DHS Science and Technology Directorate

Resilient Electric Grid (REG)

Grid Vulnerabilities and Architecture Limitations

With 60 percent of the U.S.'s gross domestic product tied to electricity, the electric grid is a vital pillar of the economy. Estimated losses due to power failures are over $100 billion annually, and every four months a blackout impacts over a million people. Additionally, Presidential Policy Directive-21 "identifies energy… as uniquely critical due to the ena-bling functions they provide across all critical infrastructure sectors."

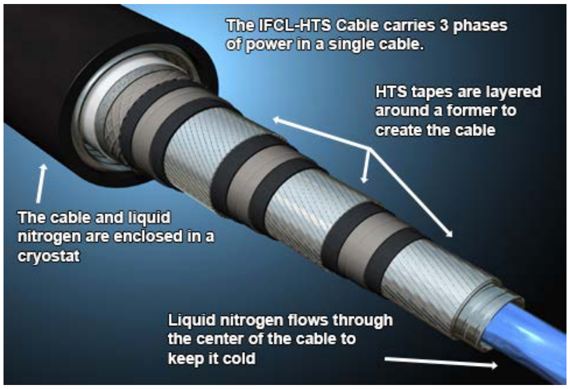
Despite the importance of the grid, it faces vulnerabilities from severe weather, solar storms, and man-made attacks, and the options for dealing with these threats resiliently are constrained to the architecture of the grid. Currently, urban power distribution substations are intentionally isolated from each other to prevent cascading effects from fault cur-rents (i.e., power surges). However, this architecture limits the resiliency of the grid as substations operate in isolation and restricts recovery options for outages.

Outages in Manhattan due to Hurricane Sandy (Credit: New York Magazine).

Re-Architecting the Grid with IFCL-HTS Cables

To address this architecture limitation and improve the re-siliency of the grid, the Resilient Electric Grid (REG) pro-gram has developed an inherently fault current limiting, high temperature superconducting (IFCL-HTS) cable. This cable will enable re-architecting grids to be interconnected in an internet-like fashion and allow multiple paths for power to flow. This capability will allow power to be re-routed around downed substations and enable rapid and re-silient recovery to grid outages.

How the IFCL-HTS Cable Works



Structure of the cable (Credit: American Superconductor Corporation).

During normal operation, the cable is cooled to a supercon-ducting state, allowing current to flow unimpeded. How-ever, during a fault current event, the cable's temperature rises and enters a non-conducting state, halting the flow of current. This provides the cable's inherent fault current lim-iting capability and prevents fault currents from cascading to connected grid components.

Additional Benefit: Sharing of Power and Assets

Due to its superconductivity, the IFCL-HTS cable has ten times the power density of traditional copper cables and en-ables connecting substations to share power and assets. In-stead of having to build out new, expensive substations to serve additional load in high-growth areas, utilities will have the option to use an IFCL-HTS cable to share power from underutilized substations.

Pilot Installation Underway with Con Edison

An in-grid pilot demonstration of the IFCL-HTS cable is underway with Con Edison in Yonkers, N.Y. After comple-tion of the installation, the system will continue to be tested for a one year observational period.

Commercial-Scale Installation under Evaluation

Plans for a commercial-scale installation in downtown Chi-cago with Commonwealth Edison are currently under eval-uation. This installation would validate the maturity of the technology in an operational environment, increase utility interest in the technology, and reduce the cost of the cable system to commercially sustainable levels.

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To learn more about the Resilient Electric Grid project, contact Sarah Mahmood, Program Manager, at SandT.RSD@hq.dhs.gov.

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