Statement for the Record
C. Paul Robinson, Director
Sandia National Laboratories

United States Senate
Committee on Armed Services
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INTRODUCTION

Mr. Chairman and distinguished members of the committee, thank you for the opportunity to submit this statement. I am Paul Robinson, director of Sandia National Laboratories. Sandia is managed and operated for the National Nuclear Security Administration (NNSA) of the U.S. Department of Energy (DOE) by Sandia Corporation, a subsidiary of the Lockheed Martin Corporation.

Sandia National Laboratories is one of the three NNSA laboratories with research and development responsibility for nuclear weapons. Sandia's job is the design, development, qualification, and certification of nearly all of the non-nuclear subsystems of nuclear warheads. Our responsibilities include arming, fuzing, and firing systems; safety, security, and use-control systems; engineering support for production and dismantlement of nuclear weapons; field support to the military; and surveillance and support of weapons in stockpile. We perform substantial work in programs closely related to nuclear weapons, including intelligence, nonproliferation, and treaty verification technologies. As a multiprogram national laboratory, Sandia also conducts research and development for DOE's energy and science offices, as well as work for other national security agencies when our special capabilities can make significant contributions.

I will begin my statement by reviewing highlights of Sandia's recent accomplishments in the nuclear weapons program and other national security programs, including Sandia's contributions to homeland security and the war on terrorism. I will then discuss issues of concern to Sandia in fiscal year 2003 and address in detail Sandia's responsibilities in NNSA's stockpile stewardship and nonproliferation missions. Before concluding, I will comment on the NNSA Administrator's governance initiative for improving the NNSA-contractor relationship.

HIGHLIGHTS OF RECENT SANDIA ACCOMPLISHMENTS

The NNSA laboratories accomplished much during fiscal year 2001. The investment the nation makes in these unique institutions yields valuable results for national security.

At Sandia National Laboratories, we perform our scientific and engineering work with the mission in mind—never solely for its own sake. Even the fundamental scientific work that we do (and we do a great deal of it) is strategic for our mission needs. Sandia's management philosophy has always stressed the ultimate linkage of research to application.

We sometimes hear the phrase "science-based engineering" to describe our approach, but this term is really a solecism: Engineering is inherently scientific and cannot be

practiced with excellence unless it is deeply integrated with its supporting sciences and employs scientific methodology. When someone refers to Sandia as "the nation's premier engineering laboratory," that statement does not tell the whole story: We are a science and engineering laboratory with a focus on developing technical solutions to the most challenging problems that threaten peace and freedom.

Sandia's unique philosophy of research and development—which derives from its heritage of fifty years under industrial management—yields significant results for its sponsors. I will briefly highlight some of the outstanding achievements from our work portfolio of fiscal year 2001 in the areas of nuclear weapon activities, nuclear nonproliferation, and homeland security and combating terrorism.

Salient Accomplishments in Weapons Activities

Sandia completed work to qualify the B61-11 earth-penetrating bomb as meeting all requirements, resulting in its acceptance as a standard stockpile item. We made alterations to enhance the safety and security of all B61 bombs at field locations. In recognizing the efforts of the B61-11 certification team, the Commander-in-Chief of Strategic Command cited the weapon's many advantages over the retired B53-1 bomb.

Similarly, we concluded a three-year testing and evaluation program resulting in acceptance of the Alt. 342 W87 Life Extension Program warhead for the Air Force by the Nuclear Weapons Council as a standard stockpile item.

A significant milestone in directed stockpile work in fiscal year 2001 was our progress in redesigning the integrated arming, fuzing, and firing system (AF&F) for the W76 warhead for the Trident missile. We recently completed the redesign of a Joint Test Assembly for the W76, which will be used to periodically assess the conformance of the de-nuclearized version of the actual war-reserve warhead.

Sandia played a major role on the NNSA's B83 Systems Engineering Group, which completed development of Alt. 355 for the B83 modern strategic bomb. Alt. 355 is a near-term field retrofit kit that incorporates design modifications to certain hardware.

We completed the Warhead Simulator Package for the Type 3E Trainer for the B61-4 bomb. The Warhead Simulator Package simulates the electrical functionality of the real war-reserve weapon. The new trainer allows military personnel to realistically practice lock/unlock and arming/safing operations without exposing a real nuclear weapon to vulnerabilities. The first production unit of the trainer has been delivered.

Sandia has major responsibility in nuclear weapon use-control systems, which are designed to allow arming of the warhead by national command authority only. We completed a four-year, full-scale, code management system engineering project, which delivers a significant security enhancement to weapon code operations in Europe. The system enables recoding of nuclear weapons in a fully encrypted manner and greatly simplifies use and logistics.

We have also achieved many important advances in the science and engineering campaigns that enable our successes in directed stockpile work, including radiation-hardened microelectronics, aboveground experimental physics, and advanced simulation and computation.

Accomplishments in Nuclear Nonproliferation

Preventing the proliferation of nuclear materials or weapons to dangerous regimes or terror groups has become a matter of great urgency. NNSA's role in nonproliferation is acknowledged in its mission statement: "To strengthen United States security through the military application of nuclear energy and by reducing the global threat from terrorism and weapons of mass destruction." Sandia's recent contributions have strengthened this effort.

As nuclear fuel reprocessing is adopted by more nations, the proliferation risk associated with fissile materials increases. To evaluate the risk, Sandia developed a proliferation analysis methodology for quantifying the proliferation resistance of nuclear power production fuel cycles. The methodology uses the tools of probabilistic risk assessment to identify proliferation pathways for various definitions of proliferators.

NNSA's "Second Line of Defense" (SLD) program for the security of fissile materials provides consultation to customs agencies to combat trafficking of nuclear material across international borders. In 2001 we assisted twenty-six site surveys performed at Russian airports, seaports, railroad checkpoints, and border crossings to evaluate strategies for minimizing the risk of nuclear proliferation and terrorism. These site surveys included the deployment and acceptance of systems installed at eight Russian Federation State Customs Committee facilities to detect and deter illicit movements of nuclear materials out of Russia. The program has been successful and is growing to include other countries.

Also with Russia, after four years of negotiation and collaboration with the All Russian Institute of Experimental Physics (VNIIEF), we kicked off a joint facility-to-facility remote monitoring project in June 2001. The project will evaluate advanced fissile material monitoring and communications technologies in a bilateral verification regime.

Sandia is responsible for satellite-based sensors for detecting nuclear detonations in the atmosphere. We developed a new space-to-ground communication path for monitoring Nuclear Detection System sensors onboard the Department of Defense Global Positioning System (GPS) satellites. The launch of a GPS satellite equipped with the Nuclear Detonation Detection System Analysis Package in January 2001 significantly enhanced the nation's ability to detect nuclear detonations occurring anywhere in the earth's atmosphere.

Contributions to Homeland Security and the War Against Terrorism

Like most Americans, the people of Sandia National Laboratories responded to the atrocities of September 11, 2001, with newfound resolve on both a personal and professional level. As a result of our own strategic planning and the foresight of many sponsors to invest resources toward emerging threats, Sandia was in a position to immediately address some urgent needs.

For example, by September 15, a small Sandia team had instrumented the K-9 rescue units at the World Trade Center site to allow the dogs to enter spaces inaccessible to humans while transmitting live video and audio to their handlers. This relatively low-tech but timely adaptation was possible because of previous work we had done for the National Institute of Justice on instrumenting K-9 units for SWAT situations.

You may not be aware that a decontamination formulation developed by Sandia chemists was one of the processes used to help eliminate anthrax in the Hart, Dirksen, and Ford buildings on Capitol Hill, and at contaminated sites in New York and in the Postal Service.

Sandia developed the non-toxic formulation as a foam and licensed it for industrial production.

Sandia engineers worked around-the-clock to modify the "Steel Eagle," air-dropped, unattended ground sensor for deployment in Afghanistan. Originally designed under sponsorship of the Defense Intelligence Agency in the 1990s to identify mobile missile launchers, we modified the system to detect light trucks and armored vehicles. The sensors can be deployed from F-15E, F-16, and Predator unmanned aircraft.

Speaking of the Predator, this unmanned aerial vehicle has gained recognition for its ability to capture and transmit in real time high-quality radar images of terrain, structures, and moving vehicles through clouds and in day or night conditions. You may perhaps not be aware that the advanced synthetic aperture radar (SAR) capability on the Predator was substantially developed by Sandia National Laboratories. We began working on miniature radars based on synthetic aperture concepts in 1983 in the nuclear weapons program. In 1985 we became involved in a special-access program for the Department of Defense (DoD) to develop a one-foot-resolution, real-time SAR suitable for use in unmanned aircraft. Sandia flew the first real-time, one-foot-resolution, SAR prototype in 1990. Follow-on work sponsored by DoD continued to improve the system, and a partnership with an industrial firm, which shared program costs, transitioned the technology into the field-deployable systems used in Afghanistan.

In addition to our contributions to the military toolbox for counter-terrorism, Sandia has responded to urgent needs in the arena of homeland security. An array of devices invented by explosives experts at Sandia have proved to be effective for safely disarming several types of terrorist bombs. For the past several years, our experts have conducted training for police bomb squads around the country in the techniques for using these devices for safe bomb disablement. The shoe bombs that Richard Reid allegedly tried to detonate onboard a trans-Atlantic flight from Paris to Miami were surgically disabled with an advanced bomb-squad tool originally developed at Sandia. That device, which we licensed to industry, has become the primary tool used by bomb squads nationwide to remotely disable handmade terrorist bombs while preserving them for forensic analysis.

Detecting explosives in vehicles is a major concern at airports, military bases, government facilities, and border crossings. We have developed and successfully tested a prototype vehicle portal that detects minute amounts of common explosives. The system uses a Sandia-patented sample collection and preconcentrator technology that had previously been licensed to industry for use in screening airline passengers for trace amounts of explosives. The Technical Support Working Group and DOE's Office of Safeguards and Security funded this research.

Sandia is a partner with Argonne National Laboratory in the PROTECT program (Program for Response Options and Technology Enhancements for Chemical/Biological Terrorism), jointly funded by DOE and the Department of Justice. PROTECT's goal is to demonstrate systems to protect against chemical attacks in public facilities, such as subways and airports. For more than a year, a Sandia-designed chemical detector test bed has been operating in the Washington D.C. Metro. The system can rapidly detect the presence of a chemical agent and transmit readings to an emergency management information system. We successfully completed a demonstration of the PROTECT system at a single station on the Washington Metro. The program has since been funded to accelerate deployment in multiple metro stations. DOE has also been requested to implement a PROTECT system for the Metropolitan Boston Transit Authority.

Another major worry for homeland security is the potential for acts of sabotage against municipal water supplies. In cooperation with the American Water Works Association Research Foundation and the Environmental Protection Agency, Sandia developed a security risk assessment methodology for city water utilities. This tool has been employed to evaluate security and mitigate risks at several large water utilities. We have used similar methodologies to evaluate risks for other critical infrastructures such as nuclear power-generation plants and chemical storage sites.

These and other contributions to homeland security and the war against terror are possible because of early investment in the capabilities that were needed to respond to emerging threats. The outstanding technology base supported by NNSA for its core missions is the primary source of this capability. We also made strategic decisions to invest laboratory-directed research and development funds (LDRD) in the very things that we knew were urgent needs: items to the Afghanistan theater, the decontamination foam, the sensors we have deployed, and special-purpose robotics that we have developed. In addition, requests for Sandia services from federal agencies other than DOE for work in emerging areas of need have increased. Approximately twenty-eight percent of our total laboratory operating budget is provided by federal agencies other than DOE.

BUDGET-RELATED ISSUES OF CONCERN

Sandia National Laboratories is very busy with work for its core mission responsibilities in nuclear weapon stockpile stewardship. We have a substantial workload of life extension programs for stockpiled systems that requires refurbishment or complete re-design of electronic subsystems and other components. In addition, the responsibility for stockpile certification as weapons age is an ongoing challenge that engages our science and engineering campaigns.

Significant changes will be required to weapon systems that are scheduled to remain in the deployed stockpile or responsive force for decades. This workload is not materially affected by the recent Nuclear Posture Review. Life extension activities require substantial resources of people and facilities. In addition, several studies[1] have repeatedly shown that the infrastructure of the nuclear weapons complex has eroded significantly and needs refurbishment. These and other requirements will demand their share of resources from a program that I described last year as “wound too tight.”

In an effort to relax this tension, the Defense Programs laboratories worked closely with NNSA during the last several months to create a multi-year plan to prioritize and integrate programmatic needs within a defensible appropriations profile. The funding levels of the multi-year estimates in that plan reflect our consensus estimate of resource requirements under the guidance provided by Presidential directives, DoD requirements, and the recent Nuclear Posture Review. The plan is a significant milestone inasmuch as NNSA has for the first time outlined a multi-year planning basis agreement with the Administration. With careful management, we believe that NNSA’s major deliverables can be completed within the Future-Years National Security Plan schedule and budget profile.

The fiscal year 2003 budget request is generally consistent with NNSA’s Future-Years National Security Plan, and it should provide adequate resources for Sandia National Laboratories to meet its mission obligations as currently defined. Four issues of concern to Sandia that I would like to bring to your attention are: the Microsystems and Engineering Sciences Application (MESA) Complex; the refurbishment of NNSA’s Z Accelerator; a joint

Air Force/NNSA initiative in advanced physical security research and development for nuclear weapons; and the problem of cyber security against sophisticated network attacks.

Microsystems and Engineering Sciences Application (MESA) Complex

Sandia's Microsystems and Engineering Sciences Applications (MESA) complex is the cornerstone of our initiative to address the need for microelectronics and integrated microsystems to support a certifiable stockpile for the future.

Microelectronic components are critical to the NNSA Defense Programs mission. Several key components in deployed nuclear weapons will need to be replaced within the decade. In most cases, components cannot be replaced with replicas of the originals because they are technologically obsolete and the supplier base, materials, and design tools to support them no longer exist. Moreover, competent designers would not elect to use decades-old electronic technology, even if it were available. Sandia has little choice but to meet component replacement needs using the latest microsystem technologies.

In addition, Sandia has a requirement to preserve critical competencies in radiation-hardened microelectronics for defense and space hardware. In accordance with the Congressional mandate for a national defense electronics partnership,[2] Sandia retains the capability for radiation-hardening technology and sustains a supporting infrastructure for developing and producing radiation-hardened microelectronics. MESA will provide the infrastructure to meet that mandate for future decades.

I am pleased to report that the preliminary engineering design (Title I engineering) of the MESA complex has been completed and that final engineering design (Title II engineering) is well underway. We are working hard to bring this facility into operation on a schedule that would allow it to contribute to the scheduled stockpile refurbishment programs approved by the Nuclear Weapons Council and supported by thee Department of Defense, but it is not yet clear whether that will be possible.

Z Accelerator Refurbishment

NNSA's Z Accelerator at Sandia National Laboratories has proved to be an important and unique asset for the stockpile stewardship program. Still the world's most powerful and energetic source of x-rays,[3] Z supports NNSA campaigns in nuclear weapon primaries and secondaries, dynamic materials, nuclear survivability, and inertial confinement fusion. Moreover, the recent demonstration of short-pulse, high-power[4] lasers and the installation of the Z-Beamlet laser at Sandia has created the opportunity to cost-effectively explore new mission applications, including advanced radiography of laboratory experiments for stockpile stewardship, the fast ignition inertial confinement fusion concept, and the science of materials under extreme conditions.

Pending the completion of the National Ignition Facility, Z will continue for many years to be the most capable U.S. facility for producing the high-energy-density environments required for studying the phenomenology of nuclear explosives. A refurbishment project to replace aging components and increase the capability of Z by over fifty percent was initiated with an appropriation of $10 million in fiscal year 2002. Those incremental funds allowed us to address a backlog of experimental requests in this current operating year.

Physical Security Research and Development

For the past three decades, Sandia National Laboratories has made unique contributions to both the Department of Energy and the Department of Defense for the security of nuclear weapons. Currently, both NNSA and the Air Force have designated Sandia as their weapon security systems engineer.[5] Sandia is assisting the NNSA's Defense Nuclear Security Office in assessing and engineering security systems so that there is consistency in the approach used for security across all NNSA facilities.

Both NNSA and USAF maintain high security for the nuclear weapons, materials, or facilities under their control, and they have steadily improved security during the past two decades. I am confident that the recent allegations that security may be lax at NNSA nuclear weapon facilities are incorrect. However, we must not be satisfied with the status quo. NNSA and DoD are responding to the increased terrorist threat by examining how security systems can be significantly enhanced with new technology. Numerous upgrades at Air Force nuclear weapon sites are under consideration. Unfortunately, those upgrades may be forced to employ older technology that is actually more expensive and offers less capability. Just as new technology has revolutionized war-fighting, so it offers an opportunity for a similar revolution in security systems.

Past investments by DOE in Sandia's security systems research and development program have yielded crucial technology for the protection of DOE and DoD nuclear assets. In recent years, Sandia's extensive security expertise has been widely sought by other federal agencies and public entities, including, for example, the Secret Service, the Department of Defense, state and federal prison systems, Dade County in Florida, many public school systems, the National Institute of Justice (in support of local law enforcement), and the 2002 Winter Olympic Games.

A robust program of security research and development can adapt new technological capabilities for security applications. We have proposed a joint Air Force/NNSA research and development program in nuclear weapon security technology, to be established under the leadership of Sandia National Laboratories. Such a program will result in greater protection for our nuclear weapons and, ultimately, reduced security operational costs. We anticipate joint annual funding by the Air Force and NNSA to raise the existing programmatic effort at Sandia to the level required for this initiative.

Cyber Security

During the past several years, Sandia has experienced an increase in the level, intensity, and sophistication of network attacks directed against our computer resources. We have significant concerns about the ability of any cyber security system to withstand the very sophisticated attacks that are emerging. These developments cause us to worry that the sophistication of these threats are growing at a faster rate than we are able to respond in hardening our systems against intrusions. This remains one of my most critical concerns.

WEAPONS ACTIVITIES

At Sandia, weapons activities include directed stockpile work, campaigns to advance the scientific and engineering capabilities required for weapons qualification and certification, and readiness programs for NNSA's technology base, facilities, and infrastructure.

Impact of the Nuclear Policy Review

The Secretary of Defense released the Nuclear Posture Review (NPR) in January. It was conducted in response to a Congressional request to lay out the direction for American nuclear forces for the next ten years. The full implications of the NPR will not be known until the final configuration and schedule for the nation's nuclear arsenal is worked out. However, the NPR calls for sustaining a responsive nuclear force and maintaining a robust and responsive nuclear weapons infrastructure for the long term. It is clear that any savings that may result from the NPR will not be realized for many years.

The NPR calls for reducing operationally deployed nuclear weapons to between 1,700 and 2,200 warheads over the next decade. Most warheads that will be removed from the operationally deployed stockpile will be maintained as a "responsive force" in case of a major change in the global security environment. The intent is to maintain the warheads of the responsive force in a condition that would permit them to be redeployed in a matter of weeks or months. Consequently, warheads in the responsive force will require a level of maintenance and surveillance not substantially different from that required for deployed systems. Their limited-life components will need periodic replacement, and their electronic subsystems will have to be upgraded so as not to become obsolete with the passage of time.

Thus, the warheads of the responsive force will require life extension activities similar to what they would receive if they were in the active stockpile. Only one warhead, the W62, is proposed to be retired. The NPR calls for retiring the Peacekeeper (MX) inter-continental ballistic missile, but the relatively modern W87 warhead on that system will be retained as a replacement for the aging W62 on the Minuteman III. The B61 and B83 bombs also will be retained and may require modifications.

The NPR also calls for NNSA to improve its test readiness program for contingent resumption of underground nuclear testing. Adhering to the test moratorium continues to be U.S. policy, but should a need to test arise, the current preparation time of two to three years is considered unacceptable.

In summary, I do not expect the Nuclear Posture Review to materially impact the workload of Sandia National Laboratories in stockpile stewardship in next several years.

Directed Stockpile Work

Directed Stockpile Work encompasses all activities that directly support specific weapons in the nuclear stockpile. Those activities include current maintenance and day-to-day care as well as planned refurbishments. This work includes research, development, engineering, and qualification activities in direct support of each weapon type both in the present and future. Directed Stockpile Work maintains a balanced effort of near-term weapon activities and long-term research and development supported by campaigns.

Stockpile Research and Development

Stockpile Research and Development includes the engineering development and exploratory research and development to support near and long-term requirements of the nuclear weapons stockpile. This activity includes development of new weapon designs when needed and authorized, preproduction design and engineering activities, design and development of weapon modifications, and safety studies and assessments.

Specific focal areas anticipated for the next two fiscal years include support for system studies, mutual defense agreements, and U.S./foreign weapon cooperative safety exchanges; development of specified components and subsystems; improved engineering business practices and information systems; modernized flight test assemblies and instrumentation; refurbishment of several enduring stockpile systems; and continued vigilance through exploration of future system concepts.

Engineering Development

The bulk of the engineering development planned in stockpile research and development will support life-extension refurbishments. The objective of the stockpile life extension effort is to improve and extend the safety and reliability of U.S. nuclear weapons twenty to thirty years by upgrading or replacing components and subsystems rather than entire warheads. Sandia has been identified by NNSA to be the systems integrator for refurbishments.

Two refurbishment programs are in the engineering development phase: the W76/ Mark 4 (Trident), with a first production date of fiscal year 2007; and the W80 warhead for Air Force and Navy cruise missiles, with scheduled first production in 2006. We are also engaged in a study of technical feasibility and cost for possible refurbishment of the B61 strategic bomb, with first production in fiscal year 2004. These refurbishments will replace critical components to ensure decades of life extension.

Exploratory Research and Development

Sandia's advanced warhead concepts group participates with similar teams at the other Defense Programs laboratories and NNSA headquarters to assess nuclear weapon modernization options for emerging military requirements under the advanced concepts initiative headed by NNSA. DoD and NNSA jointly review requirements and identify opportunities for further study.

Stockpile Maintenance

Sandia's responsibilities in stockpile maintenance include design and production of certain components for system life extension programs, limited-life component exchange and repairs, as well as other engineering activities that directly support maintenance of nuclear warheads in the stockpile. For each weapon in the inventory, we must understand and resolve defects (called "significant findings"), maintain use-control equipment, and replace hardware consumed by the surveillance function. During calendar year 2001 we completed and closed eighteen significant finding investigations. Because the service lives of many nuclear weapons have been extended well beyond their original intent, we are exhausting the supply of surveillance units available for flight testing. More flight test units must be produced, but the instrumentation to measure performance in joint flight tests with DoD must be redesigned using electronics technology available today.

We have finished a complete redesign of the W76 joint flight vehicle and are currently working on redesigns of the W78 and W87 joint flight vehicles. In addition to these complete redesigns, we have added functionality to the B61 joint flight vehicle by developing and incorporating spin sensors. We are now in the process of incorporating this technology in the B83 joint flight vehicle.

Neutron Generator Production

Sandia has the production mission for neutron generators, an essential component of U.S. nuclear warheads. Sandia manages two pieces within its total production mission: (1) neutron generator production, including both the recertification of neutron generators from the field that have remaining service life and the new neutron generator build; and (2) the Concurrent Design and Engineering (CDM) production assignment. As neutron generator production ramps up and the CDM program grows to support the W76 and W80 life extension programs, production operating funds will require an increase over fiscal year 2002 of approximately $45 million by fiscal year 2005. Estimates are still being generated as the refurbishment programs continue to define the CDM components they will need.

Stockpile Evaluation

Stockpile evaluation includes laboratory tests, flight tests, quality evaluations, special testing, and surveillance of weapon systems to assess the safety and reliability of the nuclear weapon stockpile as a basis for the annual certification to the President.

Surveillance testing frequently results in recommendations for repairs and upgrades to the stockpile. Last year, following Sandia procedures, DoD replaced limited-life components in several weapon systems to add what we believe will be significant periods of maintenance-free service while the weapons are in DoD custody.

I am happy to report that we have completed Title 1 (design) of the new Weapons Test Evaluation Laboratory construction project that Congress funded as a line item two years ago. This state-of-the-art facility will replace our forty-year-old building at the NNSA weapons facility near Amarillo, Texas. Completion is scheduled for Fall 2004. We are developing advanced diagnostic tools to update existing test equipment, and we hope to incorporate other enhancements from the Enhanced Surveillance Program. Our goal is to move the surveillance program toward a predictive capability that will allow us to replace components in our aging stockpile before they affect reliability.

DoD and DOE annually conduct joint flight tests on weapons of each weapon type in the enduring stockpile. Historically, flight tests have uncovered about 22 percent of the defects in surveillance databases. After a hiatus in Air Force cruise missile testing due to missile problems and infrastructure renewal, I am happy to report that we have begun flight testing again with two successful air-launched cruise missile tests, although it will take us several years to catch up with our desired level of testing. As we work with the Air Force on flight testing for existing warheads and determine their future needs for an upgraded system, we are desperately short of Air Force test hardware for the air-launched cruise missile. We face a near-term problem of having limited opportunities for both flight testing of existing systems as well as proving the interfaces necessary to field our proposed life extension program for the W80 warhead.

To help compensate for shortfalls in flight tests and a dramatic reduction in the number and variety of reentry vehicles that can be flown if the W87 is deployed on Minuteman III, on-board instruments must be improved to provide additional performance information in fewer tests. This past year, we successfully flight-tested an enhanced-fidelity instrumentation package in the W87 reentry vehicle.

The Tonopah Test Range, which Sandia operates under agreement with the Air Force, is absolutely irreplaceable as a flight-test site for air-delivered bomb systems. Without it, we could not continue to assess and certify systems nor perform research and development

on new delivery systems. I urge continued Congressional support for joint use of the Tonopah Test Range and the proper level of funding support for range infrastructure to ensure its viability.

I would like to address the two reports issued by the DOE Inspector General this past year on the surveillance program—one on the testing backlog for flight and laboratory tests, and the other on the significant findings investigation process. While I do not believe that the situation is as dire as the headlines might have suggested, there was action necessary on the part of NNSA and the laboratories to improve performance. I assure you that we at Sandia are taking this matter very seriously. We are working with the Navy and Air Force to ensure the availability of samples and flight-test vehicles to eliminate the identified backlogs. As you might expect, as a result of the tragedy of last September and the focus on prosecuting the war, this may take longer than any of us might desire, but I can assure you that we have everyone's complete cooperation. The laboratories fully support the actions being directed by NNSA in response to the IG's reports, and I believe that future reviews in this area will show improvement.

The surveillance program is the foundation for maintaining the aging stockpile. We believe that the surveillance program should maintain an adequate number of flight tests each year using military personnel, procedures, and hardware. Therefore, I urge you to assure an appropriate level of support for the joint surveillance flight test program, for both NNSA and the DoD, to sustain confidence in the reliability of our strategic nuclear deterrent.

Campaigns

Campaigns are multifunctional efforts across the NNSA Defense Programs laboratories, the production plants, and the Nevada Test Site that, in aggregate, constitute an integrated weapons science and technology program for developing critical capabilities for weapons qualification and certification. The goal of the NNSA Defense Programs campaigns is to address current or future capability needs by employing the best scientists and engineers and using the most current scientific knowledge and technologies. Many of the campaigns are interrelated and establish a foundation for future deliverables in directed stockpile work. Without a robust campaign program, our ability to support stockpile stewardship would be seriously harmed.

Engineering Campaigns

NNSA's engineering campaigns strengthen the science and engineering competencies that directly support mission responsibilities in enhanced surety (comprising safety, use-control, and reliability), annual weapons system certification, nuclear survivability for nuclear weapons and other military systems, enhanced surveillance of the nuclear weapons stockpile, and advanced design and production technologies to support system life-extension programs.

Enhanced Surety

This campaign provides the most modern surety possible for nuclear weapons during replacement, refurbishment, and upgrades of weapon components. Specifically, this campaign is developing surety options and technologies for the B61, W76, and W80 weapon life-extension programs. It is also developing new surety assessment methodologies and

supporting the integration of microsystem components into surety components, subsystems, and architectures.

Weapon System Engineering Certification

This campaign develops validated computational models and a suite of tools to support certification of the B61, W76, and W80 life extension programs.

Nuclear Survivability

Nuclear weapons must be able to survive and function in severe environments. Radiation produces thermal and mechanical stresses that may impact the reliability of weapon components. Although large fluxes of radiation would result from hostile attacks, disruptive levels of radiation are also present in natural environments, such as space. Also, periodic weapon diagnostics and exposure to radioactive decay from the nuclear explosive package can produce lower radiation levels of longer duration. Radiation can deform, spall, or degrade materials; change the conductivity of electronic components; generate and transmit shocks in materials; and release trapped gases. Microelectronic components are especially vulnerable to these effects.

This campaign develops microelectronic technologies and certification tools to ensure that refurbished stockpile weapon components satisfy their radiation survivability requirements as defined in each weapon's stockpile-to-target sequence. These capabilities are being developed for immediate application to the W76 life extension program, which is critically dependent on their timely development and validation.

Sandia operates a number of test facilities that provide intense x-ray, gamma-ray, neutron, electron, and mechanical environments to support the qualification of weapon systems and components and to validate simulation codes.

Our goals for the next several years include demonstrating the maturity of next-generation, radiation-hardened microelectronics by designing and fabricating test devices and circuits and characterizing their performance in radiation environments. We will also conduct experiments to validate mechanical response models, mature our understanding of radiation-induced damage mechanisms in semiconductor materials, improve our diagnostic capabilities to support material characterizations, and investigate radiation hardening phenomena in microelectromechanical systems.

Enhanced Surveillance

The Enhanced Surveillance campaign develops tools, techniques, and models to measure, qualify, calculate, and predict the effects of aging on weapon materials and components and to understand how those effects impact weapon safety and reliability.

One enhanced surveillance project uncovered unexpected behavior in desiccants designed to maintain a non-corrosive internal weapon atmosphere. Our new understanding of desiccant behavior is guiding the formulation of new desiccants for weapons refurbished under stockpile life extension programs. Another project discovered problems with newly procured material for replacement o-rings. The problems with the incoming material were assessed, and a negative impact on the stockpile was averted.

In the future, enhanced surveillance techniques will strengthen the credibility of the deterrent by warning of manufacturing and aging defects in time to schedule weapon refurbishments before performance is impaired.

Advanced Design and Production Technologies

The Advanced Design and Production Technologies (ADAPT) campaign provides technology maturation and integration of modern product realization tools and methods across NNSA's product realization enterprise, including laboratories and plants.

Science Campaigns

NNSA's science campaigns advance our understanding of the physical principles of nuclear explosive systems and support weapons system certification activities.

Dynamic Materials Properties

The Dynamic Materials Properties campaign develops physics-based, experimentally validated data and models of all stockpile materials under a broad range of dynamic conditions found in nuclear explosions.

Primary Certification

The Primary Certification campaign includes experimental activities to develop the capability to certify rebuilt and aged primaries to within a stated yield without nuclear testing. Sandia's efforts in this area focus on the development and implementation of advanced compact flash radiographic sources for use on subcritical experiments.

Secondary Certification and Nuclear Systems Margins

The Secondary Certification and Nuclear Systems Margins campaign includes experimental and computational activities that will determine the minimum essential factors for producing an effective weapon.

Sandia's contribution is to support the development of computational models to predict the performance of nominal, aged, and rebuilt secondaries and perform collaborative experiments with the other NNSA laboratories in radiation case dynamics, radiation flow, and secondary performance.

Advanced Simulation and Computing Campaign

To achieve simulations with sufficient complexity and fidelity to support stockpile stewardship, NNSA must increase computational capability and capacity tremendously. The Advanced Simulation and Computing (ASC) campaign will hasten advances in computational science to enable the shift from test-based methods to computation-based methods.

ASC activities at Sandia consist of code development for stockpile applications; problem solving environments; maintenance of sufficient on-site computational, networking, and communication capabilities; and partnering alliances with university and industry researchers. We are working on new mathematical methods, algorithms, and software for solving large-scale problems on massively parallel, often distributed systems. Areas of importance include mechanical and thermal response of weapons, shock physics, chemically reacting flows, electromagnetics, and the computational analysis and design of materials. As these techniques are developed, they are incorporated into codes relevant to stockpile applications. ASC simulation tools are being used to support design and certification activities for the W80 and W76 life extension programs.

Inertial Confinement Fusion Ignition and High Yield Campaign

This campaign includes activities to support ignition implosions on the National Ignition Facility and to enhance experimental capabilities for stockpile stewardship on Sandia's pulsed power facilities. A fusion yield of 200 to 1,000 megajoules in the laboratory is a long-term goal. We are providing intense x-ray sources for weapon physics and weapon effects testing, evaluating high-yield inertial confinement fusion concepts in the laboratory using z-pinches, and developing sophisticated diagnostics for the National Ignition Facility and Z Accelerator to support stockpile stewardship.

Readiness in Technical Base and Facilities (RTBF)

Readiness in Technical Base and Facilities provides physical infrastructure and operational readiness at the laboratories, the Nevada Test Site, production sites, and other NNSA sites where the scientific, technical, and manufacturing activities for stockpile stewardship are conducted.

Operation of Facilities

Operation of facilities includes NNSA Defense Programs' share of the costs to operate and maintain programmatic facilities in a state of readiness at which each facility is prepared to execute programmatic tasks identified under directed stockpile work and the campaigns. These costs include the structures, equipment, materials, procedures, and personnel necessary to provide program sponsors with a facility that is safe, secure, reliable, and ready for operations.

Sandia has a large number of facilities supported by the Readiness in Technical Base and Facilities subcategory:

- The Microelectronics Development Laboratory maintains radiation-hardened integrated circuit technologies.
- The Compound Semiconductor Research Laboratory generates new technology options in semiconductor materials, processes, and device technologies to support directed stockpile work.
- The Tonopah Test Range in western Nevada provides Sandia with essential flight test capabilities (including those for joint test assemblies) as part of the stockpile surveillance effort.
- The Albuquerque Full-Scale Experimental Complex comprises Sandia's Technical Area III experimental facilities. The facilities and most of the test equipment they house range from thirty to fifty years old. An RTBF construction project, Test Capabilities Revitalization, is planned to renovate and refurbish the complex.
- Sandia's Z Accelerator is the world's most powerful laboratory x-ray source. It supports directed stockpile work and NNSA campaigns in dynamic materials properties, secondary certification and nuclear systems margins, inertial confinement fusion ignition and high yield, and nuclear survivability.
- NNSA's Neutron Generator Production Facility at Sandia manufactures neutron generators, a limited-life component required in U.S. nuclear warheads.

Program Readiness

Program Readiness includes activities that support more than one directed stockpile work activity, campaign, or facility and that are essential to achieving mission objectives. Sandia has numerous projects and programs covered by this budget subcategory. They include the following:

- The Defense Nuclear Materials Stewardship project develops materials management systems to enhance the safety, security, and accountability of nuclear weapons, nuclear materials, and weapon components during storage, handling, and transportation.
- The Knowledge Management Program develops workforce stewardship strategies to recruit and retain staff with essential skills, enhance career development, and improve access to retirees and other resources of knowledge for active weapon professionals.
- The Microsystems Infrastructure Readiness Project maintains Sandia's microsystems capabilities, with a secondary role of developing capabilities to support fabrication of war-reserve microsystem components.
- The Pulsed Power Technology Project maintains our capability for designing a wide variety of pulsed power drivers, ranging from high-impedance accelerators for gamma rays and radiography to high-power drivers for z-pinches.

Construction

Sandia's construction plan is designed both to provide the facilities we need to support programmatic objectives and to eliminate excess and substandard space.

Sandia's Microsystems and Engineering Sciences Application (MESA) complex, discussed earlier, is the top priority in our construction plan. Other vital line-item construction projects include the following:

- The Weapons Evaluation Testing Laboratory at NNSA's Pantex Plant will provide a state-of-the-art facility for testing weapon components and implementing advanced diagnostic techniques developed by the enhanced surveillance campaign.
- Funded as construction under the Advanced Simulation and Computing campaign, two key facilities supporting the ASCI program are under construction at Sandia laboratory locations: The Distributed Information Systems Laboratory (DISL) at Sandia's site in California will develop distributed information systems for enabling collaborative computational work across the nuclear weapons complex. The Joint Computational Engineering Laboratory (JCEL) at Sandia's site in New Mexico will support multi-physics code development on massively parallel computers.
- The Model Validation and System Certification Test Center will provide testing facilities to continue providing data for weapons certification; enhance capabilities to facilitate large-volume data delivery; and replace an aging communications infrastructure with integrated command and control, data collection, processing, and distribution systems.
- The Test Capabilities Revitalization project will modernize Sandia's nonnuclear field testing and experimental infrastructure and our diagnostic capabilities to perform weapons qualification, development, surveillance, and model validation. The project

will renovate existing facilities and provide new facilities, subject to cost-benefit studies.

General Plant Projects

General Plant Projects Program funding is essential for managing our facilities and conducting safe and reliable facility operations.

This change has given laboratory management some flexibility in determining the amount of general plant project and capital equipment funding needed to maintain infrastructures and to respond to changes in infrastructure maintenance requirements. The funding limit for general plant projects is $5 million per project. The new flexibility we have to determine the best use of general plant funds has enabled us to improve administrative and support facilities that have been neglected far too long.

Sandia received DOE approval in fiscal year 2001 to fund and construct an Institutional General Plant Project (IGPP) building. IGPPs are construction projects for general-purpose institutional space funded through indirect cost recovery rather than by direct funding from a programmatic sponsor. Sandia was the first DOE contractor to pilot this alternative that is now permitted by new regulations. We are seeking approval to construct two additional buildings through the IGPP mechanism in fiscal year 2002.

DEFENSE NUCLEAR NONPROLIFERATION

Sandia's support for the NNSA Office of Defense Nuclear Nonproliferation includes research and development on systems for detecting proliferation of weapons of mass destruction, verifying international arms agreements, enhancing the protection of nuclear material and weapons in Russia, eliminating surplus inventories of fissile materials in Russia, protecting against chemical and biological incidents, and providing mechanisms to enhance regional stability.

I am pleased that the fiscal year 2002 budget reversed a downward trend in NNSA's programs for nonproliferation and verification research and development. This important investment yields leading-edge prototypes and demonstrations that serve our national security interests exceptionally well.

The greatest successes coming from this program are the result of persistence in providing support over long periods to allow for the full development and demonstration of applied technologies. We appreciate your trust in the laboratories to take technical risks that have yielded innovative solutions for monitoring treaties, protecting nuclear materials, and protecting against threats of chemical and biological terrorism. I urge your continued strong support for this important research and development program.

Nonproliferation and Verification Research and Development

Sandia is developing a new generation of satellite-based sensors to detect low-yield nuclear explosions in the atmosphere. We also are developing a seismic data processing system to enhance detection of underground nuclear explosions. Our activities are part of a multilaboratory effort to develop affordable, deployable, and flexible sensors for seismic, hydro-acoustic, radionuclide, and infrasound data acquisition and processing. These activities are coordinated and, in many cases, co-funded by the Department of Defense, which has the operational nuclear-test monitoring responsibility for the U.S. government.

We are developing airborne and satellite-based systems for detecting and characterizing proliferation-related activities involving chemical weapons, biological weapons, and missiles. Sandia coordinated the integration of NNSA's Multispectral Thermal Imager Satellite research project, which has recently completed its second year of successful operation and research. We are also developing a laser-based system for remote detection and identification of chemical and biological species in effluent plumes. We will conduct flight tests this year of the integrated system on an unmanned aerial vehicle. We have made impressive progress toward developing specialized chemical and biological microsensors, bioinformation systems, and decontamination technologies for nuclear, biological, and chemical weapons and for detecting nuclear material smuggling. With regard to the microsensors, we are currently conducting field trials, and preliminary results are very promising.

Nonproliferation and Arms Reduction Transparency

NNSA's Cooperative Monitoring Center (CMC) at Sandia National Laboratories assists a number of countries and agencies in evaluating the applicability of arms control technologies and protocols for regional security issues. Export-approved monitoring equipment is available for representatives of regional parties from areas such as south Asia, the Middle East, the Balkans, and the Korean peninsula, to evaluate for application to specific regional problems. For example, the CMC is currently engaging Pakistan and India in a cooperative boundary monitoring project. The CMC also supports technical analysis of policy options for DOE and provides national security insight to other organizations. CMC staff also provide technical consultation to U.S. negotiating delegations.

In an effort to extend the accessibility of the CMC to an affected region, a similar institute is being established in Amman, Jordan. This development is a cooperative effort of the Department of State, the Defense Threat Reduction Agency, and NNSA. It is a significant cooperative development involving the United States and Jordan and represents an opportunity to foster stability in that region through the integration of technology and policy.

In other activities, Sandia assists with the evaluation of export licenses for technology with possible uses for weaponization activities. We also help develop technology for International Atomic Energy Agency remote monitoring and inspections. Sandia develops remotely accessed, unattended cooperative monitoring systems for applications in foreign states without nuclear weapons that are party to the Treaty on the Non-Proliferation of Nuclear Weapons. These activities typically support the International Atomic Energy Agency and bilateral safeguards agreements between the United States and foreign states with nuclear materials of U.S. origin. Other work is conducted for the physical protection of nuclear materials in the Baltic and independent states of the former Soviet Union and in states that are party to the Convention on the Physical Protection of Nuclear Material. These activities include the International Atomic Energy Agency International Physical Protection Advisory Service, training classes, and physical security upgrades.

U.S. / Russian Nuclear Security Programs

Sandia supports a broad range of cooperative programs with Russia in nuclear security. These programs, funded by NNSA, DoD's Cooperative Threat Reduction program, and the

Department of State, address the safety and security of nuclear weapons, the security of fissile materials, verification of fissile materials, and defense conversion.

I want to make special note of the importance of the activities with Russia. The terrorist attacks last September have made us all acutely aware of the catastrophic potential of weapons of mass destruction should they end up in the wrong hands. The cooperative efforts to protect nuclear materials and maintain state control over nuclear capabilities and assets in Russia are important initiatives that must continue. We promote a vision called "Global Nuclear Management" that, if realized, would assure the control of all nuclear materials in the world. However, the current state of protection for nuclear materials in Russia, while improved through the past efforts of this program, is an important indication of the potential for nuclear material proliferation. We must continue these efforts with Russia.

Russian Transition Initiatives

In support of defense conversion programs, Sandia has been an active participant in the Russian transition programs, including the International Proliferation Prevention Program, which engages weapons scientists, engineers, and technicians from the former Soviet Union in nonmilitary projects. This program provides seed money for nonmilitary research and provides links with U.S. industry to commercialize the new activities. In a particularly effective case, Sandia engineers worked with Spektr Conversion LLC, a company formed by scientists at the Russian nuclear weapons laboratory, the All-Russian Scientific Research Institute of Technical Physics (VNIITF), and a U.S. manufacturer, Numotech Inc., to design and build a wheelchair seat cushion to prevent pressure sores. The prototype cushion was clinically tested at a VA hospital and is approved by the FDA. The program provided employment opportunities in an area of civilian need for Russian technical personnel.

International Nuclear Materials Protection and Cooperation

A major Sandia program that addresses the security of nuclear weapons and fissile material in Russia is the Materials Protection, Control, and Accounting (MPC&A) program. Since 1993, Sandia has participated in this multi-laboratory effort to reduce the threat of diversion of Russia's nuclear weapons and weapon-usable nuclear material to rogue states or terrorist groups. This program, which originally included projects in Russia and a number of the newly independent states, now focuses on Russia in the areas of nuclear material and nuclear facilities operated by the Ministry of Atomic Energy, the Russian Ministry of Defense, and smaller independent ministries. Activities include vulnerability assessments, protection system design, training, and support for hardware installations and maintenance. Assistance is also provided to states other than Russia to protect fissile materials, on-site and in transit, against theft. Protecting U.S.-origin nuclear material in other countries is a particular concern. A related activity provides assistance to the International Atomic Energy Agency (IAEA) to develop physical protection guidelines.

GOVERNANCE REFORM

A very important initiative by the NNSA Administrator is an effort to redesign the NNSA contractor relationship through a new approach to governance. The goal is to implement a simpler, less adversarial contracting model capitalizing on the private-sector

expertise of the management and operating contractors while increasing contractor accountability for performance and responsiveness to NNSA requirements.

The current governance structure for the NNSA laboratories is broken. I doubt that any of my lab director colleagues would disagree that the current governance regime unreasonably constrains us from exercising prudent management authority and bold leadership in accordance with best industrial practices; and yet, that kind of leadership was precisely what the federal government bargained for under the original GOCO (government-owned, contractor-operated) contracting model. The influential Galvin Report[6] was perhaps the most adamant of several studies that have been critical of the excessively bureaucratic nature of DOE governance of the laboratories. The Galvin Task Force found that the GOCO model has been so encumbered with bureaucratic accretions that it would be better to scrap it altogether and privatize the laboratories. While that is probably too drastic a remedy, we should all be concerned that the current laboratory governance regime fails to encourage management initiative for superior performance beyond mere compliance with an array of bureaucratic prescriptions.

As originally conceived, the GOCO model was a strategic partnership between a federal agency and a premier industrial or academic entity. In simple terms, the key operating concept was that the federal sponsor articulated WHAT was to be achieved (the mission and its programmatic deliverables) while the contractor determined HOW to achieve it, in accordance with best industrial practices. The laboratory governance reform initiative that the NNSA Administrator proposes includes an assurance strategy that will employ several private-sector assurance systems such as comprehensive internal auditing, oversight by boards and external panels, third-party certifications, and direct engagement between oversight bodies and NNSA's leadership.

The first phase of this initiative will attempt to reduce contractual prescriptions that exceed those mandated by law and regulation. The second phase will design and demonstrate a new governance model, conducted as a pilot program at Sandia National Laboratories. If the subsequent appraisal of the pilot phase is positive, the new model would likely be implemented at other NNSA laboratories and plants.

CONCLUDING REMARKS

In my view, the National Nuclear Security Administration, under the businesslike leadership of General John Gordon, has made significant progress during the past year in its organizational effectiveness. The agency is now functioning with evident coordination and teamwork, attributes which will likely be strengthened even more as the Administrator's organizational and operational plans are implemented. To assure continued success, however, the agency needs long-term support from Congress and sustained resources to meet the formidable requirements of stockpile stewardship in the years ahead.

On behalf of the dedicated and talented people who constitute Sandia National Laboratories, I want to emphasize our commitment to the NNSA mission to strengthen United States security through the military application of nuclear energy and by reducing the global threat from terrorism and weapons of mass destruction. It is our highest goal to be a national laboratory that delivers technology solutions to the most challenging problems that threaten peace and freedom.

REFERENCES

[1] Nuclear Weapons Complex Reconfiguration Study; Complex 21; Defense Programs Phase I and II Maintenance Studies; Energy Federal Contractor Organization Group Study; Office of Secretary of Defense Program Analysis and Evaluation Review; Stockpile Stewardship Program Thirty-Day Review; DOE Inspector General's Defense Programs Production Facilities Assessment; FY2000 Report to Congress, Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (Foster Report).

[2] 105th Congress, 1st Session, *National Defense Authorization Act For Fiscal Year 1998,* Report 105–29 to Accompany S. 924, June 17, 1997.

[3] Power: 230 trillion watts. Energy: 1.6 megajoules.

[4] On the order of 10^{15} (thousand trillion) watts, or "petawatt" (PW).

[5] Through the NNSA Office of Defense Nuclear Security and the USAF Force Protection Command and Control System Program Office, Electronic Systems Center (ESC).

[6] *Alternative Futures for the Department of Energy National Laboratories,* Secretary of Energy Advisory Board, Task Force on Alternative Futures for the Department of Energy National Laboratories. Robert Galvin, Chairman, et al., February 1995.