

Attachment N: Cold Weather Preparation Guideline and Checklist

Introduction

During the January 2014 “Polar Vortex,” PJM experienced extreme cold temperatures in its region that required the use of emergency procedures on multiple days to maintain adequate supply to meet the demand and reserve needs of the system. Coincident with the cold weather and high demand, generator forced outages and failures to start were significantly higher than expected; as high as 22% (~40,000 MW) during the January 6 to 8, 2014 operating days.

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. This list of suggestions and typical problem areas is not meant to be all-inclusive. 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.

Desired outcome

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

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.

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

Pre-winter season items

- **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.
- Prepare and review plant-specific emergency operating plans for winter weather.
- Review cold weather scenarios affecting critical equipment.
- Include plant 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 plant.
- Develop a list of critical instruments and transmitters that require increased surveillance during severe winter weather events.
- 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.

- **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 plant switchyard to ensure minimal substation equipment and line outages.
- Consider employing the “buddy system” during severe winter weather events to promote personnel safety.

- Consider the addition of a "freeze protection operator" during adverse weather to be responsible for inspecting critical equipment and ensuring appropriate protection is in place.
- **Equipment preparation:**
 - Perform a walk down of the plant to correct and 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
 - Review cold weather scenarios affecting equipment taking into account the effects of precipitation and wind.
 - Inspect inventories of all commodities, equipment, and other supplies that could aid in severe winter weather event preparation/response.
 - 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.
 - Include plant systems, equipment, or protection systems that may have been changed or have degraded over time.
 - 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.
 - Arrange for adequate supply of demineralized water and other plant 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.
 - Determine the duration that the unit can maintain water, air, or fluid systems above freezing when offline, and 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).
- Erect secondary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.
- Review process for ensuring adequate quantities of winter weather and personal protection equipment are available (e.g., heat lamps, heaters, etc.).
- 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.
- Ensure liquid-cooled inverters have freeze protection measures, such as anti-freeze or heaters.
- For wind turbines, ensure blade de-icing capabilities are readied and operational.
- Inspect and test anemometers and other weather detection devices.
- Develop a plan for the removal of debris at plant's intake structure given the potential of freezing conditions.
- Determine if start-up times longer than currently modeled in Markets Gateway are required and update PJM dispatch and Markets Gateway if applicable.
- Provide accurate ambient temperature design operating limits for each generating unit that is included in the 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.
- Consider issues that could result in slowed valve/damper operation.
- 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.
- 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.
- 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.
- Provide adequate inventory of parts and supplies needed for cold weather operation.
- Drain any non-critical service water lines in anticipation of severe cold weather.
- 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.
- 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.
- 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.
- **Fuel and environmental preparation:**
 - Review fuel quality and quantity
 - Consider tuning combustion and environmental controls for operation during winter ambient conditions.
 - Test fuel switching equipment and capabilities where applicable including consideration of the following:
 - Time required to switch fuel.
 - Amount of unit reduction required to switch fuel.
 - 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.
- Availability of alternate fuel supply.
- 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.
- 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 plant 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 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 mitigating alternate fuel start-up problems by scheduling at least enough primary fuel for start-up.
- Consider adding kerosene to fuel oil as required to minimize gelling.
- Consider treating coal and limestone systems with anti-freezing solution.
- **Actions when cold weather is forecasted:**
 - Prepare for PJM Cold Weather 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 plant 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).
- **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 plant output.
 - For wind turbines, consider cycling turbines online (even if the wind turbines are not being used) to circulate oil to maintain temperature.
- **Actions following cold weather:**
 - Review lessons learned after each winter event and/or season. Include what went well, what needs improvements, suggestions from on duty staff, document and review prior to next cold weather season.
- **Suggestions for additions/improvements to this guideline/checklist:**
 - References:
 - [Link to NERC website that includes numerous cold weather event postings including the February 2011 Southwest event reports, various lessons learned, and reliability guidelines for cold weather preparedness and operations:](#)
 - [NERC Reliability Guideline: Generating Unit Winter Readiness – Current Industry Practices – Version 3](#)
 - [Extreme Winter Weather Events - Training Presentation](#)
 - [ReliabilityFirst's Review of Winter Preparedness Following the Polar Vortex, November 13, 2015](#)
 - [2019 FERC and NERC Staff Report: "The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018"](#)
 - [RF/SERC Cold Weather Preparedness Plan – Basic Attributes 8/24/2021](#)
 - [NAGF Human Impact and Generator Initiative related to Cold Weather 8/24/2021](#)