Nuclear Weapons

Los Alamos NATIONAL LABORATORY

Program Profile

Two directorates at Los Alamos National Laboratory, Weapons Physics and Weapons Engineering and Manufacturing, contribute to national defense by maintaining the safety and reliability of weapons in the U.S. stockpile in the absence of underground nuclear testing. This stockpile stewardship mission requires expertise and capabilities that range from advanced computing to explosives experiments to modern manufacturing of replacement components, and from materials science to applied physics and engineering. Eight technical divisions carry out this work, with support from across the Laboratory.

Stockpile Certification

The directors of the weapons laboratories of the Department of Energy's National Nuclear Security Administration—Los Alamos, Lawrence Livermore, and Sandia—certify the stockpile each year. They accomplish this through stockpile stewardship, a comprehensive program of calculations, experiments and manufacturing. DOE, the Department of Defense and others rigorously review this certification process. The secretaries of Defense and Energy then forward the certification and their recommendations to the President.

Each year since 1995, the DOE weapons laboratories have been able to certify that the stockpile is safe and reliable and that no nuclear tests are required to maintain certification.

Stockpile Surveillance

Each year, a few nuclear weapons are removed from the stockpile and subjected to rigorous reliability assessments to detect and predict problems and plan component life-extension. The advanced computational and experimental methods of stockpile stewardship help resolve problems due to aging, and enhanced surveillance technologies are developed to better predict how aging will affect stockpile components and weapons.

These methods have identified a variety of issues without nuclear testing. In addition, they have led to a fundamental scientific understanding of nuclear weapon behavior, material aging and component re-manufacturing issues.

The 9- by 15-foot Power Wall helps scientists visualize and analyze large computer simulations of instability and mixing.

Advanced Simulation and Computing

Los Alamos has always used the most advanced prototype supercomputers to guide weapon design and analysis, and has led the high-performance computer industry. Evaluating and mitigating the effects of aging requires unprecedented computational speeds and memory capacities, along with new three-dimensional codes that integrate theoretical physics, experimental data and past test results. The goal is validated simulations that realistically simulate and predict the dynamic behavior of nuclear materials, high explosives and other weapon components.

Los Alamos recently completed the Nicholas C. Metropolis Strategic Computing Complex to house the world's most powerful supercomputer and innovative tools that permit researchers to visualize enormous quantities of data.

Experiments

The absence of nuclear testing mandates a much more detailed understanding of the physics of nuclear detonations, through fundamental measurements and laboratory experiments that are compared with theoretical and computational models. These models integrate the elements of weapon performance and will be central to the certification of U.S. nuclear weapons in the future. However, they can do so only if they are based on insights and data from fundamental experiments, including:

- Conducting experiments with high explosives, pulsed-power machines, lasers, particle accelerators and other tools to acquire the data needed to validate computer models and codes
- Hydrodynamic testing and advanced radiography of mock-ups of nuclear weapons components—ones in which surrogate materials are substituted for the nuclear explosives—to better understand the effects of aging
- Conducting subcritical experiments underground at the Nevada Test Site that study how plutonium behaves under shock conditions and provide

data needed to certify re-manufactured weapons components

- Applying high-energy density physics technologies to study materials under extreme pressures and temperatures near those occurring in nuclear explosions, using such facilities as the Los Alamos' Atlas pulsed power machine, the "Z" pulsed power machine at Sandia and the National Ignition Facility at Lawrence Livermore.

Materials Science

Because nuclear weapons are made of complex materials and are now maintained far beyond their design lifetimes, the ability to characterize aging effects and to predict when materials should be replaced is crucial to extending the life of stockpiled weapons.

High explosives, which are made of molecules of explosives and plastics can dry, leading to cracks and gaps in the explosive charge. The decision to remanufacture high explosives must take place only when necessary and in conjunction with scheduled stockpile refurbishment, both due to cost and the potential risks of error or accident in weapon disassembly and assembly.

The plutonium pits at the core of nuclear weapons must endure in the stockpile for longer than the 60 years that the human-made metal has existed on Earth, yet few details are known about how plutonium ages. Advanced neutron scattering, radiography and similar tools are essential for learning how materials age, as are the subcritical experiments at the Nevada Test Site.

Manufacturing

In conjunction with surveillance of weapons components, Los Alamos is responsible for producing a limited number of pits to replace those destroyed in surveillance inspections, as well as nonnuclear components. Because the components of a nuclear weapon have limited lives, the need for a specialized manufacturing base to refurbish the stockpile is inevitable. Components may be replaced or repaired and requalified for reuse through the Stockpile Life Extension Program. The Laboratory conducts research and development for advanced, more environmentally sound pit-fabrication technologies. In some cases, new materials will replace those now obsolete or environmentally unacceptable. Los Alamos also is developing advanced manufacturing processes that are cost effective, help reduce or eliminate waste, and enhance worker health and safety. They ensure that remanufactured components support certification of the stockpile.

Los Alamos is responsible for six U.S. weapons systems that can be delivered by land, sea or air.

Quick Facts

- The Associate Directorate for Weapons Physics manages six technical divisions that carry out the work of certification, employing about 2,000 University of California employees, with a budget for fiscal year 2002 of approximately $550 million.
- The Associate Directorate for Weapons Engineering and Manufacturing manages two major divisions with approximately 1,600 employees and has a budget of nearly $300 million.
- Los Alamos' nuclear weapons program is funded primarily by the Defense Programs Office of the National Nuclear Security Administration

Stockpile Systems

Los Alamos is responsible for the design and maintenance, through lifetime extension programs, of six weapon systems in the U.S. stockpile (noted below by an *). Lawrence Livermore is responsible for the remaining systems.

Submarine-Launched Ballistic Missiles	W76 (Trident/Mark4)*
	W88 (Trident/Mark5)*
Intercontinental Ballistic Missiles	W62 (Minuteman III, to be retired)
	W78 (Minuteman III)*
	W87 (Peacekeeper)
Air-Carried Bombs	B61-3, -4, -10*
	B61-7, -11*
	B83
Cruise Missiles	W80-0, -1 (air-launched, sea -launched, advanced)*
	W84 (inactive stockpile—weapon maintained, delivery system inactive)

NOTE: Nuclear warheads are identified by a W with a program number, e.g. W88. Nuclear bombs are identified by a B with a program number, e.g. B61. Modifications include Mod numbers, e.g., B61, Mod 11, or simply B61-11.

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Los Alamos National Laboratory is operated by the University of California for the U.S. Department of Energy's National Nuclear Security Administration

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4/02