UNDERGROUND RESILIENCY FOR FERC 2222

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Federal Energy Regulatory Commission (FERC) Order 2222 requires the integration of distributed energy resources (DERs) into the transmission and distribution (T&D) system and will use the principles of transactive energy to move towards net-zero energy and carbon-free generation portfolios.

Wind energy from this Montana billboard is a distributed energy resource (DER)

FERC 2222 will require a highly reliable and resilient T&D system best delivered by undergrounding the electric distribution system. Transactive energy will require a robust and modern two-way telecommunications network to carry vast amounts of sensor derived data from sources of generation and storage,

field devices and equipment monitors as well as market pricing signals and demand projections. This paper will define FERC Order 2222 and transactive energy and demonstrate how undergrounding the electric distribution system can enhance electric system reliability and resiliency to deliver the benefits of the Order.

This antiquated 1960s design will not reliably deliver the transactive energy future required under FERC 2222

Introduction

The electric distribution system plays a critical role in delivering safe, affordable, reliable, resilient and clean electricity to consumers. Increasing deployment of DERs, such as solar panels, micro-turbines, fuel cells, electric vehicles (EV'S) and mobile and stationary energy storage systems, is creating new technical challenges to the centralized legacy electric grid. FERC Order 2222 has been issued by the Federal Energy Regulatory Commission and focuses on the removal of market barriers for DERs and allowing DER participation in wholesale energy markets. The order promotes the development and use of transactive energy platforms that facilitate the exchange of energy and services between DERs, consumers, and grid operators.

Transactive Energy

Transactive energy is an intelligent, multi-level communications platform that will theoretically enable the dynamic, decentralized, and autonomous exchange of energy and energy pricing between various supply and demand side participants in the electricity grid. It encompasses a range of market-based mechanisms, including real-time pricing, demand response, and peer-to-peer energy trading.

Under the transactive energy scenario, electricity suppliers, energy markets, the electric power grid, homes, commercial buildings, and DER's would "talk" directly or indirectly with each other to negotiate energy needs and costs. The electronic process would rapidly and automatically harmonize energy availability, consumer needs, cost preferences, and other factors, enhancing overall energy system efficiency and performance.

By enabling greater market access and coordination using the principles of transactive energy, FERC Order 2222 is designed to improve overall T&D system flexibility, efficiency, and reliability in delivering clean, renewable DER's to load.

Societies around the world strive to achieve net zero energy and carbon-free generation portfolios. Access to integrated DERs will become an indispensable component of the energy transition. Their distributed nature allows for localized generation, reducing transmission losses and enabling efficient utilization of renewable resources. DERs empower consumers to actively engage in the energy market, fostering a sense of energy independence and environmental stewardship.

Urbanova is 770 acres of living laboratory for scalable, replicable and innovative projects in Spokane, Wash.'s downtown University District. Photo courtesy of Gonzaga University.

In addition, DER integration under FERC Order 2222 can potentially contribute T&D system benefits such as grid stability, load balancing, and ancillary services. System operators can leverage the capabilities of newly integrated DERs to address fluctuations in electricity supply and demand, respond to system and market signals, and optimize the utilization of renewable energy resources. As quantifiable consumer and system benefits grow, reliable DER's will become indispensable to the 21st century grid.

This whole house stand-by generator is a DER that can connect to the underground grid and employ transactive energy

FERC Order 2222 will be a catalyst for grid modernization efforts. Upgrades to grid infrastructure, communication systems, and grid management tools will be required. The integration of DERs will need advanced monitoring, control, and forecasting mechanisms to optimize their contribution and ensure seamless grid integration. The investments in grid modernization will be concurrent with DER deployment, and these investments will drive innovation, the adoption of emerging technologies and the preferred use of highly reliable and resilient underground electric and communication systems.

Underground Electric Distribution

FERC 2222 will require a highly reliable and resilient T&D system best delivered by undergrounding the electric distribution system.

Undergrounding offers several advantages compared to overhead lines to include significantly reduced vulnerability to extreme weather events like heavy ice and snow, lightning, tornados and hurricanes, floods, and wildfires. By eliminating the impact of severe weather conditions and reducing other potential outages caused by falling tree limbs or vegetation contact, car hit poles, birds and rodents, mylar balloon impacts, ground line wood rot and more, undergrounding contributes to a much more reliable and resilient electric distribution system.

The industry defines reliability with outage duration and frequency while resilience is defined as the ability to withstand a high impact, low probability (HILP) event with little or no customer outage. Reliability is measured in outage minutes and resilience is typically measured in days. Underground provides a much more resilient system and is the proven level of performance that FERC 2222 will require.

Additional advantages of underground include:

- **Upgrades and Repairs.** Underground systems can be built with additional conduits for faster repairs, future growth or upgrades, or applications of emerging technologies.

Iconic Saguaro cut to clearance in AZ

- **Economic Protection.** The negative economic impact of sustained electric service outages can reduce the local gross domestic product (GDP)and harm businesses and services. Underground reliability and resiliency protects customers economically.

This streetscape is clear and beautiful

- **Better Aesthetics.** Except for the occasional above-ground equipment and risers, underground electric distribution is out of sight leaving a clear and beautiful streetscape and improved property values.

- **Safer Overall.** Underground lines are generally safer and more secure due to lower public visibility and the difficulty of physical access.

- **Reduced EMF Exposure.** At the same voltage and current, an underground cable will typically have a lower electro-magnetic field (EMF) exposure than an overhead line due to proximity to humans.

- **No Fifth Generation (5G).** Underground precludes the use utility poles every 100-200 yards creating unsightly clutter on said poles and potential, yet undefined, human health impacts.

- **Public Acceptance.** It is generally easier to obtain an easement for underground lines, and customers tend to be more accepting of new underground projects.

Conclusion

Undergrounding the electric distribution grid provides a compelling solution to enhanced system reliability and resiliency, especially as we strive use DER's to achieve net-zero energy and carbon-free generation portfolios with FERC 2222.

The many benefits of underground electric, including dramatically reducing weather and vegetation related outages, improving resilience to natural disasters, and delivering long-term value over the life of the asset, make it an important component of a modernized and sustainable energy infrastructure. By combining the integration of distributed energy resources through transactive energy platforms with the undergrounding of the electric distribution grid, we can meet the objectives of FERC 2222 and create a safer, more affordable and environmentally conscious energy system for the future.

About Mike Beehler

Mike Beehler & Associates, LLC offers the "Power of Experience™". We believe that strategically positioning for success and growth in the electric utility industry will require clear vision supported by entrepreneurial creativity, intellectual genius and the very best from other industries.

A New Paradigm of Thinking℠ about safety, reliability, resiliency, affordability, sustainability, compliance, cyber security, our employees.... and the customer.

Mike started his career designing and building transmission lines and substations for Tucson Electric Power and the Hawaiian Electric Company and then spent over twenty years designing T&D infrastructure and consulting on emerging trends at Burns & McDonnell, a large, international architectural/engineering/construction firm. He has written, presented and consulted on reliability centered maintenance, critical infrastructure protection, and program management. In addition, he is a well-known industry writer and speaker on the early definition of the smart grid, 3D/BIM applications in T&D, and development plans for smart cities. Most recently, he is sought for his strategic leadership and vision on the application of emerging technologies in changing business models to include the integration of distributed energy resources, augmented/virtual reality and artificial intelligence.

Mike is a registered Professional Engineer in AZ, FL, HI, TX, CO, KS, GA and AL, a Fellow in the American Society of Civil Engineers and a Member in IEEE and CIGRE. He has been married for over 40 years, and has four adult children and some delightful grandchildren.

If you'd like to chat about the future, please send Mike an email at mebeehler@protonmail.com.

Find more at

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