BIOMASS ENERGY

A New World for Wood

Janet Cushman examines species of fast-growing switchgrass that, like the hybrid poplar, is a potential energy source.

Thanks to a Department of Energy program managed by ORNL for 20 years, industry has a more efficient source of pulp fiber and wood for making paper, construction materials, and furniture. The original purpose of DOE's Bioenergy Feedstock Development Program was to develop sustainable farm-grown crops that could be converted to fuel. However, as a result of ORNL's collaborations with U.S. Department of Agriculture Forest Service and Agricultural Research stations, many universities, and several forest products companies, fast-growing trees and grasses were selected and developed that could be used for wood products, as well as energy. Poplar trees and switchgrass emerged as model crops.

The DOE program participants developed a technology of growing genetically superior hardwood trees that can be harvested every 6 to 12 years. The U.S. forest products industry has adopted this technology, especially in the Pacific Northwest and South, and, more recently, in the North Central region. Nationwide, approximately 120,000 acres are being used to grow short-rotation woody crops consisting mostly of poplars or poplar hybrids. The estimated value of the annual harvest for pulp fiber is about $50 million.—*Lynn Wright*

FUSION ENERGY

Seeking the Ultimate Source

Scientists from Russia and Japan to Europe and the United States have long sought to develop fusion as an abundant, safe, and environmentally friendly source of electric power. To reach this ambitious goal, they must overcome problems in a range of scientific and engineering disciplines. ORNL is known in the international fusion community as a laboratory that has made strong contributions in virtually every discipline of fusion science and engineering and that has the skills to maintain a central role in developing fusion energy.

Need to heat and fuel a plasma? ORNL researchers developed the physics and technology of bullet-like solid hydrogen pellets, high-frequency microwave tubes hundreds of times more powerful than a home microwave oven, and particle beams and radiofrequency heating systems with megawatts of power to heat fusion plasmas many millions of degrees.

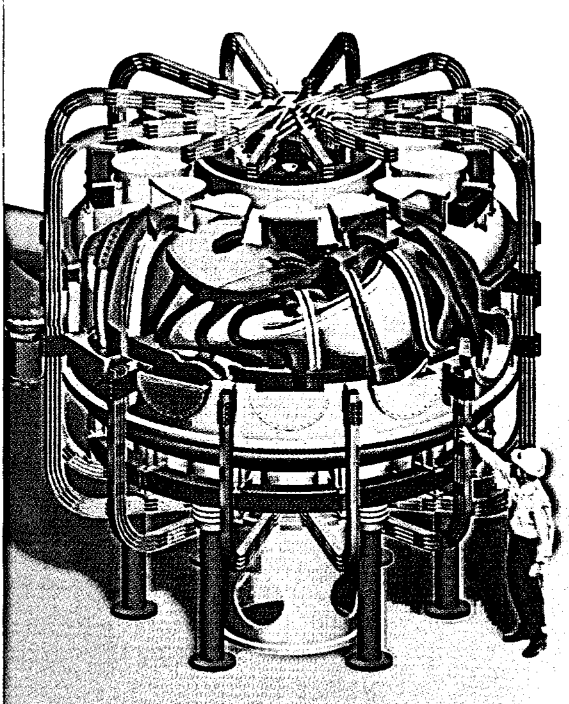
Need a better magnetic confinement system? ORNL researchers have developed improved magnetic "bottles" that are being tested in facilities in Madrid, Oxford, Moscow, and Princeton, and in new facilities under way in Princeton and Oak Ridge (i.e., the Quasi-Poloidal Stellarator, an approach to developing a smaller, less costly fusion device). These new facilities have been developed using ORNL's state-of-the-art computers.

Need longer lasting, more reliable materials? New materials that meet the needs of engineering test reactors have been developed at ORNL. Thanks to ORNL's unique irradiation and microcharacterization facilities, researchers are obtaining a fundamental understanding of how materials respond to radiation, enabling the creation of better materials.

Here are some selected highlights in ORNL's fusion energy career. To produce as much energy by sustained fusion reactions as is introduced into the fusion device (energy breakeven), certain conditions must be met. They are a sufficiently high fusion plasma temperature and density for a long enough time—the so-called Lawson criterion.

In 1978 ORNL's high-power neutral beam injection plasma heating system, developed under the leadership of Hal Haselton, enabled a tokamak at the Princeton Plasma Physics Laboratory (PPPL) to achieve a record plasma temperature. The Lawson criterion was first exceeded in 1983 in a landmark experiment on the Alcator-C tokamak at MIT using a fueling technique pioneered by Stan Milora and others at ORNL in which "bullets" of frozen hydrogen were fired into the plasma chamber from a gas gun. In 1986, a record Lawson parameter was set on PPPL's Tokamak Fusion Test Reactor in experiments performed by Milora and PPPL's G. L. Schmidt using a machine-gun-like fuel injector developed by ORNL.

In short, ORNL is known for applying its broad capabilities to advancing magnetic fusion to meet the goal of producing practical power.—*Lee Berry*



ORNL researchers have designed the compact Quasi-Poloidal Stellarator, a fusion research device that will be built at ORNL this decade.

1997

Device developed to verify conversion of Russian weapons-grade uranium to reactor-grade fuel

Initial design of mass spectrometer to help Army detect chem-bio threats

First approved release of genetically engineered microbe

VITALE devised to enhance signals from damaged videotapes, helping police solve crimes

World's largest watershed experiment shows effects of droughts and heavy rainfall on forests

1998

MicroCAT scanner invented; maps internal changes in mutated mice