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Energy Efficiency & Power Quality Series

2010 Power Quality Forecast

Are Improvements on the Horizon?

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Power quality -- or, simply, the usability of electric power -- is of vital concern to modern life. We see this reflected in the massive global market for power quality products, which last year exceeded USD$5 billion, and for the next ten years is expected to enjoy double-digit annual growth. Given this financial focus, a natural question to ask is: Will power quality improve -- or worsen -- in the near future? A look at factors involved paints a complex picture: one in which suggests things may get worse, before they get better, for end users. This paper examines some of the overarching issues that will impact power quality in the near term.

Power Quality

What is power quality? Often, it's a concept that's vaguely defined. But a simple way to understand power quality is to ask the following question: Are the current, voltage and frequency of your power now able to support the proper operation, as well as the longevity, of electrical devices?

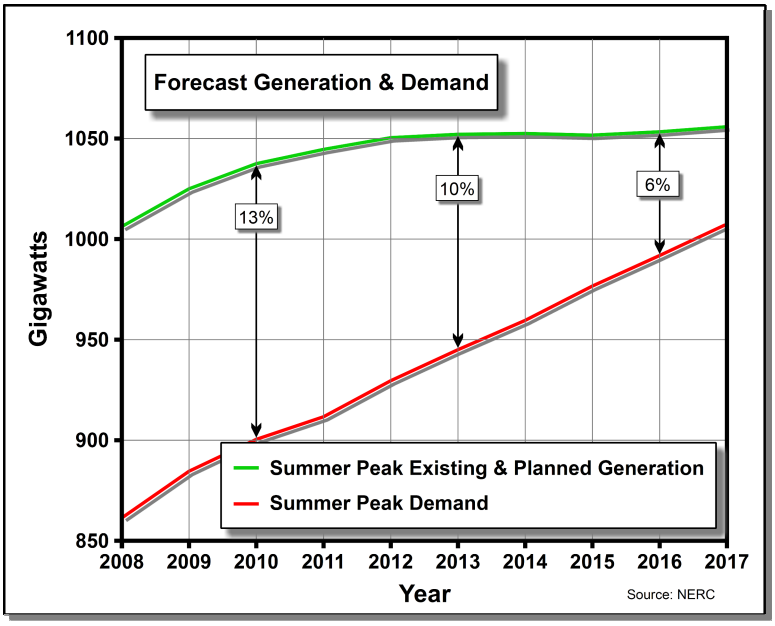
Both current and frequency rarely cause problems for end users. That's because electric current is dictated by load, and the utility -- to maintain stability of the grid -- very tightly controls the frequency of AC power. As a result, voltage quality represents the lone rogue element. Indeed, statistics reflecting so-called power quality problems show that over 95% of them are, in fact, voltage problems. These include voltage levels that are too high or too low; voltage sags (transient drops in voltage); and power interruptions (absence of voltage). Ultimately, voltage quality affects not only the operational reliability and life of sensitive electronics, as well as other electric devices, but it also has a significant impact on energy consumption and efficiency.

Factors Affecting Power Quality

In an ideal world, the voltage supplied to an electric device would always let the device operate perfectly, across its expected lifetime. In reality, this rarely happens. Engineering complexities, business considerations and the politics behind generating, transmitting and consuming electricity: all play big roles in determining power quality.

GENERATION

Electricity cannot be stored -- yet it's in constant demand. Hence, enough of it must be generated instantaneously to meet the need. More, because the need for electricity -- especially during the peak demand of hot summer months -- continues to climb, new generation will be required. But firm commitments for this new capacity are lagging behind the projected demand growth. Projections through 2017 by the **North American Electric Reliability Corp.** (NERC) show a narrowing gap between summer peak supply and demand. An excess 13% of peak electricity is currently produced, but that's expected to drop to 6% by 2016. As the margin between surplus and demand narrows to less than 10%, the risk for localized brownouts and service interruption grows substantially. Eventually, technology to generate more energy will be put into place, but the short-term forecast

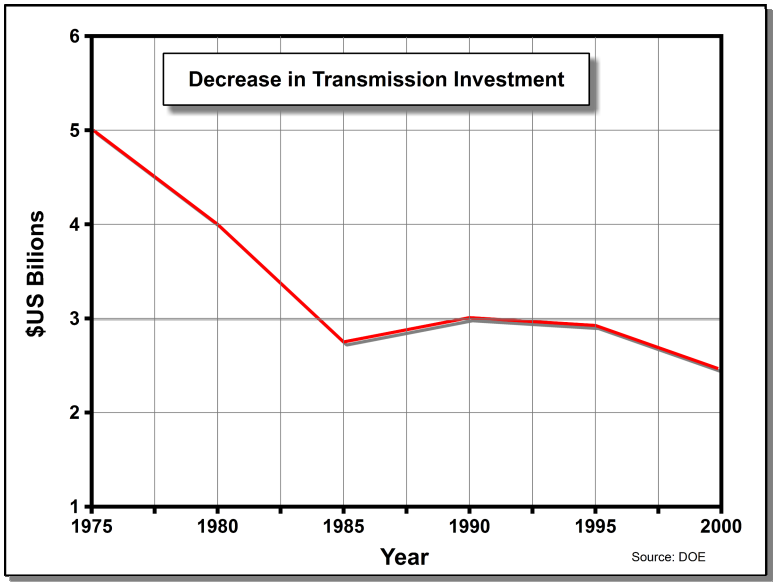


is grim. NERC has projected that areas in both the South and the Northwest will fall below the minimum generation-capacity margin between 2009 and 2010.

The push to develop renewable sources of energy -- particularly solar and wind -- as well as distributed generation -- to be supplied by small, privately owned generating units -- add complications to the power-generation equation. Such technologies increase overall capacity for power generation, but they're less reliable sources than large conventional power plants. For instance, wind and solar power -- being naturally generated -- are also subject to the whims of nature; in other words, when the sun doesn't shine or the wind doesn't blow power can't be generated. Distributed energy involves different considerations; its availability to local areas may hinge on such factors as the electricity needs of its owners, as well as maintenance and fuel and electricity costs. Increasing alternative power technologies should ultimately improve power quality. But an immediate over-reliance in them -- especially without a concurrent buildup of conventional power-generating capacity -- could have just the opposite effect.

TRANSMISSION

The electric transmission system we now have in place was developed over the last century by electric utilities that generated power and supplied it to local areas. Adjacent utilities interconnected with each other, in order to exchange generating capacity and enjoy the resultant operational and financial benefits. These facilities are now all interconnected, forming what is popularly known as "the grid." While key to our national electric power supply, this ad hoc creation was never designed to transfer large amounts of bulk electricity between widely separated regions, as it is now called on to do.



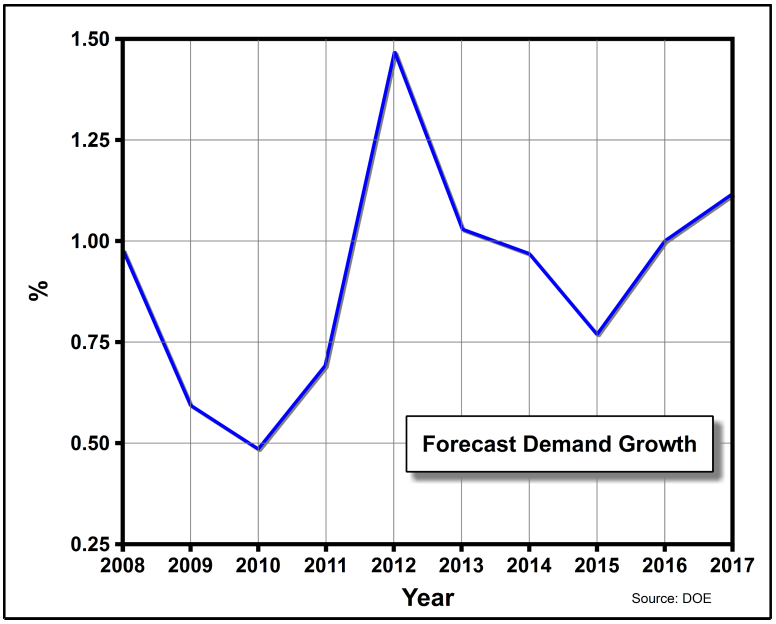
The failing health of the aging electric transmission system in North America is a major concern. The grid -- beyond being used in ways that were never intended -- is nearing peak capacity in many geographic areas. Yet there are no firm plans for a system-wide upgrade. Remedial actions to maintain it include programs to increase the load capacity on established transmission lines, in order to overcome bottlenecks, as well as the addition of new transmission lines. But even the **Department of Energy** (DOE) has portrayed these measures as inadequate. The government office has said, "*Our lights may be on, but systemically, the risks associated with relying on an often overtaxed grid grow in size, scale and number every day.*"

The good news is that the **Federal Energy Regulatory Commission** (FERC) recently empowered NERC to develop and enforce standards for the security and reliability of the bulk-electricity supply. This should bring some much-needed structure and coordination to the operation of the national grid.

But the bad news (as shown by the chart above) is that investment in new transmission lines has been halved from USD$5 billion, in 1975, to $USD2.5 billion, in 2000. Since then, only 688 miles of new line have been added to an existing system composed of 211,000 miles of line, which the DOE has deemed wholly insufficient, saying, "*As a result, [electric transmission] system constraints worsen at a time when outages and power quality issues are estimated to cost American business more than $100 billion on average each year.*"

DEMAND

The most recent economic downturn will almost certainly affect power quality. Both demand and demand growth rates will temporarily decrease, and in turn be matched by a short-term reduction in pressure on generating-capacity margins and transmission-line loading. The resultant loss in revenue and uncertainty of future demand will likely delay investment in new capacity and upgrades, as well as limit many nonessential maintenance programs. Once the economy recovers, those generation and transmission issues that were allowed to languish will once again come to light -- but on a grid that is even older and -- very likely -- has been little improved.



Meanwhile, a new subset of demand -- electronics -- is putting additional and significant pressure on the grid. Two decades ago, chip-based electronics represented only a small share of the power load. That's now changed, and it's affecting power quality. Earlier this year the DOE said, "*In the 1980s, electrical load from sensitive electronic equipment, such as chips (computerized systems, appliances and equipment) and automated manufacturing was limited. In the 1990s, chip share grew to roughly 10%. Today, load from chip technologies and automated manufacturing has risen to 40% and the load is expected to increase to more than 60% by 2015.*"

Another growing phenomenon impacting power quality is demand-side management (DSM), which represents a utility's real-time control of end users' electricity consumption. Its purpose is to put generating and transmission resources to optimal use. Combined with the far-reaching "SmartGrid" concept, DSM is meant to reduce peak demand (thereby slowing need for additional power generation capacity) and better utilize electricity from alternative sources, like wind and solar. The program will involve financial incentives or penalties for electric consumption based on time of day, peak demand and voluntary and involuntary demand curtailment, among other factors. In terms of power quality, DSM represents new challenges for electric utilities and customers, as shifting loads alter voltages across the transmission and distribution system.

POLICY AND MONEY

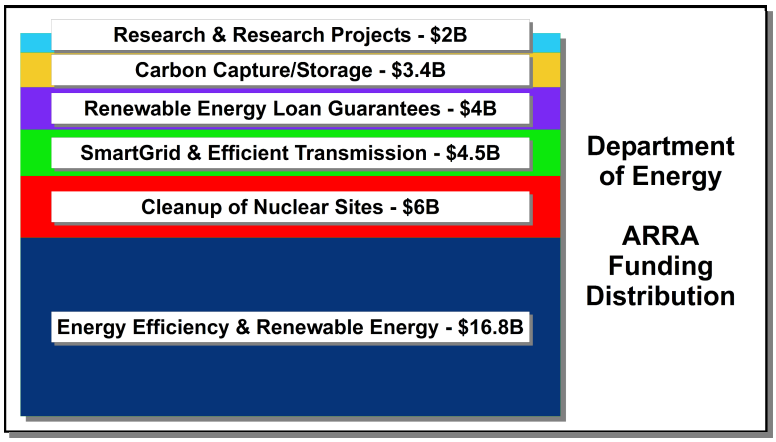
Regulation and investment should play positive roles in the successful long-term supply of electricity, but investment is substantially inhibited during periods or regulatory change or uncertainty. While most of these issues are not new to the power quality scene, their potential to dampen infrastructure investment is increasing. These factors include:

- Lack of a comprehensive national energy policy
- Threat of carbon-related taxes
- Over-dependence on natural gas
- Shifting government subsidies
- Uncertainty of fuels supplies
- Unforeseen enviro-political regulations
- The economy and interest rates, and
- Electricity cost-and-demand forecasts

The above issues are major investment risks. As a result, they're likely to heavily detract from power quality for the end user, in both the short- and long-term.

Much has been reported about the number of infrastructure improvement programs of the Department of Transportation as part of the American Recovery and Reinvestment Act (ARRA, a.k.a. “the stimulus program”),

but there is no equivalent plan for a plethora of electrical infrastructure improvement projects by the DOE. The vast majority of the $36.7B DOE receives under the ARRA goes toward energy efficiency and alternative energy programs as well as $4B dedicated to the development and demonstration of the SmartGrid. There are some geographically-targeted system improvements planned, don't look for a system-wide infrastructure upgrade any time soon.



Another, more controversial, policy may have an increasing and more immediate impact on power quality: conservation voltage reduction or "CVR". CVR is essentially a planned reduction in system voltage to conserve energy – sort of like "brownout lite". While tests by some utilities indicate that system voltage reduction appears to have a meaningful reduction in electricity demand, it is inevitable that CVR will adversely impact power quality for many consumers – increased sensitivity to voltage sags, undervoltage problems and the reduced efficiency of certain devices.

Power Quality Forecast

The deleterious factors affecting electric power quality show no signs of improving in the near future. The recent reductions in demand and demand growth should represent a ray of hope -- if they weren't driven by a significant drop in economic activity. In addition, failure by both federal and state governments to establish clear, long-term policies on energy continues to raise serious concerns about the national energy supply, as well as have a chilling effect on private-sector investment in the grid.

A current focus on developing energy efficiency, a smart grid and alternative energy programs is admirable. But it's no substitute for a comprehensive plan to provide the electricity needed by consumers in a secure, reliable and affordable manner: one that starts with energy source and type; continues with the integration of power generation, transmission and distribution; and ends with market-driven programs for efficient consumption.

DOE's following comments about the grid serve as a short-term forecast for power quality, as well as a warning about its future:

"*Engineered and operated by dedicated professionals over decades, the grid remains our national engine. It continues to offer us among the highest levels of reliability in the world for electric power. Its importance to our economy, our national security, and to the lives of the hundreds of millions it serves cannot be overstated. But we -- all of us -- have taken this marvelous machine for granted for far too long. As a result, our overburdened grid has begun to fail us more frequently and presents us with substantial risks.*"

Utility Systems Technologies, Inc. *is the leading manufactures of industrial-grade power conditioning products for voltage regulation, power conditioning and voltage sag protection. As a leader in the field of "green" power quality, all UST products have the highest performance and efficiencies available.*