RESILIENCE IN THE STORM: LESSONS LEARNED IN NAVIGATING HURRICANES AND TURBINES

In the realm of offshore wind energy in the U.S., there are well-tested logistics models that are instrumental in designing the setup of an offshore wind farm. (Courtesy: StormGeo)

Mitigating risks for offshore wind farms, especially in the face of extreme weather events like hurricanes, is a complex task that requires a deep understanding of various factors.

By ANNA HILDEN

Harnessing the power of the wind has been a pursuit of humanity for centuries, and the Gulf of Mexico is the latest frontier in this endeavor. As we embark on the journey of constructing wind turbines in this region, we find ourselves looking to the East for guidance. Asia's wind farms, seasoned by the diverse and often harsh weather conditions including typhoons, have become a beacon of knowledge and experience. The lessons learned from Asia's triumphs and tribulations in wind-energy generation can illuminate our path toward sustainable energy production in the Gulf of Mexico.

The Gulf of Mexico, with its vast expanse and consistent wind patterns, presents an enticing prospect for wind-energy generation. However, the path to harnessing this potential has been fraught with challenges and hesitation. Historically, concerns about the impact on marine life, shipping routes, and the tourism industry have been significant hurdles. The Gulf's susceptibility to hurricanes has also raised questions about the durability of wind turbines and the potential financial risks involved.

Furthermore, the region's established oil and gas industry has often overshadowed renewable energy initiatives. Despite these challenges, the lessons learned from Asia's wind farms and advancements in turbine technology are gradually turning the tide toward wind energy in the Gulf of Mexico.

Asia's wind turbines have been a testament to resilience and innovation in the face of nature's fury. Typhoons, with their high-speed winds and torrential rains, pose a significant challenge to the integrity and efficiency of wind farms. However, through strategic design and robust engineering, these turbines have not only withstood the onslaught of typhoons but have also harnessed their power to generate substantial amounts of electricity.

The lessons learned from these experiences have led to advancements in turbine technology, such as typhoon-resistant designs and automated control systems that adjust blade angles for optimal wind capture and minimal damage. These insights from Asia's wind farms are invaluable as we venture into similar endeavors in regions like the Gulf of Mexico.

Indeed, the belief is strong it is possible to construct wind farms in the Gulf of Mexico and other hurricane-prone regions, mirroring our success in building turbines in typhoon-prone areas and other offshore installations. This confidence stems from our technological advancements and the resilience demonstrated by wind turbines in the face of extreme weather conditions. However, it's crucial to acknowledge and address the unique challenges posed by hurricanes.

UTILIZING WEATHER DATA

Asia has effectively used weather forecasts to mitigate risks for wind farms. Effective weather management is crucial for the safety and success of offshore wind projects. Developers and operators gather and analyze data on various weather parameters, including winds, waves, currents, tidal waters, lightning, and tropical cyclones. This accurate, site-specific data helps ensure safe operations and prevent costly delays. Insurance companies also require dedicated local weather forecasting for all wind-farm projects. Private weather companies such as StormGeo are able to provide site-specific forecasting for each project area. Wind farms achieve maximum efficiency by using hub-height wind forecasts at the turbine level to measure wind speed, direction, and gusts. These measures guide project managers in decision-making, schedule optimization, and safety assurance.

The U.S. Gulf of Mexico can learn valuable lessons from Asia's effective use of weather forecasts to mitigate risks for wind farms. Just as in Asia, effective weather management is crucial for the safety and success of offshore wind projects in the Gulf of Mexico. Developers and operators of wind farms collect and analyze data on various weather parameters to ensure safe operations and avoid delays. Insurance companies may require dedicated local weather forecasting for all projects. Companies like StormGeo can provide site-specific forecasts. Wind farms use these forecasts to optimize efficiency and guide decision-making, scheduling, and safety measures. By adopting these strategies, the U.S. Gulf of Mexico can enhance the resilience and efficiency of its wind farms.

SEVERE HURRICANE CONDITIONS

The Gulf of Mexico is known for its severe hurricane conditions, which are often more intense than typhoons experienced in regions like Taiwan. These hurricanes, characterized by their high wind speeds and heavy rainfall, pose a significant challenge to the operation and maintenance of wind farms. Moreover, climate change projections suggest that these conditions are likely to become even more frequent and severe over the coming decades. This anticipated increase in hurricane activity underscores the need for robust, hurricane-resistant designs and proactive disaster management strategies in our pursuit of harnessing wind energy in the Gulf of Mexico.

One such innovation is the development of "hurricane-resistant" turbines, which are designed to minimize damage and maintain functionality during severe storms. These turbines feature enhanced control systems that can adjust the pitch of the blades, reducing wind load during high winds. Additionally, some designs incorporate a "teetering" hub

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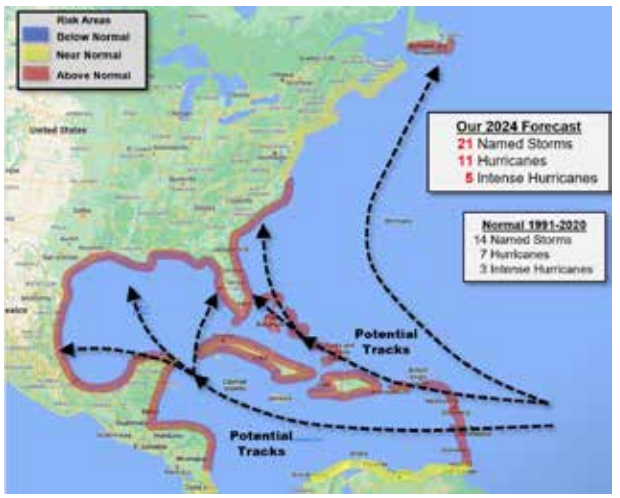
that allows the rotor to move backward slightly, relieving stress on the turbine. Furthermore, advancements in forecasting and remote monitoring technology allow for better prediction and management of hurricane events. However, the Gulf of Mexico presents a unique dilemma.

The average wind speeds in the region are relatively low, which would typically call for larger rotors to capture more wind energy. On the other hand, the region also experiences extreme high winds during hurricanes, which would ideally require smaller rotors to minimize stress on the turbine. This dichotomy is one of the many challenges we face in harnessing wind energy in the Gulf of Mexico, and it underscores the need for innovative solutions and adaptable designs.

LOGISTICS

Asia has developed innovative strategies to navigate the logistics of wind farms during typhoons. Research in Southeast China is addressing wind-turbine damage caused by frequent typhoons. This includes the development of anti-typhoon designs for offshore wind turbines and operation strategies for wind farms. In Taiwan, the typhoon season restricts installation projects to a six-month window. Meanwhile, a Japanese start-up, Challenergy, has innovated a wind turbine that can operate in cyclonic conditions, transforming a challenge into an energy opportunity. These strategies



Developers and operators of wind farms collect and analyze data on various weather parameters to ensure safe operations and avoid delays. (Courtesy: StormGeo)

Asia has developed innovative strategies to navigate the logistics of wind farms during typhoons. (Courtesy: StormGeo)

have enabled Asia to effectively manage the logistics of wind farms during typhoons.

In the realm of offshore wind energy in the U.S., there are well-tested logistics models that are instrumental in designing the setup of an offshore wind farm. These models take into account various factors such as turbine placement, maintenance schedules, and supply chain management, ensuring efficient operation and optimal energy production. Furthermore, these models are designed to be adaptable, allowing for effective planning and operation even when weather restrictions apply. This includes contingency plans for severe weather events such as hurricanes, ensuring the safety of personnel and minimizing potential damage to equipment. These logistics models, refined through years of experience and technological advancements, are crucial in navigating the challenges of offshore wind energy generation.

FINANCIAL RISK

Managing risk and insuring offshore wind farms, especially in the face of extreme weather events like hurricanes, is a complex task that requires a deep understanding of various factors. The offshore wind insurance market has been instrumental in the sector's growth by providing coverage to various stakeholders, thereby mitigating their risks. The primary areas of coverage include property damage to the wind farm, revenue loss due to such damage, and liabilities arising from third-party property damage, death, or injury during the wind farm's construction or operation.

Asia has effectively addressed the financial challenge of covering natural catastrophe risks for wind farms. Insurers in the region typically categorize certain locations as "high-risk zones" due to threats such as windstorms, earthquakes, and floods. Insurance providers typically establish a sublimit of liability on their coverage. This sublimit is not arbitrary but is calculated based on the likelihood of certain events, such as natural catastrophes, occurring over a specific period. To make these calculations, insurers use predictive modeling tools. These tools use historical data and sophisticated algorithms to predict the probability of an event occurring within a given timeframe. This approach allows insurers to manage their risk exposure more effectively.

In addition to this, there has been consideration of a potential solution that involves the creation of government-backed reinsurance pools specifically for natural catastrophe risk. This would be separate from other property risks associated with offshore wind-farm development. The idea behind this is to spread the risk among a larger pool, thereby reducing the potential impact on any single insurer. This approach could provide a more sustainable and resilient insurance framework for dealing with the financial implications of large-scale natural catastrophes.

The U.S. can adopt similar strategies to manage the financial risks associated with wind farms. The offshore wind insurance market in the U.S. has a robust insurance market for offshore wind farms, with more than 50 insurers providing coverage. This market has been crucial in the sector's growth, offering protection to various stakeholders and mitigating their financial risks.

In conclusion, we are confident in our ability to construct wind farms in the Gulf of Mexico and other hurricane-prone regions, drawing parallels with our experience in building turbines in typhoon-prone areas. However, we acknowledge that managing the unique challenges posed by hurricanes requires careful planning and strategic solutions.

ABOUT THE AUTHOR

As Global Industry Manager for Offshore Wind, Anna Hilden coordinates StormGeo's sales and business development activities in offshore wind globally. In 2020 she secured StormGeo's first forecasting assignment for an offshore wind construction project in the US. She now supports StormGeo's local teams in Texas and California in the company's move to expand in offshore wind in North America Hilden has been with StormGeo for more than a decade. She plays a key role in developing StormGeo's renewables business, especially in offshore wind. Previous employers include a wind-turbine OEM, as well as a national meteorological service. Hilden holds a master's degree in meteorology and mathematics from Copenhagen University.