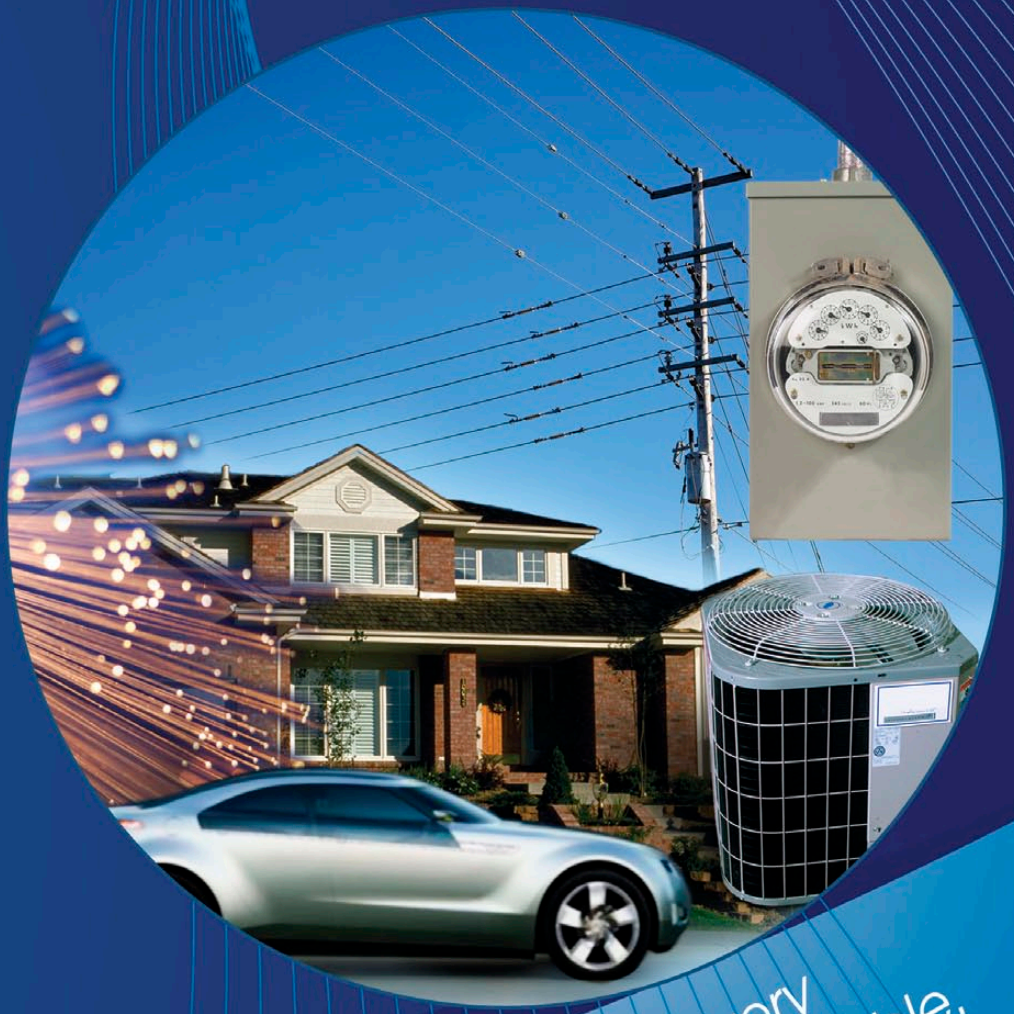
ELECTRICITY DELIVERY & ENERGY RELIABILITY

OAK RIDGE National Laboratory



Ensuring the nation's energy delivery system is secure, resilient, and reliable.

Clean Energy Transmission and Reliability

Today's electrical transmission system delivers high levels of reliability, and society's needs for electricity demand that reliability be maintained as we transition to clean electricity generation.

VERDE

Columbus Triaxial HTS Cable

The intermittent nature of many renewable resources, however, introduces system management challenges that need to be managed on a heretofore unseen scale. Oak Ridge National Laboratory (ORNL) is well positioned to address the technical problems associated with expanding the existing web of high-voltage transmission lines, developing new tools for managing the electrical grid, and developing the next generation of conventional and superconducting conductors.

Power Delivery Test Facility

Energy Storage

The power grid is a complex machine in which electricity is generated and delivered to electric loads.

Lithium Ion Batteries
(Image Courtesy of A123 Systems Smart Grid Stabilization System (SGSS™)

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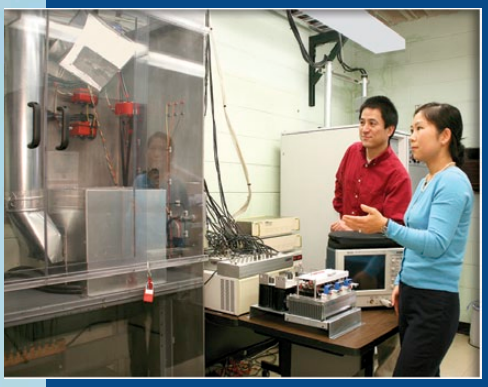
Smart Grid Researc

As the future grid unfolds there will be greater visibility and controllability across the entire electric distribution infrastructure. This will enable high penetration of clean, distributed renewables and will facilitate the transformation to electric transportation systems. ORNL is performing



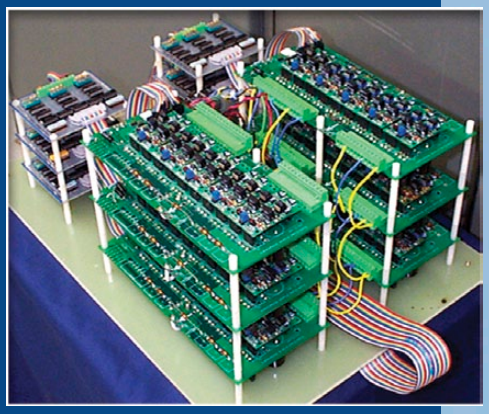
DE Systems (DECC)

work to realize a smarter, modern grid. Through the Distributed Energy Communication & Control (DECC) facility, researchers are developing and testing novel methods to regulate voltage locally and help utilities satisfy reactive reserve requirements.

Power electronic devices will be more prevalent in the transformation to the modern grid. ORNL is a leader in power electronics research and development and is working on high-power

Renewab

h and Development



Power Electronics

devices to improve reliability and reduce costs.

ORNL is also deploying smart meters with phasor measure-

Smart Meters

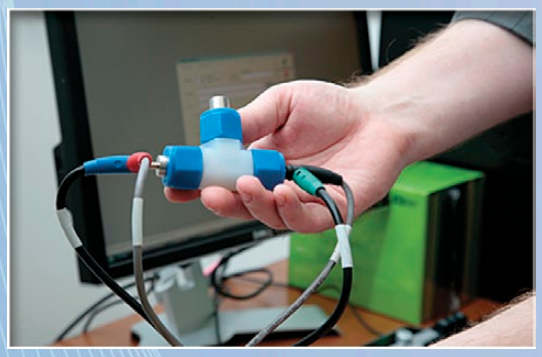
ment units to monitor the systems in real time and improve system modeling, real time analysis, and contingency prevention.

le and Distributed Systems Integration

Energy Storage (continued)

ORNL is developing energy storage technologies that can achieve greater energy density, conversion efficiency, and agility in order to respond to intermittent sources such as wind turbines and photovoltaic panels.

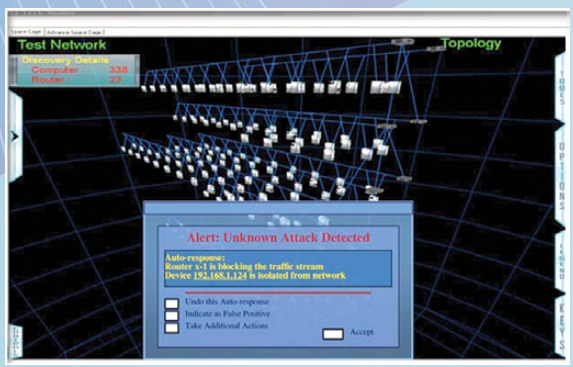
Energy Storage
(Image Courtesy of Electrosynthesis Co., Inc.)



Material Testing

Cyber Security for Energy Delivery Systems

ORNL's activities continue to support the Office of Electricity Delivery and Energy Reliability's mission to lead national efforts to modernize the electric grid, to enhance the security and reliability of the energy infrastructure, and to facilitate recovery from disruptions to the energy supply. Specifically, ORNL's activities contribute to the development of a hardened energy infrastructure that detects, prevents, and mitigates external disruptions to the U.S. energy sector.



Intrusion Detection System

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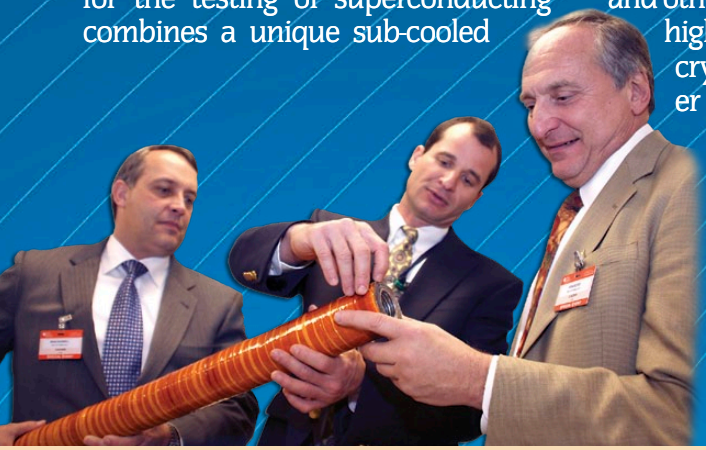
ORNL Advanced Cables and Conductors Test Facilities

In order to achieve market acceptance of advanced cable and conductor technologies for grid applications, prototype and pre-commercial power equipment must be thoroughly tested. ORNL has a number of unique facilities that are particularly suited for the task. One such capability is the Powerline Conductor Accelerated Testing Facility, which provides a realistic outdoor environment for long-term testing of advanced overhead conductors at various elevated temperatures and under high direct current. Yet another capability that was especially developed for the testing of superconducting and other high-power equipment is the ORNL Cable Test Facility. The facility combines a unique sub-cooled high-pressure circulating liquid nitrogen system capable of flowing cryogen at rates required for very long cables with high-current power supplies as well as high-fault-current and high-voltage capabilities. This one-of-a-kind comprehensive facility is the only one in the U.S. and has helped establish many significant milestones. For example, this facility validated the operation principle of the first ever fault-current-limiting high-temperature-superconducting (HTS) AC prototype power cable. It also enabled the testing of the world's first high-power (>600 MVA) superconducting DC prototype cable comprised of second-generation wires.



Chris Rey of ORNL (center) describing the HTS cable to DHS (left) and ConED (right) executives

R&D 100 Awards

Superconducting "Wires" by Epitaxial Growth on SSIFFS

The prestigious R&D 100 Awards have been helping companies provide the important initial push a new product needs to compete successfully in the marketplace. The winning of an R&D 100 Award provides a mark of excellence known to industry, government, and academia as proof that the product is one of the most innovative ideas of the year.

MELCOT: Methodology for Estimating the Life of Power Line Conductor-Connector Systems Operating at High Temperatures

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