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U.S. Power System Security

An academic paper by Chinese authors trips alarms, but are they the right alarms?

POSTED BY: BILL SWEET // FRI, MARCH 26, 2010

A theoretical paper by a Chinese graduate student and professor about the vulnerability of electric power systems like those in the United States to cascading failure has drawn attention in the U.S. press and prompted testimony to U.S. Congress. The paper, "Cascade-Based Attack Vulnerability on the U.S. Power Grid," compares "the effects of two different attacks for the network robustness against cascading failures, i.e., removal by either the descending or ascending orders of the loads." It concludes counterintuitively that that "the attack on the nodes with the lowest loads is more harmful than the attack on the ones with the highest loads."

The Chinese authors have said that their work is a theoretical exercise that just happens to model a U.S. electrical subsystem because good data is available for such a system. But because the word "attack" appears in the headline--and no doubt because there is a high level of paranoia in the United States about the country's economic and even military vulnerability to China--the article has been interpreted in some quarters as evidence the People's Republic is actually positioning itself to mount an assault on the U.S. power system.

Concerns about the fragility of the U.S. electrical grids are nothing new, and with the advent of more complex smart grids, there are well-founded worries that power system vulnerability could become greater, at least in the short run. "Although researchers have spent considerable time on smart-grid cybersecurity issues, major problems remain unsolved," a recent article in the IEEE Security & Privacy magazine reported. In a study issued last fall by the U.S. Department of Energy and the National Institute of Standards and Technology, the mounds of additional data generated in smart grids were deemed immensely helpful to grid operators and stakeholders--but also to people who could use it with ill will, as Earth2Tech's Katie Fehrenbacher put it.

To the extent grids are vulnerable to cyber intrusion, they would seem to be as vulnerable to malicious foreign attackers as to home-grown vandals. But is there realistic reason to fear such foreign attacks, and specifically a Chinese one?

As is well known, China is by far the biggest holder of U.S. national debt, and its economy is critically dependent on exports to the United States. At last tally, it owned $740 billion in U.S. Treasury securities, and it was exporting $24.7 billion in goods to the United States each month, running a positive trade balance of more than $20 billion--roughly $250 billion per year.

Under the circumstances, it's hard to imagine how it would be in China's interest to sorely disrupt the U.S. economy. The only scenario in which economic warfare would make sense would be one of all-out military warfare, say over Taiwan. But if the two countries were at war, disruption of the U.S. power grid would be the least of America's problems.

Russia, however, may be another matter. Criminal hacking is big business there and has global scope. Several years ago, when a local dispute in Estonia pitted ethnic Russians against Estonian nationals, seriously disruptive cyber attacks were mounted against the small Baltic country from sources in Russia. The culprits may have been members of the Russian intelligence services, ultra-nationalists, or just malicious hackers--and it's not reassuring that the outside world has no sure way of knowing which.

Suppose there were a military confrontation between Russia and Europe over the sovereignty of Ukraine, and suppose Russia wished to discourage the United States from coming to Europe's help. Might a cyber attack on the U.S. grid seem a tempting way of sending a shot across the U.S. bow?

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CHRIS 03.31.2010
It's easy to bury your head in the sand and say China has no plans for threatening America. If that's the case then why is China so heavily engaged in building their offensive military capabilities including a blue-water navy? Why is China engaged in thousands of cyber attacks every day on U.S. military installations? Why is China the country most aggressive in military espionage? Attacks like those upon Google are the tip of the iceberg. Attacks on Google made the news because Google reacted publicly. If China were a democracy I'd be less concerned about their military build-up, but China is a totalitarian dictatorship which brutally suppresses their own people. We should all be concerned about the rise of such a dark shadow on the world. I haven't always agreed with Bill on his environmental blogs, but I agree with Bill that we need to be concerned about the potential for attacks on our power grid from any source be it terrorists or anyone else.

RICHARD BONOMO 03.31.2010
When discussing potential threats from China, it is important to keep in mind that there are multiple groups there, as anywhere else. The Chinese commercial sector is interested in doing business, and certainly harbors no desire to inflict physical harm on its trading partners. The rapidly growing (and arming) Chinese military sector is probably not moved by the same sentiments. Over all of this is the totalitarian Party bureaucracy which is trying to embrace private enterprise while at the same time preventing social, political, and religious freedom. The Party is also a bit constrained in that it has convinced much of the population that Taiwan should be under the control of Peking, even though the Party knows that taking steps to seize control would be a disaster in many ways. Given the multiple forces acting, at times at odds with each other, the end result could easily be strange, and violent.

R GONZALEZ 03.31.2010
To persons with experience in power system planning or operations, it is not at all "counter-intuitive" that disconnection of the low-load nodes will have the greater effect. The higher-voltage buses will typically have no load directly served from them, but in most cases will have a greater influence on overall system performance than the lower-voltages buses, from which most loads are supplied.

MIT RESPECT 03.31.2010
Paranoid nonsense? How about "naiive nonsense"? Are cyberattacks from within Chinese Universities upon Google and US security sites paranoia? Or from organized groups of German hackers breaking into U.S. federal laboratories? read "The Cuckoos Egg" Peter Stoll 1989. There is an entire industry based on cyber security. Grid security as an outgrowth is an appropriate topic for IEEE. Do we lock our cars and houses? Have we after the fact mounted (inadequate) defenses against electronic identity theft? The power system and grid operators worldwide have an obligation not to ignore the vulnerability of their systems, and to assume the worst when assessing defensive countermeasures.

MARGARET FIORE 03.31.2010
As a researcher, I can assure you that there is plenty of literature coming from American sources, including students, about the development of a smart grid. Foreign students, who are more often exposed to global peer-reviewed literature, and more often able to read it in its native language (!), are as aware of these issues as any American. In plans for the national power grid, as well as other nationally critical supplies, such as food, we need to look more to plans that involve LOCAL or REGIONAL production and distribution. Such setups are less vulnerable to mischievous internal or foreign attack, or to natural disasters. If we truly were concerned with Homeland Security, this is the way to go. I would think this should be obvious to both military and economic strategists.

GENE 03.31.2010
No matter it is China or Russia or any other country or individual we shall be prepared for the worst.

HUNTER 03.31.2010
The link to the referenced IEEE Security&Privacy article did not work for me. Do you mean the article on p81, S&P, vol8, num1? Thx!

RICH 03.31.2010
Couldn't agree more with another commenter, it is a shame that war mongering is now a part of the IEEE publications. If you want to talk vulnerabilities to the grid that is one thing but speculation on attacks from Russia is ridiculous.

BRIAN 03.30.2010
"At last tally, it owned $740 in U.S. Treasury securities" Do you mean to say $740 billion?

HUJEENE 03.26.2010
It is a shame to read such paranoid nonsense on the online pages of IEEE Spectrum. The Cold War ended 20 years ago, Russia will never flex it's muscles over the sovereignty of any of their neighbors (in Georgia they were protecting a minority, and withdrew from all parts of the country that don't wish their independence, similar to the Kosovo case), and Russia and the US have never been in a war and never will be. War-mongering is a horrible act: you're just feeding the propaganda and hysteria machine. Shame on you.