Senate Committee on Armed Services
Subcommittee on Strategic
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Brigadier General Thomas Gioconda

Mr. Chairman and distinguished members of the Subcommittee, thank you for the opportunity to testify on the Department of Energy=s (DOE) FY2001 Defense Programs (DP) budget request for the Stockpile Stewardship Program. This request of $4.594 Billion represents a 6.3 percent increase over the comparable FY2000 level. Due to mission transfers out of the weapons activities account, this request is roughly comparable to a program level of about $4.7 Billion, using previous year comparisons.

As part of the FY2001 budget process, the Administration is also requesting supplemental funding for FY2000 in the amount of $55 Million to address shortfalls in production readiness at the Kansas City, Pantex, and Y-12 plants. Provision of this supplemental funding is essential to maintain employment levels and skills necessary to support important workloads in FY2000 and future years.

With your continued support, the program, to date, has achieved some major milestones as we move from underground nuclear test-based to science-based nuclear weapons assessment and certification. Most notably, we are about to certify, for the fourth consecutive year, that the safety, security and reliability of the nation=s nuclear weapons stockpile is assured without a need for underground nuclear yield testing at this time. This fourth annual certification of the nuclear weapons stockpile will be transmitted to the President by the Secretaries of Energy and Defense shortly. The people, tools and technologies supported by this budget make this accomplishment possible.

Our nuclear deterrent remains the foundation for U.S. national security. We believe that our accomplishments and the new budget and management structures we have put in place, along with your continued support, will bring us continued success in the supreme national interest.

<u>Major Changes in Program Planning and Budgeting</u>

The men and women of the Stockpile Stewardship Program continue to meet formidable challenges with ingenuity and innovation both in the way we do science and in the way we organize the work we do. Without the critical work of our Astockpile stewards@ at the labs, plants and in the federal structure B no program will succeed. Our people remain our Number One resource that must be carefully attended now and into the future.

During the past year, for the first time ever in the weapons program, we have organized our tasks according to a streamlined business model. Quite simply, in a world where competition for budget resources is intense, we need to be able to demonstrate clearly that we are taking every step to operate in a cost effective manner B we must be accountable in terms that both the folks inside and outside of the program can use to measure progress.

Our budget request is justified based on planned performance for the requested funding. It is the outcome of planning processes that focus our efforts on specific performance goals and strategies that flow from strategic planning. The cycle of planning, budgeting, program execution, and evaluation is the foundation of our program=s accomplishments and our initiatives to improve management and accountability to the Public.

The FY2001 budget is built on an integrated Stockpile Stewardship Program, consisting of three elements: Directed Stockpile Work, Campaigns, and Readiness in Technical Base and Facilities (Infrastructure).

We define the three basic focus areas of our business model to ensure the operational readiness of the U.S. nuclear weapons stockpile as:

- **Directed Stockpile Work:** All activities that directly support specific weapons in the nuclear stockpile as directed by the Nuclear Weapons Stockpile Plan. These activities include current maintenance and day-to-day care of the stockpile, as well as planned refurbishments as outlined by the Stockpile Life Extension Program (SLEP). Additionally, this category includes research, development and certification activities in direct support of each weapon system, and long term, future oriented research and development to solve either current, or projected, stockpile problems.

- **Campaigns:** Focused scientific and technical efforts to develop and maintain critical capabilities needed to enable continued certification of the stockpile for the long term. They are technically challenging, multi-function efforts that have definitive milestones, specific work plans, and specific end dates. The campaign approach was begun several years ago in planning and executing the stewardship program. There are currently 17 planned campaigns.

- **Readiness in Technical Base and Facilities (RTBF):** The physical infrastructure and operational readiness required to perform both directed stockpile work and campaign activities. It includes ensuring that facilities are operational, safe, secure, compliant and that a defined level of readiness is sustained at Defense Programs (DP) funded facilities. It is crucial that government-owned contractor operated facilities be adequately funded for the complex to deliver what the Nation needs for nuclear deterrence. No weapons work or other activities can take place unless the infrastructure is in place and ready for business providing a modern, appropriately equipped workplace with modern safety measures.

Each of these categories covers work at all of the weapons laboratories, the plants, and the Nevada Test Site, as well as work done at other major research facilities.

Another business practice introduced this year by DP was the establishment of a rigorous planning process that clearly lays out within each business line firm programmatic milestones to be achieved within each element of Stockpile Stewardship. The complete program is now defined by a series of program plans that have a five-year planning horizon, each with an accompanying annual implementation plan. Five-year program plans describe the goals and objectives of program elements, and annual implementation plans provide detailed sets of milestones that allow for accurate program tracking and improved oversight.

The rigorous planning that has been done, is key to better management, improved focus and sustaining the laboratories as premier scientific and engineering institutions, as well as supporting balanced manufacturing activities necessary to maintain and modernize the stockpile.

Within this business model structure, we have laid out an improved plan, weapon by weapon, part by part, that addresses the tasks required to maintain the stockpile over the next one, five, ten years and beyond. We have support for our program from the Department of Defense (DoD), and the Administration has committed to funding this program and all its parts.

In addition, we have established an Office of Project Management Support to serve as the focal point for all critical construction decision and performance reviews. It will conduct project readiness reviews and provide technical experts to assist line managers in project planning and execution. It will also serve as a single point of contact for construction policy and procedures, working with program offices and field elements to improve and standardize construction management within Defense Programs.

A key element of the Stockpile Stewardship=s continued success is an effective corporate level strategic planning process. I am pleased to advise you that we are on schedule to transmit the Fiscal Year 2001 Stockpile Stewardship Plan (SSP), also called AThe Green Book@ to the Congress by March 15, 2000. In the development of the SSP, we rely heavily on the DoD, the National Security Council staff, the Office of Science and Technology Policy, the Office of Management and Budget (OMB), and other senior policy officials in the Anuclear community@ to help ensure that we continue on the right track.

Accomplishments

In October 1999, Secretary Richardson ordered a review of the health and status of the nuclear weapons complex; and of the status of recruitment, retention and training of top scientists and engineers needed to sustain Stockpile Stewardship. The principal finding of this internal DOE review is that Stockpile Stewardship is on track, both in terms of specific science, surveillance, and production accomplishments and in terms of developing a program management structure that improves the certification process.

Several of the findings of this review will help to shape future decisions in the program. We must continue to prioritize investments, schedules and resources. There are 15 specific actions that emerged from the report=s findings. Key among them is the need for DOE and DoD to refine the process for determining the scheduling of stockpile refurbishments over the next several decades to take into consideration military, human and budgetary needs. We are working with DoD to address this issue right now.

Let me give you just a few examples of how Stockpile Stewardship is already working today:

• In early February our Accelerated Strategic Computing Initiative (ASCI) announced the successful completion of the first-ever three-dimensional (3-D) simulation of a nuclear weapon Aprimary@ detonation using the IBM Blue Pacific supercomputer at DOE=s Lawrence Livermore National Laboratory (LLNL). On the supercomputer, this calculation ran for more than 20 days. A desktop computer would have taken 30 years to accomplish the task. Modern nuclear weapons consist of two main components: the Aprimary,@ or trigger, and the Asecondary@ which produces most of the energy of a nuclear weapon. The ability to Asee and understand@ the action of the primary is a critically important step in simulating the entire weapon detonation in three dimensions.

$ Subcritical experiments are being conducted at the Nevada Test Site to understand aspects of weapons physics and the aging properties of plutonium to help assess the stockpile, to help qualify the pit production facility at Los Alamos National Laboratory (LANL), and subsequently to certify our pit manufacturing. The subcritical experimental program also helps to ensure nuclear test readiness as directed by the President with the current underground test moratorium.

    $ Three subcritical experiments were conducted in FY 1999. We successfully conducted the first FY 2000 subcritical experiment on November 9, 1999. It was one of the OBOE series of experiments that are conducted in vessels in the same underground alcove. These experiments are somewhat simpler than the typical Afull-size@ subcritical experiment. Since that time, we have conducted two more experiments in the OBOE series to study technical issues.

    $ We plan to conduct 4 additional OBOE experiments this fiscal year, as well as one full-sized subcritical experiment, THOROUGHBRED, to measure early time dynamic behavior of special nuclear material. In FY2001 we tentatively plan to conduct one full-size subcritical experiment and several smaller experiments similar to the OBOE series.

$ In November 1999, the first successful hydrodynamic test at the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility provided a freeze-frame photo of materials imploding at speeds of more than 10,000 miles an hour, allowing scientists to study solids and metals as they flow like liquids, thus, become hydrodynamic, when driven by the detonation of high explosives.

$ On January 27, 2000, tests that are key to certification of the W76 Acorn gas transfer system were conducted in the Annular Core Research Reactor (ACRR) at Sandia National Laboratory - five days ahead of our earliest goal. The reactor and all diagnostics and data gathering equipment operated as desired. Initial evaluation of the required data that was obtained from the tests indicate good results for Acorn certification to the stockpile.

$ On August 12, 1999, the first lot of 24 War Reserve, W76 neutron generators were placed in inventory by Sandia National Laboratories (SNL), thus demonstrating the capability lost when our Pinellas plant was closed in 1994. Neutron generators are limited life components that help to initiate a fission reaction. Sandia is more than doubling neutron generator production capacity to reflect a request by the DoD to produce enough neutron generators to support both the active and inactive stockpiles.

    $ ASCI simulations have enabled the certification of the W76 neutron generator as the first radiation hardened component certified without underground testing.

$ The Kansas City plant has successfully begun production of tritium reservoirs and is meeting new production requirements for the W76, W80 and W88 warheads parts inventory.

$ The Y-12 Plant has resumed uranium processing operations in four of five major mission areas and in portions of the fifth. We are currently working on plans for the difficult resumption of enriched uranium recycle and recovery operations.

$ **Tritium production B** We have signed a 30-year, $1.5 Billion agreement with the Tennessee Valley Authority (TVA) for irradiation of tritium producing burnable absorber rods, that, as of January 1, made three TVA reactorsBWatts Bar and both Sequoyah unitsBavailable for tritium production to begin in October 2003.

    $ A contract for the assembly of the first 6000 Tritium Producing Burnable Absorber Rods (TPBARS) and follow-up fabrication work is expected to be awarded in the next few months.

    $ Site preparation and detailed design of a Tritium Extraction Facility (TEF) are underway at the Savannah River Site. To date, we have made up three months of the FY1999, 12 month Congressionally mandated moratorium on TEF construction. The facility is scheduled to begin delivering tritium gas to the stockpile in February 2006.

$ **Pit manufacturing B** In FY1998, Los Alamos National Laboratory fabricated development pits for the W88, demonstrating a capability that DOE has not had since the closure of the Rocky Flats Plant in 1989. We expect to produce the first pit qualified for stockpile use in FY2001. By FY2007, a limited capability to manufacture replacement pits for the units destructively evaluated during surveillance activities will be available.

- $ DOE has dismantled almost 12,000 weapons since 1990. Disassembly of the W69 was finished at Pantex in FY1999. DOE plans to finish disassembling the current backlog of retired weapons by the end of FY2005.

- $ The Secure Transportation Asset (STA) has met all shipment schedules, which currently average 1000 weapon and 4000 Limited Life Component shipments per year, insofar as direct stockpile maintenance is concerned. A further demand on STA is the need to ship an annual average of 3000 containers of fissionable materials from DOE sites scheduled for closure to other DOE and customer sites for disposal or remanufacture into fuel elements for nuclear reactors. Overall, STA has transported sensitive cargo more than one hundred million miles since 1975 without compromise of its security or release of radiation.

    - $ We have continued upgrades of the STA fleet with new safeguard transporters, secure communication upgrades, and new tractor replacements. Additional security enhancements have been directed in response to security guidance and recent analyses which will accelerate these upgrades and require more intensive agent training and recruitment of additional federal agents. We have included increased funding for this in FY2001.

By using Stewardship, we have already been able to solve some problems that in the past would most likely have required a nuclear test to resolve. We expect our ability to solve problems without testing to be greater as new tools and expertise come on-line.

Keep in mind that it has been nearly 11 years since we have manufactured a new nuclear weapon and over seven years since the last underground nuclear test, yet our confidence in the safety and reliability of the current stockpile remains strong. Nuclear deterrence for our Nation demands no less!

The People

At the heart of Stockpile Stewardship are the people who make it work. The Chiles Commission on Maintaining U.S. Nuclear Weapons Expertise offered 12 specific recommendations for action under four broad categories: national commitment, program management, personnel policies, and oversight. A key driver in the time frames within which we have been planning and executing the program has been the fact that scientists and engineers with nuclear test experience are nearing retirement age and will be leaving the program in large numbers over the next decade. To transfer the knowledge they have to a new generation is ***vital*** so that the role of testing in the process of maintaining our stockpile is well understood in all its dimensions. This means we must retain test experienced workers while we recruit and train new workers to make that crucial transition properly.

In addition, we are attempting to make that transition in a booming economy where technical expertise is highly recruited and rewarded in the private sector. The skill mix at the laboratories will shift away from nuclear test-based expertise toward a more science-based expertise for maintaining the nuclear weapons stockpile. At the production plants, there will be more emphasis on computer-and-network based design tools and advanced manufacturing techniques. These changes in skill mix are major recruiting and retention challenges facing us right now.

There are fewer opportunities to conduct exploratory research at the laboratories due to limits on Laboratory Directed Research and Development (LDRD), which has been a key source of new talent and training at the laboratories. A pay freeze implemented in the early 1990s has resulted in loss of market position for the salaries of scientists and engineers, especially in highly competitive areas such as information science and technology. Increased security requirements will also be a consideration. Such factors make it more difficult to recruit and retain top scientific talent for Stockpile Stewardship.

DP is addressing many of these issues, and others that have arisen, through actions to implement the Chiles Commission recommendations. Among them is a request for supplemental FY2000 funding to avoid further layoffs at the plants and to maintain critical skills. The FY2001 request provides stability in plant funding with some flexibility to address skill mix concerns. For the nuclear weapons labs, the FY2001 request maintains our commitment to balance the pace and scope of security requirements implementation with preservation of the research environment. To that end, a restoration of LDRD funding to 6 percent for FY2001 has been requested. The FY2001 budget also provides for stability in employment and increases in support for the varied work of science-based stewardship at the labs.

<u>How Stockpile Stewardship Works</u>

Let me briefly summarize the Stockpile Stewardship process and the challenges it now faces before I go into a more detailed discussion of program elements. Each year eleven samples of each type of weapon are returned from the active force and are disassembled, examined, tested, and analyzed for defects. As defects are found, their effect on reliability and safety is assessed. Some parts, for example, neutron generators and gas reservoirs, require replacement at regular intervals, as limited life components. Other parts of a nuclear weapon are made from radioactive materials which decay; and as they decay, both their own properties and the properties of other materials within the weapon may change.

Remanufacturing replacement parts for our nuclear weapons sounds simple enough, but since the time that many of the current weapons in the stockpile were originally manufactured, some of our production plants have been closed and manufacturing processes, techniques and standards have changed. We are more aware of health and safety, and are more concerned about waste. Today, replacement parts require even tighter production controls than the extraordinarily rigid standards under which the original parts were designed and manufactured. A nuclear weapon, less than the size of a small desk, has enough explosive power to completely destroy a modern city, and yet it must be able to survive extraordinary accidents with less than a one-in-a-million chance of exploding. Industrial materials advancements and new manufacturing processes make it difficult, if not impossible, to get exact replacement parts. Yet, we, in the nuclear weapons program, must produce replacement parts using modern material and processes that will still maintain the safety and reliability of our weapons while certifying their safety, security and reliability without underground nuclear testing.

As our stockpile weapons continue to age, we expect more parts to require replacement. Because new warheads have not been produced since 1989, we are not replacing old weapons with new ones. In about ten years, most of our weapons designers with nuclear testing experience will have retired. This means that when our newest system, the W88, reaches the end of its original design life in 2014, we may no longer have anyone with the test-based job experience to help us evaluate modifications that may be required due to aging at that time. Successfully dealing with this time factor is critical to the success of the Stockpile Stewardship Program.

Instead of an underground nuclear test, we can conceptually divide the explosion sequence into each of its parts, then test and analyze each of these separately. We plan to put all the data together into a computer calculation -- a simulation -- to see if the resulting performance is within its original specification. Each part of the simulation must predict the results of each of the separate tests, and where they exist, the results must be consistent with archived underground nuclear test data and research. These simulations will be validated with state of the art experimental tools such as the DARHT and National Ignition Facility (NIF). The grand challenge of stockpile stewardship, as well as these modern codes and experimental tools, we also hope, will serve to attract and maintain the cadre of outstanding technical staff.

Stockpile Life Extension and Surveillance

We are working closely with the DoD to finalize detailed plans to indefinitely extend the lifetime of each weapon system in the stockpile. The Stockpile Life Extension Program (SLEP) is DOE's planning framework for a proactive management of system maintenance activities. Under SLEP, options are developed to address potential refurbishment actions. These life extension options address: "musts"-- to correct known problems; "shoulds"B to prevent foreseeable problems; and "coulds"Bto improve safety, use control and other items given the opportunity while working Amusts@ and Ashoulds.@ These life extension options allow the DOE and DoD to anticipate and plan for future resource requirements such as workforce, skill mix, equipment, and facilities. These requirements provide the framework for our surveillance of the stockpile and stockpile research and development activities at our laboratories, for guiding our production plants in validation of new materials, and development and certification of new manufacturing processes.

The cycle is continuous and is closely integrated. Data and information from our surveillance programs and from the hundreds of experiments and simulations being performed, help to identify which parts of a weapon are aging gracefully, and which parts present current and potential future problems.

Stockpile surveillance has been a major element of the U.S. nuclear weapons program ever since the first weapons were put into service. Approximately 100 stockpile weapons are thoroughly examined each year. The results provide data not only for assessing the current safety and reliability of the stockpile, but also for developing predictive models and age-focused diagnostics required to anticipate weapons refurbishment requirements.

The Enhanced Surveillance Program (ESP) is developing the technologies and methods, as well as a fundamental understanding of materials properties and weapons science, to significantly improve detection and predictive capabilities. For example, the ESP identified an aging mechanism in a stockpile high explosive, ultimately concluding that the changes actually improved the stability of the explosive. This assessment is permitting us to reuse the high explosive during the W87 life extension program, thus avoiding significant costs. We have also embarked on a novel strategy to accelerate the aging process in plutonium. The capability to predict the lifetime of components made from plutonium will permit us to more accurately identify when pit replacements are needed and when the significant facility investments must be made in order to support pit replacement.

Technical work on the W76/Mk4 Dual Revalidation Project drew to a close in December 1999. There were significant accomplishments in each of its major areas of investigation.

$ **System Level Assessment** B The Military Characteristics and Stockpile to Target Sequence were reviewed and updated and the system was shown to meet requirements. The system also was assessed against safety requirements and for abnormal environments and successfully met them. Results from various tests are being used to validate new computational models, leading to an improved understanding that will be used for future assessments, evaluations and other analyses.

$ **Primary Physics Assessments** B Five hydrodynamic tests were completed, four by Los Alamos National Laboratory and one by Lawrence Livermore National Laboratory. Two of the tests used stockpile-aged high explosives. A modern one point safety assessment was completed that reaffirmed the safety margin calculated in previous assessments. A modern intrinsic radiation analysis was performed. Significant progress was made in baselining.

$ **Secondary Physics Assessment** B There is an improved understanding of the secondary. Significant progress was made in baselining and benchmarking of the secondary.

$ **Physics Package Engineering Assessment** B A test of the ability of the secondary to withstand the revised long-term shipboard vibration environment was completed and the results show it meets requirements. Extensive testing of the high explosive thermal sensitivity, chemical composition, and density properties was completed. An aged physics package was disassembled, inspected, and the aged components tested. A detailed description and catalogue of the function, composition, requirements, state, and design intent of each component was assembled.

$ **Arming Fuzing and Firing (AF&F) and Weapon Electrical System (WES) Assessment** B Nineteen AF&Fs were disassembled, inspected, and put through product acceptance testing. An age aware model of the fire set was completed and electronic sub-component models were developed. Most AF&F hostile environment testing is complete.

In addition to these specific accomplishments, the Dual Revalidation Project provided an opportunity to train many people within the DOE and DoD nuclear weapons communities. Engineers and scientists responsible for the system have developed in-depth experience. The project also provided significant contributions to the W76/Mk4 6.2/6.2A life extension study. The review team reports are scheduled to be submitted by the end of March, 2000.

DOE has redirected the Dual Revalidation effort into baselining and peer review. The decision was made to baseline all the systems over the next five years while designers with underground test experience are still on the payroll. After the systems are baselined, we will assess any gaps discovered in our knowledge and develop a plan to fill them in.

Manufacturing Capabilities

Manufacturing continues to play a critical role in the Stockpile Stewardship Program. During FY1999, almost 1300 Limited Life Components (LLCs) were produced. Plans call for the production of over 2000 LLCs in FY2000. These product deliveries signal the successful transfer of production activities from plants which have been closed. The weapons complex is also performing major refurbishment actions on several weapon types, including the B61and the W87.

The W87 is a key component of the U.S. land based ballistic missile element of the U.S. nuclear deterrent triad. In December 1998, the Y-12 plant at Oak Ridge completed and shipped to Pantex the first refurbished canned sub-assembly for the life extension program of the W87 under our Stockpile Life Extension Program. Early in 1999, the first deliveries of electronic and mechanical parts for the W87 life extension were shipped to Pantex from the Kansas City plant. The first W87 life extension unit was delivered to the Air Force in May 1999. The W87 was the first production unit completed under the life extension program. This is considered a major milestone in meeting a DOE commitment made to the Air Force.

ADAPT

The Advanced Manufacturing, Design, and Production Technologies Campaign (ADAPT) is providing the Nuclear Weapons Complex with advanced capabilities for: designing, developing, and certifying components and systems; and for producing, assembling, and delivering weapons components and products for systems. ADAPT is radically changing how DOE supports the nuclear weapons stockpile by infusing new product and process technologies, and by adopting state-of-the-art business and engineering practices. Our production complex must take advantage of modern design and manufacturing techniques to keep the complex vitally strong and capable under modern technology. We have now begun to use a Apaperless@ product realization system to quickly design and evaluate components prior to their release for production. Once released for production, the same paperless designs (computer models) are used to develop and drive manufacturing operations. This approach is already cutting cost and time while improving our ability to deliver ***extremely*** high quality parts. We have begun to use computer-based multimedia systems to guide production technicians on the shop floor and we expect to see quality improvements similar to those now being gained in U.S. industries using these methods, where manufacturing defects have been cut 60-90%. As an additional example, we are using models of the various operations in our production complex to identify and alleviate scheduling and operational bottlenecks. In one instance, we were able to remove a bottleneck in certain dismantlement operations, allowing us to cut in half the time required to complete dismantlement of a warhead being removed from the stockpile with no compromise in safety and security.

We remain committed to exploring a robust and world-class microsystems engineering capability at Sandia National Laboratories. This effort could allow us to both develop and exploit emerging technologies that show great promise for miniaturizing weapon components, improving their reliability ***and*** for maintaining a critical capability in radiation-hardened electronics needed to address potential safety, security and hostile radiation threat environments of the future.

Tritium

Every U.S. nuclear weapon requires tritium to function as designed. Because tritium, a radioactive isotope of hydrogen, decays at a rate of 5.5 percent per year, it must be periodically replenished. DOE has not produced tritium since 1988 and the current START I inventory will be sufficient only until about 2005, after which the five year tritium reserve will be reduced. Therefore, a new source of tritium will be needed.

In May 1999, the Department issued a Record of Decision that formalized the Secretary=s December 1998 announcement that Tennessee Valley Authority (TVA) reactors would be used to produce tritium. That decision was codified in the National Defense Authorization Act for FY2000.

Three TVA reactorsBWatts Bar and both Sequoyah unitsBwill be available to irradiate DOE designed, commercially manufactured tritium-producing rods. DOE plans to start production of tritium in TVA reactors beginning with the scheduled refueling of the Watts Bar reactor in October 2003. After irradiation, the rods will be shipped to the Savannah River Site where a new Tritium Extraction Facility is being built. The facility will extract tritium gas from the rods and send it to the existing Tritium Loading Facility. Extraction operations are scheduled to begin in February 2006, later than originally planned because of the Congressional restriction against tritium construction activities in FY 1999. Again, we have made up three months of this 12 month construction moratorium. The Tritium Extraction Facility=s operating capacity will be such that the five year reserve will be fully replenished in two to three years.

An interagency agreement between DOE and TVA went into effect on January 1, 2000. TVA, with DOE and commercial technical assistance, is preparing requests to the Nuclear Regulatory Commission (NRC) to amend the licenses of the TVA reactors to permit tritium production. TVA plans to submit those requests at the beginning of calendar year 2001. The NRC review of the license amendment cannot begin until TVA has submitted its application for amendment of the operating licenses for Watts Bar and the two Sequoyah units. TVA will be putting that license amendment package together during the rest of calendar year 2000, with assistance from its two fuel vendors (Westinghouse and Framatone) and DOE. Core analyses with production quantities of tritium rods, specific to the TVA reactors, will be developed by TVA's fuel vendors. TVA corporate and plant licensing and engineering personnel will also be performing analyses and preparing significant portions of the license amendment submission. This work is on schedule.

Also during FY2000, DOE will award a contract for commercial fabrication of 6000 tritium-producing rods. Thirty-two rods underwent an irradiation demonstration in the Watts Bar reactor over the course of a full reactor operating cycle that was completed in March 1999. The rods have been taken to a DOE laboratory and are currently undergoing a series of examinations. So far, the results of all examinations have been as expected. Site preparation and detailed design of the Tritium Extraction Facility are in progress this year. In FY 2001 we will begin construction of the facility building.

The Record of Decision on tritium production stated that the Accelerator Production of Tritium (APT) alternative would be developed as a backup tritium technology by completing engineering development and preliminary design. With the success of the commercial light water reactor (CLWR) program and with competing financial demands on other parts of Stockpile Stewardship, DOE has been forced to redefine the work associated with the APT, the backup tritium technology. Overall Defense Programs funding for FY2001 is constrained and there are other, higher priority activities that must be completed if we are to meet our primary national security commitments. In addition, the success to date of the commercial reactor tritium project has reduced the current need for a backup technology.

Consequently, we plan to work with the Congress in the FY2001 National Defense Authorization Act to suspend APT preliminary design work. Limited engineering development and demonstration activities at LANL will continue. In addition, DOE will explore the potential for a multi-mission accelerator program that could include tritium production and other uses of accelerators.

Experimental Programs

It is at the DOE's Los Alamos, Sandia, and Lawrence Livermore National Laboratories and at the Nevada Test Site that the science base of the Stockpile Stewardship Program is developed and applied. The experiment program is how, in the absence of nuclear testing, we divide the physics of the explosive sequence into each of its parts, and analyze each separately. Information that we have from the production and surveillance activities described previously, helps us to focus our experiments. Information from over 1000 U.S. nuclear tests also tells us what we don't know and where we need to fill in gaps in our knowledge through experiment and observation.

Thousands of experiments, large and small, are performed each year in support of Stockpile Stewardship. Subcritical experiments help us fill in gaps in empirical data on the high pressure behavior of plutonium; realistically benchmarking data on the dynamic, non-nuclear behavior of components in today's stockpile; analyzing the effects of remanufacturing techniques; understanding the effects of aging materials; and, addressing other technical issues. Information from these experiments will be key to qualifying the pit production capability at Los Alamos National Laboratory (LANL), as well as certifying the performance of weapons which will contain the replacement pits. These experiments also contribute significantly to the maintenance of the critical infrastructure and educational base of skilled personnel at the Nevada Test Site. In addition to helping us understand the effects of aging on plutonium, these experiments are key to our test readiness program.

With adequate tools, we can do a thorough job of investigating the first part of the nuclear explosion; that is, the implosion of the plutonium pit by high explosive, with non-nuclear experiments. We can measure a number of important features by taking X-ray pictures during critical parts of the experiment, and we can measure the time evolution of the implosion with arrays of contact sensors (called pins). We can then compare these pictures and time histories with calculations and with previous data from the more than 1000 underground nuclear tests and 14,000 surveillance tests. Ultimately, we require better pictures at multiple times to certify rebuilt pits and 3-D simulations of weapon performance. During FY1999, we conducted some 14 non-nuclear hydrotests at the Pulsed High Energy Radiographic Machine Emitting X-rays (PHERMEX) and related facilities at the Los Alamos National laboratory (LANL), and about 15 tests at the Flash X-Ray (FXR) and B851 Site 300 facilities at Lawrence Livermore National Laboratory (LLNL). In addition, we conduct up to 1000 less complex experiments per year aimed at preparing for larger tests and subcritical experiments, and for understanding high-explosives behavior and explosive effects on materials. In FY2000 and FY2001, we anticipate conducting a similar number of experiments with major radiography shots, primarily at the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility.

The DARHT Facility at Los Alamos National Laboratory, a massive, advanced X-ray facility, will examine an imploding pit model from two different directions at greatly improved resolution and will replace PHERMEX as the primary radiography machine at Los Alamos. The first axis of DARHT is now operational. In addition, under the auspices of the National Hydro Program, DARHT will perform some of the Livermore tests formerly done at FXR. The building to house the second axis of DARHT is complete, and the accelerator is under construction, due for completion in FY2002.

The FXR firing site has been shut down since early FY1999 for construction of the Contained Firing Facility (CFF) which will be completed in FY2001. FXR is currently being used for non-explosive, beam target development tests in support of the second axis of DARHT.

Experiments using the Los Alamos Neutron Science Center (LANSCE) are investigating proton radiography, a new technique in which proton beams from a linear accelerator are used directly in a novel approach to hydrodynamics-radiography that, if successful, could provide required additional information to our radiographic process of certifying pits. This technique is one of the candidate technologies being considered to make detailed, three-dimensional "motion pictures" of the implosion process. Smaller-scale dynamic proton radiography experiments have already been performed at LANSCE to address important certification issues (e.g., cold high-explosives performance), paving the way for validation of advanced explosives simulation models.

In 1998, the Z-pulsed power facility at Sandia achieved record X-ray energy and temperature levels. In 2001, we plan to conduct about 180 shots in Z in the areas of weapons effects, weapons physics and ignition. A major activity at Z during FY2001 will be the completion of installation of the Beamlet laser from Lawrence Livermore National Laboratory which will be used as a diagnostic on Z. This diagnostic will enhance investigations in all areas. The Inertial Confinement Fusion (ICF) program, in conjunction with the other stewardship campaigns, is currently developing detailed experimental plans to achieve ignition and to address other stewardship issues during National Ignition Facility (NIF) operations.

Construction is underway for the NIF, an essential element in the long-term success of the Stockpile Stewardship Program. NIF, the world's largest laser, will enable our scientists to generate conditions of temperature and pressure approaching those that occur in nuclear weapons. Demonstrations of how aged or changed materials could behave under these unique conditions will provide data essential to validate computer based predictions. Demonstration of the enabling technologies required for construction of the NIF are complete with the exception of: (1) final demonstration of laser glass production; and, (2) development of coatings that will not sustain damage at the laser energy levels required for ignition later in this decade. The NIF building is about 85 percent completed. The 10-meter diameter aluminum target chamber is installed in the building. The Optics Assembly Building used for final precision cleaning of the optical components to be installed in the laser's beampath, and the Central Plant and its cooling towers have been turned over to the laboratory for operation.

Integration, schedule and cost problems associated with the construction of the National Ignition Facility (NIF) were identified to DOE in late August of last year. On September 3, 1999, Secretary of Energy Richardson announced a series of actions to address these problems. In response, the Office of Defense Programs, DOE=s Oakland Operations Office, Lawrence Livermore National Laboratory, and NIF project management have been working together to put the project back on track as directed by Secretary Richardson. The NIF project method of execution is being changed to address the increased complexity of this state-of-the-art system, and cleanliness problems in assembling and installing the laser and target system infrastructure. As a result, assembly and installation of the beampath infrastructure system will now be managed and performed by industrial partners with proven records of constructing similarly complex facilities.

At the Secretary=s direction, an independent Task Force was formed by the Secretary of Energy Advisory Board (SEAB) to review options to complete the project and to recommend the best technical course of action. The overall conclusion in the Interim Report to the SEAB stated, AThe Task Force has not uncovered any technical or managerial obstacles that would, in principle, prevent the completion of the NIF laser system. Nevertheless, serious challenges and hurdles remain. The NIF Task Force believes, however, that with appropriate corrective actions, a strong management team, additional funds, an extension of the schedule and recognition that NIF is, at its core, a research and development project, the NIF laser system can be completed.@ The project is currently developing a new NIF baseline which will be certified by the Department and submitted to Congress by June 1, 2000. We will be working with the Lawrence Livermore National Laboratory management and internally within Defense Programs to get the project back on track. Your continued support of the NIF project, as a key element of the Stockpile Stewardship Program, is essential.

Simulation and Computation

Data from U.S. nuclear tests, from experiments and from surveillance and production activities, provide input to the Stockpile Stewardship Program supercomputers. Sandia, Los Alamos and Lawrence Livermore National Laboratories are collaborating on the supercomputing program. While advanced computing has always been a feature of the nuclear weapons program, the computing speed, power and level of detail required to certify existing nuclear weapons without nuclear testing has required an extraordinary collaborative effort that is breaking barriers undreamed of only five years ago.

The Accelerated Strategic Computing Initiative (ASCI) is developing the high-performance computational modeling and numerical simulation capabilities necessary to integrate theory, existing data, and new experimental data to predict results that can be verified and validated. The ASCI program, a collaborative effort between the Government and U.S. industry, is developing the world's fastest, most powerful computational and advanced simulation and modeling capabilities. These advanced supercomputers are needed to fully implement science-based methods and to assess and certify the safety, security, and reliability of the stockpile without underground nuclear testing.

Advanced computational capabilities that include application codes, computing platforms, and various tools and techniques, are being developed under ASCI and incorporated into ongoing stockpile computational activities. This technology is being developed at about twice the rate of commercial computing speed and power advances. ASCI has been highly successful in meeting its milestones and providing effective new tools to support Stockpile Stewardship. Information developed from other elements of the Stockpile Stewardship Program, such as NIF and our subcritical experiments, will provide the basic physics models and data for ASCI simulations.

At the end of FY1998, ASCI unveiled its second generation of computing systems. Two major systems capable of running in excess of three trillion operations per second (3 TeraOps) peak speed were delivered ahead of schedule and within budget. Blue Pacific, developed by IBM, is located at Lawrence Livermore National Laboratory (LLNL), and Blue Mountain, developed by SGI, is located at Los Alamos National Laboratory (LANL). These systems are each 15,000 times faster and have roughly 80,000 times the memory of the average personal desktop computer. Under the Blue Pacific program, a world record 1.2 TeraOPS was achieved on a hydrodynamics benchmark while a second benchmark run set a world record with 70.8 billion zones. NOTE: Zones are small volume elements into which a physical domain is divided for computational modeling.

On February 12, 1998, the Department announced the selection of IBM to partner with ASCI on the Option White 10 TeraOps supercomputer to be located at LLNL. Building upon the experience and knowledge gained with the 3 TeraOps Blue Mountain system, LANL is procuring a computational system that will achieve a peak performance level of 30 TeraOps by mid-year 2001. And the Department's first generation Option Red Intel computer system, installed at Sandia National Laboratories in 1996, has been upgraded with faster processors and more memory and is now operating in production mode at a peak speed of more than 3 TeraOps.

The ASCI Defense Applications and Modeling Campaign has recently completed the first three-dimensional simulation of a nuclear weapon primary explosion and has compared the results with the data from an underground test. This calculation, an important first step toward simulating a complete nuclear weapon, was performed by the Lawrence Livermore National Laboratory during December 1999.

Completion of the prototype ASCI burn code required to perform the above calculation was the first of an ambitious serious of mileposts required to achieve a high-fidelity simulation of a full nuclear weapon system by 2004. The code team at LLNL met this very difficult milepost on

schedule and with code capabilities that exceeded the established programmatic specifications. Future mileposts require a continued effort to extend this calculation to nuclear weapons secondaries and later to full weapons systems. At the same time, other mileposts address the advanced physics and materials models that will be required to achieve the highly accurate simulations that are needed in the absence of underground nuclear tests.
Weapons designers are already utilizing these new three-dimensional codes and the ASCI computer systems to support assessment of the stockpile. They have run simulations to support the certifications of the B61 modification and the W76 neutron generator. These simulations would not have been possible without the capability provided by the ASCI platforms performing at the TeraOps level. However, three-dimensional, high-fidelity simulation of a full weapon system and its performance, as defined by scientists and engineers at DOE national laboratories, will require a minimum of 100 TeraOps of computing capability.

The unprecedented computational power of ASCI is also being made available to selected groups in the university community through the Academic Strategic Alliances Program. In 1997, the Department awarded contracts to five major U.S. universities--Stanford University, California Institute of Technology, the University of Chicago, the University of Utah, and the University of Illinois. The work of the university teams is of similar difficulty and complexity to that needed for Stockpile Stewardship and will provide benchmarks by which we can assess the accuracy of our own work. These projects are expected to lead to major advances in computer simulation technologies as well as to discoveries in basic and applied science, areas important to ASCI, the broader Stockpile Stewardship Program, and other application areas. Applications being developed and run by the university teams are unclassified and deal with significant non-defense scientific priorities.

Technology Partnerships Programs

The Defense Programs Technology Partnerships Program, which has been restructured and directly integrated into Stockpile Stewardship activities, represents an important investment in near-term and future capabilities. The private sector has technical leadership in many areas that are critical to the nuclear weapons program. Technology Partnership Program initiated collaborations between the Defense Programs laboratories, plants and industry are contributing to all components of the Stockpile Stewardship Program. Developing these collaborations has been challenging but there are a number of successes. For example, a partnership between Sandia National Laboratories (SNL) and General Electric has improved SNL=s capability in the production of neutron generators, a critical weapons component. Another example is the Los Alamos National Laboratory collaborations with Dow Chemical and PPG on predictive modeling of materials aging. The ability to predict accurately material lifetimes and reliability has paramount consequences for the Nuclear Weapons Stockpile Stewardship Program and for major industrial challenges like aging effects on an array of materials from car frames and engine parts to medical implants. Measured progress in these partnerships remains beneficial to Stockpile Stewardship and to other national concerns.

Conclusion

Stockpile Stewardship is a one-of-a-kind endeavor. It is unique in that we are responsible for a product that everyone hopes we will never have to use. It is unique in the same way that the Manhattan Project and Apollo moon program were: innovative, creative approaches to something new under the sun with no margin for error. It is unique in that we are not making any new weapons, but are only maintaining existing inventory. We must continue both to maintain current models without total system testing, but also be prepared to return to design, production and testing if directed to do so by the President. Every year, our success on the job must be certified to the President. Our responsibilities and capabilities are often the focus of heated public debate and occupy a singular position in the formulation of foreign and defense policy.

On the other hand, Stockpile Stewardship involves many industrial processes common to private industry. We must be sure that product replacement parts continue to be available and that new materials and processes are compatible with maintaining our existing inventory in perfect working order without underground nuclear testing. To get the job done right, we rely on advanced scientific expertise, complex experimental capabilities, historic product data, and highly sophisticated computer calculations -- bottom line -- more high tech than many private corporations today. We have high level security and safety concerns, transportation needs, environmental responsibilities, downsizing requirements, workforce and training issues, cost-benefit trade-offs to consider, and other problems similar to those faced by private businesses, although in a unique context. And, as is usually the case in any business or government activity, our people remain the key to our success now and in the future.

Properly supported and carefully managed, I believe the Stockpile Stewardship program will continue to maintain, indefinitely, a safe and reliable stockpile without the need to conduct nuclear testing. I know of no other national security issue more important for our Nation in this new millennium of great challenges.

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