# NATIONAL NUCLEAR SECURITY ADMINISTRATION MANAGEMENT OF ITS NATIONAL SECURITY LABORATORIES

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## OPENING REMARKS AND SUMMARY

Mr. Chairman and Members of the Committee, thank you for the opportunity to testify today on the National Nuclear Security Administration Management of its National Security Laboratories. I am Parney Albright, Director of the Lawrence Livermore National Laboratory (LLNL).

LLNL is one of the Department of Energy's (DOE) National Nuclear Security Administration (NNSA) nuclear design laboratories responsible for helping sustain the safety, security, and effectiveness of our nation's strategic deterrent. In addition to our stockpile stewardship efforts, we also leverage our capabilities to develop innovative solutions to major 21st-century challenges in nuclear security, defense and international security, and energy and environmental security. I thank the committee for your continuing support for the important work we do.

This is a challenging period for the federal government, with many priorities that require attention at a time of budget austerity. This is also the case for the nation's Stockpile Stewardship Program, including the activities at Livermore. We are very excited about recent and prospective major accomplishments, which I will highlight, but we are also very concerned about impediments to current programs and long-term success in stockpile stewardship. In particular, I stress four points:

- Without sustained support for nuclear weapons science, stockpile stewardship will eventually fail.
- We remain optimistic about the prospect of long-term success of "science-based" stockpile stewardship provided that support is sustained. The skills deriving from a solid science base will enable stockpile stewards to maintain a safe, secure, and effective deterrent and deliver on challenging life-extension programs.
- Recognition of and support for the NNSA laboratories serving as "national security laboratories" will better help the United States meet a broad set of 21st-century security challenges. These broader activities complement our nuclear weapons responsibilities, adding depth, breadth, and strength to the laboratories' capabilities.
- The NNSA laboratories would perform their vital national security mission much more effectively if they were managed as trusted partners of the federal government and governed in a more streamlined/cost-effective way, consistent with the original intent of the federally-funded research and development center (FFRDC) construct.

## NUCLEAR WEAPONS SCIENCE

The Stockpile Stewardship Program (SSP), which formally began in the 1990s with the decision to enter into a moratorium on nuclear testing, is an ambitious experiment. It is founded on the premise that the expertise of a workforce (and the judgments they make) that results from a detailed understanding of the *fundamental science* of how nuclear weapons work can serve as a substitute for the expertise (and judgment) developed historically through multiple and frequent design efforts—efforts that ultimately had to be proven in nuclear tests. To add to the complexity of this enterprise, this new workforce must deal with weapons that will be deployed well beyond their initially intended service lifetimes, and over time upgraded with the (highly desirable) safety and security features called for by the recent Nuclear Posture Review—features that represent changes to previously tested configurations of those weapons.

It is important to note that at the time we stopped nuclear testing, we did not understand well enough how weapons worked (which is why we had to test); there were a great number of empirical factors and approximations built in to the weapons design process that allowed efforts to proceed, but with that there was a landscape of test failures that indicated our lack of understanding of the basic underlying science. Hence, for stockpile stewardship to work, we needed to learn far more about the physical processes that transpire in the functioning of a weapon. When the SSP was initiated, the nuclear stockpile was in good shape, which meant that we had a window of time to develop necessary nuclear weapons science tools and knowledge before more difficult-to-deal-with problems would likely arise.

Developing these science tools has been—and remains—extremely challenging. Our knowledge of the underlying basic physics is ultimately embodied in computer models. These models utilize scientifically justified approximations—rendered more and more accurate by improvements in computing power, and by controlled experiments that determine needed parameters—to represent what we believe to be reality. However, these models cannot become “holy writ;” it is crucial that they be tested repeatedly against experiments conducted at relevant physical conditions, so that the assumptions and approximations embedded in the models can be verified and corrected as needed. To do otherwise is to invite disaster. Hence, the pillars of the SSP have included both the development of independent analytic capabilities—utilizing the world’s most capable computing platforms—at Lawrence Livermore and Los Alamos national laboratories (each laboratory with differing approaches to modeling the underlying physics); but also the development of experimental facilities to collect data at the conditions relevant to the operation of a nuclear weapon. It is worth noting that every acknowledged nuclear state that has abjured testing is following the same approach to maintaining their stockpile.

Of course, the scientific understanding of nuclear weapons is not an end, but rather, as noted above, a process that underlies our capability to maintain the stockpile. First, each laboratory director provides an annual assessment of the stockpile. Hence, a crucial component to the SSP is the ongoing surveillance of the stockpile and the development of better surveillance methods. Again, here, the underlying premise of the SSP—that developing a detailed understanding of fundamental weapons science will lead to a workforce with the judgment and intuition heretofore developed through new weapons design and testing—is critical. If an issue is identified in a stockpile weapon, we as a nation need to know whether it can be ignored, fixed in the field, or is critical enough to call into question the reliability of a portion of the deterrent.

Finally, that judgment and experience must be turned toward Life Extension Programs (LEPs) that both sustain the extant stockpile and also allow for critical improvements in its safety and security. These advancements will in some cases result in deviations from fully tested configurations, and hence rely heavily on improvements in our understanding of fundamental weapons science. Furthermore, even if a weapon system were to have its lifetime extended without any deviations from the prior design, the reality is that component manufacturing processes change with time, some materials are no longer available, and no "blueprint" is sufficiently detailed to fill in all the decisions made historically on the production line. Certifying any weapon requires a workforce that understands the fundamental scientific aspects of nuclear weapons.

The full spectrum of SSP activities—a fundamental understanding of weapons science (based on theory and, crucially, experiments); its application to assessments; stockpile surveillance and development of better surveillance methods; dealing with significant findings and fixes; and LEPs—all serve to sustain the stockpile, exercise the skills and judgments of stockpile stewards, and, importantly, train the next generation of stewards. When the next round of LEPs for the extant stockpile is expected to begin in the 2030s, the people executing those LEPs will have been trained by people who themselves have never engaged in the development of a new design, nor executed a full nuclear test.

SSP depends on stockpile stewards being fully capable of identifying issues that arise in stockpiled weapons; resolving those issues through minor fixes or LEPs; and certifying the safety, security, and performance of the modified weapon without conducting a nuclear test. Strong support of all aspects of the SSP is required, because questions about safety, security, and performance will arise as long as the United States has nuclear weapons. Laboratory scientists and engineers must have the wherewithal to find and address problems, and the nation must have confidence in their ability to do so.

We have made remarkable progress in developing the necessary computational and experimental tools and in using them to gain knowledge about key issues. And we are attending to the immediate needs of the stockpile. Today, however, the hard challenges are now much closer as weapons age beyond their intended service life and important work to resolve key issues in nuclear weapons science remains to be done.

As noted briefly above, the simulation codes must have much higher fidelity than those originally used in the design of the weapon. Evaluating the performance of a weapon "as designed" is one issue; evaluating it when materials have aged and anomalies are present is much harder. Materials age at an accelerated rate when confined for years in the radioactive environment inside a nuclear weapon. The improved physics models required for science-based SSP are very complex (e.g., turbulence and the interaction of intense radiation with matter) and necessitate powerful computers. However, these codes—which embody our state of knowledge—must be tested against data.

Data collection about nuclear weapons performance falls into two broad categories: information pertaining to dynamics of the primary implosion and information pertaining to the nuclear explosion itself.

We collect data about the hydrodynamics of a weapon primary implosion at LLNL's Contained Firing Facility (CFF) and at the Dual Axis Radiographic Hydrodynamics Test (DARHT) Facility at Los Alamos National Laboratory (LANL). For example, in FY 2010, one of our large-scale tests explored advance safety and security concepts that could be used in future LEPs; another demonstrated advanced capabilities for assuring weapon performance. Through marked improvements in diagnostics, we are obtaining greater amounts of higher fidelity data about implosion dynamics. These data are compared to pre-shot predictions of results—performed with our most advanced computers—and gauge how well our physics models work.

Other key experimental facilities managed by Livermore that provide information about non-nuclear performance include the High Explosives Applications Facility (HEAF), where state-of-the-art diagnostics are used to study the performance of aging high explosives in nuclear weapons, and the Joint Actinide Shock Physics Experimental Research (JASPER) Facility at the Nevada National Security Site. A two-stage gas gun, JASPER is used to produce an extremely high-pressure shock wave in plutonium and collect material properties data critical to the simulation codes. JASPER completed mandated upgrades in FY 2011 and now operates as a Hazard Category 3 nuclear facility. Since JASPER returned to operation, five plutonium shots so far have collected vital data for LLNL and LANL.

A critical gap in our understanding of nuclear weapons science is the need for experimental data pertaining to the behavior of materials at the extreme conditions of a functioning nuclear weapon (100 million degrees temperature and 10 billion atmospheres pressure). With the National Ignition Facility (NIF) (and lesser but complementary capabilities in the Omega laser at University of Rochester's Laboratory for Laser Energetics and the Z-machine at Sandia National Laboratories (SNL)), it is now possible to gather high-energy-density (HED) science data at a precision and experimental rate that simply would not be possible by other means. Crucially, the NIF holds the promise of probing experimentally the conditions in a nuclear weapon that occur during the initial detonation—in particular, the boost process that determines the performance of the primary, which, in turn, drives the overall performance of the weapon. The ability to anchor the simulation codes with ignition data is pivotal to any discussion of design margins and performance.

## STOCKPILE STEWARDSHIP PROGRAM SUCCESSES AND CHALLENGES

My discussion of recent successes and challenges in the SSP will largely focus on NIF, high-performance computing, and the W78 LEP, which are crucial to long-term success.

### The National Ignition Facility (NIF)

NIF was commissioned at LLNL in 2009, and since then, the 192-beam laser has been performing very reliably as a high-precision experimental tool. During FY 2011, a total of 286 shots were fired on NIF, with 62 shots for the National Ignition Campaign (NIC) and 50 shots for stockpile stewardship and HED science applications. Over 100 shots were fired in January and February of 2012—a record performance for complex shots. The demands for experimental time are high. Even with NIF operating 24 hours a day, seven days a week, the requests for shots in FY 2012 total more than 500 days.

Researchers are executing the program to achieve fusion ignition and energy gain, and the wide range of record breaking experiments results to date demonstrate the enormous utility of NIF as a users' facility for nuclear weapon science, broader national security applications, frontier science, and pursuit of fusion power for energy security. We are making excellent progress toward transforming NIF into a users' facility in FY 2013.

***NIF Laser Performance.*** In March 2012, NIF delivered a record-setting 1.875 million joules (MJ) of ultraviolet laser light to the center of the facility's target chamber. NIF generates nearly 100 times more energy than any other laser. This shot met a major milestone and exceeded NIF's design specification of 1.8 MJ. NIF is now able to conduct routine operations at full power. Very importantly, the record-setting event was also one of the most precise shots ever fired at NIF. The laser's precision and enormous flexibility in how to use the beams make possible the fielding of many different types of ignition and HED science experiments for which more than 50 different types of diagnostic instruments, many developed specifically for NIF, are providing exceptional data for a wide range of types of experiments.

***Support of Stockpile Stewardship.*** NIF has already made a pivotal contribution to stockpile stewardship with resolution of the "energy balance" issue after a series of experiments performed last year. The issue was originally identified during the era of nuclear testing and it has remained a significant anomaly for 40 years—an anomaly that in the past was an important reason for full nuclear testing. Over the last decade, experiments on a variety of experimental facilities contributed to improving the understanding of this anomaly and pointed to its likely source. LLNL researchers developed a sophisticated computational model that better simulated nuclear weapons performance and, in particular the specific aspects of performance that could possibly explain the anomaly. The unique capabilities of NIF were required to validate simulation results. With resolution of the energy balance anomaly, LLNL and LANL will have more confidence in assessments of the current weapons, which continue to change with age, and will be able to make better-informed choices in upcoming LEPs.

Additional SSP-supportive experiments were conducted in FY 2011-12 to study how materials that are normally solids behave when subjected to unprecedented pressures—in this case tantalum and carbon. These experiments are important stepping stones toward understanding the more complex material behavior of substances like plutonium. FY 2013 is projected to be a very busy year for SSP experiments at NIF. Future plans call for a wide range of types of experiments to be performed by LLNL and LANL to better understand the physics of boost (thermonuclear burn in the primary explosion) and answer questions crucial to stockpile assessments, investigation of significant findings, and certification of LEPs.

***The National Ignition Campaign.*** The goal of the National Ignition Campaign (NIC) is to compress and heat a millimeter-size target filled with deuterium and tritium to achieve fusion ignition and energy gain (at least as much energy output as input). The NIC team is also transitioning NIF to routine operations as a highly flexible HED science experimental facility. NIC, which concludes at the end of FY 2012, is managed for NNSA by the Laboratory and includes many national and international partners, representing national laboratories, academia, and industry.

NIC is making substantial progress in the quest to achieve fusion ignition and burn. Activities are progressing through a series of milestones with ignition and burn as a major milestone scheduled for the fourth quarter of FY 2012. The goal is to compress the cryogenically-cooled fusion fuel to a very small volume (compressed by more than a factor of 10,000 in density) and create a central "hot spot" that ignites and consumes a larger amount of surrounding hydrogen fuel. The goal is to turn mass into energy. A series of four shocks that must be precisely shaped and timed are used to implode the capsule and ignite the fuel.

NIC researchers are conducting a series of experiments to optimize the target implosion following the standard scientific approach of interweaving experiments and theory. These experiments occur at energies, temperatures, and pressures that have never before been probed, and hence that are well outside of the domain where our simulation models have been anchored—a domain that approaches the conditions inside a nuclear weapon. Through the iterative process of pre-shot prediction, experiment, and post-shot data analysis, new ground is being broken on the path to ignition. We are learning new physics and gaining a more fundamental understanding of thermonuclear reactions. This information is being used to continue improving our models as we move through the program, which in itself is testimony to the need for anchoring data and skepticism of models that are based solely on theory or are validated outside the domain of interest.

NIC (and more generally, the SSP) is a grand challenge with many scientific and engineering obstacles that test the skills and ingenuity of NNSA laboratory researchers. So far, we have overcome many obstacles and I have confidence that the NIC team will reach its objective of fusion ignition and burn. Others around the world see great value in having NIF-like capabilities and share confidence that the goal is within reach. China, Russia, and France are all committing to build (or have started to build) large laser systems for inertial confinement fusion (ICF); the United Kingdom works closely with NIF; and Japan and Korea are making substantial investments in ICF.

### High-Performance Computing (HPC)

HPC is and always has been a defining strength of our Laboratory. SSP advances have required continuously pushing the envelope in HPC. As part of NNSA's Advanced Strategic Computing (ASC) program, we work closely with U.S. computer manufacturers to improve capabilities, and every generation of state-of-the-art computers pioneered at LLNL or LANL has later found broad application in making U.S. industry able to develop better products more quickly. Livermore is currently bringing into operation two highly capable machines: "Sequoia" and "Zin."

***Sequoia*.** In January 2012, the IBM technical team began installation of the first four racks of Sequoia, the next leap forward in computing capability; the last of the 96 racks arrive this month. This next generation "BlueGene/Q" technology operates at an order of magnitude faster than previously deployed systems. Sequoia, which includes 1.5 million processors and 6 million threads, is capable of record-setting 20 petaflops (20 quadrillion, or a million billion, floating point operations per second). Sequoia is also record-breaking in power efficiency—at over 2 billion calculations per watt, it is nearly 50 percent more power efficient than any competing technology. Our goal is to have the machine fully performing science simulations before the end of 2012 and dedicated to classified computing in mid-2013.

Sequoia is an important step toward even larger computers that are needed to run predictive models of boost physics and thermonuclear burn processes in nuclear weapons. Equally importantly, considerable effort has gone into development of improved methods to efficiently characterize and bound margin to failure and its uncertainties. Quantification of Margin and Uncertainty (QMU) provides the underpinning of our assessment and certification processes. Rigorous implementation of QMU requires running many thousands of high fidelity simulations to map out the impact of uncertainties on weapon performance, which, in turn, requires more powerful computers.

***Zin.*** In March 2012, LLNL completed installation and began classified computing on Zin, a machine with 1 petaflop performance. As part of the ASC Tri-Lab Capacity Cluster 2 (TLCC2) program, similar computers are being installed at LANL and SNL to increase computing capacity. LLNL led the vendor selection to procure standardized hardware and software environment through TLCC2 so that the laboratories would realize significantly reduced costs, increased efficiencies, and enhanced collaboration. Zin provides a substantial boost to classified computing at LLNL, and full deployment of TLCC2 will allow users from all three laboratories to begin preparing their codes on the actual architecture that they will experience when Sequoia goes into service.

***High-Performance Computing as a National Security Imperative.*** To meet the demanding needs of SSP, we urge support for an initiative to reach the challenging milestone of exascale computing (a billion billion calculations per second) by 2020. LLNL is working with other NNSA and DOE laboratories to formulate a strategy for how to achieve this ambitious goal. Exascale computing is also critical to our role as a broad national security laboratory, with Livermore bringing to bear on critical problems HPC as one of our principal strengths. Modeling and simulation of complex systems to understand and predict their behavior is key to solving challenging problems in national security, energy security, and economic competitiveness. Other nations equally recognize the value of leadership in HPC to their futures. Sequoia puts the United States back in the lead (surpassing Japan and China) and it is critical that we sustain leadership by reaching exascale performance level before competitor nations.

### The W78 Life-Extension Program (LEP)

In June 2011, LLNL and the U.S. Air Force launched a concept development study to extend the life of the W78 Minuteman III warhead. The W78, which is the dominant system for the ICBM leg of the nation’s nuclear deterrent, is well beyond its planned service life and will reach 40 years before the LEP production begins. We need to address concerns identified in the surveillance of W78 that do not now affect performance. The LEP process, which begins with concept development (Phase 6.1), will take at least a decade to complete. As the program is conceived, production would start in FY 2023.

The concept development study is evaluating different LEP approaches including refurbishment, reuse, or replacement of weapon components. As required by the

Department of Defense (DoD), the study encompasses options that improve safety and security features and that make the warhead adaptable for deployment on SLBMs as well as ICBMs. At the end of the study, which should conclude this year, the California team (LLNL and SNL–California) will report findings and recommendations to the DoD/NNSA Project Officers Group. A key issue is the manufacturability of LEP components and systems—cost-efficiency, waste reduction, and avoidance of use of hazardous materials are important factors.

In addition to meeting the critical need to extend the service life of the W78, the LEP serves the long-term need to work on the full spectrum of stockpile stewardship activities—including warhead development from physics and engineering design through production engineering. This is an essential part of hands-on training to increase skills and expert judgment. The young scientists and engineers who worked on the W87 LEP in the 1990s are now the technical leaders for the W78 LEP, and they are training the next generation of leaders.

**Other Stockpile Stewardship Program Successes and Challenges.**

***Assessments and Directed Stockpile Work (DSW).*** LLNL completed Cycle 16 of the Annual Stockpile Assessment with support from the newly implemented Independent Nuclear Weapon Assessment Process (INWAP) to strengthen peer review. Cycle 16 benefited from reduced uncertainties and increased scientific rigor due to improved simulation models, results of recent plutonium aging experiments, and better fundamental nuclear data deriving from joint work with LANL. Livermore also effectively managed its Significant Finding Investigation workload and its stockpile surveillance activities. However, our weapon assessments and DSW support activities are funding constrained, and of the systems in the stockpile, the B83 bomb and W80 cruise missile warhead are the least supported. With the FY 2013 proposed budget, we will likely have to curtail activities that impact our ability to assess the performance of these systems. Funding for technology development to improve certification and safety is also very constrained.

***Facilities.*** LLNL sustained very nearly 100 percent availability of its mission-critical and mission-dependent facilities throughout FY 2011 as part of its Readiness in Technical Base and Facilities (RTBF) effort. However, we have not been able to keep pace with the needs for reinvestment in the Laboratory's aging overall infrastructure. LLNL receives less RTBF funds (by a factor of greater than two) than any other site in the complex. RTBF activities include our ongoing effort to prepare for shipping from the site special nuclear material requiring the highest level of security protection. More than 93 percent of the material has been removed and the work is on schedule to be completed in 2012. Important programmatic activities continue at the Laboratory's Superblock Facility and this well-maintained facility stands ready to support NNSA's new plutonium strategy with the planned delay in construction of the Chemistry and Metallurgy Research Replacement–Nuclear Facility (CMRR–NF) at LANL.

***Additional Budget Burdens.*** The Lawrence Livermore National Security (LLNS), LLC, Defined Benefit Pension Plan up to now has been sufficiently funded that contributions have not been legally required. However, with interest rates at an historic low, liabilities have grown dramatically since mid-2009. As a consequence, statutory requirements of the Pension Protection Act of 2006 are forcing LLNS to act, and NNSA has granted LLNS approval to begin employee and employer contributions in FY 2012. By starting now, we save NNSA almost $200 million through FY 2022. I urge Congress to examine whether the provisions of the Pension Protection Act, designed to protect private sector pension plans, are appropriate for the NNSA complex of laboratories and plants. If a Pension Protection Act waiver/exception/modification is not enacted, $88 million will have to be diverted from programmatic work in FY 2013.

## LLNL AS A NATIONAL SECURITY LABORATORY

For many years, LLNL employees have applied their very special capabilities to develop innovative technical solutions to help meet a broader set of national needs. Work for NNSA on nuclear nonproliferation and counterterrorism, the Office of Science and others in DOE, other federal agencies, and additional sponsors (e.g., in U.S. industry), is very important and has long been integrated into our mission and contribution to national security in the broadest sense. Our notable accomplishments in FY 2011-12 include:

- *Radiation Detection.* LLNL researchers developed the first plastic material capable of identifying nuclear substances such as uranium and plutonium from benign radioactive sources. The new technology could be used in large, low-cost detectors for portals to reliably detect nuclear substances that might be used by terrorists.
- *Emergency response.* Operating around the clock for 22 days, LLNL's National Atmospheric Release Advisory Center (NARAC) provided up-to-date atmospheric dispersion predictions, plume projections, and radiation dose estimates to agencies in the U.S. and Japan responding to the Fukushima nuclear reactor disaster.
- *Low-collateral-damage munition*. The U.S. Air Force funded LLNL in May 2010 to rapidly develop the design for a new low-collateral damage munition (BLU-129/B). Fielding of the munition was approved in September 2011. The effective integration of experiments with HPC simulations enabled quick and effective optimization of munition performance while meeting demanding engineering requirements.
- *Cyber security.* LLNL has created new capabilities for cyber-security work sponsors to provide real-time situational awareness inside a large computer network using a distributed approach to monitoring for anomalous behavior.
- *Space situational awareness.* LLNL has developed detailed physics-based simulations to provide real-time analysis of space flight safety risks, and we are designing new prototype collision-warning mini-sensors for deployment in orbit.
- *Rapid development of new pharmaceuticals*. Working with an industrial partner, LLNL researchers applied sophisticated computer models to sift through a large range of possibilities and identify three efficacious drug candidates in three months (normally a two- to five-year process).
- *Industrial partnering in HPC*. In March 2012, LLNL selected six pilot projects to partner with industry to accelerate the development of energy technology using LLNL's (unclassified) HPC resources through the Livermore Valley Open Campus (adjoining LLNL and SNL–California).

It is widely appreciated that the NNSA laboratories are unique (in terms of capability, talent, scale, and dedication to mission) national resources that should be more broadly applied to address pressing 21st-century needs in defense and international security, energy security, and innovations to enhance economic competitiveness. As a dual benefit, the activities crucially add depth, breadth, and strength to the laboratories' technical base, which is important to long-term success in stockpile stewardship. *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories*, recently prepared by a National Academy of Sciences (NAS) committee at the behest of Congress, recommended "that Congress recognize that maintenance of the stockpile remains the core mission of the Labs, and in that context consider endorsing and supporting in some way the evolution of the NNSA Laboratories to National Security Laboratories…" Formal recognition of our national security mission responsibility would be very beneficial—as would steps to help lower operating costs at the laboratories and simplify the processes for arranging inter-agency work.

## THE LABORATORIES AS TRUSTED PARTNERS IN NATIONAL SECURITY

Employees at the NNSA laboratories and plants are dedicated to national service. At the laboratories, we take on careers because we believe we can "make a difference" working with outstanding colleagues at state-of-the-art facilities on nationally important problems. As federally-funded research and development centers (FFRDCs), our management contracts in principle place the day-to-day responsibility for national security research in the hands of non-federal employees in order to ensure that staff and infrastructure of the highest quality are available and dedicated to the missions of our government sponsors. In this model, the government decides "what" needs to be done and provides the funding, and the laboratories decide "how" to assure the needed capabilities are available, and then how best to accomplish those tasks within the federally defined constraints. This partnership with the government should indeed be a partnership

The national laboratories, along with the plants, are the sinew and muscle of the nuclear weapons enterprise; they are the corporate memory, the execution arm, and the infrastructure. In many ways, they fulfill the same role within NNSA as does the uniformed military within DoD. Such a relationship works well when there is mutual trust between the partners, a clear understanding of roles and responsibilities, and a shared vision and clear focus on mission.

The *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories* report by the NAS committee speaks of the broken relationship between NNSA and the laboratories, stemming from a fundamental lack of trust. We need to return to a strong partnership between the government and the laboratories with active engagement of the laboratory directors in collaborative strategic discussions with NNSA management about program direction, health of the laboratories, and mission priorities.

The NAS committee's findings are not new. *America's Strategic Posture*, issued in 2009 as the final report of the Congressional Commission on the Strategic Posture of the United States, is highly critical of the governance structure and "micromanagement and unnecessary and obtrusive oversight." An investigation of other FFRDC governance models should be able to provide alternatives and help affect a cultural change in the way the laboratories are managed. We need to move from a duplicative, multi-layered, and poorly aligned governance system to a more streamlined, cost-effective approach that would restore a focus on mission and a trusted partnership. An operational way to do this is to provide a level of funding for oversight that is consistent with best practices for other FFRDCs. The savings, which could be substantial—within the government and at the laboratories, which have to absorb the costs of transactional oversight—could be reinvested to make for stronger programs and healthier laboratories.

As an example of how other agencies approach FFRDC governance, the Jet Propulsion Laboratory (JPL) is an instructive (but by no means unique) example. There are significant differences between JPL and LLNL; even so, the contrast in the FFRDC relationship is striking. JPL is a $1.5 billion center with more than 5,000 employees, managed by the California Institute of Technology as an FFRDC for the National Aeronautics and Space Administration (NASA). NASA governs the agency with three-agency level councils and the center directors are members. The Site Office at JPL performs no assessments and Headquarters performs Mission and Environment, Health, and Safety reviews three times per year. In contrast, over 1,300 external audits were performed at LLNL in FY 2011 as part of NNSA's transactional oversight.

NNSA monitors performance at LLNL using an annual Performance Evaluation Plan (PEP). In FY 2011, the PEP had 11 Objectives, 42 Measures, 79 Targets, 5 Award Term Incentives, 12 Multi-site Targets (all but two applicable to LLNL), and a large number of supporting metrics to gauge performance. The DOE/NNSA Site Office at Livermore defines 324 elements in their management assessment plans. JPL and NASA dispensed with the PEP approach, deciding that it interfered with a focus on mission.

There is one area where we have seen improvement toward an effective partnership with NNSA: reform of security policy and procedures. The effort, which began about two years ago, is led by NNSA's Defense Nuclear Service (DNS) and is collaborative with NNSA sites and contractors. DNS formed combined teams (federal and contractor) of subject matter experts (e.g., in Information Security and in Physical Protection). The goal was to review and replace DOE Office of Health, Safety and Security (HHS) orders with a more streamlined set of NNSA policies (NAPs) that provide the security directors at NNSA sites greater flexibility to meet their particular needs. So far, two NAPs have been created, which is saving an estimated $37 million per year in operating costs at LLNL alone. Seven more NAPs are in the pipeline and expected to be released soon.

## CLOSING REMARKS

My overall message is a "good news" story with a note of caution. With continuing investments in HPC and with NIF coming on-line as a unique experimental facility to gather necessary input and validation data for nuclear weapons science simulation codes, science-based stockpile stewardship is on the path to success. However, vigilance and strong partnerships are required to sustain program support so that there will be skilled and motivated stockpile stewards as long as the nation relies on nuclear deterrence.

All of us at LLNL look forward to serving as a trusted partner in the nation's national security enterprise and are proud to provide innovative science and technology to meet a broad set of national security needs. We thank you for your continuing support.