

Attachment N: Cold Weather Preparation Guideline and Checklist

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1. Introduction:

- a. 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. PJM believes that improvements in the performance of resources during extreme cold weather events is necessary.
- b. 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.

2. Desired outcome:

-
- a. 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:
 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 other operational problems such as slowed or impaired field devices, or
 8. Create a safety hazard.
 3. **Safety:**
 - a. Safety remains the top priority during winter weather events. Job safety briefings should be conducted during preparation for and in response to these events.
 4. **Training:**
 - a. 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.
 5. **Pre-winter season items:**



outages.

5. Consider employing the “buddy system” during severe winter weather events to promote personnel safety.

c. Equipment preparation

1. Perform a walk down of the plant to correct and identify:
 - a. Broken/damaged/degraded doors and windows,
 - b. Degraded missing lagging on exterior piping,
 - c. Heat tracing equipment damage,
 - d. Damaged instrument air lines,
 - e. Locations of standing water
2. Review cold weather scenarios affecting equipment.
3. Include plant systems, equipment, or protection systems that may have been changed or have degraded over time.
4. 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.
5. Prepare units that have been off line for lengthy periods of time for start-up and operation during severe winter weather events.
6. Develop cooling tower operating procedures for cold weather that specifies the cycling of fans to minimize the forming of icicles.
7. 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.
8. Arrange for adequate supply of fuel (e.g. kerosene) for portable space heaters.
9. Arrange for adequate hydrogen supply considering additional losses due to hydrogen seal contraction during cold temperatures.



- 10. 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.
- 11. 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).
- 12. Erect secondary wind barriers as deemed appropriate to protect critical instrument cabinets, heat tracing and sensing lines.
- 13. Review process for ensuring adequate quantities of winter weather and personal protection equipment are available (e.g., heat lamps, heaters, etc.).
- 14. Review process for monitoring instrument air dew points year-round to ensure air is moisture free.
- 15. Develop a plan for the removal of debris at plant's intake structure given the potential of freezing conditions
- 16. Determine if start-up times longer than currently modeled in eMKT are required and update PJM dispatch and eMKT if applicable.
- 17. 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 eMKT systems as appropriate.
- 18. Consider issues that could result in slowed valve/damper operation.
- 19. 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.
- 20. Evaluate piping insulation and correct deficiencies that may allow water infiltration which would result in freezing during cold weather.
- 21. 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.

22. 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.

23. Drain any non-critical service water lines in anticipation of severe cold weather.

24. Maintain Substation Equipment:

- _____
- a) 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.
 - _____
 - b) 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.
 - _____
 - c) 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.

d. Fuel and environmental preparation

- _____
- 1. Review fuel quality and quantity
 - _____
 - 2. Consider tuning combustion and environmental controls for operation during winter ambient conditions.
 - _____
 - 3. Test fuel switching equipment and capabilities where applicable including consideration of the following:
 - _____
 - a) Time required to switch fuel.
 - _____
 - b) Amount of unit reduction required to switch fuel.
 - _____
 - c) Unit capacity while on alternate fuel.
 - _____
 - d) Operator training and experience.
 - _____
 - e) Fuel switching equipment problems



f) Boiler and combustion control adjustments needed to operate on alternate fuel.

g) Availability of alternate fuel supply.

4. Consider mitigation measures to alleviate derates during cold weather events due to emission limitations.
5. Inform PJM of any limitation of operating hours due to environment permits considering extended operation on alternate fuel.
6. Inform PJM of fuel type being used during each operating day for dual fuel units via the PJM eMKT system. Ensure that up to date schedules for the alternative fuels are entered into eMKT in case they are needed during the operating day.
7. 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 M13, Emergency Procedures <http://pjm.com/~media/documents/manuals/m13.ashx>
8. Consider issues that could adversely affect the delivery of fuel to the units such as limited fuel delivery trucks, etc.
9. Consider need to contact appropriate governmental agencies to approve waivers to allow fuel truck delivery drivers to work extended hours.
10. Consider mitigating alternate fuel start-up problems by scheduling at least enough primary fuel for start-up.

6. Actions when cold weather is forecasted:

- a. Prepare for PJM Cold Weather Alert
- b. Review PJM Manual M13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
- c. Review plant special operations instruction (just prior to or during a severe winter weather event)
- d. Run emergency generators immediately prior to severe winter weather events to help ensure availability.

- _____ e. Where applicable, consider availability and reliability of black start units during adverse weather and emergency conditions.
- _____ 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.
- _____ g. 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.

_____ **7. Actions during cold weather:**

- _____ a. Implement PJM Emergency Procedures as directed
- _____ b. Review PJM Manual M13, Emergency Operations and take the steps outlined in the manual including reporting of any fuel or environmental limitations and deferring maintenance activities.
- _____ c. Keep PJM up to date on all operational limitations that will or may affect plant output.

_____ **8. Actions following cold weather:**

- _____ a. 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.

_____ **9. Suggestions for additions/improvements to this guideline/checklist:**

_____ **10. References:**

- _____ a. 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: <http://www.nerc.com/pa/rrm/ea/Pages/February-2011-Southwest-Cold-Weather-Event.aspx>
- b. NERC Reliability guideline:
http://www.nerc.com/pa/rrm/ea/ColdWeatherTrainingMaterials/Relibility_Guideline_Generating_Unit_Winter_Weather_Readiness.pdf
 - c. NERC Findings and recommendations from the FERC/NERC Staff Report on the 2011 Southwest Cold Weather Event:
<http://www.nerc.com/pa/rrm/ea/ColdWeatherTrainingMaterials/FERC%20NERC%20Findings%20and%20Recommendations.pdf>
 - d. PJM Polar Vortex Presentation at FERC Technical Conference, 4/1/14
<http://pjm.com/~media/documents/reports/20140331-presentation-of-michael-kormos-regarding-polar-vortex-ferc-20140401.ashx>
 - e. Extreme Winter Weather Events - Training Presentation
<http://www.nerc.com/pa/rrm/ea/ColdWeatherTrainingMaterials/Cold%20Weather%20Training%20Presentation%2020131001.pptx>

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