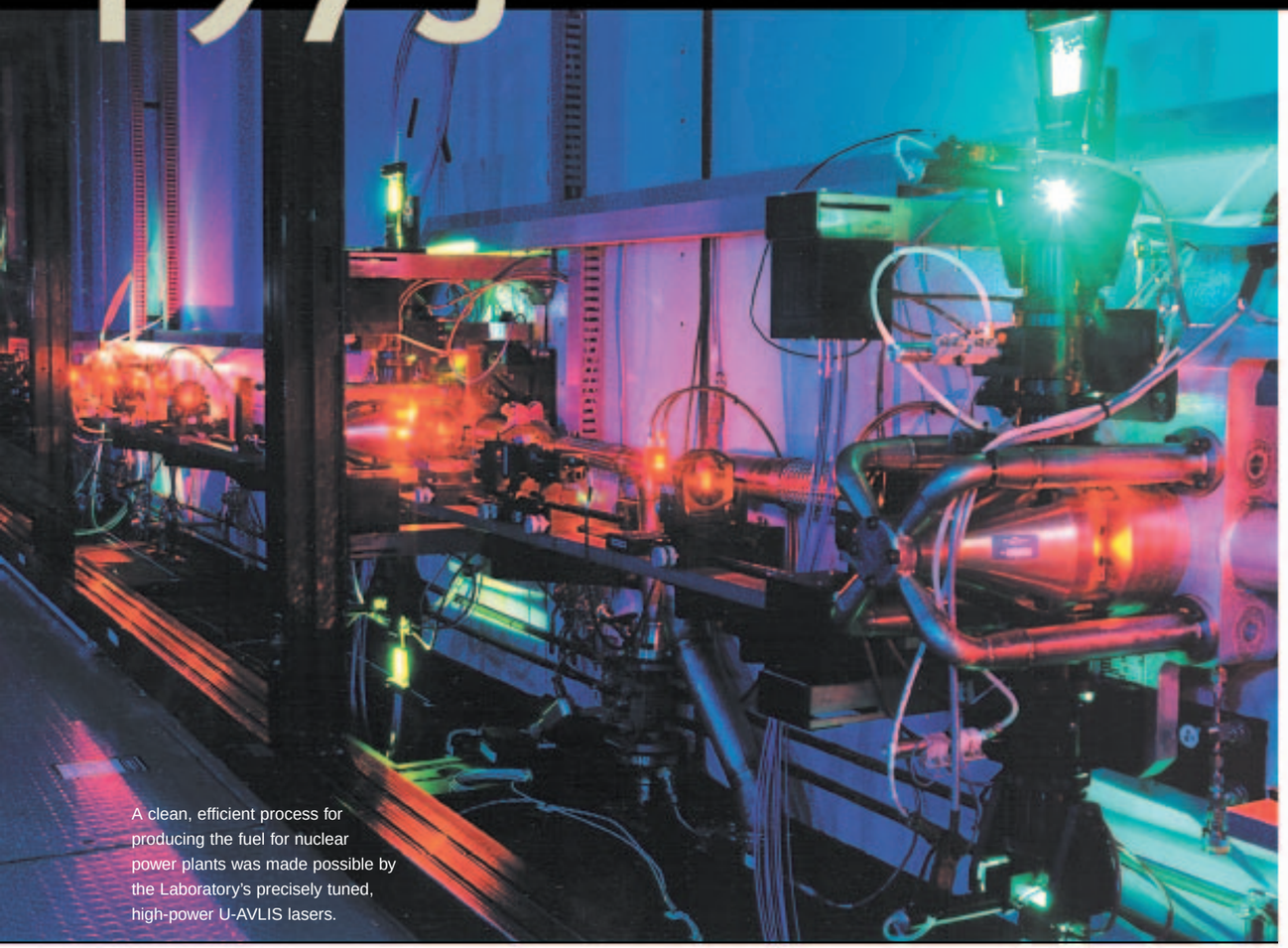
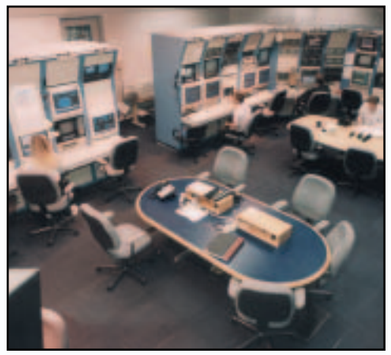
1973 U-AVLIS Program Begins



A clean, efficient process for producing the fuel for nuclear power plants was made possible by the Laboratory's precisely tuned, high-power U-AVLIS lasers.



Livermore's plant-scale uranium separator system was one of the largest technology transfer projects in the Laboratory's 50-year history.

Industrial-Scale Applications for Lasers

In the early 1970s, many analysts were projecting a shortage of electricity starting in the next decade. One option was expanded use of fission energy, for which an inexpensive source of enriched uranium fuel was needed. At the same time, the inherent properties of lasers were recognized as having the potential of leading to a low-cost method to produce such fuel by selectively ionizing uranium 235 and electrostatically separating it from uranium 238. The Uranium Atomic Vapor Laser Isotope Separation (U-AVLIS) program began at Livermore in 1973 to help maintain the U.S. market share of enriched uranium fuel for the host of nuclear power plants that would be constructed to meet the world's energy needs.

The U-AVLIS process for separating isotopes of uranium presents numerous advantages. It achieves separation in one or two passes through the laser beam, rather than the hundreds of passes required in other processes. It needs only 1/20th the electrical power required by diffusion plants, producing significant cost savings. Because U-AVLIS uses uranium metal as the source material rather than uranium hexafluoride, the process is less expensive and less hazardous and produces less low-level nuclear waste.

In the early years of the program, the U-AVLIS process used copper vapor lasers to pump liquid dye lasers to effect the separation process, while in later years, more efficient solid-state lasers were developed as the pump lasers. Dye lasers were used because they can produce a broad and almost continuous range of colors. An optical system in the laser is able to "tune," or select, the laser to the precise color needed to separate the desired isotope.

Through its 25-year history, the U-AVLIS Program progressed from the Morehouse experiment that produced the first milligram quantities of enriched uranium in 1974 through the REGULIS separator in 1980, the MARS Facility in 1984, and the Uranium Demonstration System and the Laser Demonstration Facility in the 1990s. In the process, tunable laser technology was dramatically advanced, and significant scientific progress was made in the physics of laser–atomic interactions. In addition, the Laboratory staff gained valuable experience in laser-based industrial production, which contributed not only to the U-AVLIS program but also to other projects such as the Laser Guide Star (see Year 1996), the Laser and Materials Processing program, and the National Ignition Facility (see Year 1997).

Congress created the United States Enrichment Corporation (USEC) in 1992, which was a government corporation until privatized in 1998, to move the U-AVLIS program into the private sector. By the late 1990s, however, the energy economies of the world and the supply versus demand for enriched uranium had changed. USEC suspended the U-AVLIS program in 1999, retaining the rights to U-AVLIS technology for commercial applications.

A technician works with the diode-pumped solid-state green laser developed for U-AVLIS. The technology is being used for precision machining and many other applications, such as pumping ultrashort-pulse lasers, creating laser displays, and treating disfiguring skin conditions.