Reliability Myths in the New World Order

George C. Loehr

The electric power industry now exists in the "brave new world" of "deregulation." That term has been significantly replaced. Proponents now refer to it as "restructuring," a small but significant acknowledgement that regulation has dramatically increased under "deregulation." Be that as it may, restructuring or deregulation has struggled with a series of disasters, the most notable of which were the so-called California Meltdown and the 2003 Blackout. The latter in particular spawned a host of myths about the interconnected electric power system in North America. Let us examine a few.

THIRD WORLD GRID

The 2003 Blackout occurred because we have a "third world grid." That was said by former Secretary of Energy and present Governor of New Mexico Bill Richardson. Lest I be accused of partisanship, President Bush characterized the grid as "antiquated." The truth is that if the Eastern Interconnection really were a third world grid, the 2003 Blackout would never have happened. With a peak load of almost 600,000 megawatts, the Eastern Interconnection is arguably the largest synchronous interconnection on the planet. It stretches from the Atlantic coast of North America to New Mexico, Colorado, and Alberta—and from the Maritimes and northern Ontario to the Gulf of Mexico. Hardly third world! As *Slate* magazine stated, "this was a first world blackout."

George C. Loehr (gloehr@elucem.com) is a nationally recognized expert on bulk power system reliability. He is the former executive director of the Northeast Power Coordinating Council and now does management consulting, appears as an expert witness, and speaks, writes, and teaches a variety of courses on power systems for nontechnical professionals.

NOT ABOUT DEREGULATION

Deregulation or restructuring (choose your poison) resulted in a massive increase in the number of players on the electric power system. Instead of a series of vertically integrated utilities, the grid is now home to a hodgepodge of transmission owners/operators, energy marketers, generating companies, electric service providers, and others. In many parts of the country, this means a tenfold increase in the number of entities. Additionally, many compete with one another.

This increase has led to greater institutional complexity, more (and more complicated) rules and regulations, and additional operating difficulties. As one former power pool operating manager told me, "It was difficult enough when there were eight utility companies in my system—now there are about a hundred players."

Along with the increase in numbers came a culture shift. Since the November 9, 1965, Northeast Blackout, the industry's culture had been one of cooperation and coordination. Now the culture has changed to one of competition and confrontation.

Finally, since deregulation began with the passage of the Energy Policy Act of 1992, there has been a massive increase in the number and scope (and intrusiveness) of federal regulations. From organization governance to operating standards, Washington now holds the cards in more areas of the electric power business than ever envisaged in the past. Not about deregulation? You've got to be kidding!

Further, in the rush to deregulate, policy makers have consistently ignored the laws of

physics. Rather, they have attempted to force physics into econometric models. Engineers who tried to warn of the consequences were described as old fuddy-duddies who just did not want to change—blacksmiths in the age of automobiles.

When the laws of physics collide with the laws of economics, physics always wins. The consequence of ignoring this has been power shortages and blackouts. Nevertheless, despite the mounting evidence, the marketing fundamentalists have not changed their minds. Social scientists characterize this inability to see the facts and recognize their failure as "cognitive dissonance."

Interestingly, deregulation has functioned best where in the past there had been an integrated, single-control-area power pool (i.e., in New York, New England, and PJM).

Whether you are a proponent or opponent of deregulation, these changes are facts. To ignore them is to take a pass on any chance of making things work better in the future.

MORE TRANSMISSION EQUALS GREATER RELIABILITY

This myth seems so self-evident that even many power system engineers have embraced it. But wait. Increased electric power transmission will increase transfer capabilities (i.e., the amount of power that can be shipped from one point on the grid to another). However, reliability will remain the same if the same transmission standards are used to establish those transfer capabilities. More transmission equals greater transmission transfer capabilities, and there is nothing wrong with that. Only tougher, more stringent standards will result in greater reliability.

That said, it must be pointed out that there are places on the grid where new transmission is needed to satisfy reliability requirements. Such locations can usually be described as "load pockets," areas where the existing transmission cannot handle the net load (load minus existing generation). These are usually radial systems in congested urban areas. Moreover, the situation is often made worse by the need or desire to retire older generating facilities within the load pocket.

Let us focus on the high voltage grid. To increase transmission transfer capability, build more transmission. If increased reliability is the goal, use stronger, more stringent transmission standards or criteria. To accomplish both, do both.

More transmission might actually make the grid less reliable. That is because adding transmission lines reduces the transfer impedances of the grid (i.e., it makes the system electrically smaller). New York is electrically closer to Atlanta, Chicago, or Kansas City. Minneapolis is closer to Miami. Thus, an extreme contingency (like simultaneous tripping of several generating units, or fault and loss of a number of transmission lines) will adversely affect a larger area. Was it just a coincidence that the 2003 Blackout covered a much larger area than the 1965 Blackout?

More transmission might actually make the grid less reliable.

Consider Loehr's Axiom: Reliability is a function of the standards or criteria used, not the amount of wire in the air.

NATIONAL/UNIFORM/MANDATORY STANDARDS

We need national standards, no argument with that. However, they should be a floor, not a ceiling. New York should have tougher reliability requirements than my home state, New Mexico. New York State has countless buildings more than 20 stories high; New Mexico has one. More people live in Nassau County, New York, than in the entire state of New Mexico. Additionally, New York City has hundreds of miles of underground subways. It should be clear to everyone that certain parts of the country must have more stringent standards than others. These standards should not be subject to a national organization like the North American Electric Reliability Council (NERC) or the federal government.

It is difficult to imagine that anyone would want to lower reliability standards in the wake of the largest blackout in the nation's history. Nevertheless, there is a movement afoot to do just that (i.e., to actually lower the present NERC reliability standards). A new NERC standard (FAC 010-1) has been proposed that would eliminate the use of multiple-element contingencies in calculating transmission transfer capabilities. Thus, contingencies like

loss of both lines on a common tower, a transmission fault with a stuck breaker, or loss of both poles of a high voltage direct current (HVDC) line would no longer be used. Even if some systems steadfastly stick to their own more stringent criteria, they would be vulnerable to lower standards used by their neighbors. Moreover, this proposal follows on earlier reductions in the standards addressing spinning and ready reserves.

There is a movement afoot to actually lower the present NERC reliability standards.

The Energy Policy Act of 2005 has been heralded for making compliance with national and regional standards mandatory. But compliance was already mandatory in the Northeast Power Coordinating Council (NPCC), the Mid-Atlantic Area Council (MAAC), the Southeastern Electric Reliability Council (SERC), and parts of the Western Electricity Coordinating Council (WECC). In my own more-than-40-year association with the NPCC, I cannot recall a single example of intentional noncompliance. In fact, I do not think there were any purposeful violations of NERC or regional standards on August 14, 2003. It seems to me that the mandatory compliance requirement of the Energy Policy Act of 2005 is a solution in search of a problem.

SMART GRID

Proponents of a "smart" grid argue that today's "dumb" grid must be transformed into a smart, self-healing, digital, Internet-like grid. Does this mean that blackouts will happen as often as my server goes down?

What is often ignored is the principle of unintended consequences. The more active elements that have to operate correctly when there is a contingency on the system, the less reliable the system will be. Greater reliance on sophisticated bells and whistles means a greater incidence of failure, like not being able to start your car because the security system has malfunctioned. Piper Cubs fail less often than F-16s. State-of-the-art control systems certainly should be looked at. Nevertheless, as Elmer Fudd might say, "Be vewy vewy careful"; overcomplication can lead to lower reliability.

PROPERLY STRUCTURED MARKETS WILL TAKE CARE OF EVERYTHING

As stated earlier, when the laws of physics collide with the laws of economics, physics always wins. Kirchoff's Laws, not the laws of the economists or politicians, control how power systems work. No economic theory, no legislation, and no government regulation can change the laws of physics.

ENERGY POLICY ACT OF 2005 WILL TAKE CARE OF EVERYTHING

Despite all the hype to the contrary, the Energy Policy Act of 2005 does nothing, absolutely nothing, to improve reliability. However, what about the "new reliability standards" the Secretary of Energy talks about? Sorry, Secretary Bodman, but you are wrong. There are not any in the act. Not a single one, new or old. However, the regional reliability councils have had their own standards since the 1960s. They were always considered mandatory. In fact, no one even raised this issue before deregulation/restructuring. It just never was an issue because in the "old world order," everyone recognized that reliability was in their own (and everyone's) best interest.

What about "mandatory" compliance? A solution in search of a problem—no major North American blackout has ever been caused by intentional violation of reliability standards.

What about the $13.1 billion that Sen. Pete Dominici (R-New Mexico) claims will be spent for "electricity reliability?" Sorry, Senator, that is all in incentives for new transmission, which, as we have already seen, might increase transfer capabilities but will do nothing for reliability. As was said earlier, reliability is a function of the standards used, not the amount of wire in the air.

On the second anniversary of the 2003 Blackout, Secretary of Energy Samuel Bodman said that the Energy Policy Act of 2005 would force utilities to comply with reliability standards not in place before 2003, and would assist "our" efforts by requiring a higher standard of reliability. Both statements are completely false. Nevertheless, no one stepped forward in the press to point this out.

GRID IS A PATCHWORK OF LINES BUILT WITHOUT COORDINATION

This could only be said by someone totally—and culpably—ignorant of the history of the

electric power industry. For decades, single system planning and operation was practiced by tight power pools such as existed in New York, New England, and PJM. Regional reliability councils have provided mechanisms for coordination since the 1960s. Interregional groups such as MAAC-ECAR-NPCC (MEN), VACAR-ECAR-MAAC (VEM), and VEPCO-AEP-Southern-TVA (VAST) have performed interregional studies and coordination over wide areas. All of these efforts were characterized by a culture of cooperation and coordination. When plans proposed by one entity raised reliability problems for others, the plans were modified—often significantly. The design, scope, and operating procedures for the so-called Hydro Quebec-New England Phase 2 Interconnection between James Bay and the Boston area were significantly altered to prevent problems in New York and PJM, following studies conducted jointly by all three potentially affected regional reliability councils.

GRID WAS NEVER INTENDED FOR HEAVY, LONG-DISTANCE TRANSFERS

Such a statement ignores such major undertakings as the Niagara and St. Lawrence projects and 345-kilovolt transmission system in New York, the mine-mouth plants and 500-kilovolt system in PJM, the Southern-TVA 500-kilovolt interconnection, the massive Pacific Northwest to California AC and DC inertia, other western projects like Four Corners and Intermountain, the Quebec-to-New York and Quebec-to-New England projects, and many others. Heavy, long-distance transfers have been a fact of life for a long time.

IT IS ALL BECAUSE OF GROWTH IN ELECTRIC DEMAND

I have news for you: the demand for electricity has been growing since Thomas Edison began operating the Pearl Street plant in 1882, through wars, recessions, and periods of political turmoil. The only time electric energy consumption in the United States declined was the period immediately following the Great Depression. During the 1960s, electric consumption grew at a rate in excess of 7 percent. Right now, the growth rate is about 1½ percent. The only thing unusual about load growth now is that it is so low.

VEGETATION MANAGEMENT

Take a look at any listing of upcoming electric power conferences and I bet you'll find at least one or two about "vegetation management." Trees are convenient scapegoats for blackouts; trees do not fight back. A "near miss" in upstate New York in 1971 was blamed on a fast-growing Christmas tree. The July 1996 Blackout on the West Coast was caused by a tree in southwestern Wyoming (perhaps the only one in a hundred miles). The 2003 Blackout in the Midwest and Northeast was blamed on poor tree-trimming on transmission rights-of-way. Even the blackout of all of Italy in 2003 was blamed on . . . wait for it . . . trees.

Trees are convenient scapegoats for blackouts; trees do not fight back.

This is not to suggest that trees or poor vegetation management never cause blackouts. However, they are invariably the immediate cause or the symptom, not the underlying cause. Blaming trees is like blaming your car for running out of gas, when the underlying problem is that you forgot to fill it up. How long will our fauna stand for this abuse? Perhaps, at some point, rogue Ents from J. R. R. Tolkien's *Lord of the Rings* will leave Middle Earth to take their vengeance on us.

"WE DID ____ TO FIX THINGS"

This includes the Energy Policy Act of 2005 and vegetation management, both of which we have already discussed. Other candidates frequently heard are the following:

- *NERC's "Version 0" standards.* These were promoted as the industry's response to the 2003 Blackout, and reported as such in newspapers as prestigious as the *Wall Street Journal.* However, in actuality, "Version 0" was no more than a repackaging of earlier NERC standards that had been around for many years before the blackout or even before deregulation.
- *Repeal of the Public Utility Holding Company Act (PUHCA).* While debate goes on regarding the good or evil that PUHCA's repeal will cause for consumers, one thing

is incontrovertible: it will not improve reliability.

- *ReliabilityFirst Corporation.* This is a much-heralded merger of several existing regional reliability councils—MAAC, the East Central Area Reliability Coordination Agreement (ECAR), the Mid-America Interconnection Network (MAIN), and possibly eventually the Midwest Reliability Organization (MRO)—into a single council. There is nothing wrong with it (though one wonders if inclusion of MRO would create a regional reliability council too large to effectively manage). The problem is that it will not really do anything for reliability as long as systems in ECAR and MAIN insist on maintaining their own independent and relatively small control areas. If I were asked to cite a single reason for all the confusion on August 14, 2003, and why no one recognized the scope of the developing problem, I'd point to the large number of geoelectrically small control areas in the Midwest. ISO-New England, the New York ISO, and PJM all operate as single-control areas—appropriate models. Reducing the present Midwestern grab bag to something like two control areas in the ECAR system and one in MAIN would do far more to improve reliability than the creation of ReliabilityFirst.

"WE STOPPED THE SPREAD OF THE BLACKOUT"

Statements like this were made by several individuals shortly after the 2003 Blackout. Most notable was a claim made by a high official of PJM that quick action by their system operators had kept the blackout from spreading further. In fact, during a press conference shortly after the blackout, the Federal Energy Regulatory Commission's (FERC's) then-Chairman Pat Wood publicly thanked PJM for keeping the blackout from spreading even further than it had. (The next day he was privately corrected by an executive from one of the federal systems.)

The problem is that the system does not work the way most people think. Blackouts do not creep slowly across the electric power grid like something from the 1950s cult sci-fi film *The Blob.* Power system instability occurs in seconds, not in minutes or hours. There is rarely sufficient time for operator intervention. Additionally, a blackout's ultimate extent is governed by the configuration of the system prior to the initiating contingency, predisturbance conditions (load, generation, and power flows), the nature of the initiating contingency, and Kirchhoff's Laws. As we all know, Kirchhoff's Laws cannot be altered or repealed.

Will your system be part of the blackout or not? It is more a matter of dumb luck than the skill or wisdom of your operators.

ERO—HERO?

The upcoming selection by FERC of an electric reliability organization (ERO) will almost certainly trigger a power struggle between the selected ERO and at least some of the regional reliability councils. The move could also renew the disputes between the federal government and the states. Will states or the regional reliability councils be able to maintain more stringent standards than the EROs, when and if they desire to? Will they have to submit them for ERO or FERC approval?

Even a casual reading of the FERC Notice of Proposed Rulemaking on the ERO suggests that FERC itself may be overlooking some provisions of the Energy Policy Act of 2005 (for example, as regards the relationship between the ERO and the regional organizations). Will the ERO standards continue to be watered down? If so, will FERC step in? Stay tuned!

The Act gives FERC ultimate jurisdiction over reliability standards and enforcement. FERC is authorized to select an ERO, which then will be empowered to develop mandatory and enforceable reliability standards. However, state actions to ensure safety, adequacy, and reliability are not preempted, as long as such actions "are not inconsistent with" the ERO's reliability standards. Thus, there is a potential stumbling block: what does "not inconsistent with" mean? Bet on lots of haggling over that.

Surprisingly, the Act also provides that New York State specifically may establish rules that result in greater reliability, as long as these do not result in lower reliability outside of New York. Additionally, provision is made for multistate regulatory advisory bodies. What will those be like, and who will serve on them? Again, stay tuned. We will live in interesting times.