

## SECURITY

# North Korea nuclear ambition hikes threat to grid

Peter Behr, E&E News reporter • Energywire: Monday, August 21, 2017



Late afternoon on Aug. 14, 2003, an electrical surge out of Ohio and into New York tripped circuit breakers across southeastern Canada and the northeastern United States. Lights went out in New York City, sending hordes of people home by foot. Alex Lines/Flickr

Second in a two-part series. [Click here](#) for part one.

At 4:10:38 p.m. Aug. 14, 2003, a tsunami of electric power measuring over 3.5 million kilowatts surged out of Ohio and into New York, then Canada and then Detroit, tripping circuit breakers along the eastern Great Lakes power network. Tens of thousands of people were left in the dark.

Stunned operators throughout the region were clueless about the causes of the cascading outage. But they immediately began to restore power from the bottom up, restarting one power plant, then another and another.

The industry calls the recovery operation "blackstart." It worked in 2003. After the Northeast Blackout, most customers had power by the next day. Still, some areas of the United States were dark for two days, and parts of Canada's Ontario province faced rolling blackouts for weeks.

To some experts, the confrontation over North Korea's missile and nuclear weapons expansion has elevated the risk of a catastrophically different outcome, in which an atmospheric explosion of a nuclear weapon over the United States triggers electromagnetic pulse (EMP) shock waves attacking electricity networks and triggering a blackout worse than the 2003 outage.

For more than a decade, reports from a [task force](#) appointed by Congress, known as the EMP Commission, and other researchers have warned that a large EMP blast would disrupt or destroy unshielded computers and electronic devices across a digitized America. That includes the sensors and monitors that run the electric grid and act as the brains of a blackstart recovery after a major power outage.

In the EMP doomsday scenario, millions of people become evacuees, with devastating consequences for the economy and national security, according to the EMP Commission in its 2008 report.

"All critical infrastructure sectors are at risk from EMP," Brandon Wales, a Department of Homeland Security official who focuses on physical and cyber threats to U.S. infrastructure, testified before Congress last year.

"Anything like a control system, anything that is run by a computer or has digital electronics, is vulnerable to being temporarily disrupted or permanently destroyed," said Edl Schamiloglu, associate dean for research at the University of New Mexico's engineering school and chairman of the International Electrotechnical Commission, which develops civilian technical standards for protection against EMP threats.

"A lot of folks in the community have been raising red flags about this, but it just hasn't had the traction it should," Schamiloglu said.

At least not in the United States, he said. In South Korea, the business of EMP protection is booming.

### Jigsaw puzzle assembly

A half-century after U.S. Cold War military strategists began worrying about EMP warfare, the government's policy for defending power grids against it is still in flux. Arms control experts and utility engineers are in a heated debate about the consequences of an attack ([Greenwire](#), Aug. 26, 2011).

A new [analysis](#) of the EMP threat by the Electric Power Research Institute, requested by the Energy Department and due next spring, and an updated threat analysis by the EMP Commission will take the debate to a new level, pitching the issue to President Trump and the Federal Energy Regulatory Commission.

"When the final stage of the EPRI report is done, we'll have to look at it and see if it lends itself to a standard," said Cheryl LaFleur, the former acting chairwoman of FERC, which approves security regulation of interstate power grids.

"It certainly will lend itself to action, I hope, whether we pilot something first, whether we direct a standard," she said in June. "The research is being done not to push the problem off, but to understand, so we can act on it."

The North Korean challenge joins a list of other "black sky" events that interrupt the sleep of emergency planners, as described in a 2014 [report](#) to state utility commissioners by Paul Stockton, former assistant secretary of Defense for homeland security. California, Florida, Hawaii and other states are creating plans for disasters "more destructive than they have ever before experienced," he said.

Blackstart recovery plans, mandated by FERC, are the essential starting point for putting society back together after a massive outage. "Every [grid] planning coordinator is required to have a blackstart plan," said John Moura, director of reliability assessment for the North American Electric Reliability Corp.

It's a process of jigsaw puzzle assembly.

Large power plants cannot start with the push of a button. They must be energized first with power from hydroelectric dams or small emergency generators running on oil or diesel fuel. Once running, generators are reconnected to the grid one by one along designated transmission lines or "cranking paths." Each power plant must be matched with a selected "island" of customers, keeping the grid's equilibrium of energy supply and demand in balance.

Then the islands, which could be several suburban counties or parts of large cities, are tied together carefully by transmission operators and regional grid coordinators until the high-voltage network is whole again. Getting it wrong risks triggering a new blackout or equipment damage, pummeling a still-wounded system.

"You only get one shot at that. It's a very important process," Moura said.

FERC and NERC staff issued a detailed assessment of blackstart plans last year, based on a survey of nine unnamed grid operators, including a generating company, transmission operators and control coordinators. All the participants had prioritized who would get electricity first, including metropolitan areas and nuclear power plants, to support safe shutdown of their reactors, preventing crises like the Fukushima Daiichi nuclear plant disaster in Japan.

Some [plans](#) also gave preference to natural gas and oil pipelines, military installations and flood control infrastructure.

The review offered no assessment of how many U.S. grid operators measure up to the best-performing companies in the survey, or how many are outliers with their guard down.

Some companies do not test their startup processes under the stressed conditions of an actual blackout, the report found. Some assume, for example, that replacement hardware will be available in a widespread emergency.

### Coal, gas or wind? It's all vulnerable

Cyber weapons are the latest threat to blackstart recovery, putting power grid operators on alert for hidden, destructive malware. But the greatest threat is the older one — EMP.

A nuclear weapon embedded in a missile launched or detonated from a satellite above the United States would release three separate EMP shock waves. The slowest of the three, named E3, could threaten high-voltage transformers that move electricity over transmission lines. E2, resembling a lightning strike, is not a grave concern. But the fastest pulse, E1, would disrupt or destroy all sorts of unprotected electronic devices, including grid operators' digital monitors and controls.

Operators would have to piece together the jigsaw puzzle while blindfolded and with important pieces missing.

The increasing reliance on digital controls, the adoption of "smart grid" electronics and cloud computing all increase vulnerability to a high-impact EMP weapon, said Schamiloglu of the University of New Mexico. "The coal plant, an older technology, would be less vulnerable," he said.

Arshad Mansoor, senior vice president for research and development at the Electric Power Research Institute, said coal units are important parts of recovery plans. "For blackstart, we do look at large plants with redundant power supplies," he said. "There is no doubt about that."

But coal plants are complicated, grid experts noted, with lots of moving parts and critical sensors monitoring temperature and pressure, and all of that may have to be protected against an EMP-related outage.

Moreover, if large parts of the transmission grid are disabled by an EMP, the source of electricity generation is not the most important issue. "The communications from a control center to a wind plant or a control center to a coal plant will be pretty much the same, so vulnerability will be there in both cases," Mansoor said.

Rooftop solar units won't operate unless the grid is running. Unshielded gas pipeline controls are also vulnerable to EMP.

### Arms control and the grid

U.S. strategies for defending the grid have been held up as a dispute over the potential severity of an EMP event divides arms control experts from power industry executives and grid engineers.

The EMP Commission, which is made up of arms control experts and was originally led by a former science adviser to President Reagan, ran tests of EMP pulse damage on grid equipment a decade ago. It found that "a substantial and highly significant fraction of all control and protective systems within the EMP affected area will experience some type of impact."

FERC, the power industry's regulator, has issued regulations against the related threat to grid equipment from a massive solar storm. But it has historically framed an EMP attack as an act of war that required a strategic response. It hasn't engaged deeply in the debate.

"That is a Defense Department set of issues," said former FERC Commissioner Philip Moeller, executive vice president of the Edison Electric Institute, which represents U.S. investor-owned utilities. "Not that we can be oblivious, or not do anything," Moeller said, but he added that FERC — an economic regulator — "shouldn't be taking the lead on a set of issues that is more national defense related."

The Department of Energy is partnering with EPRI, a nonprofit research group, to re-examine the impact of an EMP attack on the nation's power grids. EPRI issued initial findings in February indicating that "a limited number of bulk-power transformers" were at risk of damage from a high-altitude nuclear explosion. Still, it concluded, more work needed to be done to draw final conclusions about the larger grid ([Energywire](#), Feb. 20).

EPRI's Mansoor said the EMP Commission's report in 2008 included "very limited testing, and not a good representation of what you see in the grid today." Grid technology has changed. "It was done by folks that did not have a full breadth of understanding of power system equipment and how the system [components] work together."

Mansoor said, "Can you bring the grid down? We are getting to the point of having a credible answer to that question."

But Mansoor asserted that "there is no credible testing" suggesting an EMP attack could bring down the grid across a large part of the United States. "Bringing a substation down is different than bringing the grid down," he said.

"We don't feel data exists today to make a risk-informed decision on how to protect the grid against EMP. That is the reason why we are doing this very deliberate and very thorough research."

Peter Pry, executive director of the EMP Commission, which was reinstated by Congress in 2015, fired back at EPRI.

"The authors of the EPRI report never worked professionally on EMP for DOD or the intelligence community or as defense contractors — the real national repository of expertise on EMP. They are essentially amateurs, and out of their depth," he said in an interview.

As this debate continues, some utilities have begun protecting their systems against EMP. Dominion Energy, which runs Virginia's largest utility, plans to spend up to \$500 million by 2020 to harden its system against attack, including construction of an \$80 million operations center shielded against EMP waves.

## The right balance

Duke Energy Corp. has started a project to protect three of its generation plants in the Carolinas. In the case of an EMP attack, energy from Duke's hydropower unit at Lake Wylie on the North and South Carolina border would be available even if everything else went down.

Its energy could keep Duke's Catawba nuclear reactors' cooling water pumps operating and prevent a reactor meltdown if outside power were lost and the reactors' backup diesel generators could not operate. The hydro unit could also restart the utility's Allen coal plant on Lake Wylie to bring more of the grid back up.

The Lake Wylie project was conceived by Henry "Hank" Cooper, former head of the Strategic Defense Initiative for missile defense launched by Reagan and shelved by President Clinton.

Cooper, 80, says he has given up on Washington and the electric power industry to do what is necessary to protect the power grid.

"I concluded several years ago that I would never see major progress in dealing with the EMP existential threat in my lifetime, especially if the current conditions remain," Cooper said.

Retrofitting the entire U.S. electrical grid against EMP would be impossibly expensive, many experts conclude. But hardening the system's most critical generators and substations can be done, Schamiloglu said. "In the end, there probably is a right balance."

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