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STATE OF THE GRID

QUARTER 4, 2024

Connecting the dots for a smarter energy future.

Expert consulting services tailored to utilities and their vendors focusing on Smart Grid and System Operations.

IN THIS ISSUE

Welcome to our newsletter!

In this edition of our quarterly newsletter, we are thrilled to share insights and updates that showcase the noteworthy progress and potential of the latest advancements and innovations shaping the future of our energy systems.

Join us on this exciting journey towards a smarter, greener, and more resilient energy future. Together, we can build a grid that not only meets today's demands but also paves the way for a brighter tomorrow.

INDUSTRY EVENTS AND INFORMATION

SURVALENT PODCAST

Dr. Vadari joined podcast host and Survalent CTO Young NGO in a two-part series, part of Survalent's **Exploring the Utiliverse™** podcast. Listen to their engaging discussion on the pivotal drivers of grid modernization, from cutting-edge technological advancements to the transformative role of distributed energy. Listen here.

DISTRIBUTECH 2025

March 22-24 in Dallas, TX

Catch MGS consultants in the halls of the largest T&D event in the country. This year, Distributech is focusing heavily on topics like transportation electrification, advanced distribution operations with DERMS and virtual power plants, smart city integration, grid modernization with grid edge technologies, and more! More info here.

WEI OPERATIONS CONFERENCE

April 15-18 in Vancouver, BC, Canada

John (JD) Hammerly will represent at this annual in-person conference which brings together hundreds energy industry professionals for three days of education and networking. More info here.

MGS RECOGNIZED AS ONE OF INC. MAGAZINE'S POWER PARTNERS OF 2024!

MGS is thrilled to be recognized as one of Inc. Magazine's 2024 'Power Partners.' This award highlights our commitment to providing entrepreneurs and small to medium-sized businesses with the essential tools and resources to start, run, and grow their ventures. We are honored to be among the top B2B companies acknowledged for our performance and support. Learn More.

Happy New Year!

Modern Grid Solutions eagerly anticipates a transformative 2025 as the energy industry is witnessing a surge in innovation, with significant advancements in renewable energy integration, energy storage solutions, and smart grid technologies.

Modern Grid Solutions is excited to be part of this dynamic landscape, working alongside industry leaders and policymakers to develop and implement cutting-edge solutions.

2025 promises to be a pivotal year, with numerous projects and collaborations aimed at creating a smarter, more resilient energy grid that can meet the demands of the 21st century. Modern Grid Solutions looks forward to continuing its mission of connecting the dots for a smarter energy future by helping our clients realize a truly transformed energy network and creating value for all their stakeholders.

M&A

ConnectDER raises $34M to expand footprint

ConnectDER, a provider of home energy technology for distributed energy resources (DER), has secured $35 million in Series D funding to accelerate its market expansion and product development. ConnectDER has also unveiled its next-generation meter socket adapter (MSA), the "IslandDER," designed to integrate with the utility grid and enable islanding of solar, battery storage, electric vehicles (EVs), and other distributed energy resources, for whole-home backup and resiliency. Read more.

Excelsior Energy secures deal with LG Vertech

Renewable energy infrastructure investor Excelsior Energy Capital announced a multiyear, 7.5 GWh reservation agreement with LG Energy Solution Vertech, a global player in energy storage system integration. Through the multiyear agreement, LG Energy Solution Vertech will provide Excelsior with a reliable supply of domestically manufactured, high-quality battery energy storage systems (BESS) to support its growing portfolio of standalone and hybrid energy storage projects across the United States. Read more.

100-year-old trucking company partners with Tesla

Saia LTL Freight has partnered with Tesla to introduce two of the company's first Tesla Semi trucks to its fleet. As Saia celebrates its 100th anniversary, it says "this collaboration signifies not just a milestone in the carrier's history but also a commitment to the future, exploring the latest technology to better serve its customers." Read more.

Verizon acquires Frontier Communications

Verizon Communications has acquired Frontier Communications Parent in a deal valued at $20 billion. This move will enhance Verizon's position as a leading fiber internet provider in the U.S., expanding its nationwide fiber footprint. The acquisition aims to accelerate Verizon's ability to deliver premium mobility and broadband services to existing and new customers while bolstering its intelligent edge network to support digital innovations like AI and IoT. Read more.

Siemens Energy acquires majority stake in Grid Pulse

German company Siemens Energy has acquired 76% of Slovenian company Gridpulse, which specializes in line monitoring of overhead lines, from Austrian manufacturer Mosdorfer and Slovenian investment company C & G Skupina Investiranje In Svetovanje, per deal advisor to the buyer. The deal was signed on August 26 and closed on December 1. Financial details of the transaction were not disclosed. Read more.

ABB acquires Gamesa's power electronics business

As part of an agreement between ABB and Siemens Gamesa, Gamesa Electric's power electronics business will be acquired by ABB. The acquisition includes Gamesa Electric's portfolio of power converters, inverters and control cabinets products for wind, solar and energy storage industries. The generators business of Gamesa Electric is not included in the agreement. The parties have agreed not to disclose the purchase price. As part of the transaction, both companies have entered a long-term collaboration agreement through which ABB will provide power electronics to Siemens Gamesa turbines, both onshore and offshore. Read more.

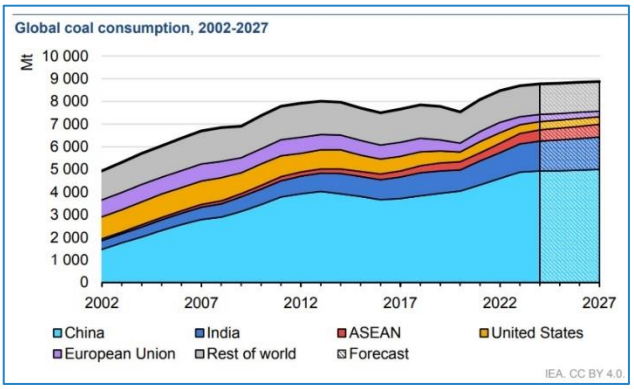
Iberdrola completes acquisition of Avangrid

Iberdrola completed its merger with US subsidiary Avangrid after acquiring the 18.4% of the shares it did not already control. The operation was completed after the green light was given by the Federal Energy Regulatory Commission (FERC), the Maine state regulator and also the New York state regulator. Once this transaction is completed, Avangrid will operate as a private company, maintaining its headquarters in Connecticut. The merger will allow Iberdrola to invest in the United States more efficiently. Read more.

KEY HIGHLIGHTS

Global coal demand to hit a new high

According to the International Energy Agency, global coal demand is expected to reach a new peak this year and remain stable through 2027. Despite the rapid expansion of renewable energy sources challenging coal's long-standing dominance in electricity generation, increasing power demand is offsetting this trend and boosting coal usage, as stated in IEA's Coal 2024 report. The future of coal will largely depend on developments in China, the world's largest coal consumer. See chart.>>



Keeping the lights on during the fourth-hottest summer on record in the US

The average temperature for the contiguous United States during meteorological summer (June through August) was 73.8°F, which was 2.5°F above average. Five states had their warmest summers on record: Arizona, California, Florida, Maine, and New Hampshire. Phoenix, Arizona, had more than 60 days with a high temperature of at least 110°F! Now that summer is over and data have been gathered, researchers at NREL have released a new publication on how the grid performed. Read the NREL report here (PDF).

NMPRC approves $344M grid modernization plan

The New Mexico Public Regulation Commission (NMPRC) approved an application by Public Service Company of New Mexico (PNM) designed to modernize its grid infrastructure using state-of-the-art technology for a more resilient, reliable, efficient, and decarbonized electric system. The filed six-year plan includes $344 million of investments supported by a cost-benefit analysis. Consistent with the state's grid modernization legislation passed in 2020, the approved investments will be recovered through a tariff rider reviewed annually. Read more here and here.

The largest transmission investment in U.S. history

MISO's MTEP24 (MISO Transmission Expansion Plan) is making history as the largest transmission portfolio ever undertaken in the United States. This ambitious plan covers 488 projects stretching over 5,000 miles across 15 states. These projects include local reliability improvements, the Long Range Transmission Planning (LRTP) Tranche 2.1 initiatives, and Joint Targeted Interconnection Queue (JTIQ) projects with Southwest Power Pool (SPP). Read more.

PSE and Northwestern sign MOU to invest in Northern Plains Connector HVDC line

Puget Sound Energy and NorthWestern Energy have signed nonbinding agreements for stakes in the proposed North Plains Connector transmission line. Puget Sound Energy would own 750 MW of the 3,000-MW high-voltage direct-current line, while NorthWestern Energy would take a 10% stake (300 MW). The 420-mile line would connect the Pacific Northwest with the Midcontinent Independent System Operator and the Southwest Power Pool, creating the first HVDC transmission link among the three U.S. electric energy markets. Avista Corp. and Portland General Electric are also part of the $3.2 billion project. Read more.

MISO approves historic transmission plan

MISO's MTEP24 transmission plan is making history as the largest transmission portfolio ever undertaken in the United States. This ambitious plan covers 488 projects stretching more than 5,000 miles across 15 states. These projects include local reliability improvements, the Long Range Transmission Planning (LRTP) Tranche 2.1 initiatives, and Joint Targeted Interconnection Queue (JTIQ) projects with Southwest Power Pool (SPP). Read more.

'World's first' grid-scale nuclear fusion plant announced in the US

Commonwealth Fusion Systems (CFS) will build the world's first grid-scale commercial fusion power plant at the James River Industrial Park in Chesterfield County, Virginia. CFS has partnered with Dominion Energy Virginia for non-financial collaboration, including development expertise and leasing rights. Dominion Energy Virginia owns the proposed site. The facility is

expected to produce enough energy to power about 150,000 homes sometime in the early 2030s. CFS will independently finance, build, own, and operate the plant, known as ARC. Read more. Another good article about CFS and fusion here.

BPA to double its transmission asset investments
Renewable energy development in the Northwest region is booming. To meet this need, BPA identified that its traditional model for deploying transmission capital would not be sufficient to meet customer needs. BPA determined it would need to double its transmission capital execution by 2028. To accomplish this, BPA is looking to improve and expand upon its existing portfolio delivery methods. Read more.

FERC approves plan to stimulate 29 GW of renewables
The Federal Energy Regulatory Commission (FERC) recently approved a joint transmission plan by the Midcontinent Independent System Operator (MISO) and the Southwest Power Pool (SPP). This plan, known as the Joint Targeted Interconnection Queue (JTIQ), aims to advance $1.8 billion in transmission projects, enabling about 29 GW of new generation, primarily from renewable sources. The projects are expected to begin coming online in 2031. The JTIQ framework provides benefits such as a streamlined generation interconnection queue process, optimized network upgrades, and greater cost and timing certainty for the transmission projects. Read more.

Constellation secures $1B Nuclear Power Deal with US Government
Constellation, the nation's largest producer of clean, emissions-free, reliable energy, has been awarded more than $1 billion in combined contracts by the U.S. General Services Administration (GSA) to supply power to more than 13 government agencies and perform energy savings and conservation measures at five GSA-owned facilities in the National Capital Region. Under a 10-year, $840 million contract, the largest in GSA history, Constellation will supply the GSA with more than 1 million megawatt hours (MWh/yr) annually, beginning in 2025. Read more.

$2B awarded in latest GRIP smart grid grants round
As part of the Bipartisan Infrastructure Law, the Grid Deployment Office is managing a $10.5 billion GRIP Program to enhance grid flexibility and resilience against extreme weather and climate change. On October 18, 2024, the U.S. Department of Energy announced nearly $2 billion for 32 projects to protect the U.S. power grid, lower costs for communities, and increase grid capacity. This includes 24 projects selected under Smart Grid Grants. See the full list of projects.

DOE to loan PG&E $15 billion for power upgrades
The Loan Programs Office announced a conditional loan commitment of up to $15 billion for Pacific Gas & Electric Company's Project Polaris. The project "will support a portfolio of projects to expand hydropower generation and battery storage, upgrade transmission capacity through reconductoring and grid enhancing technologies, and enable virtual power plants throughout PG&E's service area," the DOE said. Read more.

Off-grid solar and storage could power AI data centers
A report by climate tech and microgrid firms found that off-grid solar and storage can provide clean power for AI data centers at nearly the same cost as off-grid natural gas turbines. Solar microgrids can be built faster than new grid connections and are highly scalable. The southwest U.S. alone has enough land near roads and gas pipelines to build 1,200 gigawatts of off-grid solar microgrid data center capacity, far exceeding future needs, according to Zeke Hausfather, lead climate researcher at Stripe.Read report here.

DEWA to launch $1.9B smart grid initiative by 2035
Dubai Electricity and Water Authority (DEWA) is implementing a smart grid with total investments of AED 7 billion (USD $1.9 billion). The smart grid ensures seamless, 24/7 integrated services, offering advanced features such as automated decision-making and interoperability across the electricity and water network. By leveraging disruptive technologies from the Fourth Industrial Revolution, including artificial intelligence (AI) and the Internet of Things (IoT), the smart grid ensures efficient, reliable and sustainable operations. Read more.

FEATURED ARTICLE

THE INCREASING DEMAND FOR CLEAN ELECTRICITY: THE UTILITY'S DILEMMA

By John David (JD) Hammerly, CEO of the Glarus Group

The electric utility industry must transition through a gauntlet of rapidly increasing electricity demand and the urgent need to decarbonize its electricity supply. Load growth continues to receive unprecedented press coverage, particularly regarding the explosion of data center load, but onshoring of key industries, electrification of transportation and industry, and production of hydrogen, ammonia, and methanol may surpass data center load growth in the next decade.

Data Center Boom

Data centers, particularly to support AI, are one of the fastest-growing drivers of electricity demand. According to a report by Grid Strategies, U.S. electricity demand forecasts show record growth, surpassing historical load growth annual percentages. In some areas, load growth could be three times higher than any previous annual load growth. The report estimates that data centers could account for 44% of U.S. electricity load growth from 2023 to 2028.

Onshoring Key Industries

Key industries like semiconductors, battery manufacturing, and pharmaceuticals are returning to the US. The CHIPS and Science Act and other government incentives encouraged domestic production of critical components, as evidenced by the construction of new domestic factories, many of which are massive in scale and energy-intensive. Where these factories go into production, the local utility faces enormous new block loads taxing their grids, and these new customers desire carbon-free electricity. These factories drive fan-out impacts, creating jobs driving community transformation, requiring a robust supply chain, needing sufficient transportation infrastructure, and propelling cultural transition with the influx of a more diverse workforce.

Transportation and Industry Electrification

The electrification of transportation and traditional manufacturing will significantly increase electricity demand. According to the US Energy Information Administration (EIA), as of December 2024, 21.2% of new light-duty vehicle sales in the United States were plug-in hybrid electric vehicles (PHEVs) or battery electric vehicles (BEVs). However, when considering the entire personal vehicle fleet, plug-in hybrids and electric vehicles make up only about 8.5% of the total vehicles on the road.

Large logistic operators, such as USPS, UPS, FedEx, and smaller fleet operators, are transitioning to BEV fleets in low-cost electricity locations. The transition for heavy-duty vehicles is moving more slowly, but some short-haul and mining vehicles are already in service. Further, transit fleets are on a similar trajectory as battery electric buses and electric rail replace their fossil fuel predecessors.

Capacity Factor Problem

Ensuring the availability and reliability of electricity supply in the face of this unprecedented load growth will be daunting because, in parallel with the growth, existing high-capacity-factor fossil and nuclear resources are being retired and replaced by low-capacity-factor solar and wind. A fossil-fired generator with sufficient

available fuel routinely has a capacity factor of over 90% of the hours a year, while solar and wind capacity-factors range between 20% and 40% of the hours annually.

Storage Alone is not the Answer

Storage is central to overcoming the challenge, but storage is not a single solution. Storage capabilities must change to support the characteristics of renewable resources. For example, in the Southwest, eight-hour storage may be sufficient, but in areas with days of overcast skies without wind, longer-duration storage becomes necessary. Where seasonal renewable energy production variability is common (e.g., snow-melt hydroelectric), storage with a duration of weeks or months can capture electricity when available and release it when needed.

Additional Supply Resources

The electricity industry is building new generation, storage, and grid infrastructure while exploring emerging technologies. Further, the industry is expanding onsite power generation and storage solutions, such as industrial energy storage systems deployed to provide flexibility and support the grid during peak demand. Additionally, utilities are improving inter-regional transmission capacity to manage load growth better and ensure a reliable electricity supply at an affordable price.

Additional non-emitting supply resources are required to bridge the demand-supply chasm ahead. To serve the forecasted electricity demand, utilities will need both baseload and dispatchable generation, filling the gaps in wind and solar supply.

Nuclear generation, including large centralized and small modular reactors, fusion, geothermal, and space-based solar, could fulfill baseload and dispatchable needs, but will they be online soon enough to meet the rapidly growing demand?

Alternative Energy Molecules

While electrification is a crucial step towards reducing carbon emissions, it cannot meet all the energy demands of the industrial and transportation sectors. This gap necessitates the exploration of alternative energy molecules such as hydrogen, ammonia, and methanol. Hydrogen, for instance, can fuel high-temperature industrial processes and transportation fuel cells. Ammonia, often produced through green hydrogen, is a potential fuel for shipping and heavy industries where electrification is challenging. Methanol, another versatile energy carrier, fulfills industrial needs and fuels internal combustion engines. However, producing these molecules further increases the electrical load.

Decarbonization Cost

The transition to renewable energy sources has significant cost implications for utility customers. Wind and solar resources require more than three times the generation capacity compared to fossil-fuel-based generation because of their lower capacity factors, and the cost of energy storage adds another layer of expense. These costs can impact the electricity affordability for consumers and pose financial challenges for utilities.

To mitigate these costs, utilities are exploring innovative financing models and seeking government incentives to support their decarbonization efforts. Additionally, utilities are working to improve the efficiency of their renewable energy projects and reduce the overall cost of energy storage through technological advancements and economies of scale. These strategies aim to make the transition to renewable energy less of an economic jolt to our economy, capturing the decarbonization benefits without placing undue financial burdens on consumers.

Conclusion

The electric utility industry is at a critical juncture as it addresses the challenges of load growth while transitioning to a carbon-free future for a society ever more dependent on a reliable energy supply. By investing in new generation and storage technologies, enhancing transmission infrastructure, and collaborating with manufacturers and other stakeholders, utilities seek a reliable, affordable, and sustainable energy supply. The decarbonization path is complex and costly, but with sound strategic planning and innovation, the electric utility industry will navigate the challenge and realize a cleaner, greener future.

FEATURED ARTICLE

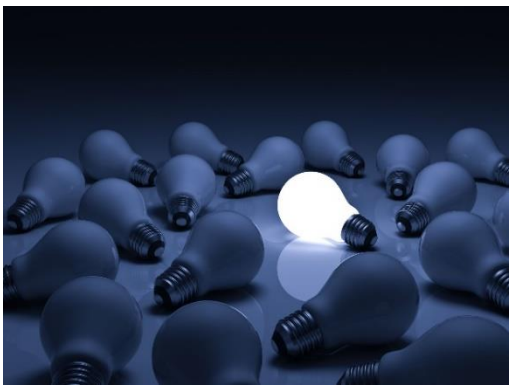
ENHANCING OMS IMPLEMENTATION SUCCESS RATES: A TETRALOGY OF ARTICLES

By Dr. Mani Vadari

This tetralogy of articles delves into the intricacies of Outage Management System (OMS) implementations, shedding light on the common hurdles that hinder initial success and offering guidance to bolster success rates. Here is an abridged version of the fourth article.

PART FOUR

OMS vendors' role for implementation success



Overview

This series explores the complexities of OMS implementations, highlighting common obstacles and offering strategies for success. The first article introduced OMS in electric utilities, tracing its evolution and benefits. The second piece examined utility business processes crucial to OMS success. The third article discussed OMS procurement, readiness strategies, and best practices.
This final article presents strategies for vendors to align their systems with utility processes and explore integration mechanisms for successful OMS implementations.

Proposed Vendor Best Practices for OMS implementations

Vendors play a crucial role in OMS success, defining and creating the OMS product. The OMS must support multiple external business processes and interface with various legacy systems. Despite these challenges, vendors must innovate and stay current with technologies like AI/ML and cloud solutions. The OMS is integral to a utility's OT/IT infrastructure, and its performance during outages or major storms directly impacts the utility's ability to deliver reliable power and restore service efficiently. Failures can attract significant public attention.

For successful implementation at multiple utilities, the vendor needs to focus on several important considerations outlined in this article: **System Design and Requirements; Architecture Design; Integration Design – Technology / System; Integration Design – Utility Business Processes; Integration Design – OMS Modeling; Integration Design – IT/OT; Reporting and Data Warehousing.**

System Design and Requirements

The vendor product must support a wide range of grid topologies and interpretations from utilities, including installations from the 1950s to new developments. This includes:

- **Grid modeling:** Radial and networked-mesh
- **Transformers**: Wye-connected, Delta-connected, Open-Wye, Open-Delta, Grounded, and others
- **System configurations**:
    - With or without SCADA
    - Connecting to D-SCADA or interfacing with combined T&D SCADA
    - With or without DMS (solved power flow)
    - With or without advanced applications like FLISR (distributed or centralized, model-based)
    - Others
- **Voltage levels**: Various
- **Switch types**: Disconnects, circuit breakers, reclosers (sensed through SCADA or not)

- **Sensing devices**: Old mechanical meters, AMR, AMI, IoT, and others
- **Technical and business constructs**: VPPs, microgrids
- **Renewables**: Solar (FTM and BTM), wind (individually or paired with storage)
- **Standalone storage**: FTM or BTM

SCADA – Supervisory Control and Data Acquisition
D-SCADA – Distribution SCADA
DMS – Distribution Management System
AMR – Automated Meter Reading
AMI – Advanced Metering Infrastructure
IoT – Internet of Things
VPP – Virtual Power Plant
FTM – Front of the Meter
BTM – Behind the Meter

The system (application, modeling, and interactions) must consider all permutations and allow for configurations and robust error handling. Fifty utilities may perform the same transaction in 50 different ways, and within a specific utility, actions may vary by jurisdiction, whether at the state or city level.

Architecture Design

OMSs must evolve to integrate with a wide range of legacy systems. They often rely on external components like IVR systems, outage maps, apps, analytics, and reporting from different vendors.
Key considerations for vendors:

- **Open Architecture**: Support open industry-standard interfaces for easier integration and continued functionality.
- **Simplified Deployment**: Ensure the OMS is easy to install, deploy, and update, accommodating utilities of varying sizes and IT capabilities.
- **Implementation Flexibility**: Adapt to different environments such as CIOPS, inside the DMZ, or other parts of the corporate network.
- **Cloud and On-Premises Options**: Offer flexibility for both cloud and on-premises implementations, addressing the many concerns and challenges of each.
- **Integration with New Technologies**: Incorporate new technologies like image recognition, AI/ML, for enhanced damage assessment and restoration planning.

Integration Design – Technology / Systems

An OMS must integrate with systems like Work Management Systems, GIS, centralized reporting databases, AMI, Customer Systems, DERMS, SCADA, DMS, and communication platforms. This integration presents challenges:

- **Varied Interactions**: Systems interact with the OMS in different capacities, sometimes separately and sometimes combined.
- **Outage Management Process**: Systems provide information at various stages of the outage management process, requiring synchronization for accurate and up-to-date information.

These complex systems, developed by various vendors with overlapping capabilities, require modularity. Utilities choose functions from each vendor, so seamless interaction is essential.

Integration Design - Utility Business Processes

Vendors should include utility personnel with deep OMS experience in their teams for sales/marketing, product development, and project implementation:

- **Sales/Marketing**: Utility-experienced personnel can communicate effectively with utility personnel, understand their needs, and relay requests to the product team.
- **Product Development**: Utility-aware experts should influence features, architecture, and the roadmap.
- **Project Implementation**: Utility-experienced personnel ensure effective system use and influence key aspects like test plans and performance testing.

Integration Design - IT / OT integration

The OMS IT/OT architecture must support interactions with various field devices:

- **SCADA Devices**: Ensure strong integration with SCADA systems from different vendors, either through the SCADA system or directly with field SCADA devices.
- **Fault Locators**: Integrate data from fault locators into the OMS model for real-time outage information.
- **AMI Meters**: Interact with AMI meters from multiple vendors for real-time data and outage location recalculations.
- **Grid-Edge Devices**: Stay updated with changes and support new technologies like IEEE 1584 and 2030.5.

The OMS must maintain an updated as-switched model, especially during large storms, and ensure robust end-to-end cybersecurity.

Integration Design – OMS Modeling

The OMS often serves as the front-end for ADMS implementation, making the underlying model crucial. Vendors must provide tools for utilities to upload the model piece-by-piece or en masse, ensuring continuous updates.
Key capabilities required from the vendor include:

- **Model Updates**: Ability to update the model without system downtime, while maintaining all legacy data.
- **Rollback Changes**: Ability to roll back changes if part of the data upload fails.

The OMS model should initially meet OMS needs but be extendable to support other ADMS applications like UBLF, VVO, and FLISR. It should handle future grid additions and distinguish between future and existing deenergized portions.

Reporting and Data Warehousing

The OMS is a key source of utility reporting. Its design should:

- **Capture Data**: Collect all data from real-time systems for reporting.
- **Support Flexible Performance Reporting**: Ensure dashboard and reporting requirements do not slow down OMS usage or real-time system performance, and support both structured and unstructured data access.
- **Enable Audit Trails**: Track changes to real-time data for understanding modifications or rolling back inappropriate changes.

In addition, the OMS should facilitate easy data transfer to data warehousing/reporting tools like Amazon Redshift and Snowflake.

OMS Vendor Best Practices – Key Takeaways

OMS software is similar to SCADA and DMS, with high readiness thresholds and less clear regulations. It shares security, performance, and accuracy profiles with financial software but lacks consistency across utilities.

Best Practices for Vendors:

- Align Sales and Engineering: Ensure sales teams do not promise non-existent features. Discuss future features as part of the product roadmap and set realistic expectations.
- Adaptable Architectures: Design software to be easy to implement and maintain, capable of expanding in features, and integrating with other vendors' systems.
- Scalable Models: Design the model to grow with the system and features, expanding to a full ADMS.

Stay tuned for the upcoming eBook, "Enhancing OMS Implementation Success Rates," which will feature the complete series of articles. Coming soon! You can find the first three articles of this series here.

DID YOU KNOW...

The world's largest offshore floating wind turbine has a swept area of about 14 American football fields (812,424 square feet)?

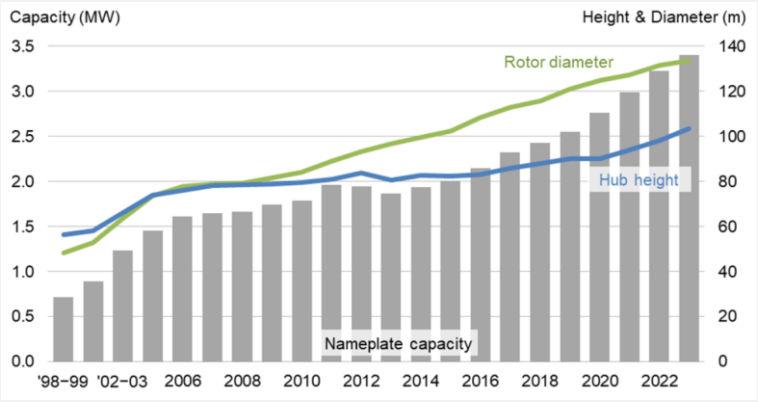
China's Dongfang Electric Corporation recently rolled out a 26MW offshore wind turbine, the largest in the world in capacity and size. This behemoth features a blade diameter* of over 1,107 feet – roughly the same height as the Chrysler Building and longer than the longest US aircraft carrier – and a hub height of 607 feet, comparable to a 63-story building, or the Seattle Space Needle which is 605 feet tall. This turbine can generate 100 GWh annually, enough to power 55,000 Chinese homes (about 9,200 American homes) per unit. It also boasts an anti-typhoon system, with the ability to withstand a Category 17 super typhoon, involving winds of up to 137 mph, similar to a Category 4 hurricane.

Blade Size Matters

Larger wind turbine blades generate more power, which is why there's a trend toward bigger turbines. Doubling the blade length increases the swept area fourfold, significantly boosting power generation. Taller turbines also capture more energy due to higher wind speeds. Bigger blades reduce the number of turbines needed, lowering construction and maintenance costs. This makes wind energy more cost-effective, driving the growth of larger systems as technology advances and demand increases.

Recent Evolution Wind Turbine Blades

The increase in wind turbine blade size and overall hub height has been driven by the need to capture more wind energy and improve efficiency. However, longer blades also put more mechanical stress on the structure, necessitating lighter materials and improved designs. Since the 1980s, blade lengths have grown significantly, from around 26 feet to over 300 feet in the 2020s. Advances in materials and engineering have allowed for larger, more efficient blades, with modern turbines featuring blades up to 554 feet long. This trend is expected to continue as technology advances and the demand for renewable energy grows.



Average turbine hub height, rotor diameter, and nameplate capacity for land-based wind projects from the Land-Based Wind Market Report: 2024 Edition.

Looking Forward

Although the growth of wind turbine blades is restricted because of physical/environmental limitations and engineering challenges, we'll likely see larger turbines continue as our industry seeks to maximize renewable energy production.

Now, all we need is some innovation in long-duration energy storage to truly address the intermittent nature of wind power and more fully take advantage of wind resources to power our electricity grids.

**This refers to the diameter of the circle the blade creates when it rotates. It's essentially twice the blade length. Blade length is measured from its base to its tip.*

WHAT'S ON MANI'S MIND?

Is the Electric Utility Software Industry Ready for Climate Change?

Climate change is no longer a distant threat—it's a present reality. The electric utility industry faces unprecedented challenges as extreme weather events increase in frequency and intensity. One critical area that requires urgent attention is the software infrastructure supporting utility operations, particularly outage management systems (OMS) and other control room software.

The Rising Frequency of Extreme Weather

Extreme weather events, such as hurricanes, wildfires, and severe storms, are becoming more common due to climate change. These events can cause widespread power outages, putting immense pressure on utility companies to restore service quickly and efficiently. 80% of all significant US power outages between 2000-2023 were due to weather. (Read more about extreme weather events on page 12 in MGS's Q3 2024 newsletter.) However, current outage management systems and control room software often struggle to cope with the sheer volume and complexity of outages caused by these extreme events.

Outage Management Systems: A Weak Link?

Outage management systems are designed to detect, analyze, and resolve power outages. However, many OMS solutions today are not equipped to handle the scale and severity of outages brought on by extreme weather. The increased volume of outages can overwhelm the system, leading to delayed response times, inaccurate ETRs (Estimated Time of Restoration), and prolonged power disruptions for customers. This highlights the need for more robust and resilient OMS solutions (people, processes, and technologies) that can adapt to the changing climate landscape. (Keep an eye out for MGS's soon-to-be-published eBook: "Enhancing OMS Implementation Success Rates.")

Control Room Software: The Heart of Utility Operations

Control room software is the nerve center of utility operations, responsible for monitoring and controlling the grid. During extreme weather events, operators must make quick and informed decisions to maintain grid stability and restore power. However, existing software can struggle to navigate these complex situations. As the frequency and intensity of extreme events increase, so does the demand for and complexity of control room software, putting strain on the industry. Enhancing the capabilities and scalability of this software is essential to providing the real-time data and predictive analytics needed to navigate these complex situations and improve situational awareness and decision-making during these more frequent crises.

Infrastructure: Implications Beyond Software

When utility physical infrastructure such as control center buildings and emergency response center buildings lose power and communications, the impacts can be severe and far-reaching. These facilities are critical for managing and coordinating emergency responses, and their functionality relies on continuous power and communication. A power outage already disrupts enough. Overlaying loss of power and communications to these critical facilities can delay emergency responses, leading to significant time loss delaying emergency responses by hours or even days. Ensuring robust backup power systems, redundant communication networks, and backup facilities that aren't exposed to the same vulnerabilities as the primary site is essential to mitigate these risks and maintain operational continuity during crises.

Data Centers: Vulnerable to Climate Impact

Data centers, which house the critical infrastructure for utility software systems, are also vulnerable to climate change. Extreme weather events can cause physical damage, leading to system failures and extended downtime. Power outages further complicate matters as it takes valuable time for backup battery power to kick in and for chillers to ramp back up to cooling temperatures. The situation worsens when telecommunications are also disrupted.

Utilities rely on data centers for energy management systems, so their operations can be severely impacted if critical data and services hosted by data centers become unavailable. Several types of data centers need to be considered: utility-owned, vendor-operated, and major providers such as Amazon (AWS), Microsoft (Azure), and so on. While many data centers have backup power systems, such as generators and battery storage, to mitigate the impact of power outages, these systems have limitations and may not be sufficient for prolonged outages. As utilities increasingly depend on data centers and use the cloud to host critical software, telecommunications to these data centers are as critical as power and telecommunications to the control centers themselves. Ensuring the resilience and redundancy of data centers is crucial to maintaining the integrity of utility software systems.

Conclusion: A Call to Action

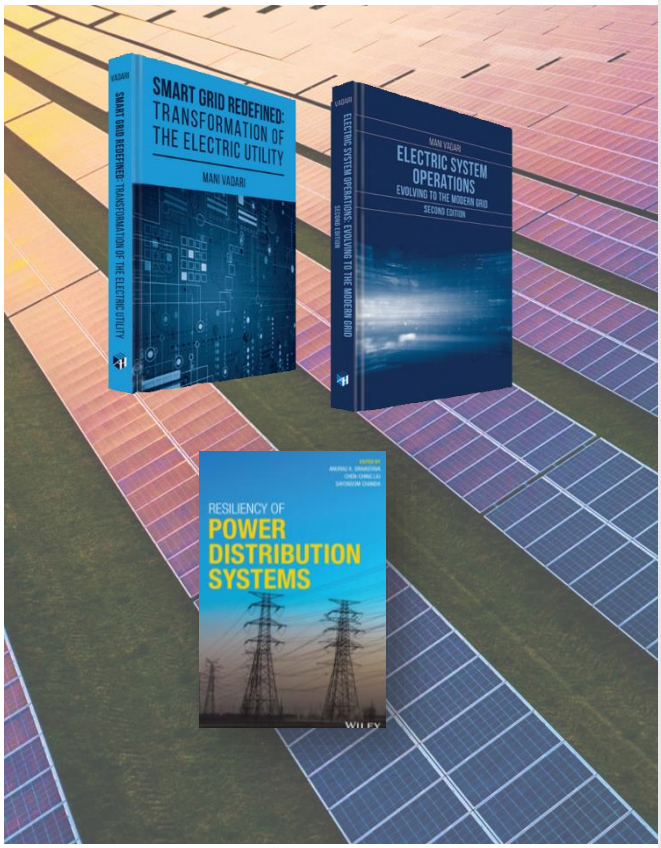
The electric utility software industry must take proactive steps to address the challenges of climate change. This includes investing in more resilient and adaptive software solutions, enhancing control room capabilities, and fortifying data centers against extreme weather. By doing so, utility companies can better manage outages, maintain grid stability, and ensure reliable service for their customers in the face of a changing climate.

ABOUT MODERN GRID SOLUTIONS

Modern Grid Solutions (MGS) is a global supplier of deep expertise in the electric industry. Our team, each with over 25 years of industry experience, delivers innovative solutions to utilities, corporate clients, and policymakers. Our experts cover a wide range of areas, including engineering, technology, economics, and operations. We're passionate about helping clients navigate the complexities of the modern grid, allowing them to focus on their core business. Our boutique consultancy stands out for its unique value proposition, where seasoned experts treat clients' businesses as their own.
Read more about MGS.

We focus on delivering value and actionable guidance to our clients, allowing them to flourish in the evolving energy landscape. Our on-going projects include:

• **Canadian Municipal Utility Transformation**	• **Northwest Utility Planning Transformation**
• Multi-OpCo Distribution Transformation	• **Energy Service Provider Assistance**
• Business Architect Role	• **Decarbonization Strategy**
• Vendor Collaboration	• **Startup Support**



The guy (literally) wrote the books!

Dr. Vadari's books serve as widely-used textbooks in universities across the US and beyond. Major utilities also favor them.

- ***Smart Grid Redefined: Transformation of the Electric Utility***
- ***Electric System Operations – Evolving to the Modern Grid. 2nd edition***
- ***Resiliency of Power Distribution Systems*** - Chapter 14, *Technology and Policy Requirements to Deliver Resiliency to Power System Networks*, by Dr. Mani Vadari, Gerry Stokes and John (JD) Hammerly.
- ***Enhancing OMS Implementation Success Rates*** Our online book and e-book are coming soon. Stay tuned for more news on their release.

Additionally, MGS is the trusted authority for conducting in-depth training sessions on critical industry subjects, including power system fundamentals and grid modernization. Ask us about our training programs.

Don't miss out on our incredible resources!
Head over to our new website and discover our eBook, "Utility Executive Quick Reference Guide," and Dr. Vadari's Blog, "Watt's on Mani's Mind?" And that's just the beginning! Explore much more on our website. Visit us and unlock a world of knowledge from our industry leaders.

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