RELIABILITY FIRST

COLD WEATHER WINTERIZATION ON-SITE ASSIST VISIT PROGRAM

AFTER ACTION REPORT

2024-2025 Winter Season

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BACKGROUND

Over the past decade, extreme cold weather events have repeatedly tested the resilience of the electric grid in North America, particularly impacting the generation or "resource" side. Notable among these events are the Polar Vortex of 2014 and Winter Storms Elliott in 2022 and Uri in 2021. The Polar Vortex brought unprecedented cold temperatures, causing widespread generator failures and significant power outages. Similarly, Winter Storm Uri resulted in one of the largest controlled firm load shed events in U.S. history, with many generating units experiencing outages, derates, or failures to start. These events underscore the critical need for robust cold weather preparedness among power generators.

The North American Electric Reliability Corporation (NERC) conducted extensive analyses and published detailed reports on these and other winter storms. The February 2021 Cold Weather Outages in Texas and the South Central United States Report and Federal Energy Regulatory Commission (FERC)'s Reliability Spotlight on Cold Weather Preparedness provide valuable insights into the challenges faced and the measures needed to enhance grid reliability during extreme cold weather conditions. These reports highlight the importance of implementing comprehensive cold weather preparedness plans, including freeze protection measures, enhanced emergency response protocols, and improved coordination between electric and natural gas industries.

For the past decade, RF has led a Cold Weather Winterization (CWW) outreach program dedicated to promoting generator preparedness and enhancing grid reliability during extreme cold weather events. For the 2024–2025 winter season, RF partnered with Pennsylvania-New Jersey-Maryland Interconnection (PJM), Midwest Reliability Organization (MRO), and Texas Reliability Entity (Texas RE) to assemble a small team of experts to visit 20 power plants and evaluate the cold weather preparedness of each plant. PJM provided significant support in these efforts, contributing significant resources, planning, and subject matter expertise. The team aimed to observe best practices and provide feedback to the Generator Owners (GOs) on documented maintenance and cold weather preparedness activities. This after-action summary outlines the best practices identified during these visits, aiming to promote generator preparedness and ensure the reliability of the electric grid during future extreme cold weather events.

The RF and PJM teams acknowledge and thank the power plants for providing and agreeing to publicly share the example photos included within this report. ***Please note this report intends to maintain anonymity and avoid identifying specific plant locations.***

PLANT SELECTION

Plant selection for the winterization walkdowns comes from several different categories, including:

- Requests received from registered entities through the RF Assist Visit program
- Results from the NERC Generator Availability Data System (GADS) from the previous two years of cold weather related losses
- PJM eDART Dispatcher Application and Reporting Tool
- New registrations with 300 MW gross output power or greater and special emphasis on natural gas-powered generators

GADS and eDART data are analyzed for plants that experienced derates or starting issues during extreme cold weather. Plant selection is risk-based, focusing on plants with larger capacity; for example, an 800 MW plant would carry a higher risk and priority for assist visit attention compared to a 100 MW plant.

Plants are also selected based on groups or clusters, enabling assembled teams to visit multiple plants in one geographic area in consecutive days where possible.

PLANT SURVEYS

In advance of the site visits, prospective plants completed and returned an informational survey to provide RF staff with plant-specific information. The image below shows a sample of questions included in the fossil fuel-powered survey.

1.0	PLANT WINTERIZATION - OVERALL CONCERNS & ISSUES
1.1	How many boiler-turbine-generator enclosures are of the outdoor type, i.e., boiler room and turbine-generator room are not enclosed and directly exposed to weather conditions?
1.2	How many boiler-turbine-generator enclosures are of the semi-outdoor type, i.e., boiler room partially enclosed with portions directly exposed to weather conditions but turbine generator room fully enclosed?
1.3	How many boiler-turbine-generator enclosures are of the indoor type, i.e., boiler room and turbine-generator room are fully enclosed and not directly exposed to weather conditions?
1.4	Due to the applicable type of configuation, describe any past problems (trips, derates, fail-to-start, etc.) caused by extreme weather and list the amount of megawatts impacted.
1.5	Does your entity presently have a plant winterization plan for all generating facilities?
1.6	Briefly describe the training program or exercise which prepares plant personnel for extreme cold weather conditions.
1.7	What plant personnel are specifically assigned or responsible for the plant winterization plan related to directing key activities before, during and after severe winter weather events?
1.8	To what level of corporate management is the plant winterization plan communicated?
1.9	What is the status of the your plant winterization plan?
1.11	What is your facility(ies) minimum starting temperature(s)?
1.12	What is your facility(ies) minimum design/operating temperature(s) and how long can the facility operate at that temperature?

ON-SITE VISITS

After receiving the written survey, and prior to the on-site activity, the cold weather winterization team reviews documentation, including but not limited to the plant winterization procedure, checklists, and maintenance activities. Visits usually take place between October and January, include between two to three subject matter experts (SMEs) and one or two observers, and generally take around four to six hours to conduct on-site. Following the on-site activity, the team writes a report noting any best practices and recommendations.

During the on-site activity, both RF and PJM (if applicable) present an overview of RF and PJM, respectively. These presentations help explain other programs available to the plants in the way of assist visits, outreach, or training.

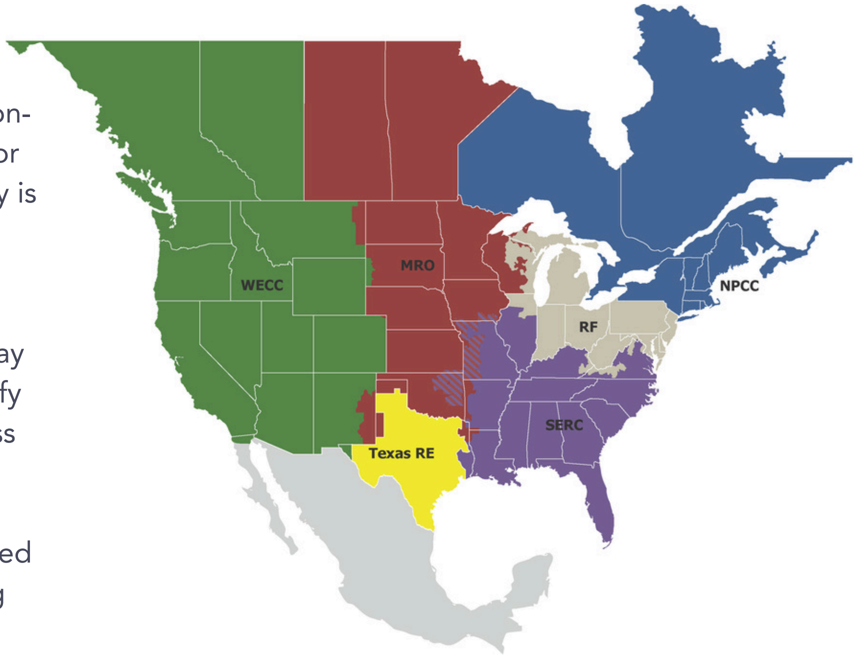
VOLUNTARY PROGRAM VS. MANDATORY COMPLIANCE

RF conducts this program outside of mandatory compliance for EOP-012-2/3 (Extreme Cold Weather Preparedness and Operations) and other NERC Reliability Standards. The program focuses on identifying and sharing best practices. However, if the entity has questions related to mandatory compliance, the cold weather winterization team can connect the entity to the appropriate RF team to assist, including submitting written compliance approach questions to a panel of RF SMEs.

APPLICABLE REGION

The RF cold weather winterization (CWW) on-site assist visit program is open to Generator Owners (GOs) in the RF Region. If the entity is part of the multi-region registered entity (MRRE) program, RF will coordinate its resources with other applicable region(s). If the plant is outside of the RF Region, RF may still be able to facilitate discussion to identify the lead region and how to start the process for a CWW on-site assist visit.

In the 2024-2025 winter season, RF partnered with both MRO and Texas RE in conducting plant visits.



BEST PRACTICES

RF built the program on identifying best practices, which are then, in turn, shared with other program participants when and where applicable. The following summary highlights some examples of best practices.

HEAT TRACING

Heat tracing is vital to ensure sensing and other lines do not freeze during the winter. For example, a critical heat tracing application for boiler drum level involves level measurement, such as differential pressure transmitters or level sensing lines. These sensing lines are susceptible to freezing in cold weather, which can obstruct accurate readings of the boiler drum level. Without accurate boiler drum level indication, the plant would be forced to shut down.

Best practices associated with heat tracing are shown in images in the sections below:

- Heat Tracing Loss-of-Power Indication/Alarm
- Heat Tracing End-of-Line Indicators
- Heat Tracing Amperage Measurements
- Pre-Post Start-Up Testing

Heat Tracing Loss-of-Power Indication/Alarm

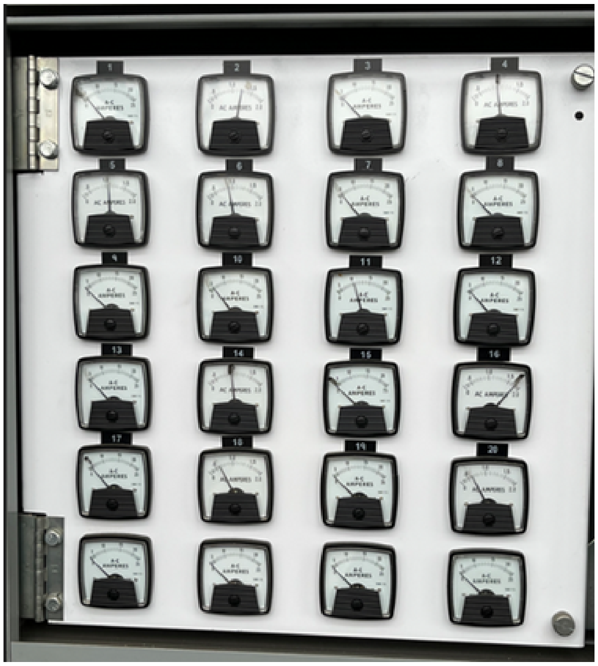
Most of the plants have panel lights to indicate power to the heat tracing circuits, with remote "loss-of-power" alarms. Operators can visually check power status when making their rounds. Operators may also receive remote alarms in the control room when a heat tracing power circuit trips off.

Heat Tracing End-of-Line Indicators

As noted above, while most plants have "loss of power" alarms for heat trace circuits, there is the possibility the heat tracing broke or has a failed connection along the path. Note heat tracing is not readily visible since it is covered with insulation. To help ensure the heat tracing has power and is intact (no breaks), some plants use end-of-line indicators. The lights are placed at the end of the heat tracing run which ensures two things: (1) power is "on"; and (2) no breaks in the heat tracing run. The direction and placement of the indicating lights are strategically located where operators can see the lights when making their daily rounds.

Heat Tracing Amperage Measurements

Another method installs ammeters for each heat tracing circuit. The operators benchmark or trend the current draw in cold temperatures for each circuit. Operators check the readings daily in cold weather. Any deviation from the normal ampere helps alert the operator to an abnormal operating condition, allowing the operators to investigate and make repairs to any damaged heat tracing circuit.



Pre-Post Start-Up Heat Trace Testing

Case studies have shown gaps in functionality of heat tracing circuits. Some plants pursue post-start-up (or periodic) outsourcing of testing of functionality of heat tracing circuits, including documenting megger testing and current draw for each circuit. Combining this circuit functionality testing approach with the heat tracing amperage method above has shown to be very effective.

Even without the real-time amperage reading, some utilities document their annual testing of functionality as shown in the following example. Both current draw and mega-ohm readings are recorded. Any anomalous readings are tracked by work order for corrective action.

PANEL #: U10 ACC/MCC EAST SIDE						
DATE:	10/1/2022					
CRKT #	DWG CUR OPER	ACT CUR OPER	MEGGER (M OHM)	Leakage Current	TYPE	work order#
1	10.3	6.4	550		MIQ	12941 (closed)
2	**	5.3	550		2 BOXES	
3	13	13.7	550		HTSX	
4	5.9*	12.7	550		HTSX&BOX	
5	17.2	15.1	550		HTSX	
6	*	4.1	550		BOX	
7	6	15.4	550		HTSX	
8	13.85	14.9	550		HTSX	
9	10.4	13.8	6.4		HTSX	
10	15.1	10.2	550		BSX	
11	15.1	9.3	550		BSX	
12	5.25	4.8	550		HTSX	
13	10.8	13.4	550		BSX	
14	11.1	6.3	550		BSX	
15	1.3	1.3	550		HTSX	
16	8.9	14.3	550		HTSX	
17	13	11.7	550		HTSX	
18	4.6	4.6	273		MIQ	12942 (closed)
19	*	8	550		BOX	
20	0.6*	0.4	550		BOX&HTSX	
21	*	4.6	550		BOX	
22	1.9*	4.3	550		BOX&HTSX	
23	14.8	18	550		HTSX	
24	12.9	16.3	550		HTSX	
25	*	0.8	550		BOX	
26	5.1	8.4	550		HTSX	
27	3.7	4.5	550		HTSX	
28	*	15.1	0.7		BSX	new work order 15183
29	SPARE					
30	SPARE					
31	SPARE					
32	SPARE					
33	*	3.3	550		BSX	
34	SPARE				?	
35	SPARE					
36	SPARE					
	*= Inst Encl on crkt with no drawing of Encl					
	51%-70% of Dwg Cur Oper value					
	>50% of Dwg Cur Oper value					

One utility created a cross-reference spreadsheet that combines all the critical heat tracing information into one easy document that can save valuable repair/maintenance response time when needed. Information is often buried in Piping and Instrumentation (P&ID) diagrams, so researching this information in advance takes time, but also saves time during critical repair times.

Unit #/BOP	Location	Device	Description	What is the Freeze Protection? Insulation	Heat Trace	Temporary Heaters	Wind Breaks	Other	Dat Inspe

Other	Date of Inspection	Maintenance Required?	Date Completed	Corrective Work Order	Comments	Obrien box and tubing associated panel	Obrien box and tubing associated Breaker	Root valves associated panel	Root valves associated Breaker

Unit #/BOP	Location	Device	Description	What is the Freeze Protection? Insulation	Heat Trace	Temporary Heaters	Wind Breaks	Other	Date of Inspection	Maintenance Required?	Date Completed	Corrective Work Order	Comments	Obrien box and tubing associated panel	Obrien box and tubing associated Breaker	Root valves associated panel	Root valves associated Breaker
UNIT 10	WEST OF STACK	10LAB30CF001	HP FEEDWATER FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC05	10		14
UNIT 10	WEST OF STACK	10LCA30CP001	COND FW PRESSURE	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	10		15
UNIT 10	WEST OF STACK	10LCA30CF001	COND FW FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	10		22
UNIT 10	NORTH BY STACK	10BJC05	MAIN HEAT TRACE PANEL	NA	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX				
UNIT 10	NORTH BY STACK	10BJC06	MAIN HEAT TRACE PANEL	NA	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX				
UNIT 10	NORTH HP FW INLET	10LAB30CP001	HP FW PRESSURE	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	21		11
UNIT 10	NORTH HP FW INLET	10LAE01CF001	HP SPRAY WTR FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	21		8
UNIT 10	NORTH HP FW INLET	10LAB60CP001	IP FW PRESSURE	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	21		8
UNIT 10	EAST OF BFP ROOM	10LAB10CF001	BFP SUCT HDR FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	20		*
UNIT 10	EAST OF BFP ROOM	10LAB10CP002	COND PREHTR PRESS	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJC06	20		*
UNIT 10	EAST OBR BOX #9	10LBA80CP001	LP STEAM PRESSURE	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	24		27
UNIT 10	EAST OBR BOX #9	10LBA80CF001	LP STEAM FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	24		27
UNIT 10	WEST HRSG STEPS	10BJD04	MAIN HEAT TRACE PANEL	NA	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX				
UNIT 10	FUEL GAS HTR CV	10LBA10CF001	HP STEAM FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	17		17
UNIT 10	FUEL GAS HTR CV	10LBC40CP004	CRH STEAM HD PRESS	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	34		22
UNIT 10	EAST HRSG STEPS	10HAJ55CP001	REHEAT INT ATT PRESS	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	16		11
UNIT 10	HRSG STEPS E 16W	10LBA50CF001	IP STEAM FLOW	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	35		22
UNIT 10	HRSG STEPS E 16W	10LBA50CP001	IP STEAM PRESSURE	Yes	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD04	35		*
UNIT 10	TOP HRSG SW	10BJD05	MAIN HEAT TRACE PANEL	NA	Yes	No	No	NA	9/19/2024	No	9/19/2024		OBRIEN BOX				
UNIT 10	TOP OF U10 HRSG- SW CRNR (THEN GO DOWN LADDER)	10LBA10CP001	HP Steam Pressure	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	12		26
UNIT 10	TOP OF U10 HRSG- SW CRNR (THEN GO DOWN LADDER)	10LBB40CP001	Reheater Steam Outlet Pressure	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	12		3
UNIT 10	TOP OF U10 HRSG-SE CRNR (THEN GO DOWN 1 LVL & WALK NORTH	10HAC10CP001	-HP FW Outlet Pressure	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	18		8
UNIT 10	TOP OF U10 HRSG- EAST	10HAD10CP001	-HP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	Yes	9/19/2024	14191	OBRIEN BOX	10BJD05	20		4
UNIT 10	TOP OF U10 HRSG- EAST	10HAD10CP002	-HP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	Yes	9/19/2024	14191	OBRIEN BOX	10BJD05	20		4
UNIT 10	TOP OF U10 HRSG- EAST	10HAD10CP003	-HP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	Yes	9/19/2024	14191	OBRIEN BOX	10BJD05	20		4
UNIT 10	TOP OF U10 HRSG- EAST	10HAD50CP001	-IP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	21		8
UNIT 10	TOP OF U10 HRSG- EAST	10HAD50CP002	-IP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	21		8
UNIT 10	TOP OF U10 HRSG- EAST	10HAD50CP003	-IP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	21		8
UNIT 10	TOP OF U10 HRSG- EAST	10HAD80CP001	-LP Drum Pressures	Yes	Yes	No	Yes	NA	9/19/2024	No	9/19/2024		OBRIEN BOX	10BJD05	22		16

	A	B	C	D	E	F	G	H	I	J	K
1	Thermon Heater Number	P&ID	Instrument Enclosure if Applicable	Description	Panel Number	Circuit Breaker #	Panel Location	Power Connection Location	Replaced/ Repaired info	DWG Current	Actual Current
2	1	00MD0140-SH2 00MD0155-SH1		Raw water supply line 00SGX01BR001 from raw water tank connection N6, on 00MD0140-SH2, to electric pump suction line 00SGX01BR011 and diesel pump suction line 00SGX01BR003, on 00MD0155-SH1	00BLA06	1	Water Treatment Building MCC	South of Water Treatment Building 4' Elevation WT-3		16.5	10.4
16	16	00MD0142-SH1		Demineralized water tank outlet line 00GHC10BR001 from tank connection N10 to demin forwarding pump inlet line 00GHC10BR002, in water treatment building	00BLA06	8	Water Treatment Building MCC	On demin water tank box WT-20 3' elevation.	water in cable. Baked out and siliconed end of cable. 2024 wo14333 closed	3.7	2.1
17	17	00MD0140-SH2		Raw water / firewater tank line 00LCA25BR004 from tank connection N11 to underground connection on line 00LCA25BR003 from unit 10 and 20 condensate reject lines.	00BLA06	6	Water Treatment Building MCC	South of H2O treatment building box WT-1 3' elevation - Fuel gas filter seperator yard box WT-7A 3' elevation		1.8	2.4
18	18	10MD0151-SH2		HRSG blowdown sump pumps discharge line 10GMA75BR001 from enclosure outlet lines 10GMA15BR001 and 10GMA16BR001 , on 10MD0151-SH2, to underground connection line 00GMA80BR001, on 10MD0151-SH2, in North East corner of HRSG	10BJC06	19	North West Corner of HRSG Ground Level	No Access or no tag			
19	19	10MD0151-SH2		GT inlet evaporative cooler blowdown/drain line 10GMA60BR401 from connection on evap cooler to underground connection on line 10GMA60BR402 to HRSG blowdown sump	10BJD04	29	West Side of HRSG by Stairs Ground Level	CCW skid under intake box 10B-171 10' elevation		2	3.4

CRITICAL COMPONENT HOUSING

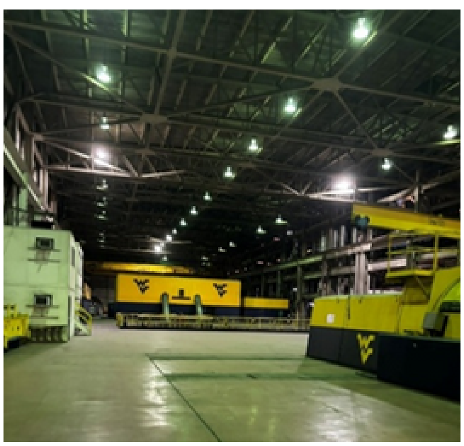
Generating units that have equipment located outdoors are at greater risk of experiencing a Generator Cold Weather Reliability Event because critical process instruments can freeze, fault, and trip the plant offline. In recent years, economics influenced more plants to be built with equipment located outdoors (e.g., wind, solar, and modern natural gas plants) compared to plants built in past years (e.g., traditional coal and nuclear plants).

While the focus of this CWW After Action Report is not compliance, it is noted under EOP-012, the definition of a Generator Cold Weather Critical Component excludes any component or system located inside a permanent building with a heating source that regularly maintains the space at a temperature above 32 degrees Fahrenheit. To mitigate this risk to Critical Components located outdoors, it is fundamental that GOs identify all Generator Cold Weather Critical Components and implement freeze protection measures to provide the capability to operate at the unit's Extreme Cold Weather Temperature per EOP-012-2/3.

Best practices associated with critical component housing are shown in the images below for:

- Permanent, heated buildings
- Temporary wind breaks
- Temporary/seasonal enclosures

Permanent Heated Buildings






Temporary Wind Breaks

Temporary/Semi-Permanent/Seasonal Enclosures

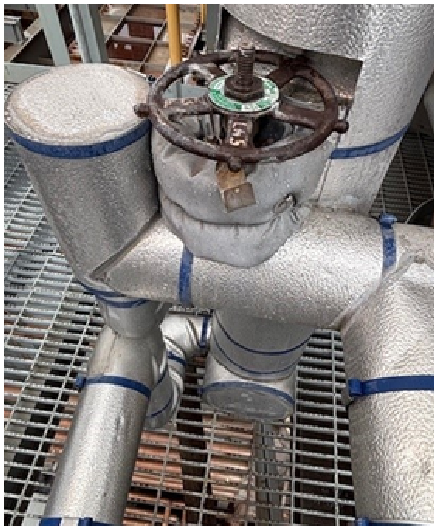
The teams noted that most new plants have extensive components outdoors, such as modular platforms with piping, racks, pumps, compressors, or skids that require using temporary coverings in cold weather to prevent freezing. In some examples, the scaffolding structural framework remains installed and in place the entire year and the plant removes the membrane covering in the spring and reinstalls the covering in the fall, saving time and resources in the process.

These examples show structures wrapped in fire-retardant material to protect susceptible components against freezing during winter months.

INSULATION

While insulation for a pipe is fairly routine, insulation for non-standard shapes, such as valves and piping transitions can be complex. Custom insulation is required for these instances.

Valve stem without insulation



Valve stem with insulation

Insulation of structural support between piping to reduce heat transfer

Custom-fit insulation covers to protect irregular shaped and hard-to-reach components

COMPRESSED AIR

Compressed air dryer controls maintain a very low dewpoint (~ 50° F) and combine with an automatic blowdown (i.e., method to remove accumulated water) inside the receiver tank to operate with less risk in cold weather.

Compressed air supply system

TRANSMITTER/INSTRUMENT ENCLOSURES

Power plants rely on functioning transmitters to operate. Transmitters are crucial for monitoring and controlling various aspects of the plant, such as temperature, pressure, and flow rates. Without reliable transmitters, the plant cannot accurately manage its processes, leading to potential safety hazards and operational inefficiencies, resulting in plant shutdown. A common theme across plants with outdoor equipment is protection from the elements for transmitters. While these are insulated and heated, it is still important for staff to periodically check or monitor the temperature inside the enclosure to ensure the heater is properly functioning. Checking transmitter enclosures is usually included in the daily operator rounds/checklist.

Left: Transmitter manifold assembly enclosed by a protective clamshell using an internal heater.

Above: This entity uses an indicating light and a small thermometer in the transmitter enclosure box to assist operators during inspection rounds helping to demonstrate proper heater functioning.

Above: Local visual temperature indication on transmitter enclosures.

PRE-STAGING/WINTERIZATION SUPPLIES

Pre-staging temporary heaters, portable generators, and other winter supplies ensures that equipment will be accessible during extreme cold weather.

PRE-WINTER AND DAILY CHECKLISTS

An eLogger checklist reminds an operator to perform specific tasks and records the results, dates, and times of the activities:

INSTRUCTIONS

- CHECK ITEMS **TWICE** A SHIFT WHEN AMBIENT TEMPERATURES ARE BELOW **32°F**. HIGHLIGHTED ITEMS ARE TO BE CHECKED **EVERY 3 HOURS** WHEN AMBIENT TEMPERATURES ARE BELOW **20°F**.
  - ENSURE ALL HEAT TRACE CIRCUITS ARE ENERGIZED AND FREE OF ALARMS.
  - VERIFY THAT INSULATION IS IN SERVICEABLE CONDITION WITH NO DAMAGE OR WEAR.
  - CONFIRM THAT ALL O'BRIEN BOX HEATERS ARE FUNCTIONING PROPERLY.

COLD WEATHER CHECKLIST

Add	BOX NO.	LOCATION	XMTR KKS	DESCRIPTION	HTR CKT NO.	NOTES	RESULT	
	1	East Side BFW Pump House	10LAB10CF001 10LAB10CP002	•BFP Suction Header Flow •Condensate Preheater Press.			SAT UNSAT	Delete
	2	HRSG East & West Heat Trace Panel	10LAB30CP001 10LAE01CF001 10LAB60CP001	•HP Feedwater Pressure •HP Spray Water Flow •IP FW Pressure			SAT UNSAT	Delete
	3	Fuel Gas Heater Control Valve Area	10LBA10CF001 10LBC40CP004	•HP Steam Flow •CRH Steam Header Pressure			SAT UNSAT	Delete
	4	Turbine Exhaust Duct Drain Pot	10MAG05CL001 10MAG05CL002 10MAG05CL003	•Duct Drain Pot Levels			SAT UNSAT	Delete

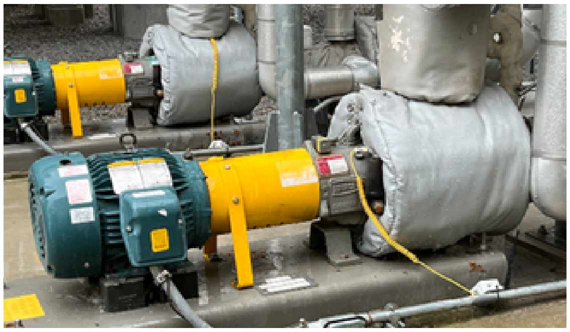
Add

AIR INTAKE FILTER AND COOLING TOWER FREEZING

Forced air movement at air inlets and cooling towers can present challenges. Moving air with freezing precipitation makes a good recipe for icing. In some cases, the "plume" of mist from the cooling tower can float over to the air intake to cause air intake freezing issues.


A best practice is to monitor the delta pressure across the filters. A drop in pressure could indicate freezing filters. Some plants use air inlet filter heating or "puffers" to prevent freezing of air intake. In some examples, plants use waste heat to heat inlet air.


To mitigate the effects of a frozen cooling tower, one plant switched over to a standby pond as an alternate condensate cooling method.




Remote temperature sensors on pumps/piping provide continuous temperature indication. (A wireless signal is sent back to the control room).

TRAINING

There is a growing trend for companies to develop generic or common training programs for their generation fleet. However, entities must understand the NERC Reliability Standard EOP-012-2/3 (Extreme Cold Weather Preparedness and Operations) calls for "generating unit-specific training."

While the training deck may contain material common to the entity’s fleet, it is recommended that training material for each plant also includes information unique to that specific plant.

For example, the training material for the specific plant should include plant name, location, and plant specific procedures, including checklists.

As the arrow shows in the image above, one wind farm used a full-size wind turbine nacelle sitting at ground level (instead of several hundred feet in the air) to facilitate educational and training purposes for new staff.

Inverter-Based Resources (IBRs) - Wind/Solar/Battery

The cold weather winterization team also continues to visit renewable plants.

SF6 Breakers and Station Batteries

While IBRs don't have issues related to freezing water lines, valves, or pressure sensors, renewable plants still have manufacturer specifications for space heating equipment. And, like traditional spinning resources such as coal or nuclear-powered Bulk Electric System (BES) generators, renewable plants also must focus on heating battery rooms and monitoring gas pressure in sulfur hexafluoride (SF6) breakers.

Above: Examples of a solar panel-cleaning robot.

Above: Typical SF6 breakers installed at an IBR.

Left: It is also important to maintain proper battery temperature within station battery rooms. This image illustrates a line of batteries within an IBR electrical room.

Left: Typical SF6 instrument gauge

SF6 breakers rely on gas pressure to operate. When the SF6 gas pressure gets too low because of extreme cold weather, the breaker will either (1) trip, or (2) disable the breaker trip. It is important to monitor SF6 gas pressure through periodic operator rounds and/or remote alarming.

NEXT STEPS

RF plans to continue the cold weather outreach winterization on-site assist visit program in the upcoming 2025-2026 winter season. RF will seek to continue its working partnerships with registered entities, PJM, MRO, and Texas RE, as well as build new relationships with other registered entities, Regional Entities, and Reliability Coordinators (RCs). RF plans to expand our winterization site visits, which included 20 sites in 2024-2025, to approximately 30 sites in the 2025-2026 winter season.

If your company owns power generation, we hope you find value in this report and continue to enhance your reliability and resiliency during extreme cold weather. We thank those Generator Owners (GOs) that contributed to best practices outlined in this document. If your company would like a winterization on-site assist visit, if you have a best practice not yet illustrated, or if you have any questions, please reach out to us through the RF Assist Visit program.

FURTHER READING

Event reports:

January 2025 Arctic Events Report

January 2024 Arctic Storm Report

December 2022 Winter Storm Elliott Report

February 2021 Event Texas and South Central US

January 2018 South Central Cold Weather Report

January 2014 Polar Vortex Report

Other resources:

NERC Reliability Guideline: Generating Unit Winter Readiness

2024 NERC Small Groups Advisory Session (SGAS) FAQ

NERC Cold Weather Information Resources

FERC Cold Weather Preparedness Spotlight

RF Assist Visit Program

RF Generator Winter Preparedness