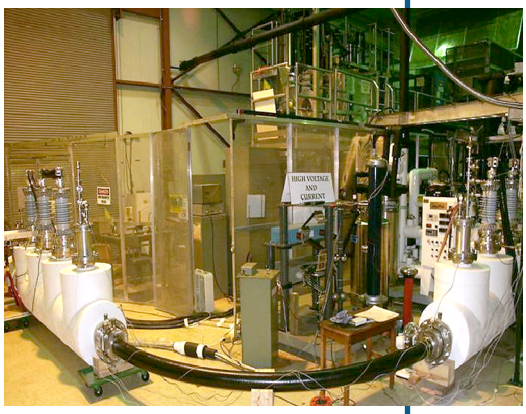
EES
Energy and Engineering Sciences

Electricity Delivery and Energy Reliability

The Oak Ridge National Laboratory (ORNL) performs technology research, development, and demonstration in partnership with U.S. industry and universities in support of DOE's Office of Electricity Delivery & Energy Reliability (OE), with the goal of modernizing the electric grid to meet the nations's need for reliable, electric power, enhancing security and reliability of the energy infrastructure, and facilitating recovery from disruptions to energy supply. Major research areas are high temperature superconductivity, visualization and controls, energy storage and power electronics, and distributed systems.

High Temperature Superconductivity (HTS)

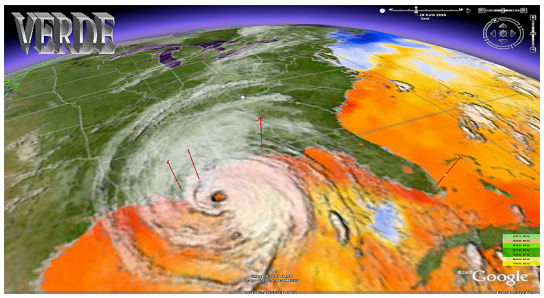


A 5-m prototype for the world's most compact superconducting cable is tested in collaboration with Southwire Company

Superconductors are important to meeting the nation's energy needs in the future because they have virtually no resistance to electric current, offering the possibility of new electric power equipment with more energy efficiency and higher capacity than today's systems. Superconductivity technology may help improve power flow control in an environmentally friendly manner. ORNL initiated research in high-temperature (20 K up to 135 K) superconductivity in 1988, soon after its discovery in 1986 and continues to perform research in wire and conductor development, cryogenic systems and dielectrics, enabling technologies for HTS applications, and component testing.

Visualization and Controls

Major power outages in the United States over the past decade have been caused, in part, by a lack of wide-area situational awareness. ORNL is developing a national visualization and analysis capability for OE. This resource will enable real-time status of the electric grid and critical energy sectors to assist federal agencies in the coordination and response during major events such as wide-area power outages, natural disasters and other catastrophic events. Real-time geo-visualization capability characterizes the dynamic behavior of the electric grid across multi-regions, substantially mitigating the risk of and accelerating the recovery from a large area power disruption.



Visualization and modeling tools at ORNL help assess potential impact of natural events on the nation's energy delivery system

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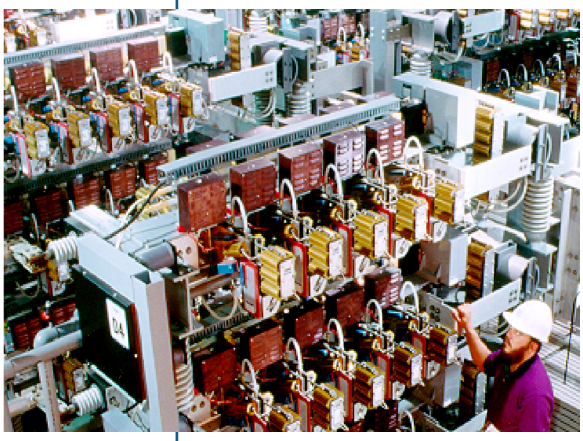
Additionally, ORNL provides key technical support and expertise in several key areas within visualization & controls such as energy interdependency analysis, next generation components, development of strategic test facilities, utilization of responsive loads and working with the U.S. electric power industry to improve the modernization of the electric grid.

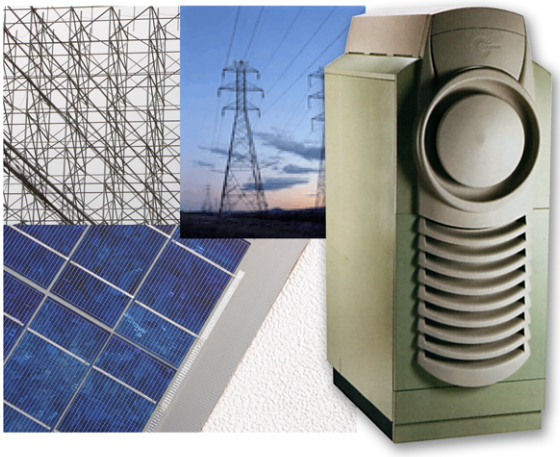
Energy Storage and Power Electronics

Large scale, megawatt-level electricity storage systems can significantly reduce transmission system congestion, help manage peak loads, make renewable electricity sources more dispatchable, and increase the reliability of the overall electric grid. Energy storage, when complemented by advances in power electronics, forms the basis of solutions to grid-related problems associated with the increasing power quality demands of high tech, digital industries. Power electronics are also needed for direct current lines, superconducting transmission lines, faster fault protection, and as a linkage between energy storage, distributed energy resources, and the grid.



Power electronics allow for power system controllability and improved reliability

Distributed Systems Integration



Deployment of renewables and other distributed technologies such as distributed generation, local intelligent systems, and plug in hybrid electric vehicles continues to increase within the electricity infrastructure. DOE is conducting research, development and demonstration to investigate the framework for grid architecture and technology integration while improving operational efficiency, reducing congestion and peak load, and maintaining security. ORNL is working with the U.S. DOE to increase the utilization of distributed resources to improve system operation in a cost-effective manner. Through innovative approaches and control methodologies, these technologies can provide ancillary services that traditionally have only provided stand-by generation. ORNL is partnering with industry to demonstrate these concepts on actual feeders. This is part of ORNL's effort to create an electric grid of the future.

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