DHS Science and Technology Directorate

Resilient Electric Grid

Fulfilling a need

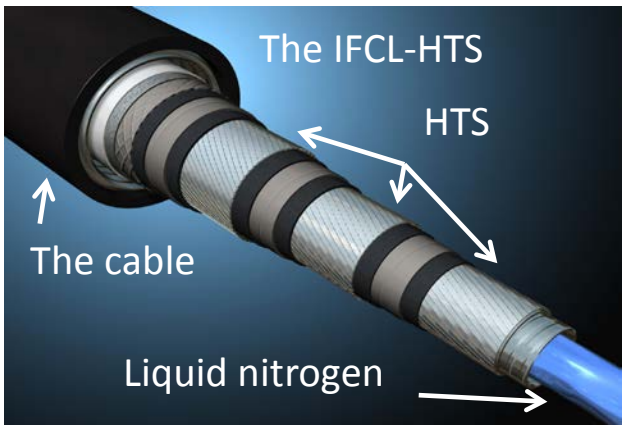
In the United States, more than 60 percent of the gross domestic product is tied to electricity. Annual losses due to power estimated at more than $100 billion nationwide. On average, once every four months, a blackout effects more than a million people. Presidential Policy Directive (PPD-21) highlights the energy sector as particularly vital amongst the critical infrastructure.

The Department of Homeland Security Science and Technology Directorate's (S&T) Resilient Electric Grid program uses advanced technologies to increase the reliability, flexibility and resiliency of the nation's grid.

Currently, power distribution substations are intentionally isolated from one another to prevent power surges, known as fault currents, from cascading through the system and causing serious damage. This protection scheme limits the ability to reroute power from one substation to another in the event of an emergency. S&T is developing a new cable that will allow distribution networks to interconnect and share power while eliminating the risk of cascading fault currents. The inherently fault current limiting, high temperature superconducting (IFCL-HTS) cable enables a more flexible architecture, making the grid more resilient.

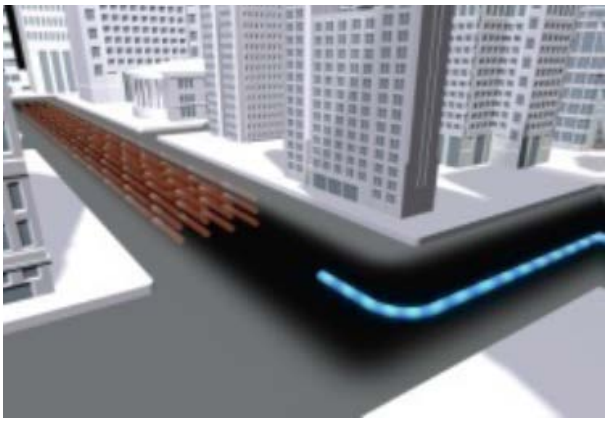
How it works

Under normal operation, the cable is cooled under cryogenic conditions so it can operate in a superconducting state, allowing electric current to flow through the cable unimpeded. If the current exceeds the established 'critical" level, as in the event of a fault, the cable heats up and exits its superconducting state and no more current can pass. This capability enables the cable to limit the flow of excess current, protecting downstream equipment from fault currents.



Added benefits

IFCL-HTS cables carry 10 times the power density of traditional copper cables, so fewer cables are needed to carry the same load.



Since IFCL-HTS cables superconduct, they have minimal losses as compared to conventional copper transmission or distribution lines in which up to 10 percent of the power transmitted is lost as heat. Replacing conventional transmission and distribution lines with IFCL-HTS cables can eliminate this loss, thereby decreasing the necessary amount of power generated for the same load conditions.

Additionally, fault current limiting allows for the integration of more distributed renewable sources of power, such as wind and solar, further increasing the grid's resilience.

Con Edison of New York is piloting REG at one of its substations in Yonkers, New York

S&T has successfully completed laboratory testing of a 25 meter IFCL-HTS cable that will be used in a pilot demonstration to connect two Con Edison substations together in Yonkers, New York, a suburb of New York City. The demonstration will begin in FY2015 with results expected to be reported out after one year.

Homeland Security
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To learn more about the Resilient Electric Grid, contact sandt.rsd@hq.dhs.gov.

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