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from blackout to blackout

1965 to 2003: how far have we come with reliability?

THE DATES IN THE TITLE ARE the 1965 Northeast Blackout and the recent Northeast Blackout of 14 August 2003. I was a graduate student at Rensselaer Polytechnic Institute in Troy, New York, at the time of the 1965 Northeast Blackout. As with many of my friends in the IEEE PES, the 1965 Northeast Blackout was a defining event in our lives and careers. The 1965 Northeast Blackout launched the drive to build computer systems that would monitor the power system, predict which contingencies would cause overloads or voltage problems, and calculate safe operating strategies.

Some Background on Real-Time Security Analysis

I was first employed by Leeds and Northrup Company, one of the major suppliers of computer systems for power system control in the United States. One of my early assignments after joining L&N was to be part of a group preparing a proposal for the newly formed New York Power Pool—now the New York ISO. There were many things we didn't know at the time of that proposal, and in looking back I can see how far we were from a real solution. This was in the late 1960s. Some of the barriers that the industry had to overcome included the following.

- ✔ Computers were slow and memory was extremely costly. It wasn't until the Wisconsin Electric Power Company control center was built by Control Data Corporation in the early 1970s that sufficient scientific computer power was available to run many of the big application programs.
- ✔ We first heard about state estimators from Fred Schweppe at the 1967 Power Industry Computer Applications Conference. However, in spite of creating and installing many state estimator programs throughout the United States, it was not until the 1990s before truly reliable state estimators were developed so that operators could monitor their system without frequent crashes of the algorithm.
- ✔ Contingency analysis with ac power flow ability were developed in the 1970s but it took until the late 1980s to achieve sufficient speed so that operators were satisfied that all possible contingencies were covered.
- ✔ Optimal power flows were first presented by Jacques Carpentier in the early 1960s, but again reliable algorithms were not available until the late 1980s and early 1990s.
- ✔ Unit commitment by dynamic programming was available in the 1970s but the advanced codes needed to solve a unit commitment with security constraints were not available until the Lagrange Relaxation techniques had been hammered out in the 1970s and 1980s.

Thus it took roughly a 25 to 30 year time span to learn the nature of the algorithms and computer codes needed and for the computer hardware to come up to speed before a modern security monitoring and analysis system could be built. Interestingly, the same software that allowed us to build such systems also allowed the formulation of open markets in electric power and the assurance that the newly commissioned ISOs were going to be able to run the markets reliably. Then we had the second Northeast Blackout on 14 August 2003, and one wondered if nearly 38 years of research, development, and creation of advanced computer systems and software had been for naught. Were our developments simply not sufficient for the task, or was there something else happening?

I shall refrain from any specific remarks about the causes of the 2003 Northeast Blackout. The reader should note that I am writing this before a detailed report on the 2003 Northeast Blackout is released. I do not have any inside information to allow an analysis of the events at this point. However, I can make several observations about aspects of the 14 August 2003 blackout that have bothered me and that may have played a part.

Reliability Versus Profits

Deregulation of the electric industry has placed the system operators and engineers in a very different world from that in which we lived in the past. Most importantly, the regulated systems, having their profit margins fixed by regulators, deemed it their responsibility to

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provide the maximum reliability that the customers could afford. The costs of high reliability were placed in the rate base and passed on to customers. This was brought home to me when I completed my Ph.D. dissertation at the University of Pennsylvania in 1974. The title was “A Decision Theory Approach to Power System Security” in which I posed the problem of power system reliability as one that traded off operating profits versus system reliability. A few years after completing the thesis, I spoke with the chief system operator of a large eastern U.S. utility and was told that, no, they didn’t look at whether an outage event was more or less probable. If the event was at all possible and would cause problems, his operators were instructed to fix it—without regard to operating cost. So much for my thesis’ idea of a tradeoff.

However, in the spring of 2003 I attended a conference where one of the speakers, who represented a European electric company, gave a paper where he indicated that just such tradeoffs were being made. When the prices were very high and security limits forced them to pay even higher prices due to transmission constraints caused by the security analysis—they relaxed the operation from the familiar n–1 contingency criteria to simply n (they ignored contingencies and only paid attention to existing loading). After his talk I jumped up and asked if I had understood him correctly—I had. In order to make lower priced purchases they ignored contingencies. He did say that if there was a storm in the area or other circumstances that raised their risk, they would return to the n–1 security analysis criteria.

When millions of dollars of profits are on the table, will operators push the operation of a power system beyond established reliability limits? One would certainly hope not, but this leads to the next point.

Who Is in Charge?

In response to the 1965 Northeast Blackout, the privately owned electric companies in the Unites States founded the North American Electric Reliability Council (NERC). NERC is a voluntary industry organization that writes guidelines and monitors generation and transmission reliability—but does not have the authority to enforce the way things should be done. Then there is the Department of Energy, which certainly has the full authority of the U.S. government behind it, but not the mandate to set reliability. Given this situation, it would not be surprising to me that there may have been companies that cut corners on reliability. When the monitoring organization does not have the authority to enforce and the government does not have the mandate, this might be expected.

This is very different from the situation with the Nuclear Regulatory Commission (NRC) or the Federal Aviation Administration (FAA). The NRC and FAA have the mandate to require adherence to strict safety and reliability standards necessary for public acceptance. The NRC, for example, is an agency of the federal government that has the statutory authority to license nuclear reactors and reactor operators and to demand expensive changes to nuclear plants when deemed necessary.

The Blame Game

I was rather shocked to read of the finger pointing between electric companies in the immediate aftermath of the 2003 Northeast Blackout. To my recollection, there was little or none of this following the 1965 Northeast Blackout nor was it present after some of the other large U.S. outages in 1996, for example. My experience has taught me that finger pointing usually comes when one member of a group is singled out for blame but everyone knows that all the members of the group actually share the blame to some degree. Nowhere was this more evident than on the night of 14 August 2003 when several false reports were made about the cause of the blackout being a lightening strike or a failure at a nuclear plant. None of these reports was true, but some felt the need to asses blame very early on.

My Conclusion

I believe that given the will and the funding, we can build and operate very reliable power systems. We have the technology and the problems are not insurmountable. However, this will not come in the same way as did the changes after the 1965 blackout, simply because the game is played differently now. Profits and reliability are a tradeoff in the absence of regulation, and the drift toward cutting corners in order to add to profits is irresistible. This is particularly the case when there is no governing body that can actually force companies to keep within the rules. Ultimately such authority must come from the government; voluntary organizations should not be given such authority. Unfortunately, the Department of Energy lacks the technical ability to set strict power system operating standards—and they should be *standards,* not guidelines. In my opinion the government should set up a PSRC (Power System Regulatory Commission) like the NRC with statutory authority to enforce planning and operating reliability standards written by IEEE and NERC. The PSRC would not regulate economic factors as long as power systems were built and operated within reliability criteria. p&e

The views expressed in the “In My View” column are those of the individual, not of this magazine, its editorial board, or the IEEE Power Engineering Society. If you agree or disagree with the opinions you see here, we want to know. Please send your comments to Melvin Olken at m.olken@ieee.org.