

Attachment N: Cold Weather Preparation Guideline and Checklist

N.1 Introduction

Based on previous cold weather events the following is meant to provide generators with a guide to lessen and optimistically eliminate these and similar problems during future cold weather events. The list of suggestions and typical problem areas is not meant to be all inclusive. Individual Generation Owners should review their Generating Facility design and configuration, identify areas with potential exposure to the elements, ambient temperatures, or both, and tailor their plans to address them accordingly.

Generation Owners should also use past experiences at the Generating Facility to identify the potential for freezing issues (including potential fuel concerns) and notify PJM if potential measures to address the issue are not available.

This Attachment has been updated to improve alignment with the guidance provided in NERC Generating Unit Winter Weather Readiness Guideline, Revision 4.

N.2 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:

Senior Management

Set expectations for safety, reliability, and operational performance

Ensure that a winter weather preparation procedure exists for each operating location

Consider a fleet-wide annual winter preparation meeting, training exercise, or both to share best practices and lessons learned

Share lessons learned across the fleet and through industry associations (formal groups or other informal networking forums)

Note: Generation Owners are responsible for ensuring that generation resources are properly prepared for cold weather operation, even if the Generating Facility is managed and/or operated by a third party.

Plant Management

Ensure development of a cold/winter weather preparation program and consider appointing a designee responsible for keeping its processes and procedures updated with industry identified best practices and lessons learned

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

Ensure proper execution of the winter weather preparation procedures

Conduct a Generating Facility readiness review prior to an anticipated severe winter weather event

Encourage Generating Facility staff to look for areas at risk due to winter conditions and bring up opportunities to improve readiness and response

Following each winter, conduct an evaluation of the effectiveness of the winter weather preparation procedure and incorporate lessons learned

N.3 Pre-Winter Season Items - All Generating Facilities

Based on previous cold weather events, a list of typical problem areas is provided below. This is not meant to be an all-inclusive list. The list has been split into two sections to assist with the identification of issues seen at conventional generators and inverter-based resources. Generation Owners should review their Generating Facility design and configuration, identify areas where critical components' potential exposure to the elements, ambient temperatures, or both might cause issues and tailor their plans to address them accordingly.

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 Generating Facilities.

A business continuity and emergency response plan should also be available and communicated in the event of a severe winter weather event. Review snow removal and de-icing plans, especially for wind and solar facilities. Regularly assess potential safety hazards that may be introduced by the presence or accumulation of snow/ice.

Training

Generation Owners should coordinate annual training in winter specific, Generating Facility-specific awareness, and maintenance training. This should include:

- response to freeze protection panel alarms,
- troubleshooting and repair of freeze protection circuitry,
- identification of Generating Facility 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](#).

Personnel Preparation

- Hold winter readiness meetings on an annual basis to prepare for severe cold weather operation before the winter begins highlighting preparations and expectations.
- Assign, prioritize and schedule tasks.
- Review and act on lessons learned from prior cold weather operation.

Communications

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

Maintain Substation Equipment

- Ensure that the SF6 gas in breakers and metering and other electrical equipment is at the correct pressure and temperature to operate safely during extreme cold, and also perform annual maintenance that tests SF6 breaker heaters and supporting circuitry to assure that they are functional.
- Maintain the operation of power transformers in cold temperatures by checking heaters in the control cabinets, verifying that main tank oil levels are appropriate for the actual oil temperature, checking bushing oil levels, and checking the nitrogen pressure if necessary.
- Determine the ambient temperature to which equipment, including fire protection systems, is protected (taking into account the accelerated cooling effect of wind), and ensure that temperature requirements are met during operations.

N.4 Equipment Preparation - Conventional Generating Facilities

Identify and prioritize components, systems, and other areas of vulnerability that may experience freezing problems or other cold weather operational issues.¹¹

Prepare and review Generating Facility-specific emergency operating plans for winter weather. Review cold weather scenarios affecting equipment, taking into account the effects of precipitation and wind. Include review of systems, equipment, or protection systems that may have been changed or have degraded over time. Ensure all engineered modification and construction activities are performed such that the changes maintain winter readiness for the Generating Facility.

Schedule any routine cold weather inspections, repairs, and winterization work to be completed prior to the local seasonal freeze date. Depending on the Generating Facility, further checks and winterization activities might be needed prior to forecasted extreme weather events as described below,

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Winterization efforts should include addressing critical components and systems that have the potential to:

- Initiate an automatic unit trip,
- Impact unit start-up,
- Initiate automatic unit runback schemes 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, or
- Create a safety hazard.

Perform a walk down of the Generating Facility to correct identify:

- Broken/damaged/degraded doors and windows.
- Degraded missing lagging on exterior piping.
- Heat tracing equipment damage.
- Damaged instrument air lines,
- Locations of standing water.

¹¹ https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline_Generating_Unit_Winter_Weather_Readiness_v4.pdf

- Erect secondary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.
- Evaluate piping insulation and correct deficiencies that may allow water infiltration which would result in freezing during cold weather.
- Install heated blankets on critical water lines as required to prevent freezing.
- Drain any non-critical service water lines in anticipation of severe cold weather.
- Check heat tracing on critical lines and pipes monitored throughout winter weather events to ensure the circuits are functional.
- Evaluate the use of infrared cameras, and other technologies, to inspect critical heat circuits.
- Place thermometers in rooms containing equipment sensitive to cold and in freeze protection enclosures to ensure that temperature is being maintained above freezing and to determine the need for additional heaters or other freeze protection devices. Pre-position heaters in known problem areas.
- Evaluate whether there is sufficient electrical circuits and capacity to operate portable heaters, and perform preventive maintenance on all portable heaters prior to cold weather.
- Install temporary heaters and ducting as required to prevent the formation of ice and snow on the surface of air inlet filters.
- Consider pre-warming, operating at full speed no load, early start-up, and/or putting on turning gear scheduled units prior to a forecasted severe winter weather event.
- Prepare units that have been off line for lengthy periods of time for start-up and operation during severe winter weather events.
- Develop cooling tower operating procedures for cold weather that specifies the cycling of fans to minimize the forming of icicles.
- Monitor instrument air systems year - round and maintain or upgrade instrument air drying systems as required to ensure a continuous supply of moisture-free instrument air to control valve actuators, etc.
- Develop a plan for the removal of debris at Generating Facility's intake structure given the potential of freezing conditions.
- Consider issues that could result in slowed valve/damper operation.
- Store lube oil and greases for mechanical equipment necessary to support generation in heated locations not exposed to weather.
- Protect and heat areas with lead acid batteries or other batteries and UPS systems in locations that need to be protected from weather.
- Potential vulnerabilities associated with emergency generators, including Blackstart Resources, should be evaluated when developing the site-specific winter weather preparation procedure(s) as they may provide critical system(s) backup.
- For combustion turbines, ensure that manual corrective actions are proactively taken when unexpected icing may occur due to intermittent interference from outside sources of warm,

moist air streams from rivers, lakes, or oceans or near artificial sources that emit warm, saturated air streams, such as cooling tower plumes, exhaust stack plumes, blowdown tank vents, or flash tank vents.

- Develop a list of critical instruments and transmitters, including telemetry cabinets that require increased surveillance during severe winter weather events.

Evaluation of Critical Components

The following is a list of critical components, mainly taken from NERC Generating Unit Winter Weather Readiness Guideline that should be included and evaluated in conjunction with preparation of Generating Facility for cold weather operations.

- Critical level transmitters
 - Drum level transmitters and sensing lines
 - Condensate tank level transmitters and sensing lines
 - De-aerator tank level transmitters and sensing lines
 - Hotwell level transmitters and sensing lines
 - Fuel oil tank level transmitters/indicators
- Critical pressure transmitters
 - Gas turbine combustor pressure transmitters and sensing lines
 - Feed water pump pressure transmitters and sensing lines
 - Condensate pump pressure transmitters and sensing lines
 - Steam pressure transmitters and sensing lines
- Critical flow transmitters
 - Steam flow transmitters and sensing lines
 - Feed water pump flow transmitters and sensing lines
 - Natural gas or liquid fuel flow transmitters and sensing lines
- Instrument air system
 - Verify that automatic blow downs, traps, dew point monitoring, and instrument air dryers are functioning correctly within acceptable parameters
 - Ensure that low point drain lines are periodically drained by operators to remove moisture during extreme cold weather
- Motor-operated valves, valve positioners, and solenoid valves
- Drain lines, steam vents, and intake screens
- Water pipes, water treatment, and fire suppression systems
 - Low/no water flow piping system
- Fuel supply, materials, and ash handling
 - Coal piles, other solid fuel storage, and handling equipment

- Transfer systems for backup fuel supply
- Gas supply regulators, other valves, and instrumentation (may require coordination with gas pipeline operator)
- Fuel oil heaters and flow control devices
- Ash disposal systems and associated equipment
- Lime storage and transfer equipment
- Tank Heaters
 - Conduct initial tests
 - Check availability of spare heaters
 - Record current tank indicators for sodium-based solution injection systems, flue gas desulfurization systems, dibasic acid additives, mercury control additives, etc
- Lube oil and greases for mechanical equipment necessary to support generation in locations that may be exposed to cold weather
- Ensure batteries and uninterruptible power supply systems critical to the functioning of the facility are housed in temperature-controlled locations and protected from weather
- Functional heat tracing, insulation, and temperature responsive ventilation (heaters, fans, dampers, and louvers) based on expected weather conditions
- Adjust operation of cooling tower fans, deicing rings, and riser drains to prevent icing
- Operation of necessary equipment to prevent accumulation of ice or snow on combustion turbine air inlet filter medium
- Steam soot-blowing systems (transmitters, regulators, drain valves, and traps)

Fuel and Environmental Preparation

- Review fuel quality and quantity available
- Inform PJM of fuel type being used during each operating day for dual fuel units via the PJM Markets Gateway system. Ensure that up to date schedules for the alternative fuels are entered into Markets Gateway in case they are needed during the operating day.
- Review Generating Facility environmental permits to determine if there is the potential of requesting discretionary enforcement in support of grid reliability. Refer to Attachment M of PJM Manual M-13, Emergency Procedures <https://www.pjm.com/-/media/documents/manuals/m13.ashx>
- Consider tuning combustion and environmental controls for operation during winter ambient conditions.
- Consider issues that could adversely affect the delivery of fuel to the units such as limited fuel delivery trucks, etc.
- Consider need to contact appropriate governmental agencies to approve waivers to allow fuel truck delivery drivers to work extended hours.
- Consider adding kerosene to fuel oil as required to minimize gelling.

- Consider treating coal and limestone systems with anti-freezing solution.

Operation on Alternate Fuel

- Test fuel switching equipment and capabilities where applicable including consideration of the following:
 - Availability of alternate fuel supply.
 - Time required to switch fuels.
 - Amount of unit reduction required to switch fuels.
 - Unit capacity while on alternate fuel.
 - Operator training and experience.
 - Fuel switching equipment problems.
 - Boiler and combustion control adjustments needed to operate on alternate fuel.
 - Consider mitigation measures to alleviate derates during cold weather events due to emission limitations.
 - Inform PJM of any limitation of operating hours due to environment permits considering extended operation on alternate fuel.
 - Consider mitigating alternate fuel start-up problems by scheduling at least enough primary fuel for start-up.

Non-Fuel Consumables

- Review inventories of all commodities, equipment, and other supplies that could aid in severe winter weather event preparation/response.
- Arrange for adequate supply of demineralized water and other Generating Facility consumables considering the potential of extended operation on primary or secondary fuel during extreme cold weather and high winds.
- Arrange for adequate supply of fuel (e.g. kerosene) for portable space heaters.
- Arrange for adequate hydrogen supply considering additional losses due to hydrogen seal contraction during cold temperatures.
- Review process for ensuring adequate quantities of winter weather and personal protection equipment are available (e.g., heat lamps, heaters, etc.).
- Provide adequate inventory of parts and supplies needed for cold weather operation.
- Consider putting together emergency freeze protection kits that include all tools and equipment necessary to thaw a frozen component and then thoroughly insulate / protect component from future freezing.
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- Arrange for adequate hydrogen supply considering additional losses due to hydrogen seal contraction during cold temperatures.
- Review process for ensuring adequate quantities of winter weather and personal protection equipment are available (e.g., heat lamps, heaters, etc.).
- Provide adequate inventory of parts and supplies needed for cold weather operation.
- Consider putting together emergency freeze protection kits that include all tools and equipment necessary to thaw a frozen component and then thoroughly insulate / protect component from future freezing.

Operating Parameters

- Determine if start-up times longer than currently modeled in Markets Gateway are required and update PJM dispatch and Markets Gateway if applicable.
- Determine the duration that the unit can maintain water, air, or fluid systems above freezing when offline. Have contingency plans for periods of freezing temperatures exceeding this duration. Check heat tracing on critical lines and pipes monitored throughout winter weather events to ensure the circuits are functional. Evaluate the use of infrared cameras, and other technologies, to inspect critical heat circuits.
- Provide accurate ambient temperature design operating limits for each generating unit that is included in the Generation Owners portfolio (including the accelerated cooling effect of wind), and update them as necessary. These limits should take into account all temperature-affected generator, turbine, and boiler equipment, and associated ancillary equipment and controls. Update PJM's eDART and Markets Gateway systems as appropriate.
- Ensure that heat tracing, insulation, lagging and wind breaks are designed to maintain water temperature (in those lines with standing water) at or above 40 degrees ambient temperature, taking into account the accelerated heat loss due to wind.

Staffing

- Consider enhanced staffing (24x7) during severe winter weather events.
- Arrange for lodging and meals as needed.
- Arrange for transportation as needed.
- Arrange for support and appropriate staffing from responsible entity for Generating Facility switchyard to ensure minimal substation equipment and line outages.
- Consider employing the "buddy system" during severe winter weather events to promote

N.5 Equipment Preparation - Inverter-Based Resources

Inverter bases resources that are typically not staffed, and controlled remotely must also be prepared for cold weather operations by performing on-site inspection.

Evaluation of Critical Components

The following is a list of critical components, mainly taken from NERC Generating Unit Winter Weather Readiness Guideline that should be included and evaluated in conjunction with preparation of Generating Facility for cold weather operations.

- Ensure all control cabinets are sufficiently heated to prevent freezing
- For wind turbines, ensure blade de-icing capabilities are readied and operational (if applicable.)
- Inspect and test anemometers and other weather detection devices.
- Functional wind turbine lube oil equipment within the nacelle, such as radiators, fans, heaters, and bypass valves
- Adequacy of tracking systems' lube oil for expected temperature during cold weather
- Accessibility of roads throughout the facility
- Ensure liquid-cooled inverters have freeze protection measures, such as anti-freeze or heaters, to address expected temperatures for that location
- Ensure winterization measures for battery systems are sufficient for expected cold weather conditions
- Consider snow removal and de-icing plans for facilities

N.6 Actions When Cold Weather is Forecasted

Prepare for PJM Cold Weather Advisory/Alert

- Review PJM Manual M-13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
- Review Generating Facility special operations instruction (just prior to or during a severe winter weather event)
- Run emergency generators immediately prior to severe winter weather events to help ensure availability.
- Where applicable, consider availability and reliability of Black Start Units during adverse weather and emergency conditions.
- Place in service critical equipment such as intake screen wash systems, cooling towers, auxiliary boilers, intake filter heaters and fuel handling equipment, such as coal and limestone conveyors where freezing weather could adversely impact operations or forced outage recovery.
- 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.

- Monitor room temperatures, as required to prevent freezing of instrumentation and equipment in enclosed spaces (e.g. pump rooms).

N.7 Actions During Cold Weather

- Implement PJM Emergency Procedures as directed.
- Review PJM Manual M-13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
- Keep PJM up to date on all operational limitations that will or may affect Generating Facility output.
- For wind turbines, consider cycling turbines online (even if the wind turbines are not being used) to circulate oil to maintain temperature.
- Inform PJM of fuel type being used during each operating day for dual fuel units via the PJM Markets Gateway system. Ensure that up to date schedules for the alternative fuels are entered into Markets Gateway in case they are needed during the operating day.

N.8 Actions Following Cold Weather

After a severe cold weather event, Generation Owners should utilize a formal review process to determine what program elements went well and which need improvement. Identify and incorporate lessons learned within applicable procedures. Changes to the procedures and lessons learned must be communicated to the appropriate personnel prior to next cold weather season.

N.9 References

Links include numerous cold weather event postings including the and reliability guidelines for cold weather preparedness and operations

[NERC/FERC Winter Storm Elliott Report: Inquiry into Bulk-Power System Operations During December 2022](#)

[NERC Reliability Guideline: Generating Unit Winter Weather Readiness - Current Industry Practices - Version 4](#)

[NERC Cold Weather Preparation and BPS Impacts and Lessons Learned](#)

[February 2011 Southwest event reports, various lessons learned](#)

[Extreme Winter Weather Events - Training Presentation](#)



2019 FERC and NERC Staff Report: The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018