

GRID

DOE opts for industry-led emergency transformer stockpiles

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The Energy Department has told Congress it does not favor creation of a federally owned emergency stockpile of high-voltage grid transformers that could be dispatched around the country to speed recovery from natural disasters, cybersecurity attacks or violent space weather.

Instead, DOE proposes in a report to put the federal government in a support role, backing up current industry-led programs to make spare transformers available to restore power before extended power blackouts would force large-scale evacuations.

The report says "the most efficient and effective approach is one which builds on industry-based approaches," including collaboration between utilities and transformer manufacturers. This was the strong preference of industry representatives who met with DOE officials over last summer and fall, the report indicated.

It states that the industry would not disclose to DOE where spare transformers are located "due to concerns about the proprietary and sensitive nature of this information."

Whether the lack of that information could handicap DOE's effort to coordinate power grid restoration in a catastrophic earthquake or state-backed cyberattack was not discussed in the report. When Congress called for the transformer report at the end of 2015, it also directed DOE to prepare a plan for overseeing the protection and restoration of power delivery in a presidentially declared grid emergency, which has not yet been made public.

DOE did not respond to an interview request about the report or how DOE Secretary Rick Perry's new top staff views any of the many-sided transformer challenges ([Energywire](#), Feb. 2).

The DOE report, sent to members of Congress last month, notes expanding efforts in the utility industry to procure replacement high-voltage grid transformers for emergency use, as well as other critical equipment. A technical review led by the Oak Ridge National Laboratory determined that there appears to be more available spare transformers than earlier studies had identified.

The Oak Ridge research began by identifying the transformer substations most critical to the operation of the three North American synchronized power networks, and the number of transformers they contain, to establish a baseline of how many spares might be needed.

"We picked a scenario where we would catastrophically eliminate all the transformers in a critical substation of question," study participant Rich Lordan, senior technical executive at the Electric Power Research Institute, explained in an interview. "Then moving that scenario around, we tried to determine what the impact was on the grid and on society. Then we looked for available spares and the time to deliver them."

Lordan continued, "There are any number of generic recovery plans that exist for potential threats. I do not know if specific plans for these substations exist, per se, and I am not sure the plans should be communicated widely should they exist."

There are trade-offs with confidentiality and risks if such plans became public, he said.

Scenario planning is important, but each event is unique, and the event rarely if ever matches the scenario. When the actual event occurs, the industry responds accordingly.

"I think industry's approach was really prudent," Lordan said.

The DOE study concluded that utilities' purchases of spare transformers were increasing. Where no undamaged spares were available, "most utilities have catastrophic emergency procedures in place to replace [large power transformers] in crucial substations with operational LPTs taken from less crucial substations." No overall conclusion was stated about the adequacy of transformer reserves given different emergencies.

Preparing for 'once-in-a-century' events

The vulnerability of large transformers, which are essential to moving power across long-distance transmission lines, has been on Washington's policy agenda for more than a decade.

Government studies have warned that a "once-in-a-century" solar storm would trigger rogue currents that could cause unprotected transformers to overheat, potentially destroying them, although the extent of that vulnerability is debated.

A wartime nuclear explosion in the atmosphere above North America would release a powerful electromagnetic pulse that could also damage exposed transformers as well as many kinds of electronic devices. Then there is the threat of a coordinated, sophisticated cyber campaign such as the Stuxnet attack worm that struck centrifuges used in Iran's nuclear program.

"If the electric grid sustained substantial damage, the process of replacing equipment such as LPTs would be costly and could take months, if not years," the study said.

DOE said that creating a federally owned and managed reserve would be expensive. If as many as 100 transformers were required for the stockpile, the minimum purchase cost could reach \$450 million just for the units, with another \$50 million or more required for transport, storage, maintenance and security, the report concluded. A federal stockpile would need five or more sites nationwide, DOE said.

But cost was not the only issue identified.

"Industry engagement and information-sharing also would be critical to design the [federal] reserve" with the right mix of sizes and designs of transformers, the report said.

"To date, industry has been reticent to provide the level of detailed information that would be needed to design an effective federal reserve," the report said. It noted that DOE has the authority to compel disclosure of such information, and the Federal Energy Regulatory Commission and a Commerce Department security bureau also have some ability to demand information. But the report did not point to any conclusions about federal demands for data.

The study said data were "unavailable" for seven of eight potential options for replacing damaged large transformers, including availability of on-site spares, emergency spares provided by neighboring utilities and prearranged early delivery contracts with manufacturers.

Beyond transformers

Led by the Edison Electric Institute, the grid industry has moved beyond a spare transformer registry to game-planning transportation strategies for moving the massive transformers, many of which weigh 400,000 pounds and would have to be disassembled, moved on special equipment, reassembled and activated. One utility, MidAmerican Energy Co. in Des Moines, Iowa, said an accelerated campaign to relocate an existing transformer still took 45 days ([Energywire](#), Nov. 23, 2015).

A group of power companies led by American Electric Power Co. Inc. has formed a consortium, Grid Assurance, which plans to create an inventory of at least 100 transformers, funded by subscribers, which could be rapidly deployed. The report notes other industry initiatives on the issue. Meanwhile, DOE has committed \$5 million in 2016 to a research initiative called Transformer Resilience and Advanced Components, with five programs involving manufacturers, utilities, DOE national labs and other researchers focused on advanced transformer technologies.

If members of Congress were looking for a comprehensive solution to the transformer issue in its directive to DOE, they will have to look further, the report suggests.

Next steps that DOE proposed include more work to independently assess the resilience of critical transformers; more research on regional threats and impacts and regional equipment-sharing programs; and possible incentives for smaller utilities, cooperatives and municipal power companies that lack funds to participate in top-level transformer-sharing efforts.

Also unresolved is how transformer stockpile programs might dovetail with FERC's ongoing regulation of solar geomagnetic disturbance (GMD) threats to the high-voltage grid. The current North American Electric Reliability Corp. timeline requires grid companies covered by the regulation to complete an assessment of transformer vulnerabilities to GMD impacts by July 2022. If utilities conclude their equipment doesn't pass vulnerability screens, they must submit corrective plans.

FERC directed NERC to develop plans for non-hardware remedies with a two-year deadline and for hardware fixes, if needed, on a four-year timetable. Those plans are not final, and the compliance clock has not yet started.

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