Soft Winterization: An Intelligent, Operational Solution for Planning and Risk Mitigation

PROBLEM

Extreme weather conditions pushed critical infrastructure to its breaking point, resulting in widespread power outages across the state of Texas

SOLUTION

An AI-enabled crisis management system capable of issuing temporary operating instructions to drive real-time process change and mitigate operational risk

OUTCOME

Increased operational resilience during future extreme weather events like the Texas freeze of 2021

INTRODUCTION: FROM BLACK SWANS TO BLACKOUTS

On February 14th, 2021, a devastating winter storm descended upon the state of Texas. Ice, snow, and below-freezing temperatures gripped the state for over a week, with temperatures dipping below zero (-2° Fahrenheit) in Dallas on Feb.16th, its coldest recorded temperature in over 70 years.

Critical energy and grid infrastructure buckled under extreme conditions impacting every power generating company in Texas. Almost **half of all power generation went offline** at some point as demand for gas and electric-generated heat spiked across the state. In fact, the Electric Reliability Council of Texas (ERCOT), which operates the state's independent grid, reported they were within minutes of a total collapse of the statewide grid that would have taken weeks to restore. Millions of residents endured multiple days without power, water, and access to essential supplies and services, sparking a statewide humanitarian crisis that resulted in more than 50 deaths. Analysts estimate this event to be one of the costliest disasters in state history, potentially eclipsing the **$125 billion toll from Hurricane Harvey** in 2017.

Numerous outlets were quick to dub the weather-induced blackout a "black swan" event that couldn't have been anticipated, even though meteorologists at ERCOT and the National Oceanic and Atmospheric Administration (NOAA) issued warnings of the storm's severity a week in advance. In addition, a similar weather event took place in Texas just 10 years earlier, leading federal regulators to issue a **report detailing** vulnerabilities to power generation during extremely cold weather along with recommendations to winterize critical infrastructure and mitigate future risks.

Business management circles have adopted the acronym VUCA, first coined by The Army, to describe a modern world that has become increasingly filled with volatility, uncertainty, complexity, and ambiguity. As society and its systems continue to become more complex and interdependent, black swan events like COVID-19, the 2008 financial crisis, and the 2021 Texas power crisis no longer seem as impossible or unlikely as was previously believed. Better visibility and planning are critical, but they can only go so far.

Emerging technologies like artificial intelligence (AI) offer predictive analytics and decision support capabilities that provide a significant opportunity for power generation leaders to better prepare for extreme events in the future, and just as importantly, operate more effectively and efficiently when the unthinkable black swan disaster strikes again.

RETHINKING PLANNING AND RISK MITIGATION

In the wake of the recent winter storm, there is strong agreement to finally heed past recommendations and winterize critical energy infrastructure. Various winterizing retrofit solutions are available in the market today, but they are relatively expensive and many of them will take years to be completely deployed. These "hard winterization" solutions include building insulated enclosures around critical components, insulating instrumentation cabinets, heat tracing water, air, sensing and drain lines, and much more.

Hard winterization is an important step to protect critical infrastructure going forward, however, operators should also consider adding additional layers of protection that increase operational resilience further. These cost-effective solutions utilize AI technologies like machine learning-based predictive analytics to provide asset performance management (APM) and decision support that is a complementary force multiplier to hard winterization efforts while also yielding immediate benefits before those efforts have been completed.

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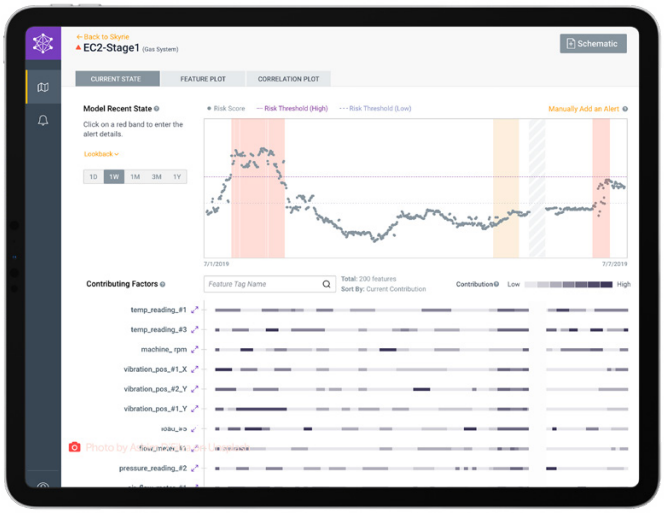
Artificial intelligence can help leaders de-risk their operations by giving greater visibility and ample time to deal with high-impact, low-probability events as well as real-time assistance in the form of an intelligent advisor to help drive appropriate process change to handle extreme events as effectively and efficiently as possible. AI is the key to operational resilience in a world of increasing complexity and uncertainty, augmenting the operational capacity of the workforce by providing the right insights to the right people at the right time. With AI solutions developed by SparkCognition, "soft winterization" of critical infrastructure can be achieved within months, providing an invaluable layer of protection against extreme weather conditions in the future.



A NEW WAY TO NAVIGATE POWER PLANT OPERATIONS

The current state of digital transformation in industrial domains is marked by a convergence of Information Technology (IT), Operational Technology (OT), and the utilization of the Internet of Things (IoT) to fully digitize processes and capabilities, generating an abundance of data that can lead to increased awareness and improved handling of operational impacts in real-time. But data by itself is insufficient to deliver substantial value to enterprises.

Artificial intelligence can unlock the full value of generated data when operationalized and enable solutions that are more flexible, adaptable, and effective in times of great uncertainty. These solutions enable operators to execute necessary process change to keep operations up and running, greatly enhancing the human-driven activities of the workforce.

Leveraging existing components of solutions that already serve customers in the power generation sector, SparkCognition offers an operational solution comprised of three elements:

- A reliability/engineering assessment that scores the risk of plant's assets, sensors, and systems to freezing conditions
- An AI-enabled intelligent advisor capable of issuing temporary operating instructions to drive necessary process change and mitigate operational risk in real time
- Digital twin technology to handle failures in sensors and instrumentation in support of the intelligent advisor and human workforce

Reliability/Engineering Plant Assessment

The first step provides power plant operators with a comprehensive evaluation of their risk during extreme weather events. This assessment uses Reliability-Centered Maintenance (RCM) analysis to explicitly evaluate failure modes and identify the most vulnerable components and sensors during freezing conditions.

Intelligent Advisor

An AI-enabled APM system is customized based on the RCM assessment results and acts as an intelligent advisor to help track, mitigate, and avoid risks during cold weather events. For example, the system may recommend an inspection to test all vulnerable components or assets ahead of an incoming storm. The intelligent advisor might issue a temporary operating instruction to start monitoring the weather enclosure heating systems and to direct personnel to begin cycling backup pumps and valves as temperatures continue to drop. Other examples include triggering an alarm to drain or purge water from the systems that are currently down or tripped, as well as monitoring ice formation in cooling towers, inlet air ducts, and filters. More importantly, this solution does not simply provide human workers with new visualizations of existing processes to monitor; the AI-enabled intelligent advisor enhances their ability to monitor process execution and make better, faster decisions to course-correct as needed to deal with a crisis that may continue to unfold in unexpected ways.

Digital Twin Technology

Instrumentation, sensors, and sensing lines are among the most vulnerable components in a power plant during freezing conditions. As sensing inputs fail or provide inaccurate readings, data-based analytic solutions become compromised as well, frequently leading to equipment derates or trips. As the popular saying in data science goes, garbage in equals garbage out.

This vulnerability can be eliminated, however, by employing digital twin technology to identify sensor and instrumentation failures and provide real-time imputation of missing or inaccurate values using statistical techniques applied to the uncompromised inputs and overall model of the system. If there is a likelihood of instrument malfunction due to severe weather, the expected calculated value could be used temporarily as the operation shifts into an emergency mode of operations.

> **"The question that faces the strategic decision maker is not what his organization should do tomorrow. It is, what do we have to do today to be ready for an uncertain tomorrow?"**
>
> —PETER DRUCKER

CONCLUSION

Governments, power generation companies, and other leading organizations have a significant opportunity to prepare for low-probability, high-impact events like the recent winter storm that devastated Texas. Repeated climate disasters can be avoided with a new operational capability based on digital twin technology and an AI-powered intelligent advisor to assist with real-time crisis management that reduces the impact of black swan events. SparkCognition's soft winterization solution provides an added layer of operational resilience that enhances the benefits of hard winterization initiatives and can be deployed immediately to de-risk operations before those efforts have been completed.

ABOUT SPARKCOGNITION

We catalyze sustainable growth for our clients throughout the world with proven artificial intelligence (AI) systems, award-winning machine learning technology, and a multinational team of AI thought leaders. Our clients partner with SparkCognition to understand their industry's most pressing challenges, analyze complex data, empower decision-making, and transform human and industrial productivity. To learn more about how SparkCognition's AI applications can unlock the power in your data, visit www.sparkcognition.com.