Cold Weather Preparedness for Natural Gas Processing Facilities

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While the polar vortex is well documented, its effects have potentially become more extreme as the result of climate change, bringing polar air farther south.[1] In February 2021, Texas experienced severe and widespread freezing temperatures as the result of Winter Storm Uri. Extreme cold temperatures that lasted for several days, combined with snow and sleet, caused the widespread failure of the state's electrical grid system. The storm left more than 10 million people without electricity for several days and resulted in more than 100 deaths. Economic losses from lost output and damages are estimated to be $130 billion in Texas alone, exceeding that of Hurricane Harvey in 2017.[2]

The immediate effects produced by Winter Storm Uri disrupted natural gas production at the wellhead, processing facilities, and in the transportation system. Analysis of research results produced by Enverus, an energy Software as a Service (SaaS) provider, stated that midstream operators suffered a loss of production due to the following factors:

- Loss of power
- Lack of production from upstream operators
- Logistical problems due to obstructed roadways and lack of availability of work crews
- Equipment freeze-offs[3]

Increasing Reliable Production

Enervus found that the main contributing factor to disruptions in natural gas production was the loss of power. The loss of power at midstream facilities cannot be overcome by insulation, maintenance programs, housing, etc. Steps must be taken to ensure that a reliable form of emergency or backup power is available so that critical functions continue operating normally when primary power fails.

Battery power is often a preferred form of backup or emergency power because battery systems do not need to be refueled during extended periods of power loss. This is important where the facility is not accessible by staff or fuel suppliers due to poor road conditions. Keep in mind that the batteries selected must be designed for use in extreme cold weather.

Providing reliable power and equipment winterization can only do so much to ensure normal operations during extreme cold weather events. Equipment must be maintained, inspected, and tested prior to these events to ensure that they are not damaged and will operate as intended.

Emergency generators fueled by diesel or propane can be considered to keep a facility running when battery power is not practical or sufficient. However, steps must be taken to ensure that fuel supplies are adequate to support generator operations for 10 to 14 days without being refueled. Field gas should not be used as a primary fuel source as natural gas supplies to the facility may be reduced or disrupted during an extreme cold weather event.[3]

Facility Winterization

After ensuring that a reliable emergency or backup power source is in place, the next step will be to conduct a cold weather risk assessment to identify and winterize critical functions that may be susceptible to cold weather events. These critical functions would include system components such as instrumentation, injection pumps, saltwater disposal pumps, compression equipment, heating equipment, etc.

Winterizing Techniques

Winterizing equipment vital to normal operations during extreme cold weather events is key to ensuring that natural gas continues to flow at anticipated volume/pressures and to minimize the risk of property damage. Some techniques that provide reliable forms of extreme cold weather protection include the following:

- Install properly designed cold weather barriers to protect compressors and other similar equipment from cold winds.
- Insulate above-ground fuel lines, water lines, injection lines, process piping, supply valves, instrumentation panels, and other critical equipment.
- Utilize UL Listed heat trace in combination with insulation to create more efficient protection than with just insulation alone.
- Inject methanol into gas flow streams.
- Use solid absorption systems or glycol contact towers to remove water from natural gas flow streams.
- Install hot lubricant and circulation heaters to prevent engine oil or fuel lines from freezing.
- Utilize Supervisory Control and Data Acquisition (SCADA) system to monitor key cold weather equipment indicators such as decreasing gas temperature, system pressure, declining battery voltage, low methanol tank levels, etc., in real time. Staff can use these system alerts to take preventative measures before a system failure occurs.[4,5]

Preventative Maintenance Practices

Providing reliable power and equipment winterization can only do so much to ensure normal operations during extreme cold weather events. Equipment must be maintained, inspected, and tested prior to these events to ensure that they are not damaged and will operate as intended. At a minimum, the following preventative practices should be implemented prior to an extreme cold weather event:

- Cleaning and lubricating equipment with temperature appropriate grease or oil.
- Drain water accumulation in surface lines and equipment exposed to moisture.
- Drain cooling systems and replace with antifreeze as applicable.
- Ensure in-line filters are installed in air systems leading to control panels to ensure high-quality responses from sensors.
- Test and inspect critical equipment 60-90 days prior to the anticipated date of the first freeze for your region.
- Maintain inventory of critical spare parts.[4,5]

A formal approach to cold weather preparedness will be required to be successful in this endeavor, including creating a thorough cold weather preparedness program.

Cold Weather Preparedness Program

While engineering controls are vital to prevent equipment failures due to extreme cold weather events, human element programs are the foundation of ensuring that natural gas production is maintained during these types of events. A sound human element program begins with implementing a formal cold weather preparedness program. A cold weather program should at least contain the following components:

- Conduct a cold weather risk assessment, keeping in mind that the presence of water is a critical risk factor that must be identified and evaluated.
- Ensure an emergency power supply is in place with an adequate fuel supply.
- Winterize critical equipment identified in the cold weather risk assessment.
- Develop an itemized preventative maintenance schedule for critical equipment subject to freezing.
- Establish an equipment testing matrix for use prior to severe cold weather events.
- Make plans to ensure adequate staffing levels are present on-site during and immediately after an extreme cold weather event.
- Develop formal plans to restart plant equipment in the event any disruptions occur in plant operations.
- Assign responsibility for various winterization tasks to qualified employees and/or contractors.
- Implement a formal technical and safety training program.
- Coordinate cold weather emergency response plans with critical suppliers and contractors.
- Test the program to ensure there are no gaps in the program.
- Review the program annually or whenever any material changes occur in operations.[5]

Looking Ahead

As the effects of climate change continue to accelerate, severe weather events are expected to occur more frequently in most areas of the world. As a result, it is imperative to be prepared to take actions that will prevent unnecessary property damage, ensure continued operations, and prevent needless loss of profits. A formal approach to cold weather preparedness will be required to be successful in this endeavor, including creating a thorough cold weather preparedness program. This comprehensive approach will help to ensure that your organization is adequately prepared to withstand the next cold weather event.

References

1. Polar Vortex – Science and Climate
2. Cascading risks: Understanding the 2021 winter blackout in Texas
3. Winter Storm Uri – Natural Gas Analysis
4. The Texas Oil and Natural Gas Industry Remains Ready for Winter
5. Texas Electricity Supply Chain Security and Mapping Committee Mapping Report

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