The greatest challenges in stockpile stewardship lie ahead, as weapons continue to age. Success depends on bringing into operation vastly improved scientific capabilities, which will be used by our experienced nuclear weapons designers to train the next generation of stockpile stewards, who will rely on the new tools. At Livermore, we are acquiring powerful supercomputers to better simulate weapons performance, and we are constructing the National Ignition Facility to perform needed thermonuclear physics experiments.

Stockpile Stewardship—Greater Capabilities to Come

In 28 tractor-trailer trucks from Poughkeepsie, New York, the IBM ASCI White supercomputer—the world's fastest and most powerful—was delivered to the Laboratory during summer 2000. The machine is powered by 8,192 IBM RS/6000 processors and covers an area the size of two basketball courts. ASCI White has enough memory to hold six times the entire book collection of the Library of Congress.

World's Most Powerful Computer

In summer 2000, Livermore became home to the world's most powerful supercomputer with the delivery from IBM of ASCI White, which is capable of performing over 12 trillion operations per second (12 teraops). The ASCI White machine was acquired through the Accelerated Strategic Computing Initiative (ASCI), a key component of the Stockpile Stewardship Program. ASCI is rapidly advancing the state of the art in computers, modeling techniques, and data-management tools needed to simulate the performance of nuclear weapons.

ASCI White is based on the next-generation IBM processor, node, and switch technology. It has 512 nodes, each with 16 processors. Exceeding its contractual performance requirements, the machine is about three times faster than Livermore's Blue Pacific computer, which was used to perform the first-ever 3D simulation of an exploding nuclear weapon primary. About 100,000 times more powerful than a typical desktop computer, ASCI White provides over 12 terabytes (trillion bytes) of main memory and over 147 terabytes of global disk space.

The advanced computing capabilities made possible by ASCI move us closer to the goal of performing full-scale simulations of weapons performance based on first-principles physics without resorting to simplified models. These new capabilities—on smaller, unclassified systems—offer future unprecedented levels of understanding in climate and weather modeling, environmental studies, the design of new materials, and many areas of physics.

NIF Plans Revised as Construction Continues

Construction continued at Livermore on the National Ignition Facility (NIF) as the NIF project team developed a rebaselined plan for finishing the project. The new baseline plan was validated and approved by DOE in September. It calls for laser operations to begin in FY 2004 and completion of the project in FY 2008.

Conventional construction for NIF is essentially completed, and installation of the laser beampath infrastructure is under way. The 118,000-kilogram target chamber, a 10-meter-diameter aluminum sphere, has been installed, leak-tested, and prepared for additional shielding. Mounted on the chamber's outer surface will be hundreds of diagnostic instruments and 48 final optics assemblies that will convert the laser pulses from infrared to ultraviolet and focus the light precisely on a target the size of a BB-gun pellet.

The NIF project was rebaselined to enhance the planned method of assembling and integrating the lasers and to ensure that strict beampath cleanliness requirements would be met. The NIF project team contracted with experts from industry to implement plans for installing laser components, and the team took steps to greatly improve project management.

In parallel, exceptional progress was made on many technical fronts. In September 2000, DOE's Energy Systems Acquisition Advisory Board approved the new NIF baseline, and the Secretary of Energy submitted his certification of the NIF project plans to Congress. The Secretary of Energy's Advisory Board (SEAB) also concluded that the corrective actions undertaken by the NIF project team together with the revised cost and schedule baseline in the Secretary's report to Congress are sufficient to permit the NIF project to be completed as planned.

Construction activities in 2000 bring the conventional facilities to 95 percent completion—both for the optics assembly building and the stadium-size laser building with its laser and capacitor bays, laser-beam switchyards, and target bay. The NIF integration management and installation contractor is making great progress installing the enclosures for the laser beams and support systems. Over 1,000 tons of beampath infrastructure were in place by January 2001. The design of line-replaceable units—modular components that constitute the special laser, target, and optical equipment—is nearly complete, and more than 1,000 laser glass slabs meeting NIF specifications have been produced.

With the world's most powerful laser in NIF, many fundamental processes of thermonuclear ignition and burn soon will become accessible for laboratory study and analysis. By focusing its energy on a BB-size target for a few billionths of a second, NIF will generate in experiments the temperatures and pressures needed to validate weapons-physics computer codes and address important issues of stockpile stewardship.

The development of improved methods for manipulating and interpreting terabytes of data is an important focus of ASCI. Livermore researchers test the usefulness of new visualization tools—a novel desktop display and "data gloves" that allow the user to reach out and seemingly move and examine images.

Design is completed for the Terascale Simulation Facility, which will house Livermore's next supercomputer after ASCI White. The $89-million facility will include a computer complex with about an acre of floorspace as well as office space for a growing staff of computer and physical scientists who support ASCI.