



## ORNL and Nine Partners Develop Facility to Test Power Transmission Systems

Nine industrial, utility, and university partners are working with Oak Ridge National Laboratory (ORNL) to provide a unique facility to test and evaluate electricity transmission systems. Electricity transmission capacity in the United States is declining relative to the demand for power, which is expected to increase by 25% over the next decade. The National Transmission Technology Research Center (NTTRC) being developed by ORNL is a collaborative effort by government and industrial partners to respond to urgent transmission reliability and security problems. It is hoped their efforts will eventually more than double the amount of electricity carried over high-voltage power lines in the United States.

The technologies to be characterized at the NTTRC include advanced conductors, existing conductors, advanced sensors and controls, and transmission power electronics. Testing of aluminum conductor, composite-reinforced (ACCR), a new 3M composite-core conductor for power cables, is now under way at ORNL. The new conductor, which uses 3M Nextel ceramic fibers embedded in an aluminum matrix surrounded by aluminum–zirconium wires, increases the current carrying capacity of transmission lines. Because the conductor is more heat-resistant than conventional conductors, it also will prevent sagging of lines caused by the heat resulting from high current loads.

Transmission Test Facilities				
Program Research Areas	T1. Outdoor PCAT	T2. Indoor PCAT	T3. PCOT	T4. TPET
	Outdoor thermal cycling facility	Indoor thermal cycling facility	High voltage, high current test facility	Transmission Power Electronics Test Facility
R1. Advanced conductors	●	●	●	
R2. Existing conductors	●	●	●	
R3. Advanced sensors and controls	●	●	●	
R4. Transmission power electronics				●

PCAT – Powerline Conductor Accelerated Testing  
 PCOT – Powerline Conductor Operations Testing  
 TPET – Transmission Power Electronics Testing

The NTTRC consists of four facilities, all located on the Oak Ridge Reservation and the Tennessee Valley Authority right-of-way:

- The outdoor Powerline Conductor Accelerated Testing (PCAT) facility is a closed loop of about 1200 feet of cable. A dc power supply fed by a transformer provides current. It is located near the main ORNL complex.
- The indoor PCAT facility, to be developed on the Oak Ridge Reservation, will be able to test four full transmission spans indoors under controlled atmospheric conditions.
- The Powerline Conductor Operational Testing (PCOT) facility will place conductors to be tested into operational transmission lines in a controlled environment where they can be heavily instrumented and inaccessible to the public.
- The Transmission Power Electronics Test (TPET) bench will provide infrastructure and protocols for evaluating the performance of medium-voltage power electronics devices and systems in a controlled environment.

## The Project Partners

Under the U.S. Department of Energy program, the team will conduct rigorous field tests to document the performance of medium-diameter and large-diameter conductors under various conditions, evaluate potential economic benefits, and develop industry standards. In addition to ORNL, the following are project partners:



- **3M Corporation** is a large multinational company with areas of interest that include electronics, electrical equipment, power markets, and specialty materials. Minnesota-based 3M is responsible for overall management of the team's efforts, manufacturing of the ACCR core wires, validation of conductor performance, process control, and working with utilities to determine and document the conductor's economic value.
- **Preformed Line Products**—PLP, headquartered in Ohio, is an international designer and manufacturer of products and systems used to build and maintain energy and communication networks. It has developed the Thermolign, family of high-performance transmission hardware designed for use with high-temperature transmission conductors such as ACCR. Thermolign suspension products are being tested along with the ACCR cables at the NTTRC.
- **Alcoa-Fujikora**—Alcoa is a leading North American supplier of fiber optic products and transmission accessories, including compression terminations, dampers, and electrical connectors. Alcoa has an extensive accessory product line of high-temperature conductors and is collaborating with 3M to develop a line of terminations, connectors, and dampers for composite conductors.
- **Nexans**— An international leader in the electrical cable industry, Paris-based Nexans has broad experience in advanced copper and optical fiber cable systems. Nexans has collaborated with 3M for 5 years to combine strands of composite conductors with high-temperature aluminum.
- **Wire Rope Industries** is North America's largest manufacturer of high-performance wire rope products. Its products are used in a wide range of industrial applications, including electrical utilities. Wire Rope Industries collaborated with 3M to develop and manufacture the composite core for ACCR.
- The **Tennessee Valley Authority** is the largest public power company in the United States, providing power to nearly 8.3 million residents of the Tennessee Valley. TVA has worked with ORNL to design the line structures for the NTTRC test facilities. It also provided and installed the poles and hardware and installed the special conductor accessories manufactured by Alcoa and Preformed Line Products.
- The **Western Area Power Administration** is testing a one-mile test segment of ACCR cable on its transmission network in North Dakota. The field test will show how well the cable can withstand the extreme winter and summer weather conditions on the northern Great Plains. Western, a public utility operating in 15 western states, has identified more than 20 constrained transmission paths in its cable network, including the path between northern and southern California.
- The **National Electric Energy Testing, Research, and Applications Center** is a member-supported electric energy research, development, and testing center housed at the Georgia Institute of Technology. The center performs tests to national standards including ASTM, IEEE, ANSI, and NEMA. It is testing all the components associated with the ACCR project in its laboratories.

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