NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Guideline

Generating Unit Winter Weather Readiness – Current Industry Practices – Version 2

Preamble:

The NERC Operating Committee (OC), Planning Committee (PC) and Critical Infrastructure Protection Committee (CIPC) develop Reliability (OC and PC) and Security (CIPC) Guidelines, which include the collective experience, expertise and judgment of the industry. The objective of the reliability guidelines is to distribute key practices and information on specific issues critical to promote and maintain a highly reliable and secure bulk power system (BPS). Reliability guidelines are not binding norms or parameters to the level that compliance to NERC's Reliability Standards are monitored or enforced. Rather, their incorporation into industry practices is strictly voluntary. Reviewing, revising, or developing a program using these practices is highly encouraged.

Purpose:

This reliability guideline is applicable to electricity sector organizations responsible for the operation of the BPS. 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. This document is a collection of industry practices compiled 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 to promote and achieve the highest levels of reliability for these high impact weather events.

Assumptions:

1. Each BPS Generator Owner (GO) and Generator Operator (GOP) is responsible and accountable for maintaining generating unit reliability.
2. Balancing Authorities (BAs) and Market Operators should consider strategies to start-up and dispatch to minimum load prior to anticipated severe cold weather units that are forecasted to be needed for the surge in demand, since keeping units running through exceptional cold snaps can be accomplished much more reliably than attempting start-up of offline generation during such events. Entities should develop and apply plant-specific winter weather readiness plans, as appropriate, based on factors such as geographical location, technology and plant configuration.

Guideline Details:

An effective winter weather readiness procedure, which includes severe winter weather event preparedness, should generally address the following components: (I) Safety; (II) Management Roles and Expectations; (III) Processes and Procedures; (IV) Evaluation of Potential Problem Areas with Critical Components; (V) Testing; (VI) Training; and (VII) Communications.

I. Safety

Safety remains the top priority during winter weather events. Job safety briefings should be conducted during preparation for and in response to these events. Robust safety programs to reduce risk to personnel include identifying hazards involving cold weather such as personnel exposure risk, travel conditions, and slip/fall issues due to icing. A Job Safety Analysis (JSA) should be completed to address the exposure risks, travel conditions and slips/falls related to icing conditions. Winter weather Alerts should be communicated to all impacted entities. A Business Continuity and Emergency Response Plan should also be available and communicated in the event of a severe winter weather event.

II. Management Roles and Expectations

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.

1. Senior Management
    a. Set expectations for safety, reliability, and operational performance.
    b. Ensure that a winter weather preparation procedure exists for each operating location.
    c. Consider a fleet-wide annual winter preparation meeting, training exercise, or both to share best practices and lessons learned.
    d. Share insights across the fleet and through industry associations (formal groups or other informal networking forums).
2. Plant Management
    a. Develop a winter weather preparation procedure and consider appointing a designee responsible for keeping this procedure updated with industry identified best practices and lessons learned.
    b. Ensure the site specific winter weather preparation procedure includes processes, staffing plans, and timelines that direct all key activities before, during, and after severe winter weather events.
    c. Ensure proper execution of the winter weather preparation procedure.
    d. Conduct a plant readiness review prior to an anticipated severe winter weather event.
    e. Encourage plant staff to look for areas at risk due to winter conditions and bring up opportunities to improve readiness and response.
    f. Following each winter, conduct an evaluation of the effectiveness of the winter weather preparation procedure and incorporate lessons learned.

III. Processes and Procedures

A winter weather preparation procedure should be developed for seasonal winter preparedness. Components of an effective winter weather preparation procedure are included as Attachment 1.

After a severe winter weather event, entities should utilize a review process to formally recognize procedural strengths, evaluate improvement opportunities, and identify and incorporate lessons learned within applicable procedures. Changes to the procedure and lessons learned must be communicated to the appropriate personnel.

IV. Evaluation of Potential Problem Areas with Critical Components

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

This includes critical instrumentation or equipment that has the potential to:

1. Initiate an automatic unit trip,
2. Impact unit start-up,
3. Initiate automatic unit runback schemes or cause partial outages,
4. Cause damage to the unit,
5. Adversely affect environmental controls that could cause full or partial outages,
6. Adversely affect the delivery of fuel or water to the units,
7. Cause operational problems such as slowed or impaired field devices, or
8. Create a weather-related safety hazard

Based on previous cold weather events, a list of typical problem areas are identified below. This is not meant to be an all-inclusive list. Individual entities should review their plant design and configuration, identify areas with critical components' potential exposure to the elements, ambient temperatures, or both and tailor their plans to address them accordingly.

1. Critical Level Transmitters
    a. Drum level transmitters and sensing lines
    b. Condensate tank level transmitters and sensing lines
    c. De-aerator tank level transmitters and sensing lines
    d. Hotwell level transmitters and sensing lines
    e. Fuel oil tank level transmitters/indicators
2. Critical Pressure Transmitters
    a. Gas turbine combustor pressure transmitters and sensing lines
    b. Feed water pump pressure transmitters and sensing lines
    c. Condensate pump pressure transmitters and sensing lines
    d. Steam pressure transmitters and sensing lines
3. Critical Flow Transmitters

   a. Steam flow transmitters and sensing lines
   b. Feed water pump flow transmitters and sensing lines
   c. High pressure steam attemperator flow transmitters and sensing lines
4. Instrument Air System
   a. Automatic blow downs, traps, dew point monitoring, and instrument air dryers are functioning correctly.
   b. Low point drain lines are periodically drained by operators to remove moisture during extreme cold weather.
5. Motor-Operated Valves, Valve Positioners, and Solenoid Valves
6. Drain Lines, Steam Vents, and Intake Screens
7. Water Pipes and Fire Suppression Systems[1]
   a. Low/no water flow piping systems
8. Fuel Supply and Ash Handling
   a. Coal piles and coal handling equipment
   b. Transfer systems for backup fuel supply
   c. Gas supply regulators, other valves, and instrumentation (may require coordination with gas pipeline operator)
   d. Ash disposal systems and associated equipment
9. Tank Heaters
   a. Conduct initial tests
   b. Check availability of spare heaters
   c. Record current tanks indicators for SBS injection systems, flue gas desulfurization systems, dibasic acid additives, mercury control additives, etc.

Potential vulnerabilities associated with emergency generators, including Blackstart Resources, should be evaluated when developing the site specific winter weather preparation procedure, as they may provide critical system(s) backup.

V. Testing[2]

In addition to the typical problem areas identified above, emphasis should be placed on the testing of low frequency tasks such as startup of emergency generators, where applicable.

[1] For safety reasons, fire protection systems should also be included in this identification process. These problem areas should be noted in the site specific winter weather preparation procedure.
[2] See Attachment 1, Section 8 "Special Operations Instruction" for more information

VI. Training

Coordinate annual training in winter specific 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, fuel switching procedures, 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.

1. Consider holding a winter readiness meeting on an annual basis to highlight preparations and expectations for severe cold weather.
2. Operations personnel should review cold weather scenarios affecting instrumentation readings, alarms, and other indications on plant control systems.
3. Ensure appropriate NERC Generation Availability Data Systems (GADS) coding for unit derates or trips as a result of 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.”

VII. Winter Event Communications

Clear and timely communication is essential to an effective program. Key communication points should include the following:

1. Before a severe winter weather event, plant management should communicate with their appropriate senior management that the site specific winter weather preparation procedure, checklists, and readiness reviews have been completed.
2. Before and during a severe winter weather event, communicate with all personnel about changing conditions and potential areas of concern to heighten awareness around safe and reliable operations.
3. Before and during a severe winter weather event, the affected entity(ies) will keep the BA up to date on changes to plant availability, capacity, or other operating limitations. Depending on regional structure and market design, notification to the Reliability Coordinator (RC) and Transmission Operator (TOP) may also be necessary.
4. After a generating plant trip, derate, or failure to start due to severe winter weather, Plant Management, as appropriate, should conduct an analysis, develop lessons learned, and incorporate good industry practices.
    a. This process should include a feedback loop to enhance current winter weather readiness programs, processes, procedures, checklists and training (continuous improvement).
    b. Sharing of technical information and lessons learned through the NERC Event Analysis Program or some other method is encouraged.

Related Documents and Links:

1. *Report on Outages and Curtailments during the Southwest Cold Weather Event of February 1-5, 2011*, dated August 2011, Federal Energy Regulatory Commission and North American Electric Reliability Corporation
2. *Winter Weather Readiness for Texas Generators*, dated April 13, 2011, Calpine, CPS Energy, LCRA, Luminant, and NRG Energy
3. *Electric Reliability Organization Event Analysis Process*, dated January 2017, ERO Event Analysis Process and associated Lessons Learned
4. Previous Cold Weather Reports

Revision History:

Date	Version	Reason/Comments
12/03/2012	1.0	Initial Version – *Winter Weather Readiness* *(Approved by the Operating Committee March 5, 2013)*
06/05/2017	2.0	Three year document review per the OC Charter *(Approved by the Operating Committee August 23, 2017)*

Elements of a Winter Weather Preparation Procedure[3]

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 of potential exposure to the elements and ambient temperatures, and tailor their plans to address them accordingly.

1. Work Management System
   a. Review Work Management System to ensure adequate annual preventative work orders exist for freeze protection and winter weather preparedness.
   b. Ensure all freeze protection and winter weather preparedness preventative work orders are completed prior to the onset of the winter season.
   c. 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.
   d. 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.
   e. 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.
2. Critical instrumentation and equipment protection
   a. Ensure all critical site specific problem areas (as noted above in section IV. Evaluation of Potential Problem Areas with Critical Components) 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.
   b. Develop a list of critical instruments and transmitters that require maintenance prior to winter and increase surveillance during severe winter weather events.
3. 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:
   a. Insulation thickness, quality and proper installation

[3] Plants that will remain offline during the winter season would not need to perform winterization preparations unless it is necessary for asset protection/preservation.

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.

b. 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. Label heat tracing and insulation in the field in reference to the circuit feed panel to reduce troubleshooting and repair times. This inspection may include checking for loose connections, broken wires, corrosion, and other damage to the integrity of electrical insulation that could lead to 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.

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).

(1) For example, inspect heat tracing before it is covered by insulation, to confirm that the extra cable length specified by the designer, for the purpose of being concentrated at valves and supports, has not been applied as a constant-pitch spiral over the length of the line.

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.

v. Require a report of calculations from the heat tracing contractor and ensure that their design basis is consistent with the insulation that will be applied with regards to exposure of valve bonnets, actuator, and pipe supports.

c. Wind breaks

i. Install permanent or temporary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.

d. 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.

e. Covers, enclosures, and buildings

i. Enclose cold-weather sensitive critical transmitters in enclosures with local heating elements.

ii. Install covers on valve actuators to prevent ice accumulation.

iii. Inspect building penetrations, windows, doors, fan louvers, and other openings for potential exposure of critical equipment to the elements.

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

   a. Tarps
   b. Portable heaters, heat lamps, or both
   c. Scaffolding
   d. Blankets
   e. Extension cords
   f. Kerosene/propane
   g. Temporary enclosures
   h. Temporary insulation
   i. Plastic rolls
   j. Portable generators
   k. Portable lighting
   l. Instrumentation tubing
   m. Handheld welding torches
   n. Ice removal chemicals and equipment
   o. Snow removal equipment
   p. Cold weather personal protective equipment (PPE) available to personnel as appropriate.
   q. Properly winterized service vehicles functioning 4WD

5. 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:

   a. Aluminum sulfate
   b. Anhydrous ammonia
   c. Aqueous ammonia
   d. Carbon dioxide

   e. Caustic soda
   f. Chlorine
   g. Diesel fuel
   h. Ferric chloride
   i. Gasoline (unleaded)
   j. Hydrazine
   k. Hydrogen
   l. Sulfuric acid
   m. Calibration gases
   n. Lubricating oils (lighter grades or synthetic)
   o. Welding supplies
   p. Limestone
6. Staffing (as necessary)
   a. Enhanced staffing (24x7) during severe winter weather events.
   b. Arrangements for lodging and meals.
   c. Arrangements for transportation.
   d. Arrangements for support and appropriate staffing from responsible entity for plant switchyard to ensure minimal line outages.
   e. Arrangements for storage of in-house food inventories for extended work shifts.
   f. Arrangements for on-site lodging during severe winter weather events.
7. Communications
   a. Identify appropriate communication protocols to follow during a severe winter weather event.
   b. Identify and verify operations of a back-up communication option in case the Interpersonal Communications capability is not available (i.e. satellite phone).
   c. Include availability of Interpersonal Communication capability and available back-up communication options in job safety briefing for severe winter weather events.
8. Special operations instruction (just prior to or during a severe winter weather event)
   a. Utilize the “buddy system” during severe winter weather events to promote personnel safety.
   b. Utilize 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, so that instrumentation and equipment in enclosed spaces (e.g. pump rooms) don’t freeze.

c. Test dual fuel capability where applicable. Identify alternate suppliers of fuel as necessary. Ensure that alternate fuel suppliers are capable of delivering required quantities of fuel during adverse winter conditions

d. Initiate pre-warming and/or early start-up, of scheduled units prior to a forecasted severe winter weather event.

e. Run emergency generators immediately prior to severe winter weather events to help ensure availability. Review fuel quality and quantity.

f. 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.