ASK THE EXPERT

TEXAS' DEEP FREEZE AND TRANSMISSION IN THE LONE STAR STATE

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INTRODUCTION

The deep freeze that gripped Texas in mid-February 2021 led to a series of cascading crises. The economic damage of this electric and human catastrophe could reach $200 billion, rivaling the most destructive hurricanes in U.S. history.

Black & Veatch's Power industry subject-matter experts Kevin Ludwig, Mark Dittus, and Sean Tilley take a deeper look at the importance of freeze protection to help ensure that power plants have the capability to operate throughout the possible range of environmental conditions. They also emphasize the importance of transmission expansion within ERCOT (Electric Reliability Council of Texas) itself as renewable power grows in importance.

Q: An estimated 312 electric generating units — gas, wind, coal, and nuclear — in Texas froze during the mid-February cold snap, idling as many as 52,000 megawatts (MW) of generating capacity, about half of the state's capacity. Would installation of freeze-protection equipment at those units have kept them running, or was it more a question of winterization maintenance protocols, or a combination of both?

A: It would be a combination of both. Many of the units that failed had systems in place, but the conditions were so extreme that the equipment's design capabilities were exceeded. There were reports of some systems working beyond their original design capabilities, but the low temperature and duration of the freeze eventually exceeded the design basis by enough that the freeze protection systems could not keep up. Once this happened, it became very difficult to keep the units running.

Q: Describe the equipment that is usually installed to address cold-weather requirements. What kind of winter protocol measures are implemented to help keep power plants operating during a deep freeze?

A: Electric heat tracing and insulation are the keys to winterization. In northern climates, most equipment is located indoors. But in southern states, indoor installations are not normal. Therefore, to winterize systems you would need to install heat tracing and insulation on more of the piping and instrument lines.

Most plants have weather-related protocols such as system testing that cover potential problem areas. Maintaining and following these protocols helps ensure the system in place is operating as planned and would identify areas that need to be watched when cold-weather events occur.

It's important to note that these mitigating measures only ensure that systems at the power plant site are functional during climatic extremes. Fuel supplies are also vulnerable to climatic events and as a result plants in other regions in North America may have on-site storage of fuel which provides a short-term mitigation of fuel supply upsets. This may entail fuel oil storage at Natural Gas plants which can be used in combustion turbines until stable fuel supply returns.

Q: What are some key economic and technical considerations when determining whether wind turbines require freeze-protection technologies?

A: The principal consideration is economic. Most common cold-weather deployments include specific materials, such as oils and lubricants, as well as heating equipment within wind turbines, to ensure the turbines continue to work in sub-freezing conditions. These technologies are most commonly selected and installed at the onset of the project, as this is the most cost-effective way to integrate them.

Specific technologies will vary by original equipment manufacturer, but in general technologies such as winter operations controls strategies and blade anti-icing systems are standard. The cost-effectiveness of these systems is dependent on the number of cold-weather events that would place the turbine outside its standard operating envelope, and how the incremental costs of a cold-weather upgrade would compare to the potential loss in revenue from a freeze event.

As our understanding of climate change improves, future wind energy facilities may see greater need to integrate additional measures to allow turbine operations in a wider range of weather.

Q: Does Black & Veatch have experience installing freeze-protection equipment or instituting cold-weather protocols at power plants in cold-weather regions? What has that experience taught you?

A: Black & Veatch has extensive experience with the design and installation of cold-weather power systems. We have designed a large number of facilities located in the northern U.S. and Canada, where freeze protection is a critical part of the plant. This includes experience in Michigan, Wisconsin, and Alberta.

Even on our plants that are in the southern U.S., we consider extreme weather conditions and make recommendations to clients to incorporate freeze-protection systems. Our experience has taught us to identify critical systems and equipment that need to be protected from extreme weather, understand the technology that is available and appropriate for each situation, and know how to integrate the system into the plant operations using our Asset 360™ data analytics and monitoring software.

Q: Could any of the recent service interruptions in Texas be traced to equipment failures of the state's transmission system?

Transmission systems are commonly very reliable, which has led to society counting on electricity for products and services we rely on. There have been service interruptions due to transmission equipment failures. There also have been large-scale service interruptions resulting from severe weather such as hurricanes, lightning strikes, and floods.

The nation's transmission system is designed to accommodate multiple failure contingencies so that equipment failures do not lead to large-scale outages. But planners have not considered wide-scale regional loss of generation, such as what occurred in Texas. As a result of that event, transmission planning contingencies may be expanded. To this end, FERC has recently announced a technical conference focused on climatic events and their impact on electric system reliability.

Q: Over the last decade or so, billions of dollars have been invested to build thousands of miles of transmission projects across Texas, mainly to bring wind power from West Texas to communities across the state. Why do we need more?

A: As large-scale renewable generation becomes a larger portion of the Texas energy mix, that will require building additional transmission lines. In recent years, renewable generation has nearly tripled to about 30,000 MW of capacity, according to ERCOT, and that number is expected to more than double, to about 65,000 MW in 2023.

This expected surge in transmission has been factored into numerous studies which have been performed recently that identify steps to get to a decarbonized power sector by 2050. Black & Veatch's own *2020 Strategic Directions: Electric Report*, based on a survey of more than 600 power sector stakeholders, showed that renewable energy received the highest number of survey responses as the key driver of new transmission investment over the next five years.

Q: Over the next few decades, will renewable energy grow as a percentage of the electricity fuel mix?

A: Multiple forecasts have been made by the U.S. Energy Information Administration (EIA) and others about the growth of renewables in Texas and beyond. Those forecasts vary and are contingent on tax policy, commodity price movements, electric demand, and state-level actions. The EIA's 2021 Annual Energy Outlook baseline forecast is that renewable energy, mainly solar and wind, will account for as much as 81 percent of the electric generation fleet by 2050.

Q: Is now the time to have FERC compel the integration of ERCOT into the Eastern and/or Western interconnection(s)?

A: FERC has begun to investigate the February outages and integration may be examined as part of this review. From a technical perspective, interconnection must be evaluated in terms of the benefits and detriments to ensure that reliability is delivered with the interconnections. There have clearly been situations in the past where large, interconnected grids have experienced outages as a result of cascading failures. The 2003 Northeast blackout is an example of this phenomenon. There are also benefits with interconnected grids in terms of ability to increase import/export power throughout a larger geography, which will be important with a growing renewable-based energy mix.

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