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Introduction

I am pleased to have the opportunity to address this Subcommittee this morning. I have now been the Director at Los Alamos for a little more than a year, and it has been stimulating and rewarding. Your support for the Laboratory and its mission has been a major factor in our successes this year.

I would like to make four key points in this testimony today.

- We completed the third annual formal certification process, and I have certified to the Secretaries of Defense and Energy that the Los Alamos weapons in the stockpile are currently safe and reliable.
- I am confident that the Stockpile Stewardship Program will allow continued assurance of the safety and reliability of the stockpile without nuclear testing.
- The Stockpile Stewardship Program is moving from concept to performance and has demonstrated significant technical progress this past year, notably in the Accelerated Strategic Computing Initiative, subcritical tests, and dynamic radiography.
- We are increasingly responsive to today's new environment for operating a nuclear laboratory: we are making progress in operational effectiveness, from safety to construction project management, and in demonstrating that we are a considerate neighbor in our community.

Your encouragement and support will continue to be necessary ingredients for the full success of the Stockpile Stewardship Program.

Strategic Environment

Although the Cold War has been over for almost a decade, the events of the past year demonstrate that the world remains a dangerous place. Two countries, India and Pakistan, have conducted nuclear tests and have declared their intention to weaponize their nuclear capability. Other countries, most notably North Korea, are developing ballistic missiles that could threaten the United States or our allies. It seems likely that some or all of these countries are considering weapons of mass destruction, including nuclear weapons, as the warheads of choice for these missiles. Given these and other emerging threats, the U.S. nuclear deterrent remains essential to the nation's defense. No one must doubt our ability, our resolve, and our progress in assuring that our nuclear weapons remain safe and reliable, and will perform as expected if called upon to do so.

A number of policy reviews of nuclear deterrence and stockpile issues have been conducted since the end of the Cold War. One of the most current is last year's DoD study, "Defense Science Board Task Force on Nuclear Deterrence—Final Report." The Task Force noted that under likely foreign-policy scenarios, nuclear weapons would remain a cornerstone of the U.S. defense posture, contingent on stockpile readiness. The Task Force pointed out the need for a robust Stockpile Stewardship Program, endorsed the new capabilities for providing stockpile confidence without nuclear testing, and urged more comprehensive and thorough planning.

The strength of the U.S. nuclear deterrent has benefited world security over the last half century and has helped to establish the conditions for cooperative threat reductions. The Laboratory provides technical expertise for threat reduction, and as these cooperative steps are considered, we also help the nation maintain continued vigilance to ensure that our national security is not eroded by other threats.

Core Mission

The Stockpile Stewardship Program (SSP) mission is to ensure the safety, reliability, and performance of the nation's nuclear weapons. In the absence of nuclear testing, this demanding challenge requires a multidisciplinary approach that includes theory, advanced computation, experimentation, and materials science, in conjunction with modern manufacturing techniques.

To ensure that our nuclear deterrent remains viable and credible, the SSP focuses on the condition of the entire U.S. nuclear stockpile. Los Alamos has lead responsibility for systems in all three legs of the strategic triad including the Minuteman III W78 warhead, the Trident I/II W76 and W88 warheads, the W80 cruise missile warhead, and B61 gravity bombs including the "Mod 11" earth-penetrating version. This is our core mission, and we are fully aware of its continuing national importance.

Certification

President Clinton, in his August 11, 1995 speech on the Comprehensive Test Ban Treaty, called for a new annual certification requirement for the U.S. nuclear weapons stockpile. This annual process requires the Secretaries of Energy and Defense to certify to the President the safety and reliability of each weapon type in the stockpile. Additionally, the Secretaries must identify significant issues that may need to be addressed by nuclear testing.

The ultimate certification metrics for the stockpile are military characteristics (MCs) and the stockpile-to-target sequence (STS) requirements. The MCs and STS are weapon specifications

jointly agreed upon between the DOE and DoD. Certification in the absence of nuclear testing is a very demanding scientific and technical challenge that requires an integrated and multidisciplinary approach. To meet these complex requirements, the Stockpile Stewardship Program (SSP) was created.

The program was initially conceived in general terms, based on the realization that the DOE complex was designed for continuous new weapon production, not for “indefinite” weapon maintenance. With experience, the program has developed stronger focus and definition, as described in the DOE “Green Book.”

Stewardship is a dynamic process: it is being refined through the discovery of stockpile anomalies and problems during weapon surveillance and through the re-establishment of production capabilities. The program continues to develop the technology, facilities, and infrastructure to carry out the main mission more effectively. Additional activities include improvements in safety and surety, better alignment with a modern regulatory framework, and adoption of environmentally sound manufacturing technologies.

As Director of the Los Alamos National Laboratory, I am responsible for certifying Los Alamos weapons systems, and last year was my first annual certification. I am confident in reporting that the Los Alamos-designed weapons remain safe and reliable—no nuclear testing is required at this time. Let me explain to you the process I used and why I am confident.

The certification process at the Laboratory begins in January. The project leaders for each weapons system initiate an in-depth review, by weapon type, of the available information. This review, which incorporates new technologies developed by the Stockpile Stewardship Program, includes data from experiments, surveillance of stockpile weapons, simulation of weapon performance, and theoretical studies. Over the course of several months, this information is analyzed and compiled into a Technical Certification Report. The analyses may involve modeling and simulation, to determine possible effects of weapons anomalies, and statistical methods to estimate probable trends and effects. Other designers, engineers, scientists, and management then critically review the report. At the end of this review process, the report is presented to me and I discuss the results with the experts. I use a roundtable format allowing all to speak freely and challenge the data and analyses. After careful review and deliberation, I then sign a certification letter to the Secretaries of Energy and Defense.

An additional certification question occurs when components are manufactured with technologies different from those originally used. Confidence in these new components depends upon executing a coherent program to demonstrate compliance with the design intent. With some

components, it is possible to physically measure features and to bench test performance in a laboratory.

Other components cannot be bench tested and may require unique strategies for assessment. Plutonium pits are an important example. Before 1989, pits were produced at Rocky Flats in Colorado. This production was terminated in 1989, and the mission was formally transferred to Los Alamos in 1996 as part of the DOE production-complex downsizing. In the interim, technologies and regulations changed. Many environmentally harmful chemicals can no longer be used for production, and some of the older Rocky Flats technology could not be transferred or reproduced. We are further limited by facility capability in the existing Los Alamos plant. All of these factors mean that we will be using new processes, so the Los Alamos pits will not be identical to those built at Rocky Flats. However, I am confident that the Los Alamos-built pits will perform to design expectations.

We are learning from our certification reviews. As our weapons get older, the number of anomalies, significant findings, and stockpile problems is increasing. To a great extent, anomalies can be analyzed by standard engineering methods and through component tests. Sometimes no further action is required because the anomaly is benign; otherwise, a component change or remanufacture may be necessary. The Stockpile Stewardship Program is providing the tools and knowledge we currently need for certification and for training the next generation of weapons experts.

Because of the progress we are making, my confidence in the stockpile is much greater today than it would have been if we had followed the 1993 trajectory of plummeting budgets and uncertain commitments.

Status of Stockpile Stewardship

Capabilities

The DOE stockpile stewardship program integrates a comprehensive set of facilities, tools, and technologies for use in stockpile science and manufacturing. An example of this integration is visible as Los Alamos prepares to certify future W88 warheads containing Los Alamos-built pits. This program has four major elements: production-process evaluation, dynamic nuclear material characterization, implosion condition simulation, and weapon performance determination.

- The production-process evaluation invokes advanced technologies such as neutron scattering experiments at the Los Alamos Neutron Science Center (LANSCE) to determine material-processing changes, for example, measuring residual stress from welding.
- Dynamic nuclear material characterization, which produces information about key phenomena like the plutonium behavior under high pressure, is achieved with a wide range of advanced capabilities that includes neutron scattering, gas guns, and subcritical and high-energy-density experiments.
- Implosion experiments are conducted in our x-radiography facilities to radiograph the hydrodynamic compression of primary assemblies containing surrogate materials.
- Weapon performance determination includes an integration of all these data, including past nuclear tests, in weapons simulation codes in order to assess the net condition.

Accomplishments

The Stockpile Stewardship Program has produced new and vital capabilities. Our accomplishments over the last year include the following:

- ASCI/Computing—The Los Alamos/Silicon Graphics-Cray supercomputer, capable of running more than 3 trillion math operations per second (3.1 Teraops) with 6,144 processors, is now on-line. In November 1998, this computer established a record as the world's fastest computer. New weapon simulations are already operating on this system. Based on ASCI's impressive results, I believe the 30-Teraop system is achievable by 2002 and I fully support a 100-Teraop system by 2004. To achieve the 2002 goal, it is imperative that the new Strategic Computing Complex at Los Alamos is built on schedule.
- Advanced Experimental Facilities—The Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility at Los Alamos is within weeks of producing its first electron beam. We expect that the first of its two x-ray systems will be operational by the end of June, with the second axis, intended to give stereo viewing and multiframe ("motion picture") capability, to be completed in 2002.
- Proton Radiography—At LANSCE, Los Alamos has developed and used multiframe radiography with protons to image weapons materials during high-explosive detonations. Protons provide some distinct advantages over x-rays, particularly for materials in high-explosives systems. This technology has already contributed to weapon certifications.

- Subcritical Experiments—In 1998, Los Alamos successfully executed two subcritical experiments, *Stagecoach* and *Cimarron*, in Nevada. These subcritical experiments are key to comparing Rocky Flats-built pits with Los Alamos-produced pits and provide valuable data on plutonium material characterization under weapons pressure that are used for weapon simulations, for manufacturing process qualification, and to provide information related to plutonium aging.
- Enhanced Surveillance—New diagnostics and predicative capabilities were created to gain insights into weapon materials characteristics and aging. For plutonium, new measurement techniques were invented for dynamic strength, elastic properties, compressibility, microstructural texture, and density. The first estimates of service lifetime of our high explosives were made with a complex chemistry model of our binder materials benchmarked by experiments.
- Pit Rebuild—In 1998, the TA-55 plutonium facility at Los Alamos produced the second W88 development pit. We continue our progress toward the current goal of the first war-reserve pit by 2001.
- Stockpile Support—The W76 Acorn, a component in the W76 warhead, was delivered on schedule to the Navy in October 1998 produced by a cooperative effort among the DP plants and laboratories.

Sustained Commitment

The Stockpile Stewardship Program is meeting its milestones, but critical needs remain. An essential factor in our ability to do this job is sustained support for the program from Congress. To plan effectively, our people must have confidence that resources will be provided to carry out plans. Part of the effectiveness of our nuclear deterrent is credibility—credibility in the resolve of our country to maintain a strong stewardship program and technical credibility demonstrated by mission successes such as DARHT, ASCI, and pit production. Also fundamental are the requirements for relevant theoretical, experimental, and engineering experience for our next generation of scientists and engineers; they must be able to detect problems, assess the consequences, and formulate solutions.

The technical challenges ahead merit further clarification. For example, we still attach a wide uncertainty range to estimates of the lifetime of a plutonium pit. Although considerable work has been initiated to understand pit aging, including extensive experiments and theoretical calculations, we are still several years away from having a definitive answer on pit lifetime or the

lifetime of high-explosives components. Steady progress is being made, and these centrally important answers will become available if we maintain momentum.

Our ability to certify our weapons is directly associated with the science and manufacturing technology missions of the Stockpile Stewardship Program. This program is starting to yield excellent results, and it has the promise of significant breakthroughs in several areas. Continued improvement in the infrastructure, capabilities, and personnel require the sustained support for the Stockpile Stewardship Program by the Department of Energy, the Department of Defense, and Congress.

Nuclear Threat Reduction

Russian Engagement for Nonproliferation

The potential leakage of Russian materials and technology for weapons of mass destruction remains a major concern. The DOE laboratories have contributed materially, and successfully, to the full spectrum of U.S. programs that are reducing this threat. These include

- nuclear weapons dismantlement assistance and weapons security enhancements;
- nuclear materials protection, control, and accounting;
- the purchase and blending down of 500 tons of highly enriched uranium;
- disposition of fissile materials, including the demonstration of plutonium pit dismantlement using the ARIES technique at TA-55;
- cooperation on export control;
- redirection of the activities of nuclear scientists into civilian programs; and
- development of economic opportunities in closed nuclear cities to facilitate downsizing of the Russian nuclear complex.

Because of the slower-than-expected pace of institutionalizing the nonproliferation programs in Russia, much work remains to be done. I support the expansion and extension of these key programs.

Analysis of Foreign Nuclear Weapons Capabilities

The Department of Energy and its field intelligence units at the national laboratories provide expert analysis of foreign nuclear weapons capabilities. Issues related to the India and Pakistan nuclear tests and the continued uncertain nature of Russian and Chinese nuclear weapons programs require such analysis. With the growing worldwide concern about prospects of more countries developing nuclear capabilities, there is much more that can and should be done in this

arena. The three nuclear defense laboratories have significant technological capabilities that can address these concerns.

Nonnuclear Defense R&D

Counterproliferation, Counterterrorism

Capabilities in the defense nuclear science sector have been used for many years to reduce threats to U.S. security from weapons of mass destruction. Because of the focus of this hearing, I have emphasized nuclear capabilities in my testimony; but Los Alamos, Sandia, and Livermore have served as resources in addressing threats from chemical and biological weapons as well. In addition, novel new threats to our information and physical infrastructures have emerged. Some of these threats to the United States and to international security may be mitigated by cooperative action among nations. Some threats that are resistant to feasible multilateral efforts can be constrained by the promise or use of U.S. conventional military force. But some threats require new technologies to enhance our ability to effectively address them.

We have developed technical programs at Los Alamos and the other DOE laboratories to contribute to U.S. efforts to deal with these new threats. Particular strengths at Los Alamos include advanced intelligence techniques, sensor development, weapons materials expertise, modeling and simulation, and complex systems engineering. Advanced remote sensor systems (often satellite-based) and new types of sensors can detect and characterize the development, production, and use of weapons and materials. Since potential adversaries are applying deception and denial techniques with ever-increasing effect, we need to identify new signatures and develop methods to detect them from considerable distances.

There are many research opportunities that could be pursued if the R&D budgets in these areas were commensurate with current challenges and opportunities.

Conventional Forces

As the Department of Defense looks ahead to its future capabilities through Joint Vision 2010, it has recognized that technologically superior equipment will continue to be critical to the success of our forces in combat.

The weapons laboratories are developing new scientific and technical capabilities that will support nuclear stockpile stewardship and will address the emerging nonnuclear defense requirements as well. Our particular strengths of interest to DoD include systems analysis;

expertise in developing sensors, detection systems, and advanced analysis and displays; electromagnetic systems and technologies; and advanced materials. Working from these strengths, and in consultation with DOE officials and DoD users, the laboratories have identified several important new R&D initiatives related to next-generation military needs.

We are considering ways in which these capabilities provided the innovations currently needed by the U.S. military, such as ballistic missile defense, alternatives for antipersonnel mines, improved modeling and simulation, and defeat of hard and deeply buried targets (HDBT). In the case of HDBT, the DP laboratories have developed an integrated program for hard and deeply buried target defeat. We believe that it, along with additional pilot programs that should be created, will serve as a model for closer DoD/DOE cooperation in the future. I support formalizing these joint efforts in mechanisms such as the DoD/DOE memorandum of understanding that allows the laboratories to perform R&D for DoD munitions programs.

State of the Laboratory

To sustain a high level of technical performance, a national laboratory must demonstrate operational excellence. As incoming Director, I made a number of commitments, including making substantial and visible progress on safety, the environment, construction project management, safeguards and security, counterintelligence, and community relations. I can report significant progress in these areas, but many challenges remain.

Operations

Safety and Environment

We began the introduction of Integrated Safety Management into our work in December 1996. We have significantly changed our basic management and work processes, from office operations to the handling of nuclear and explosive material. As a result, since the inception of ISM we have continually improved our safety performance. One measure, OSHA-reportable occurrences, has been reduced by a factor of two since ISM started, and we have made a commitment to realize an additional factor-of-two reduction.

We have made significant progress in meeting environmental goals. In water quality, we have achieved 98–99% compliance with our permit limits, reduced the number of permitted outfalls from 141 to 33, and reduced the wastewater discharge from our high-explosives facilities from 12 million gallons to 130 thousand gallons per year.

In air quality, during the last reporting year, the Laboratory's off-site concentration levels of tritium, uranium, plutonium, and americium were well below any applicable standards. On-site concentration levels did not exceed the Department of Energy's limits. The Laboratory has 53 monitoring stations that measure these particles.

We are working to reduce our waste and to improve our compliance in hazardous waste handling. We have achieved a rate of sanitary waste recycling that is now over 80%. Overall, our rate of waste minimization has risen to an 8% reduction per year.

The objectives for safety and the environment in the current management and operating contract between the DOE and the University of California contain stretch goals for the Laboratory. Our current rate of progress gives us a very good chance of achieving those goals as we pass the milestones established for the 3-1/2 remaining years of that contract.

Construction Project Management

Following my commitment to you last year, I formed a construction project management advisory panel that brought in independent outside experts, and I acted on their advice by following a sequence of steps. These steps included

- creating a Project Management Division and an Infrastructure Revitalization program office;
- signing a memorandum of understanding with DOE that spells out our joint commitment to improvements in project management;
- conducting regular and systematic management reviews of all construction projects according to accepted project-management practices;
- hiring trained, experienced project managers and engineers;
- strengthening our architect/engineering services; and
- improving structure, discipline, and formality in these activities.

Safeguards and Security

We have been upgrading our efforts in safeguards and security for the past year. In April of 1998, I created a new Security Division and hired a new Division Director with years of professional security experience in the Air Force. A greatly improved Site Safeguards and Security Plan was developed, approved by DOE, and published. As one of my goals for the Laboratory, I have established a Labwide goal of "Zero Safeguards and Security Violations," and strong sanctions are being taken by line managers for security infractions. Recent audits by DOE

indicate a number of areas that need improvement, and they have confirmed that the Lab is on an upward trajectory.

Counterintelligence

Recent attention has been focused on the need to improve the nation's system for protecting defense secrets. The three nuclear defense labs are working closely with the Department of Energy to make improvements in our protection systems.

At Los Alamos I have taken the following steps:

- Counterintelligence functions have been separated into an internal security office that reports directly to the Director's Office.
- A former FBI agent has been hired to head this office and is on board.
- I have had three discussions in our monthly all-managers meetings to emphasize the importance of improving our counterintelligence efforts.
- We are improving computer security by restricting public access to a separate and very small portion of our computer system (there has never been public access to our classified computer system).

More steps will be taken as we proceed with the system being developed in concert with DOE.

Community Relations

I have made a personal commitment to demonstrate to northern New Mexico communities that we will strive to be a good neighbor. We intentionally set a high standard for ourselves with challenging metrics on regional economic investment, involvement, and outreach. Although I am gratified by our midterm report card grade of "outstanding" from a recent DOE assessment, we know that the real test is continued excellence.

One particular highlight is the establishment of the Los Alamos National Laboratory Foundation. This foundation is a nonprofit organization that is raising money and distributing it to schools, social service agencies, student scholarships, and other worthy recipients. The surrounding communities now have a better chance to see the Laboratory in its role as corporate citizen and good neighbor.

Institutional Vitality

Sustained excellence in mission execution requires that the Laboratory continually reinvigorate itself with fresh ideas and new people provided with state-of-the-art facilities.

LDRD

Scientific institutions must have some resources that allow their researchers to pursue new innovative ideas that are too embryonic for programmatic focus. The ability to direct resources to such work is often the difference between institutional excellence and mediocrity. At the "Innovation Summit" held at the Massachusetts Institute of Technology last winter, sponsored by the Council on Competitiveness, CEOs from major corporations indicated that an investment of 12–20% of their total expenditures was needed for exploratory research of a sort similar to LDRD. This benchmark provides further evidence that the 6% allowed for LDRD is a minimal investment in the Laboratory's ability to provide the scientific and technical expertise the nation expects from us now and in the future.

I will provide just two examples from among dozens to show the value of LDRD to the Laboratory and its mission. In one current project, researchers are combining new chemical diagnostic methods with modeling and experiments to predict high-explosives response with great accuracy. In another project, researchers are developing tools for modeling, simulation, and analysis of new x-ray radiography sources; these techniques will enable high-resolution, 3D multiframe imaging in hydrodynamic tests during implosion.

LDRD projects also often lead to important practical applications. In the past three years, 8 out of the 12 of the R&D 100 awards received by the Lab have had roots in LDRD projects.

The LDRD program has created powerful scientific and technological capabilities for our mission and is a major reason the DOE laboratories have remained technically strong while other government labs have declined in excellence. At the current level of funding, existing review mechanisms are adequate, and further oversight and constraints will undercut the purpose of LDRD. I ask for your support in sustaining present program levels and in resisting further limitations.

Staffing

LDRD and nondefense programs across the spectrum of recognized scientific disciplines remain an important vehicle for attracting new talent to the Laboratory. Without such programs and sufficient flexibility to use them effectively, we would be hard-pressed to retain our base of scientific skills and the vitality of a changing, creative staff. I am very appreciative of Congressional support for these programs.

The Chiles Commission report, due in March, will highlight the need to improve the conditions that will attract the high-level talent needed for the Stockpile Stewardship Program. I hope that the Congress will give it special attention.

Infrastructure

Core areas of the Laboratory have many buildings and other facilities that are over 40 years old. Most of these structures cannot be upgraded cost-effectively for safety and mission needs. About a dozen of the buildings in the central Lab area are classified as high seismic hazards and would not be occupiable under current building codes.

As the Laboratory moves to address the post-Cold War national security agenda, we need to modernize our infrastructure. Required new facilities include the Strategic Computing Complex to house the 30-Teraop and successor ASCI supercomputers and the weapons design division.

Another urgently needed new facility is the Nonproliferation and International Security Center (NISC), where we will centralize threat-reduction staff and research programs. A request to initiate the construction of NISC is included in the DOE's Nonproliferation and Verification Research and Development budget request for FY 2000, but the total funding in this account was not increased from the FY 1999 level; thus, funds available for operations will be correspondingly lower. This should be remedied; otherwise, research would decline in an increasingly important area of national security.

These proposed new buildings are part of an integrated long-range plan to rebuild the Lab's core technical area. With Congressional help, means must be found to fund these critical capital improvements while maintaining necessary operational budgets. I ask for your support for the investments necessary to revitalize our facilities.

Concluding Remarks

The challenge we face at the nuclear weapons laboratories is significant, but so is the progress.

- One year ago, we faced understandable skepticism about ASCI; but we have now broken the world's record at a sustained speed of 1.6 Teraops, and we have over 6,000 processors configured in parallel working on weapon simulations.
- One year ago, DARHT faced significant criticism; as of today, we have almost completed construction of the first axis and will run experiments this summer.
- One year ago, our ARIES process for dismantling plutonium pits was still being developed; now we are up and running, dismantling two to three pits per week.
- One year ago, people questioned our ability to recruit top people in the post-Cold War period; now we have as my principal deputy a Harvard professor who is the former Chair of JASON and member of the National Academy of Sciences (NAS). The new leader of our

Weapons Design Division is a professor from Rice University and a Fellow of the American Physical Society with nuclear weapons experience. A distinguished professor from the University of Illinois Astronomy Department, also a member of the NAS, has joined the weapons design division.

- Five years ago, we had suffered a loss of over 1,000 employees because of budget cuts; now we have recruited almost 500 new employees to bring new talent into our programs, largely in the nuclear weapons area.
- Five years ago, our safety record showed negative trends; now our data on injuries and illness show significant and steady improvement, with rates at half the level of the preceding years.

I think these examples show that our stockpile stewardship program is on the right track, although most of the task remains ahead. With your continued support, we will show steady progress in accomplishing our mission. We look forward to working with the Congress and the Department to be fully successful.