Aging Infrastructure and Smart Modernization

Dr. Mani Vadari

June, 2013

Meet the Author:

An IEEE Fellow, electricity industry visionary, and leader, Dr. Mani Vadari delivers strategic services to a global set of utilities, vendors, and service providers seeking deep subject matter expertise in setting the business and technical direction to develop the next-generation electric/energy system. As a Business Architect, Dr. Vadari has been delivering solutions focusing on Transmission/ Distribution/ generation operations, Energy markets, and Smart Grid for over 35 years. In addition, he is an Adjunct Professor at Washington State University and an Affiliate Professor at the University of Washington. He has published two popular books, "Smart Grid Redefined: Transformation of the Electric Utility" and "Electric System Operations – Evolving to the Modern Grid, 2nd Edition", in addition to over a hundred industry papers, articles, and blogs. His books are serving as textbooks at several universities in the US and around the world

https://www.moderngridsolutions.com/

Once considered a supreme engineering achievement of the 20th century, America's electric energy grid is now very much showing its age.

The traditional electricity grid was designed for a one-way flow of energy from large centralized sources of supply to large and somewhat distributed locations of consumption. It was designed for a paradigm in which demand changed independently and all the necessary adjustments were made to supply. Moreover, it was designed to keep an astounding 50 percent of its capacity underutilized in order to maintain system reliability and efficiency.

All this when smart meters weren't yet even a gleam in a far-sighted engineer's eye.

Yet, even as the aging grid infrastructure struggles to cope, new stresses abound. Electronic components in nearly everything from toys to (wind) turbines create complex load demands. Electric vehicles need charging, both at home and around town. Intermittent generation resources feed in wind and solar power, adding to the inherent complexity of transmission and distribution grid availability.
Faced with these new realities, two questions need to be answered. Is this aging infrastructure inhibiting the growth of the smart grid? Or does the smart grid actually hold the key for utilities and regulators to overcome the deficiencies of the existing grid? The answer lies in leveraging smart technologies to resolve issues in new ways.

Here are some examples:

- Growth in renewable generation: The old way of dealing with added demand for transmission would be to build more transmission lines. This is both expensive and politically complex. The smart grid solution is to either pair up renewables with tools like energy storage and demand response, or newer control methods like the creation of renewable energy zones. Improved distribution automation could also be used—particularly where there is a need to manage the change from one-way to two-way power flows.
- Transmission line siting: New lines are complex, expensive, and slow to move from design to permitting to construction. New technology better manages utilization of existing infrastructure through use of digital substations and a combination of FACTS and HVDC-based solutions to control flow.
- Transmission or distribution congestion: Growing pockets of congestion already exist throughout the North American power grid, and more are appearing as the effectiveness of traditional management methods, such as raising prices or building new capacity, wanes. The smart grid solution is to either manage these loads (demand response, energy efficiency) or use the opportunity to build smaller generation sources inside congestion zones and closer to customers.
- Transmission line capacity limits: Heavily loaded lines tend to become stability-constrained far below their thermal rating. Smart solutions such as remedial action schemes (RAS) increase capacity to much closer to thermal limits. New smart algorithms such as dynamic line ratings push this even further.

Aging Infrastructure and Smart Modernization

Dr. Mani Vadari

- *Distribution systems outages: An outage is usually identified when a customer reports lost power. In a smart grid scenario, smart meters inform the utility of outages and pinpoint the customers impacted. Meanwhile, automated switches can remotely reroute customers to other resources such as non-affected feeders.*
- *·Accommodate two-way power flow: As more customers install rooftop solar, special equipment is currently required to push excess power back to the grid—without endangering field crews. In smart scenarios, net metering automatically takes care of tracking the power and automation ensures protection for the field crew.*

So while aging infrastructure presents problems, it also presents unique opportunities for new solutions to meet load demands and customer requirements, and to extend equipment life and extract more value from existing assets.