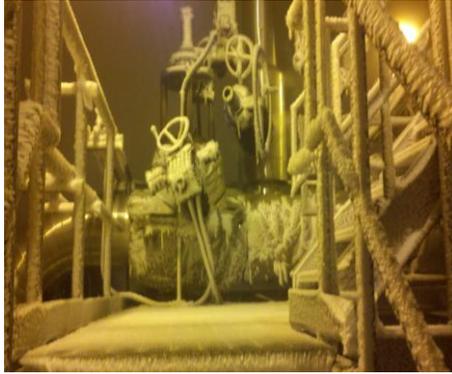
**Typical Problem Areas**

<b>Estimated Time</b>	15 minutes
<b>Lesson Objective</b>	Participants will identify Typical Problem Areas, based on those identified in the final report. The focus of the activity is to center on those areas that on the surface appear to be properly protected, but upon closer inspection there are exposed portions that lead to freezing.
<b>Lesson Summary</b>	To ensure reliability, the focus should not only be on the larger parts of a system but the smaller components. Any areas that are exposed can lead to failure of the system. To fully insulate a component and leave a valve, handle or flange exposed, the overall reliability could be compromised during an extreme cold weather event.
<b>Materials Required</b>	<ul style="list-style-type: none"> <li>• Short list of Typical Problem Areas as related to your entity (list should be considered as a primer list to begin the class discussions)</li> <li>• Practical Activity Handout 3 – Typical Problem Areas</li> <li>• Flip chart to capture thoughts and ideas</li> </ul>
<b>Recommended Activity</b>	<ul style="list-style-type: none"> <li>• Tell the participants they are the subject matter experts in the entity and you are depending on them to identify and discuss Typical Problem Areas.</li> <li>• Discuss ways in which to begin to correct/improve/reliability in these identified areas.</li> <li>• Capture ideas on flipchart</li> </ul>
<b>Delivery Tips</b>	<ul style="list-style-type: none"> <li>• Be sure to try to cover each of the areas that are specific to your entity.</li> <li>• Also, try to get input and ideas from as many individuals as possible.</li> <li>• Call time even if they were unable to determine responses for each of the designated topics. – DON'T EXCEED planned time.</li> <li>• Any additional comments and or thoughts can be added to the parking lot – provide additional paper, sticky notes for this</li> </ul>

## Slide 42

**Proactive vs. Reactive**

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



Access to equipment after the fact can be very difficult.

42

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Ask the class to brainstorm and determine what preventative measure could have been taken in this instance.

Human Related Failures:

Inability or failure to fully execute inspection of watch tasks.

Failure to perform inspection of watch task specified for cold weather operation can result in the failure to detect freezing conditions and related malfunctions of critical components

Takeaway – Be proactive in utilizing available technology for monitoring to minimize dependency upon physical inspections

Slide 43



V. Training

Coordinate annual training in winter- and plant-specific awareness and maintenance training.

Response to Freeze Protection Panel Alarms	Troubleshooting and Repair of Freeze Protection Circuitry
Identification of plant areas most affected by winter conditions	Knowledge of the ambient temperature for which the freeze protection system is designed

**Considerations:**

1. Consider holding a winter readiness meeting on an annual basis.
2. Operations personnel may review cold weather scenarios affecting equipment.
3. Prepare for cold weather before the winter season begins.

**Key Message:**

Coordinate annual training in winter- and plant-specific awareness and maintenance training. This may include response to freeze protection panel alarms, troubleshooting and repair of freeze protection circuitry, identification of plant areas most affected by winter conditions, review of special inspections or rounds implemented during severe weather, knowledge of the ambient temperature for which the freeze protection system is designed, and lessons learned from previous experiences or the NERC Lessons Learned program.

- Consider holding a winter readiness meeting on an annual basis to highlight preparations and expectations for severe cold weather.
- Operations personnel may review cold weather scenarios affecting instrumentation readings, alarms, and other indications on plant control systems.
- Ensure appropriate NERC GADS coding for unit derates or trips as a result of a severe winter weather events to promote lessons learned, knowledge retention, and consistency. Examples may include NERC GADS code 9036 “Storms (ice, snow, etc.)” or code 9040 “Other Catastrophe.”

## Slide 44

**VI. Winter Event Communications**

**Before** a severe winter weather event, plant management should communicate and confirm that the preparation procedures have been completed.

**During** a severe winter weather event, update the BA on changes to plant availability.

**Before & during** a severe winter weather event, communicate with all personnel about changing conditions and potential areas of concern to heighten awareness around safe a reliable operations.

Should a generating plant trip, derate, or fail to start due to cold weather, ensure effective communications with appropriate authorities.

**Key Message:**

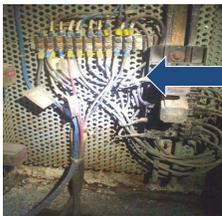
Ask your attendees to discuss current local procedures you have in place to address each phase of the process now.

- The Process should include feedback loop, to enhance current winter weather readiness programs process and procedures, checklist and training ( continuous improvement)
- Sharing of technical information and lessons learned through the NERC Event Analysis Program or some other method is encouraged.

## Slide 45

**Other Considerations**

- Unlike plants in the North, plants in the South are designed primarily for summer heat.
  - The equipment is outdoors or exposed to outside temperatures.
- Plant systems, equipment, or protection systems may degrade over time.
  - Example: building torn down or low wind break



Corrosion



Low wind break

45

RELIABILITY | ACCOUNTABILITY

**Key Message:**

One must also consider condition variables.

Have the group discuss various condition variables that may exist in their current working environment.

Note- review chart and the codes that are related to condition variables and their impact on reliability

Slide 46



Condition Variables

Supporting Table:

A large percentage of weather-related outages are due in part to the design and construction of generating facilities in the Southwest.

Unlike facilities in cold climates, generating stations in the Southwest are typically designed and constructed so that their boilers, turbines, and other auxiliary systems are exposed to ambient weather conditions.

Cause	# of Unique Units	MWh
Total Frozen Sensing lines:	89	432,897
Frozen - Drum level sensing lines	48	150,000
Frozen - Other Sensing lines	41	282,896
Frozen Equipment (General)	21	153,393
Frozen Water lines	14	80,091
Frozen Valves	12	20,603
Blade Icing (Wind Turbines)	10	53,989
Low Temperature Limits (Wind Turbines)	17	80,389
Transmission Loss	2	2,944
Fuel Supply Problems (Curtailments/Quality)	32	119,844
Mechanical Failure	47	192,610
Control System Issues	34	33,872
Operator Error	9	3,792
Emissions	4	10,508
Fuel Switching	15	29,106
Miscellaneous	11	7,952

46

RELIABILITY | ACCOUNTABILITY

Key Message:

## Slide 47

## Condition Variables

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



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

47

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Equipment Related Failure:

Frozen Valves and Piping: Can result in loss of control of process equipment and plant trip functions (e.g. drip legs, float switches, etc.)

**Takeaway:**

These types of failures are most often the results of inadequate and/or failure of heat tracing circuitry.

Slide 48

## Condition Variables

The formation of ice in the cooling tower is a risk to the circulating and component cooling water pumps.



What preventative measures could be taken?



Develop cooling tower operating procedures for cold weather that specifies the cycling of fans to minimize the forming of icicles.

48

RELIABILITY | ACCOUNTABILITY

**Key Message:**

**Takeaway-** Ensure continued cooling tower operation minimize the formation of icicles.

## Slide 49

**Condition Variables**

Corroded Freeze Protection Panel

**Discussion Topic:**

What areas should be inspected for possible corrosion?

49

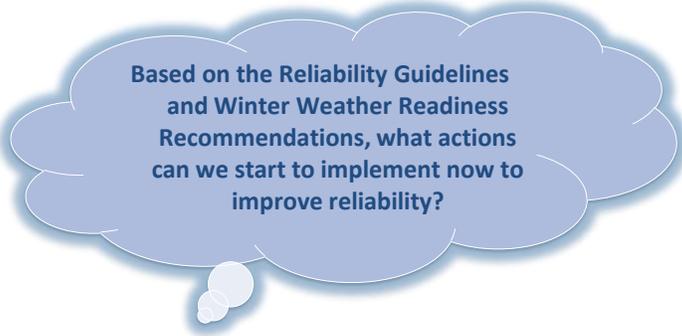
RELIABILITY | ACCOUNTABILITY

**Key Message:**

Inspect and maintain heat-tracing equipment on all generating units. The failure of a freeze protection panel during cold weather can cause heat trace cables connected to that panel to fail. Failure to properly maintain or inspect the panel can cause corroded connections to go unnoticed and go unrepaired, possibly resulting in a short circuit that shuts off power to other panels.

Slide 50

**Practical Application**



Based on the Reliability Guidelines and Winter Weather Readiness Recommendations, what actions can we start to implement now to improve reliability?

**Key Message:**

If you have a local procedure, review and discuss specific activities, you or your position would take to ensure reliability. If no local procedure exists, use the guidelines to determine what would be done to protect your facility from cold weather effects.

Breakout into small groups and brainstorm and identify what can be done to improve reliability.

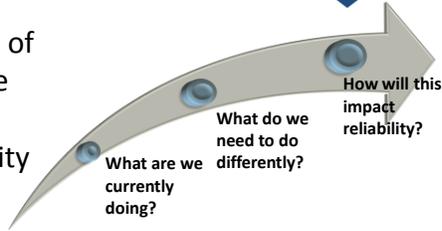
Slide 51



## Reliability Check-up

**Local Reliability Guidelines**

In the spaces provided, list some of the guidelines you currently have in place in your facility based on the areas outlined in the Reliability Guidelines.



Topic	Reliability Recommendation	What can we do to impact reliability?
I.	Safety	
II.	Management Roles	
III.	Evaluation	
IV.	Process and Procedures	
V.	Training	
VI.	Communications	

**Key Message:**

See Instructions on next page

**Practical activity 4:**

**Reliability Checkup**

<b>Estimated Time</b>	20 minutes
<b>Lesson Objective</b>	Participants will identify components of their local Reliability Guidelines to compare them to the guidelines that were recommended in the overall report. During the discussions, individuals should seek areas in which they can improve on their current guidelines and areas where there are no current guidelines and discuss ways to develop guidelines.
<b>Lesson Summary</b>	There have been several Cold Weather events in the past that have lead to outages on the system. In each instances there have been recommendations, and some changes based on those recommendations. To ensure future success, there has to be systems put in place and the processes institutionalized and monitored on a regular basis to ensure reliability.
<b>Materials Required</b>	<ul style="list-style-type: none"> <li>• Reliability Guidelines Recommendations</li> <li>• Practical Activity Handout 4 – Local Reliability Guidelines</li> <li>• Flipchart to Capture thoughts and ideas</li> </ul>
<b>Recommended Activity</b>	<ul style="list-style-type: none"> <li>• Tell the participants they are the subject matter experts in the entity and you are depending on them to identify and discuss potential areas of exposure.</li> <li>• Discuss ways in which to begin to correct improve/reliability in these identified areas.</li> <li>• Capture ideas on flipchart</li> </ul>
<b>Delivery Tips</b>	<ul style="list-style-type: none"> <li>• Be sure to try to cover each of the areas that are specific to your entity.</li> <li>• Also, try to get input and ideas from as many individuals as possible.</li> <li>• Call time even if they were unable to determine responses for each of the designated topics. – DON'T EXCEED planned time.</li> <li>• Any additional comments and or thoughts can be added to the parking lot – provide additional paper, sticky notes for this</li> </ul>

Slide 52 - Transition to Discuss the Attachment 1 of Reliability Guidelines



## Elements of a Winter Weather Preparations Procedure

52

RELIABILITY | ACCOUNTABILITY

**Key Message:**

This attachment provides key points to address in each of the winter weather preparation procedure elements. Including severe winter weather event preparations. These are not all inclusive lists. Individual entities should review their plant design and configurations, identify areas with potential exposure to the elements. Ambient temperatures, or both and tailor their plans to address them accordingly.

## Slide 53



## Attachment 1 – Winterization Process

This [document](#) provides some key points to address in each of the winter weather preparation procedure elements, including severe winter weather event preparedness.

**These are not all inclusive lists.**

Individual entities should review their plant design and configuration, identify areas with potential exposure to the elements, ambient temperatures, or both, and tailor their plans to address them accordingly.

**Key Message:**

Guidelines to begin the process of proper winterization to ensure protection from the elements.

Slide 54



## Attachment 1 – Winterization Process

Elements of a Winter Weather Preparation Procedure:

- Seasonal and severe winter weather event preparedness
- Plants that remain offline during the winter season would not need to perform winterization preparations unless necessary for asset protection and preservation
- Review elements of the procedure and compare to your local procedures.

**Key Message:**

When you are going through each of the panes read some of the text behind the ideas on what should happen during each phase:

Slide 55



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## Elements of Procedure

Work Management System	Critical Instrumentation and Equipment Protection	Process and Procedures: Heat Trace and Other Protection Options
<p>Review to ensure adequate annual preventative work orders exist for freeze protection and preparedness.</p>	<p>Ensure all critical site-specific problems have adequate protection to ensure operability during a severe winter event.</p>	<p>Insulation, heat trace, and other protection options to verify adequate protection and necessary functionality.</p>

**Key Message:**

Discuss each column based on the items identified below – listed for each category

Discuss some (if not all) of the components in each of the categories of the guidelines that are in place to address each of the specific areas outlined in the Elements of the Procedure

Slide 56



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Elements of Procedure

Supplies	Staffing	Communications	Special Operations Instruction
<p>Prior to the onset of the winter season, ensure adequate inventories of all commodities, equipment, and other supplies are available.</p>	<p>Consider enhanced staffing (24x7) during events.</p> <p>Make arrangements for lodging and meals.</p>	<p>Ensure appropriate communication protocols are followed.</p> <p>Identify a back-up communication option.</p>	<p>Test dual fuel capability and ensure adequate fuel supply.</p> <p>Just prior to during a severe winter weather event</p>

**Key Message:**

Discuss each column based on the items identified below – listed for each category

Discuss some (if not all) of the components in each of the categories of the guidelines that are in place to address each of the specific areas outlined in the Elements of the Procedure

---

# Attachment 1

## Elements of a Winter Weather Preparation Procedure<sup>1</sup>

This Attachment provides some key points to address in each of the winter weather preparation procedure elements, including severe winter weather event preparedness. These are not all inclusive lists. Individual entities should review their plant design and configuration, identify areas with potential exposure to the elements, ambient temperatures, or both, and tailor their plans to address them accordingly.

### A. Work Management System

1. Review Work Management System to ensure adequate annual preventative work orders exist for freeze protection, winter weather preparedness, or both.
2. Ensure all freeze protection, winter weather preparedness preventative work orders, or both are completed prior to the onset of the winter season.
3. Review Work Management System for open corrective maintenance items that could affect plant operation and reliability in winter weather and ensure that they are completed prior to the onset of the winter season.
4. As appropriate to your climate, suspend freeze protection measures and remove freeze protection equipment after the last probable freeze of the winter. This may be a plant specific date established by senior management.
5. Ensure all engineered modification and construction activities are performed such that the changes maintain winter readiness for the plant. Newly built plants or engineered modifications can be more susceptible to winter weather.

### B. Critical Instrumentation and Equipment Protection

1. Ensure all critical site specific problem areas (as noted above in section III. Evaluation of Potential Problem Areas) have adequate protection to ensure operability during a severe winter weather event. Emphasize the points in the plant where equipment freezing would cause a generating plant trip, derate, or failure to start.
2. Develop a list of critical instruments and transmitters that require increased surveillance during severe winter weather events.

### C. Insulation, Heat Trace, and Other Protection Options –

Ensure processes and procedures verify adequate protection and necessary functionality (by primary or alternate means) before and during winter weather. Consider the effect of wind chill when applying freeze protection. Considerations include but are not limited to:

1. Insulation thickness, quality and proper installation
  - i. Verify the integrity of the insulation on critical equipment identified in the winter weather preparation procedure. Following any maintenance, insulation should be re-installed to original specifications.
2. Heat trace capability and electrical continuity/ground faults
  - i. Perform a complete evaluation of all heat trace lines, heat trace power supplies (including all breakers, fuses, and associated control systems) to ensure they maintain their accuracy. This inspection may include checking for loose connections, broken wires, corrosion, and other damage to the integrity of electrical insulation which could lead to the heat trace malfunctioning. Measure heat trace amperage and voltage, if possible, to determine whether the circuits are producing the design output. If there are areas where heat tracing is not functional, an alternate means of protection should be identified in the winter weather preparation procedure.

---

<sup>1</sup> Plants that will remain offline during the winter season would not need to perform winterization preparations unless it is necessary for asset protection/preservation.

- ii. Evaluation of heat trace and insulation on critical lines should be performed during new installation, during regular maintenance activities, or if damage or inappropriate installation is identified (i.e., wrapped around the valve and not just across the valve body).
  - iii. Re-install removed or disturbed heat tracing following any equipment maintenance to restore heat tracing integrity and equipment protection.
  - iv. Update and maintain all heat tracing circuit drawings and labeling inside cabinets.
3. Wind breaks
- i. Install permanent or temporary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.
4. Heaters and Heat Lamps
- i. Ensure operation of all permanently mounted and portable heaters.
  - ii. Evaluate plant electrical circuits to ensure they have enough capacity to handle the additional load. Circuits with Ground Fault Interrupters (GFIs) should be continuously monitored to make sure they have not tripped due to condensation.
  - iii. Fasten heaters and heat lamps in place to prevent unauthorized relocation.
5. Covers, Enclosures, and Buildings
- i. Install a box or enclosure with inside heat for some transmitters.
  - ii. Install covers on valve actuators to keep the actuator from accumulating ice.
  - iii. Inspect building penetrations, windows, doors, fan louvers, and other openings for potential exposure of critical equipment to the elements.

**D. Supplemental equipment –**

Prior to the onset of the winter season, ensure adequate inventories of all commodities, equipment and other supplies that would aid in severe winter weather event preparation or response, and that they are readily available to plant staff. Supplemental equipment might include:

- 1. Tarps
- 2. Portable heaters, heat lamps, or both
- 3. Scaffolding
- 4. Blankets
- 5. Extension cords
- 6. Kerosene/propane
- 7. Temporary enclosures
- 8. Temporary insulation
- 9. Plastic rolls
- 10. Portable generators
- 11. Portable lighting
- 12. Instrumentation tubing
- 13. Handheld welding torches
- 14. Ice removal chemicals and equipment
- 15. Snow removal equipment
- 16. Cold weather Personal Protective Equipment (PPE) as appropriate to the respective regions

**E. Operational supplies**

Prior to the onset of a severe winter weather event, conduct an inventory of critical supplies needed to keep the plant operational. Appropriate deliveries should be scheduled based on the severity of the event, lead times, etc. Operational supplies might include:

1. Aluminum Sulfate
2. Anhydrous Ammonia
3. Aqueous Ammonia
4. Carbon Dioxide
5. Caustic Soda
6. Chlorine
7. Diesel Fuel
8. Ferric Chloride
9. Gasoline (Unleaded)
10. Hydrazine
11. Hydrogen
12. Lighter Oil (#2 Diesel)
13. Sulfuric Acid
14. Calibration Gases
15. Lubricating Oils
16. Welding Supplies
17. Limestone

**F. Staffing**

1. Consider enhanced staffing (24x7) during severe winter weather events.
2. Arrange for lodging and meals as needed.
3. Arrange for transportation as needed.
4. Arrange for support and appropriate staffing from responsible entity for plant switchyard to ensure minimal line outages.

**G. Communications**

1. Ensure appropriate communication protocols are followed during a severe winter weather event.
2. Identify a back-up communication option in case the primary system is not working (i.e. satellite phone).
3. Ensure communication is discussed as part of the job safety briefing during a severe winter weather event.

**H. Special Operations Instruction (just prior to or during a severe winter weather event)**

1. Consider employing the “buddy system” during severe winter weather events to promote personnel safety.
2. Institute operator rounds utilizing cold weather checklists to verify critical equipment is protected – i.e. pumps running, heaters operating, igniters tested, barriers in place, temperature gauges checked, etc. i. Monitor room temperatures, as required. Instrumentation and equipment in enclosed spaces (e.g. pump rooms) can freeze.
3. Test dual fuel capability and ensure adequate fuel supply (where applicable).
4. Consider pre-warming, early start-up, or both of scheduled units prior to a forecasted severe winter weather event.

5. Run emergency generators immediately prior to severe winter weather events to help ensure availability. Review fuel quality and quantity.
6. Place in service critical equipment such as intake screen wash systems, cooling towers, auxiliary boilers, and fuel handling equipment where freezing weather could adversely impact operations or forced outage recovery.

Slide 57



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Practical Activity

**Local Procedures Review**

In the spaces provided, list some of the local procedures you currently have in place in your facility based on the areas outlined in Attachment 1.

Local Procedures	Yes/No	Details
Work Management System		
Critical Instrumentations and Equipment Protection (identification of exposure)		
Process and Procedures: Heat Trace and Other Protection Options (missing or broken insulation)		
Supplies		
Staffing		
Communications		
Special Operations Instructions		

**Key Message:**

Follow instructions located on the Practical Activity Handout

**Local Procedures Review**

In the spaces provided, list some of the local procedures you currently have in place in your facility based on the areas outlined in Attachment 1.

**Practical activity:**

**Local Procedure Review**

<b>Estimated Time</b>	<b>15 minutes</b>
<b>Lesson Objective</b>	Participants will identify components of the Winter Weather Preparations Procedures as recommended in the attachment 1 document. During the exercise, individuals should review the documents and procedures that are currently being followed to see where improvements in reliability are be made.
<b>Lesson Summary</b>	Based on the final report, there areas are addressed in a timely and routine manner an entity will reduce the incident of a disruption in their system. Reviewing and preparation will increase reliability.
<b>Materials Required</b>	<ul style="list-style-type: none"> <li>• Recommendations based on list from Attachment 1</li> <li>• Practical Activity Handout 5 – Local Procedures Review</li> <li>• Flip Chart to capture any thoughts and ideas</li> </ul>
<b>Recommended Activity</b>	<ul style="list-style-type: none"> <li>• Tell the participants they are the subject matter experts in the entity and you are depending on them to identify and discuss potential areas of exposure.</li> <li>• Discuss ways in which to begin to correct improve/reliability in these identified areas.</li> <li>• Capture ideas on flipchart or via scribe</li> </ul>
<b>Delivery Tips</b>	<ul style="list-style-type: none"> <li>• Be sure to try to cover each of the areas that are specific to your entity.</li> <li>• Also, try to get input and ideas from as many individuals as possible.</li> <li>• Call time even if they were unable to determine responses for each of the designated topics. – DON'T EXCEED planned time.</li> <li>• Any additional comments and or thoughts can be added to the parking lot – provide additional paper, sticky notes for this</li> </ul>

## Slide 58 – Transition to Lessons Learned



## Lessons Learned

- On August 16, 2011, FERC and NERC released a staff report making recommendations to help prevent a recurrence of rolling blackouts and natural gas curtailments experienced by customers in the Southwest during extreme cold weather the first week of February 2011.
- Concluding a six-month inquiry, the task force found a majority of the electric outages and gas shortages were due to weather-related causes.

**Key Message:**

This section was designed to highlight the lessons learned from the event and to provide guidelines in which to prevent a future event from occurring. As the instructor, lead the team through the lessons learned that are applicable to your registration(s).

**Slide 59 - Transition to Discuss Lessons Learned**



**Reports on the Event**

There were many contributing factors leading up to the outage. Review the [Analysis, News Release, and FERC/NERC Staff Report](#) to gain more insight.

**Key Message:**

Slide 60



Practical - NERC Lessons Learned

Review the Lessons Learned based on applicable audience.

- Talk through the Lessons Learned.
  - Question and Answer session
- Discuss how a similar situation could have happened in your facility.
- Discuss what steps can be taken to prevent a comparable occurrence in your facility.

Lessons Learned Developed in response to the Cold Weather Event of February 1–5, 2011

"audience" indicates appropriate audience for the Lesson Learned -

TOPIC	Target Audience											
	Transmission Owners	Transmission Operators	Load Serving Entities	Distribution Providers	Generator Owners	Generator Operators	Reliability Coordinators	Balancing Authority	Plant Owners	Plant Operators	Interchange Authority	Purchase-Selling Entity
Rotation Load Shed	Audience	Audience	Audience	Audience								
Transmission Facilities and Winter Weather Operations	Audience	Audience			Audience	Audience						
Plant Fuel Switching Cold Weather							Audience	Audience	Audience	Audience		
Generating Unit Temperature Design Parameters and Extreme Weather Conditions					Audience	Audience	Audience	Audience				
Adequate Maintenance and Inspection of Generator Freeze Protections					Audience	Audience						
Plant Instrument and Sensing Equipment due to heat trace and Insulation failures					Audience	Audience						
Plant On-Site Material & Personnel needed for a Winter Weather Event					Audience	Audience						
Plant Operator Training and Prepare for a Winter Weather Event					Audience	Audience		Audience				
Capacity Awareness During an Energy Emergency Event	Audience	Audience			Audience	Audience	Audience	Audience			Audience	Audience
Winter Storm Inlet Air Duct Icing					Audience	Audience						
Wind Farm Inter Storm Issues					Audience	Audience		Audience				
Transformer Oil Level Issues During Cold Weather	Audience	Audience			Audience	Audience		Audience				
Gas and Electric Interdependency					Audience	Audience	Audience	Audience				

Prior to class print and make copies for review and discussions

Slide 61



## NERC Lessons Learned

Review and discuss each [Lesson Learned](#) based on corresponding interest groups.

61

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**Key Message:**

Slide 62

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## Summary of NERC Lessons Learned

<p><b><u>Rotational Load Shed</u></b> Primary Interest Groups: Transmission Owners, Transmission Operators, Load-Serving Entities, Distribution Providers</p>	<p><b><u>Transmission Facilities and Winter Weather Operations</u></b> Primary Interest Groups: Generator Owners, Generator Operators, Transmission Owners, Transmission Operators</p>	<p><b><u>Plant Fuel Switching and Cold Weather</u></b> Primary Interest Groups: Reliability Coordinators, Balancing Authorities, Plant Owners, Plant Operators</p>
<p><b><u>Generating Unit Temperature Design Parameters and Extreme Weather Conditions</u></b> Primary Interest Groups: Generator Owners, Generator Operators, Balancing Authorities, Reliability Coordinators</p>	<p><b><u>Adequate Maintenance and Inspection of Generator Freeze Protection</u></b> Primary Interest Groups: Generators Owners, Generator Operators</p>	<p><b><u>Plant Instrument and Sensing Equipment Freezing due to Heat Trace and Insulation Failures</u></b> Primary Interest Groups: Generator Owners, Generator Operators</p>
<p><b><u>Plant Onsite Material and Personnel Needed for a Winter Weather Event</u></b> Primary Interest Groups: Generator Owners, Generator Operators</p>	<p><b><u>Southwest Cold Weather Event</u></b></p>	<p><b><u>Plant Operator Training to Prepare for a Winter Weather Event</u></b> Primary Interest Groups: Generator Owners, Generator Operators, Balancing Authorities</p>

62

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 63



Practical Activity



### Cold Weather Event: Discussion Questions

*Handout 5: Review/Overview of training content*

1. Identify the contributing factors that caused the event, as described in the event report.
  - List the weather conditions that contributed to the loss of generation during the February 2011 SW cold weather event.
  - Approximately how many generating units and how much load was shed as a result of cold weather?
  - Explain why previous experience with severe cold weather did not help prevent the loss of generation experienced during the February 2011 SW cold weather event.
  - Why did cold weather have such a significant impact on so many generating units during the February 2011 event?
2. Discuss potential *threats* in their respective work environments.
  - List typical generating unit equipment or components that can be affected by cold weather that contributed to reduced generation
  - What components at stations in your system could be susceptible to cold weather effects
  - Discuss how your system could be affected by a period of unusually cold weather
  - What are some of the key lessons learned from this event?
  - What areas of your facility are most susceptible to cold weather?
3. Describe programmatic actions to prevent such occurrences from taking place in the future at their facility using local procedures.
  - What processes are in place at your facility to prevent adverse affects of cold weather
  - What activities or programs does your facility use to ensure it is ready for the cold weather season?
  - Describe the main components of the Cold Weather Reliability Guideline
4. Identify preventative actions that can be taken when faced with a cold weather disturbance.
  - You hear on local news forecast that three days from now your area will experience 3 days with very windy conditions and maximum temps of 28 degrees [F]. What actions would your facility take to prepare? (your normal lowest temperature is typically 42 degrees)
  - What are your crew's responsibilities for an impending cold weather event?
  - Identify key locations and components to check for impending cold weather
  - What communications/reports should be made within your system
  - What coordination is appropriate to ensure system reliability?

### Discussion Questions From Lessons Learned Review

**Key Message:**

Slide 64



## Review Local Procedures and Drafts

64

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 65



## Reference Material

- [Southwest Cold Weather Event Final](#)
- [Southwest Cold Weather Event NERC Reference Material](#)
- [NERC Winter Readiness Reliability Guideline](#)
- [PUCT Substantive Rule Chapter 25](#)

65

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 66

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**Questions and Answers**

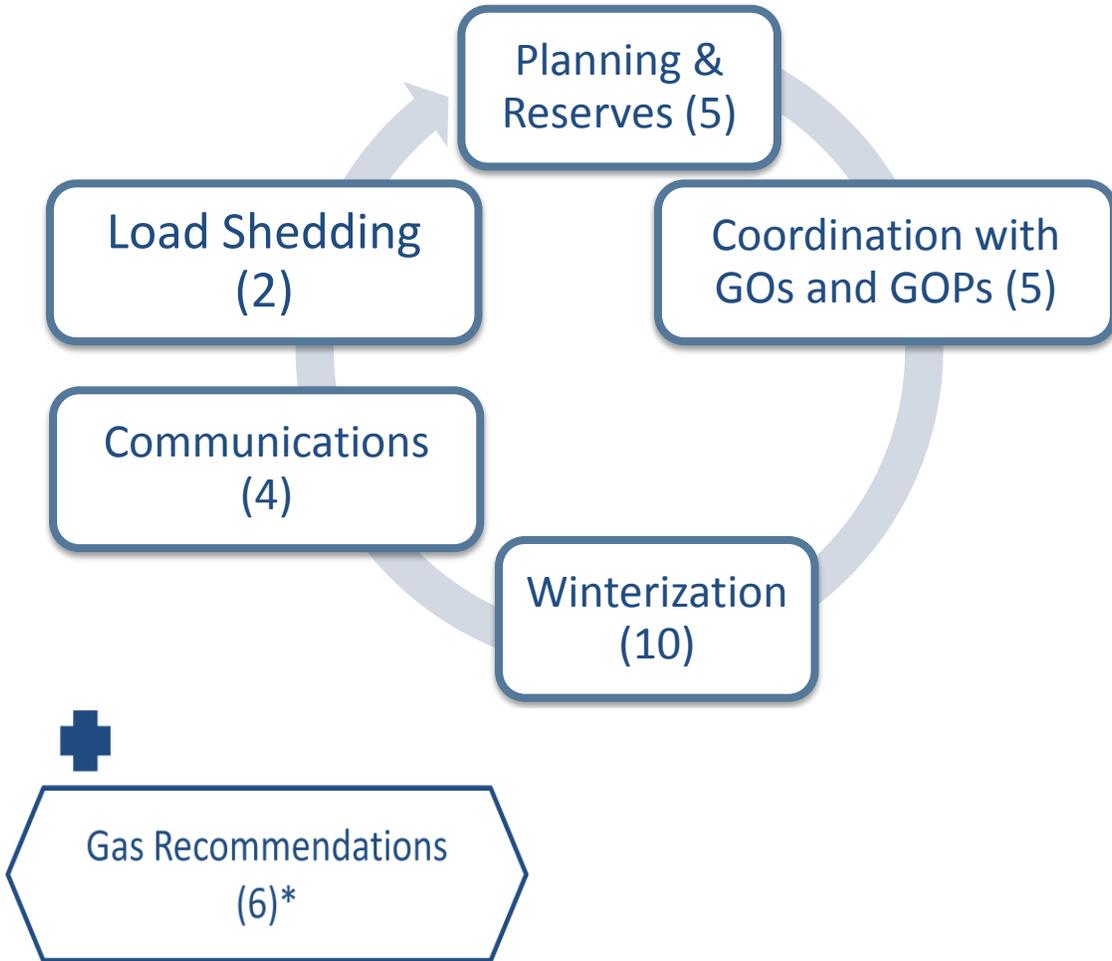
66

RELIABILITY | ACCOUNTABILITY

Handout 1:

Practical Activity

26 Electrical & 6 Gas Recommendations



**RECOMMENDATIONS**

**Planning – 5**


**Coordination – 5**


**Winterization – 10**


**Communications – 4**


**Load Shedding – 2**


**Gas Recommendations – 6**


**Handout 2: Evaluate Potential Problem Areas 14**

In the spaces provided, list some of the systems in your facility that could potentially be affected by cold weather in the Potential Problem areas identified.

Potential Problem	Local Areas of concern:
Initiate an automatic unit trip	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Impact unit start-up	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> </ul>
Initiate automatic unit runback schemes and/or cause partial outages	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Cause damage to the unit	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Adversely affect environmental controls that could cause full or partial outages	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Adversely affect the delivery of fuel or water to the units	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Cause other operational problems such as slowed or impaired field devices	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Create a safety hazard	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>

**Handout 3: Local Procedures Designate Typical Problem Areas**

In the spaces provided, identify areas in your facility that could potentially be affected by cold weather, base on the Frequent Problems Areas noted in the report. Indicate type and location if available.

#	Local Frequent Problem Areas	Locations and Identification codes in our facility to "Check" before Cold Weather Event
1	Pressure Transmitters and Sensing Lines	
2	Flow Transmitters and Sensing Lines	
3	Instrument Air System	
4	Motor-Operated and Solenoid Valves	
5	Drain Lines and Steam Vents	
6	Emergency Generators	
7	Water Pipes and Fire Suppression Systems	
8	Fuel Supply	

**Handout 4: Local Reliability Guidelines**

In the spaces provided, list some of the guidelines you currently have in place in your facility based on the areas outlined in the Reliability Guidelines:

Reliability Recommendations	What can we do to impact reliability?
Safety	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Management Roles	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Evaluate Potential Problem Areas (PPA's)	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Process & Procedures	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Training	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>
Winter Event Communications	<ul style="list-style-type: none"> <li>•</li> <li>•</li> <li>•</li> <li>•</li> </ul>

**Handout 5: Local Procedures Review**

In the spaces provided, list some of the local procedures you currently have in place in your facility based on the areas outlined in Attachment 1:

Local Procedures	Yes/No	Details
Work Management System	Yes/No	
Critical Instrumentations & Equipment Protection	Yes/No	
Process and Procedures:	Yes/No	
Heat Trace & Other Protection Options	Yes/No	
Supplies	Yes/No	
Staffing	Yes/No	
Communications	Yes/No	
Special Operations Instructions	Yes/No	

Chart Sheet for Lessons Learned Targeted Audiences:



**NERC**  
NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

# Lesson Learned Review

**Lessons Learned Developed in response to the Cold Weather Event of February 1–5, 2011**

"audience" indicates appropriate audience for the Lesson Learned -

TOPIC	Target Audience											
	Transmission Owners	Transmission Operators	Load/Serving Entities	Distribution Providers	Generator Owners	Generator Operators	Reliability Coordinators	Balancing Authority	Plant Owners	Plant Operators	Interchange Authority	Purchase-Selling Entity
Rotation Load Shed	Audience	Audience	Audience	Audience								
Transmission Facilities and Winter Weather Operations	Audience	Audience			Audience	Audience						
Plant Fuel Switching Cold Weather							Audience	Audience	Audience	Audience		
Generating Unit Temperature Design Parameters and Extreme Weather Conditions					Audience	Audience						
Adequate Maintenance and Inspection of Generator Freeze Protections					Audience	Audience						
Plant Instrument and Sensing Equipment due to heat trace and Insulation failures					Audience	Audience						
Plant On-Site Material & Personnel needed for a Winter Weather Event					Audience	Audience						
Plant Operator Training and Prepare for a Winter Weather Event					Audience	Audience		Audience				
Capacity Awareness During an Energy Emergency Event	Audience	Audience			Audience	Audience	Audience	Audience			Audience	Audience
Winter Storm Inlet Air Duct Icing					Audience	Audience						
Wind Farm Inter Storm Issues					Audience	Audience		Audience				
Transformer Oil Level Issues During Cold Weather	Audience	Audience			Audience	Audience		Audience				
Gas and Electric interdependency					Audience	Audience	Audience	Audience				

Prior to class print and make copies for review and discussions

Practical - NERC Lessons Learned

- Review the Lessons Learned based on applicable audience.
- Talk through the Lessons Learned.
    - Question and Answer session
  - Discuss how a similar situation could have happened in your facility.
  - Discuss what steps can be taken to prevent a comparable occurrence in your facility.

Slide 67



## Supplemental Photos

- Pictures of
  - Good winterization practices
  - What can happen if facility is not properly winterized
  - Measures to take to prevent or protect equipment

**Key Message:**

Slide 68

## Effective Countermeasures

### Countermeasure – Critical Valves & Sensing Lines

#### Install Insulation Blankets and Monitor Valve Performance



Insulation blankets are installed for all critical MOVs and other control valves.

**Takeaway:** Keeping critical valves and associated actuators insulated will ensure continued reliability.

**Key Message:**

Slide 69

## Effective Countermeasures

### Countermeasure – Sensing Line Heat Trace Improvement

OLD  
MI cable insulation



MI Heat Trace is easily broken and generally not insulated well.

NEW  
Upgraded Heat Trace



Upgraded Heat Trace is not easily broken and has better insulating qualities.

**Takeaway:** Consider upgrading MI heat tracing with more robust protection on critical transmitter sensing lines (e.g. drum level, feedwater flow, etc.)

12

**Key Message:**

Slide 70



## Cold Weather Challenges

The following slides will illustrate what went wrong during a cold weather event.

70

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 71



## Proactive vs. Reactive Preparation



**What preventative  
measures could have  
been taken?**

Access to equipment after the fact can be very difficult.

71

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 72

## Equipment-related Failure



**Inspect and maintain thermal insulation on all units.**

**Elevated Instrument Air Dew Point:**

High moisture levels in instrument air systems can cause air operating valve actuator freeze-ups and corresponding valve malfunctions.

72

RELIABILITY | ACCOUNTABILITY

**Key Message:**

## Slide 73

**Frozen Motors**

Excessive equipment  
vibration

Cool lubricating oil and grease temperatures cause elevated bearing vibrations that can result in the tripping of critical motors and pumps. This can also cause either trips or runbacks, or both.

73

RELIABILITY | ACCOUNTABILITY

**Key Message:**

## Slide 74



### Most Common Cold Weather Impacts

#### Process Related Failures

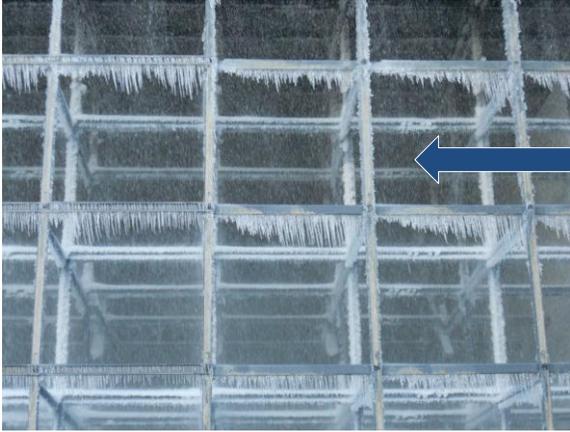
- Lack of a Cold Weather Preparation Process / Procedures:  
There exists a normal list of tasks that should be performed prior to any cold weather opportunity that outlines the critical preparation activities that must be done to ensure reliability.
- Lack of a Cold Weather Inspection of Watch Procedure:  
Lack of specific IOW procedures may result in the lack of consistency in execution. This increases the risk of imminent equipment failure.

**Takeaway:** Detailed Procedures are necessary to facilitate the comprehensive assessment of critical equipment for reliable cold weather operation.

#### Key Message:

Slide 75

## Icing on Cooling Tower



**What preventative  
measures can be taken?**

Develop cooling tower operating procedures for cold weather that specify the cycling of fans to minimize the forming of icicles.

The formation of ice in the cooling tower is a risk to the circulating and component cooling water pumps.

75

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 76

**Frozen Valves**

Inspect and maintain thermal insulation on all units.



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

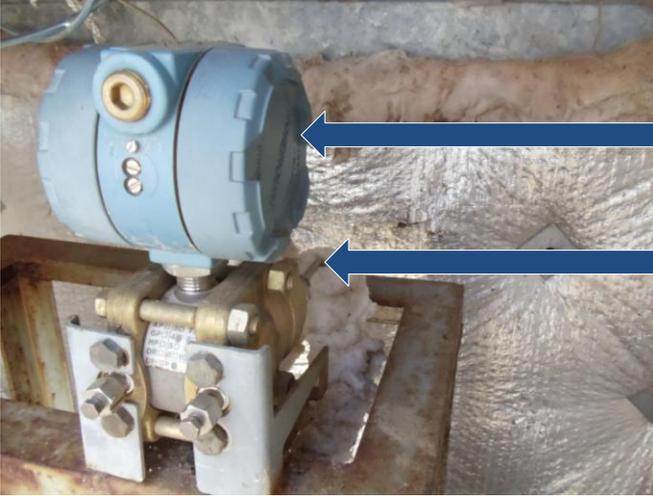
76

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 77

**Frozen Sensors**



Aerator Sensor

3/8-inch exposed  
tubing

Ensure that adequate maintenance and inspection of freeze protection elements is conducted on a timely and repetitive basis.

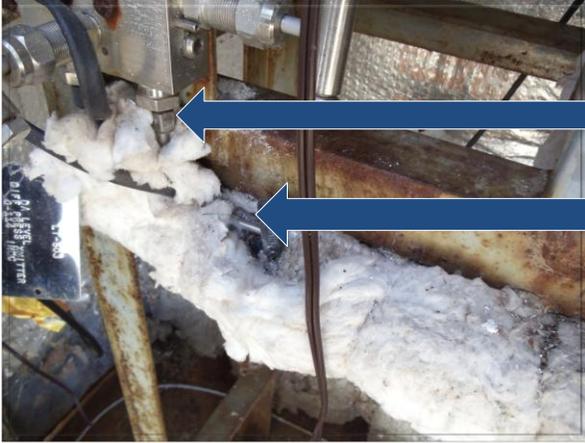
77

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 78

## Inadequate Insulation



Exposed pipes

78

RELIABILITY | ACCOUNTABILITY

Key Message:

Slide 79

**Lack of Insulation**



Burn marks from  
torch on bare tube

Outside exposure

**Key Message:**

Slide 80

**Wind Break Design**



Wind break was too short.



Feedwater  
sensor  
frozen

Wind  
break

80

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 81

## Corroded Freeze Protection Panel



81

RELIABILITY | ACCOUNTABILITY

**Key Message:**

Slide 82

**Oil-burning Wands**



Electronic heads were corroded and had not been used for five years.

82

RELIABILITY | ACCOUNTABILITY

Key Message:

Slide 83

## Fuel Transfer Valves



Frozen valve

83

RELIABILITY | ACCOUNTABILITY

Key Message:

Slide 84



**Reliability**

## What can you improve today?

84

RELIABILITY | ACCOUNTABILITY

**Key Message:**

## Slide 85

**Summary:**

- Identified the contributing factors that caused the event and consequences, as described in the event report.
- Discussed potential cold weather vulnerabilities in respective work environments.
- Identified preventative actions that can be taken when faced with infrequent cold weather disturbances.
- Addressed steps to take when faced with cold weather conditions.
- Advanced protections for cold weather.

**Key Message:**