ACCR Wires Power Grids for Greater Capacity and Efficiency

Power transmission cables using a new composite conductor are expected to greatly increase the capacity and efficiency of the U.S. electricity grid. ORNL is working with 3M, the developer of the aluminum-conductor composite-reinforced (ACCR) wires, to analyze the performance of the new conductor.

ACCR wires being installed at ORNL's PCAT facility for 3 years of operation and testing.

The high-performance conductors consist of a core of aluminum metal matrix composite wires surrounded by temperature-resistant aluminum-zirconium wires. They enable power lines to carry significantly more power than the aluminum-conductor steel reinforced (ACSR) cables used in the United States for nearly a century. ACCR operates at temperatures up to 210°C (410°F) with no degradation of its properties, while ACSR can operate only at 100°C (212°F) or below. The higher operating temperature allows ACCR to transmit two to three times more power than ACSR. In addition, the low thermal expansion of the new composite core reduces line sag when power flow increases.

ORNL researchers will provide performance data for ACCR wires based on both laboratory and field tests. An outdoor test facility, the Powerline Conductor Accelerated Test (PCAT), was built at ORNL in July of 2002. The ACCR conductors will be installed on steel poles at the PCAT and tested at high-current, low-voltage and at the rated conductor temperature of 210°C for 500 thermal cycles. Sag, tension, current, and conductor temperature will be measured. Beginning in the fall of 2002, three ACCR sizes—477, 795, and 1272 kcmil—will be tested over 3 years. The Tennessee Valley Authority is helping design and install the test lines.

3M is selecting field sites to test ACCR in use on utility networks. The first field installation under the DOE program will be conducted by the Western Area Power Administration (WAPA). It is scheduled for late 2002. ORNL is working with 3M and WAPA to provide monitoring hardware and to collect and analyze data to evaluate ACCR performance on the utility grid.

ACCR can replace conductors already in use in overhead transmission cables. ACCR wires can be installed quickly with little disturbance of neighborhoods and the natural environment.

Contact: John Stovall, 865-574-5198, stovalljp@ornl.gov

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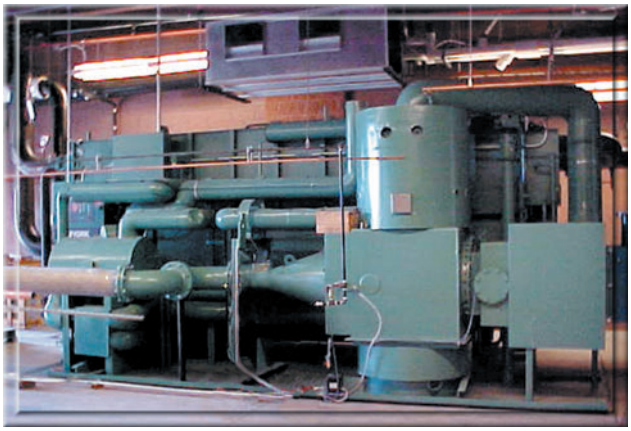
absorption chillers are heat-activated (powered by heat rather than electricity) and produce waste heat, they are a good fit for cooling, heat, and power applications.



The triple-effect chiller being demonstrated in Las Vegas.

One of DOE's aims for the demonstration is to encourage more widespread use of absorption cooling in the Southwest. Some of the innovations resulting from the triple-effect R&D (e.g., improved refrigerants, additives, control systems) have also improved the efficiency and performance of other absorption technologies.

Contact: Patricia Garland, 202-479-0292, garlandpw@ornl.gov

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The effort will culminate in production of the FP3 body-in-white (see accompanying article on p.1).

Several R&D projects at ORNL attempt to lower CF composite costs. One is developing low-cost precursors based on kraft lignin, a by-product of paper-making. Millions of tons of lignin are produced annually, most of which is burned as fuel. Another project seeks to enable the use of commodity-grade polyacrylonitrile (PAN) as a carbon fiber precursor. Commodity-grade PAN sells for about half the cost of carbon- fiber-grade PAN. The work has focused on evaluating PAN-based precursors and stabilizing the fibers using chemical modification and radiation pretreatment.

Textile-grade PAN before (left) and after being converted to carbon fiber.

A third effort is using microwave energy to convert PAN precursors into carbon fibers. Early stages of the research proved microwave-assisted processing to be a feasible alternative to oven treatment. Successive phases have scaled up the process to run continuous fiber samples at increasing lengths and production rates. The fibers produced surpass the technical targets, and the process promises to cost almost 20% less than conventional methods.

Contact: Dave Warren, 865-574-9693, warrencd@ornl.gov

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