FY 1999 Report
of the
Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile

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November 8, 1999

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EXECUTIVE SUMMARY

The Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile was created by Congress to review and assess (1) the annual process for certifying stockpile reliability and safety, (2) the long-term adequacy of that process, and (3) the adequacy of the criteria to be provided by the Department of Energy for evaluating its science-based Stockpile Stewardship Program. The fundamental issue underlying these questions is: Can the Nation sustain confidence in its nuclear deterrence capability without returning to underground nuclear testing?

Sustaining confidence requires that national leaders continue to trust that nuclear weapons will work as specified if called upon in a time of crisis. This requires continued assurance based on quantitative assessments of weapon reliability and safety, combined with trust in the people, tools, and methods used to make these assessments and to find and fix problems in the stockpile. Confidence today relies heavily on the extensive test database for existing weapons. These test data will decline in relevance over time as weapons age and modifications are introduced. It therefore will become increasingly challenging to sustain confidence. The two main elements of the strategy to meet this challenge are the Stockpile Stewardship Program and the Annual Certification Process.

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The Stockpile Stewardship Program provides the people, facilities, tools, and methods used for judging the health of the stockpile, and for finding and fixing problems. The activities of the SSP include weapon surveillance, maintenance, laboratory and field-testing, flight-testing, computer simulation, scientific experimentation, and design and production activities. The SSP, if properly supported, promises to provide a degree of confidence in a credible nuclear deterrent, but it will not be known for at least a decade just how effective the program will be. In the meantime, sustained focus will be needed to ensure the program is given the best chance of succeeding.

The Panel advocates five supporting elements for stewardship, which together form the management and programmatic foundation necessary to execute the program successfully. They are:

A. talented, well-trained people
B. adequate weapons complex diagnostic and manufacturing capabilities
C. sound base of knowledge (scientific understanding)
D. effective and integrated management structures
E. national commitment to a robust program of hands-on, innovative work.

We urge leaders in the executive branch, Congress, and the Military Services to underwrite a long-term commitment to maintaining nuclear deterrence by taking steps

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Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile

A safe and reliable nuclear stockpile is in the supreme national interest of the United States. Having suspended nuclear testing in 1992, the Nation requires new approaches for maintaining our nuclear deterrent, in particular for certifying weapon safety and reliability, and for conveying to national leaders the confidence they can expect to have that the stockpile will continue to meet national security requirements. Central to these new approaches is the Department of Energy's science-based Stockpile Stewardship Program. To ensure the adequacy of this program, the President has directed the Secretaries of Defense and Energy to certify annually the safety and reliability of the stockpile, and to inform him whether there is a need to resume underground nuclear testing. [1]

This Panel was established by the Congress to assess whether these mechanisms to sustain confidence in our nuclear deterrent would prove adequate should the suspension of testing be extended indefinitely under the proposed Comprehensive Test Ban Treaty. Section 3159 of the Strom Thurmond National Defense Authorization Act for FY 1999 stipulates that an independent panel of private citizens shall review and assess (1) the Annual Certification Process, (2) the long-term adequacy of that process, and (3) the adequacy of assessment criteria to be provided by the Department of Energy for its Stockpile Stewardship Program.[2] This is the first of three annual reports to be provided in fulfillment of the congressional requirement.

We begin with a discussion of confidence in the stockpile – its meaning, its historical basis, and what is being done to maintain confidence (Section I). We then offer our initial findings and a few high-priority recommendations (Section II on Stockpile Stewardship and Section III on the Annual Certification Process). We conclude with discussions of the implementation of these recommendations (Section IV) and of the future direction for our assessment (Section V).

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1 President William J. Clinton, Address on the Comprehensive Test Ban Treaty, August 11, 1995.

2 Pursuant to the Strom Thurmond National Defense Authorization Act of 1999, Section 3159. The certification criteria are mandated in Section 3158 of that Act. Appendix B provides the Charter.

I. CONFIDENCE

The question that has guided the Panel's assessment is: Can the Nation expect to retain sufficient confidence in its stockpile of nuclear weapons supporting deterrence, while complying with the provisions of the Comprehensive Test Ban Treaty? The assumption underlying the Comprehensive Test Ban Treaty is that its prohibitions will make it more difficult for any nation to develop weapons or to maintain an existing stockpile of weapons. We are assessing the attendant risks to the US stockpile, taking into account the potential merits of the Nation's investments in the new tools and approaches for sustaining confidence.

Confidence in the stockpile has two dimensions. First is the quantitative dimension: Confidence requires trust in the estimates of weapon safety and reliability provided by the surveillance and assessment of weapon systems. Second, and at least as important, is a judgmental dimension: Confidence also requires trust in the ability of the people, methods, and tools available to find, assess, and fix potential problems in the stockpile.

Nuclear testing historically has made a vital contribution to each of these aspects of confidence. The "Tri-Laboratory Report," a history of nuclear testing, makes it clear that it is impossible to compartmentalize the contribution of testing.[3] Testing was part of a closely integrated engineering process, wherein all the pieces played a role supporting what, at the end, were subjective expert judgments. In developing new weapons, nuclear tests demonstrated the performance of developmental hardware. These were not full-up operational tests, but were used to validate major design decisions and to assess the impact of certain environmental factors on performance. Such tests did produce surprises -- reflecting the limitations in the ability of designers and their analytical tools to predict the effects of design changes. In maintaining the weapons stockpile, nuclear tests were used to confirm problems identified through surveillance or maintenance activities. Tests also validated the subsequent fixes. Nuclear tests were not designed to provide the basis for statistical validation of reliability; there were far too few repetitive tests for that.

While testing was never the sole source of confidence, the suspension of testing will nevertheless have pervasive effects. Confidence can erode in two main ways. First, confidence today is still dependent on the legacy of the nuclear test experience with current weapons, and over time this experience will become less relevant because there were no tests of weapons that were many decades old, i.e., of the age regime that our

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3 "Stockpile Surveillance: Past and Future," Sandia Report SAND95-2751, January, 1996.

stockpile is approaching. As the stockpile ages, nuclear components will change. It will be more difficult to diagnose existing or emerging problems in the current stockpile and, more importantly, to validate the associated remedies. From year to year the changes are expected to be slight, and the reduction in confidence small. Nevertheless, the cumulative effect of these changes and stretches could, after a number of years, result in quantitative assessments that are increasingly uncertain and fuzzy. This uncertainty could undermine confidence that each weapon will perform according to requirements, for example, that it will produce the required nuclear yield.[4] If the increase in uncertainty is not recognized, it could instill a false sense of confidence in the safety and reliability of the stockpile.

Second, the suspension of testing will inhibit the ability to certify new or replicated designs that may be required to replace aging weapons or to meet new requirements. New designs will not possess the test pedigree that provides an underlying basis for certifying existing systems. A major challenge for the weapons complex is to certify adequate confidence if the stockpile incorporates systems that have never been tested.

The Stockpile Stewardship Program (SSP) is the Department of Energy's science-based approach designed to address these uncertainties and sustain confidence. Through SSP, the National Laboratories are developing improved tools and assessment methods that are intended to sustain warranted confidence in existing nuclear weapons and to meet the grand challenge of assessing and certifying changes beyond current test experience. Appendix A provides a brief description of the SSP.

One of the architects of the Stockpile Stewardship Program has described the magnitude of the challenge as follows:

> [W]e are asked to maintain forever an incredibly complex device, … filled with exotic, radioactive materials, that must create, albeit briefly, temperatures and pressures only seen in nature at the center of stars; do it without an integrating nuclear test, and without any reduction in extraordinarily high standards of safety and reliability. And, while you're

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[4] Models for predicting nuclear weapon performance are engineering approximations that summarize highly complex phenomena. They are calibrated using available test and experimental data, but they lack the fundamental theoretical underpinnings necessary to extrapolate with confidence beyond observed experience. The effects of some changes in underlying circumstances can be predicted very well, others simply cannot be handled at all within the existing frameworks. A central goal of the Stockpile Stewardship Program is to provide additional experimental data to expand the capabilities of these models. Nevertheless, there is concern that new circumstances will arise with nuclear weapons that will create significant uncertainty in the use of available analytical tools. In such cases, the concern is not whether predicted performance is acceptable, but whether the prediction itself can be believed.

> at it, downsize the industrial complex that supports this enterprise by a factor of two, and stand up critical new manufacturing processes.[5]

SSP has set ambitious goals, and this entails two distinct kinds of risk. First, there can be no guarantee that the needed scientific advances will be accomplished in time to sustain confidence without testing. The second is the more subtle risk of false confidence, described above.

At the same time, Stockpile Stewardship, if properly formulated and supported, could provide a degree of confidence in a credible nuclear deterrent. It will not be known for at least a decade and probably longer just how effective the Stockpile Stewardship Program will be. In the meantime, sustained focus will be needed to ensure the Program is given the best chance of succeeding. In this year's report the Panel therefore focuses primarily on some of the management and programmatic groundwork necessary for executing the program. Section II provides our findings and recommendations.

The Annual Certification Process was mandated by the President in 1995 in order to provide an independent review of the ability of the weapons complex to sustain confidence without returning to testing. The President is apprised annually on the safety and reliability of the stockpile, and on whether any problem has arisen that requires testing during the next year. The process draws on technical assessments performed by the National Laboratories, which are reviewed by the Military Services, the Strategic Command, and the headquarters of the Departments of Energy and Defense. Appendix A describes the Process.

The Annual Certification Process provides an opportunity for stockpile's stewards to sustain and build trust both in the Stockpile Stewardship Program and in the reported assessments of the stockpile. It should be strengthened and broadened to better play this role. Annual certification should serve dual purposes: First, scrubbing the assumptions and data of the stewards who have day-to-day responsibility for maintaining, assessing, and fixing problems in the stockpile. Second, conveying to national leaders an unvarnished assessment of the current state of health of the stockpile, along with a recommendation as to whether or not a nuclear test is needed. This perspective forms the central theme of our assessment, and the basis for our findings and recommendations on Annual Certification in Section III.

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5 Speech by Victor Reis (Assistant Secretary of Energy for Defense Programs) at Sandia National Laboratories, January 19, 1999.

II. FINDINGS AND RECOMMENDATIONS – STOCKPILE STEWARDSHIP

The SSP is designed to provide stewards with improved tools and methods for maintaining and assessing the stockpile, and fixing any problems identified. Science-based stewardship will require experimental and diagnostic facilities, such as the Dual Axis Hydrodynamic Radiographic Test Facility, the National Ignition Facility, and new computational tools enabled by the Accelerated Strategic Computing Initiative. But stewardship entails much more than these flagship programs, and these tools will be effective only if the overall program also succeeds in developing the people, facilities, and knowledge necessary to identify and fix problems.

This Panel therefore advocates five supporting elements for stewardship, which together form the management and programmatic foundation necessary to execute the program successfully. These five elements reflect and underscore the recommendations of the Commission on Maintaining Nuclear Weapons Expertise chaired by Admiral Chiles (USN, ret.) and the Defense Science Board (DSB) Task Force on Nuclear Deterrence chaired by General Welch (USAF, ret.), as well as earlier reviews of the weapons program that have delineated requirements for science-based stewardship.[6] They are:

A. talented, well-trained people
B. adequate weapons complex diagnostic and manufacturing capabilities
C. sound base of knowledge (scientific understanding)
D. effective and integrated management structures
E. national commitment to a robust program of hands-on, innovative work.

We urge leaders in the executive branch, Congress, and the Military Services to underwrite a long-term commitment to maintaining nuclear deterrence by taking steps

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6 Admiral H.G. Chiles USN (ret.), Robert B. Barker, Charles B. Curtis, Sidney D. Drell, Roland F. Herbst, Robert A. Hoover, Henry W. Kendall, and General Larry D. Welch USAF (ret.), *Report of the Commission On Maintaining United States Nuclear Weapons Expertise, (Washington, D.C.,* March 1, 1999).

General Larry Welch USAF (ret.), Jeffrey Cooper, John Foster, Donald Hicks, Maj General Ralph Jacobson USAF (ret.), John Nuckolls, Michael Pillsbury, General Jack Vessey USA (ret.), Richard Wagner, George Whitesides, and Colonel William Smith USAF, *Report of the Defense Science Board Task Force on Nuclear Deterrence*, Office of the Undersecretary of Defense for Acquisition and Technology (DoD, Washington, D.C., October, 1998).

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now to maintain and reinforce each of these five elements. Our initial observations and some high-priority recommendations are outlined here.

A. TALENTED, WELL-TRAINED PEOPLE

The judgment of the current stewards was built through their extensive experience with each weapon system, often throughout its entire cycle of design, development, testing, production and stockpile life. This rich reservoir of knowledge is the underlying basis for confidence in current certification activities. A major challenge for the future will be to attract, educate, and train the next generation of stewards, who will be responsible for assessing, maintaining, manufacturing, and certifying these weapons in the future. They will not have the same kinds of experience as the current generation of stewards, and new ways will be needed for them to earn the trust of national leaders.

The March 1999 Chiles Commission Report described the central role played by such key personnel in the weapons program, and discussed the challenges associated with recruiting, hiring, training, and retaining them. We concur with the Commission's findings and its recommendations.[7] We intend in our subsequent work to track the steps being taken to implement these recommendations.

Some of the Chiles Commission's findings and recommendations are particularly relevant to the Panel's concerns. Their report emphasized the importance of transferring knowledge and understanding from the current generation of stockpile stewards to the next generation. A key challenge in sustaining confidence in the stockpile is to build the judgment of capable people who will be able to address the complexities and subtleties of stewardship and the Annual Certification Process. It is essential to establish effective mechanisms to train a new generation of stewards to take on these responsibilities.

Today's stockpile stewards have gained the trust of the national leadership through their years of demonstrated success in a robust program of weapons work, including designing, developing, nuclear testing, manufacturing, and maintaining the stockpile. This trust was also based on the integrity and diligence of the stockpile stewards, as well as by the vigorous peer review among the design laboratories. In the future, without underground testing, building trust in new generations of stewards will depend more than ever on exercising and testing their competence and judgment through ongoing programs, and by designing programs and processes to foster continued integrity, diligence, and vigor.

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[7] The Commission's recommendations for personnel policies were to: Establish and implement plans on a priority basis for replenishing essential technical workforce needs in critical skills; Provide contractors with greatly expanded latitude and flexibility in personnel matters; Expand training and career planning programs which are adapted to the dramatically changed workforce environment; and Expand the use of former nuclear weapons program experts.

The job of future stewards will be different from past stewards. The emphasis will be on a more comprehensive understanding of weapon phenomena. The capability to produce new designs will need to be maintained without testing and fielding those designs. New regions of the weapon design space will need to be explored if consideration is given to replacing warheads with new designs. Actual design, development, and production work is key to training the next generation of stockpile stewards.

B. ADEQUATE WEAPONS COMPLEX CAPABILITIES

Sustaining confidence in the nuclear stockpile requires maintaining a weapons complex that is fully capable of maintaining and assessing weapons, and fixing problems that arise. Criteria for assessing facilities should encompass planning and analyses for the full range of future needs.

Important gaps in the Nation's weapons production capabilities need to be restored to re-establish the capability to repair, refurbish, or replace essential components. Plutonium pit manufacturing is an area of special concern. The Defense Science Board Task Force on Nuclear Deterrence found that under reasonable assumptions regarding the useful life of plutonium, it will be necessary to begin to manufacture these components at much higher rates than will be feasible at the Los Alamos plutonium facility.[8] This could become a critical limitation in the ability to maintain the stockpile if action is not taken soon and if pits degrade sooner than now anticipated. It is essential to act now on the recommendations of this study.

The Panel's concerns stem from the high degree of uncertainty in the current understanding of the useful life of plutonium pits, combined with the significant challenges and uncertainties involved in getting a new production facility built. In March of this year, the Department of Energy told Congress that its best estimate of pit life ranges between 45 and 60 years, but these estimates remain highly judgmental and problems could arise that would require the production of replacement pits before current weapons reach that age.[9] A number of weapons in the enduring stockpile have pits that

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8 The Task Force recommended that initial planning factors be established for the production complex that would be based on optimistic, but supportable, assumptions about the success of START II and START III implementation and estimates of useful pit life.

9 The Panel is concerned by the evident uncertainty in the current understanding of pit life, and the profound risks to the stockpile should widespread problems emerge before an adequate production capability is established. A year ago, in the NWC PA&E review on Pit Production, dated Sept 1998, the estimated useful life ranges from 30 years to perhaps as high as 100 years. The DoD-DOE Report on Long-Range Planning on Pit Production to Congress, dated March 1999, said that nuclear weapons scientists have estimated the conservative and nominal pit life to be 45-60 years. (Even lower estimates were briefed to the Panel.) But, it must be emphasized that the weapons community has no hard

are already approaching twenty years of age, and more. The Nation cannot afford to postpone the development of facilities capable of the timely replacement of pits.

Estimates of the time to build new plutonium facilities range from seven to ten years, upwards to 15 years, or more. The political and environmental issues that will need to be resolved before work on a new facility can begin may exceed the technical challenges in establishing a new production facility. A prudent approach to address these risks is to begin the conceptual design phase for a modular facility that can later be sized to suit the volume of production required. Such conceptual design work could be initiated at the cost of a few million dollars a year, and would provide a valuable hedge against the risk that this production facility will be needed sooner than is currently anticipated.

***Recommendation 1*: Immediately begin the conceptual design phase of a pit production facility adequate to meet national security needs.**

The Panel is also concerned that facility deficiencies must not impede the flow of needed weapon surveillance data. Facility deficiencies identified in the FY 1999 Annual Certification Process included limited availability of test facilities used in weapons surveillance and flight tests, and in certifying new components. Even though DOE is currently working off the backlog of surveillance testing, this issue merits priority attention at high levels in both DOE and DoD. We believe that these issues should continue to be raised and addressed through the Annual Certification Process. We also will pursue this issue further in subsequent reports.

In another area of long-standing concern, the Department of Energy took an important step forward last year when the decision was made to proceed with a new source of tritium. We are encouraged that this decision was made, and that the approach selected reflects a prudent allocation of DOE funds.

C. A SOUND BASE OF KNOWLEDGE

The third technical foundation for stockpile stewardship is the knowledge and data accumulated over the years from the weapons program – which, when combined with non-nuclear experimental results and analytical tools and simulation models – provide the basis for assessing and predicting weapon performance.

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evidence on the properties of plutonium pits in these age ranges, and the accelerated aging studies to better estimate the useful life of pits are still underway. The results of these studies will begin to be available in 2003.

The Panel is encouraged by the existing knowledge-retention activities such as Dual Revalidation, re-baselining, and data archiving, but believes that the current allocation of resources for such programs is too limited to match the importance, the scope and the urgency of the archiving task. Efforts must be accelerated to retain this base of knowledge before it is lost.

Recommendation 2: ***Accelerate efforts to understand and preserve test, development, and production data and insights.***

There are several dimensions to this recommendation.

1. Dual Revalidation

Dual Revalidation was initiated for the W76 Warhead, used in the Trident C-4 weapon system, in order to provide a thorough review and reassessment of the warhead's design and test data using modern engineering and computational methods. The process involved intensive peer review involving all of the laboratories, which in turn created a rigorous environment and shared learning. There is broad consensus that Dual Revalidation provided valuable learning, but there also has been concern with the time and resources it required. The W76 program took about three and a half years. This is clearly too long. At that rate, more than 30 years is needed to do a complete cycle through the stockpile. Moreover, not only did the process take too much time, it also demanded too much effort from people whose involvement is most critical to other hands-on stewardship tasks.

We urge that Dual Revalidation be continued, albeit with significant improvements in efficiency in order to speed the work and reduce the demands on the staff of experienced weapon designers. As an alternative to Dual Revalidation, the proposed re-baselining program would undertake similar tasks at a lower scale of activity. In our view, re-baselining is too limited, and lacks true peer review. The essence of Dual Revalidation is important and should be preserved in whatever form is appropriate, given time and resource constraints.

2. Archiving of Legacy Data

Despite its importance, archiving perennially seems to fall victim to other tasks that are deemed more urgent. We suggest, however, that this is a key stewardship issue. As time passes, important information disappears: test-experienced designers retire, and valuable documents are destroyed. In short, the need to act is immediate, but the urgency is not recognized because most of the consequences of inaction are in the future.

The legacy data of greatest concern, of course, are the data derived from nuclear testing. The re-baselining activity nominally addresses this issue. However, the present scope of this activity covers re-calibrating computer codes for weapons currently in the stockpile, and the collection and preservation of data is done only as needed to support this activity. The understanding and preservation of the test legacy information needs to proceed on its own merits, with as broad a scope as is reasonably possible.

The production complex also houses vital data that must be preserved.

The DOE should study the potential for additional forensics activities involving weapons that are being retired, and prepare a report reflecting analytical details. Such weapons could provide a valuable source of information on the effects of aging. As weapons are retired, they could be assessed for signs of aging or other problems in order to gain insight into the kinds of effects that could be relevant to the newer weapons in the active stockpile.

3. Validation and certification of emerging simulation codes

In future reports, the Panel intends to review activities for the verification and validation of the computer simulation codes that will be used to assess weapons in the future. Computer code validation will be essential in future certification.

Stockpile stewards must assure that the computational models properly represent the data from the experiments performed under the SSP. There are tens of thousands of equations and numbers embedded in existing codes. Some of these data are based on dependable laboratory experiments and nuclear tests, some on detailed theoretical calculations, and some are based on a rough guess. Because the codes have evolved over many years, their use depends on the judgment of analysts with years of detailed experience. Legacy data, as well as data from new experiments, must be used to validate new computational models. This will be challenging from both a technical and a management perspective.

D. EFFECTIVE AND INTEGRATED MANAGEMENT

The Department of Energy needs to address the internal management practices that have repeatedly been cited as counterproductive to the weapons program by external review groups, including the Galvin Commission, the 120 Day Study, and the Chiles Commission. Current Congressional support for reorganization may provide an opportunity to make needed changes. The key management principle that has been urged upon the Department is the integration into line management of all significant functional responsibilities, including safety and security. The Department has suffered from the diffusion of these functions across a range of staff and line organizations, leading to clouded lines of authority and blurred responsibility and accountability.

1. Management of Security Initiatives

Today, security problems within the weapons complex provide a pressing management challenge. Security is critical to the weapons complex's national security mission. These problems need to be fixed quickly and effectively. Stopgap steps are important to change direction but are not likely to provide long-lasting solutions. Despite some obvious and serious neglect of security, the great majority of the laboratory staffs are dedicated and conscientious in their adherence to security mandates. Inappropriate censure, or a hostile counterintelligence environment, will make it impossible both to do the work at hand and to retain or attract the required talent. In short, the security problems at the laboratories need to be addressed while maintaining the focus on staffing them as premier scientific institutions.

The issues that must be resolved in addressing security concerns today have strong parallels in the development of an integrated safety management approach earlier in the decade. Authority and responsibility for addressing these concerns must be placed in the hands of line managers. Harmonious and effective implementation of security and counterintelligence measures needs to flow through the same chain of authority as do the other management decisions. The institution of a high-level security position within DOE's Defense Programs can help to raise the issue of security, and can also be valuable in providing support and expertise to the field activities that need it. But this measure will not suffice — indeed, it will be counterproductive — unless it is understood across the weapons complex that security is a line responsibility, and the line managers have the authority to execute that responsibility and will be held accountable.

The leaders within the weapons complex need to teach their people the importance and proper practice of assuring security of classified information. Part of their education needs to deal with the methods by which traitors are recruited and the outcomes for those who betray. DOE's new security leadership can and ought to make this kind of resource available.

2. Management of External Reviews

The SSP is, as we have indicated, a true paradigm shift for the weapons program – both culturally and technically. This shift has required considerable coordination between the laboratories, their oversight, and external reviewers. These reviews divert needed effort from other essential weapons work. Designers are supporting dual revalidation and other data archiving activities, the design of robust warheads, weapon surveillance and annual certification, and the training and mentoring of new generations of stewards. Oversight can be made much more efficient. The Secretary of Energy should manage both the external and internal oversight burdens on the weapons complex. Activities should be

ruthlessly examined with the burden of proof of value resting squarely on the oversight activity.

E. NATIONAL COMMITMENT TO A ROBUST PROGRAM OF HANDS-ON, INNOVATIVE WORK

The Panel shares the conviction of the Chiles Commission and the DSB Task Force on Nuclear Deterrence that the success of stockpile stewardship requires sustained commitment at all leadership levels, including the President, the Congress, the Secretaries of Defense and Energy, the Military Services, and the laboratory and facilities directors. The Stockpile Stewardship Program must be given time to work, and resource allocation should reflect a shared view of programmatic priorities.

We emphasized earlier the Chiles Commission's finding that training new generations of stewards requires an ongoing program of hands-on, innovative work. Priorities and available funding must support such activities. The nuclear weapons complex should work on a range of design and development tasks that exercise and sustain the capability to produce new weapon designs. This provides both a broader set of technical options to meet future needs, and a program for training new generations of stewards.

***Recommendation 3*: To hedge against future uncertainties, the Stockpile Stewardship Program should include the capability to replicate or design replacement nuclear weapons, for our most critical nuclear systems, that will**

- ***Have a long shelf life***
- ***Be at least as safe as current weapons***
- ***Provide a high degree of confidence that the weapons are acceptably reliable without full scale nuclear testing***
- ***Be manufacturable***

This recommendation would build on the ongoing Warhead Protection Program, and expand it to cover a wider range of warheads and design teams. The Warhead Protection Program has its roots in a DoD/DOE Study on alternative warhead designs for Navy submarine-launched ballistic missiles. The resulting SLBM Warhead Protection Program (SWPP) began in April 1995. Under this program, Los Alamos is working on the design of a replacement warhead that would use a newly manufactured pit, and Lawrence Livermore is working on a replacement warhead that would re-use an existing pit. Sandia is working on a new arming, fuzing, and firing system. Currently, there is no commitment to produce hardware under the Warhead Protection Program. Nevertheless,

the program will provide options for extending the service life and increasing the safety margins for submarine-launched warheads. The program also serves the Stockpile Stewardship Program's objectives of maintaining and exercising DoD and DOE capability and expertise to design, develop, fabricate and certify replacement weapons components, subsystems, and systems.

Another important way to hedge against uncertainty is to retain a selected degree of overlap in capabilities within the weapons complex. Maintaining a variety of weapon designs, labs, production, and experimental facilities is essential for the current and future health of the Annual Certification Process and of the stockpile itself. A variety of approaches to stewardship in general and surveillance in particular will reduce the likelihood of problems escaping unnoticed. Maintaining separate, multiple teams supports a vigorous, competitive environment, facilitates peer reviews, and ensures diversity in scientific and engineering approaches.

The Annual Certification Process itself provides an important opportunity for leaders to show their interest and commitment. One excellent example of how this has been done is the USSTRATCOM Strategic Advisory Group's Stockpile Assessment Team (SAT) annual briefing to the Commander of the Strategic Command. This annual event provides incentives and encouragement to the team's participants, and underscores the Commander's personal involvement in maintaining the nuclear stockpile. Another important example was set when the Secretary of Energy met with his staff to receive briefings on the 1998 Annual Certification Process.

Finally, although the Panel has not done an in-depth examination of the funding for SSP, we are concerned that some important activities must be assigned a higher priority in the budget process. There is a need for the Administration and Congress to agree on priorities within the total budget allocation. Some key areas discussed earlier in this section should receive higher priority in executing the current year's budget.

<u>Recommendation 4</u>. The DOE should assign high priority and the appropriate FY 2000 and future year funding to support these urgent program:

- ***-- Pit production planning***
- ***– Alternative, robust weapon designs***
- ***– Archiving***
- ***– Surveillance activities***

III. FINDINGS AND RECOMMENDATIONS — THE ANNUAL CERTIFICATION PROCESS

The Panel has reviewed certification documents, received briefings from the certification process participants, and observed some of the current year's deliberations. Laboratory and government officials and former weapon designers have engaged in forthright discussions with us concerning the present and future of certification and the Stockpile Stewardship Program. In addition, we drew on prior studies of the weapons complex and nuclear deterrence issues in order to place its review in context and to develop an understanding of how the Annual Certification Process can and should address its central purpose. That purpose is to support nuclear deterrence by sustaining confidence in the nuclear stockpile on the part of the stockpile stewards, the national leadership, and potential adversaries.

A. THE CURRENT PROCESS

The Panel finds no reason to question the findings to date of the Annual Certification Process – the process appears to have met certification challenges. Today's Annual Certification Process, as described in Appendix A, is consistent with the near-term stockpile stewardship strategy of maintaining existing weapons in conformance with their design specifications. To date, modifications made in the nuclear components of stockpile weapons have been within the range that can be assessed with available tools and methods, and no nuclear components have aged to the point where their physical properties are beyond the range of previous experience. Under these circumstances, weapons experts have been willing to certify weapons without resorting to additional testing.

It must be emphasized, however, that even in the relatively short period since the suspension of testing, concerns have already arisen and actions have been taken to change the design of weapons in the stockpile. If there were not a moratorium, nuclear tests would have been performed to confirm the validity of these actions. After careful review, the risks of making these changes without requiring a nuclear test were judged to be acceptable.

There are some important strengths in the execution of the current process. The laboratories, DOE, and DoD should be commended for their involvement and commitment to the process. It provides a focus and a sense of direction to the activities associated with the surveillance and maintenance of the stockpile. It has been effective also in bringing together the community, including the laboratories, as well as military

and civilian officials from both DOE and DoD. Their participation has established a common understanding at the technical level of the status of the weapons stockpile.

The involvement of the Commander of the Strategic Command with the support of his Stockpile Assessment Team (SAT) is a valuable element of the process. Their participation provides an independent review of the work of the laboratories in assessing and certifying the stockpile. This group comprises senior individuals with strong backgrounds in the nuclear program; they ask tough questions and can interact effectively with the laboratory experts responsible for weapons certification.

It is encouraging to see that participants are looking ahead to understand and prepare for future certification challenges. These discussions provided context for the SAT's FY 1999 review, and began to lay the groundwork for the SAT to address future certification challenges. For example, in 1999 the SAT spent a full day with laboratory and government officials reviewing future certification issues and DOE programmatic thrust areas. Among the topics discussed were the Enhanced Surveillance Program, Plutonium aging studies, and DOE's programmatic "campaign" areas.

While the current process has strengths, it needs to be strengthened further and broadened. The next section presents our recommendations.

B. LONG-TERM ADEQUACY OF THE ANNUAL CERTIFICATION PROCESS

Many participants in the Annual Certification Process have observed that the real tests of its long-term viability will probably not occur for some time to come – perhaps a decade or even more as significant changes may occur in the nuclear components of the current stockpile of weapons. There is little doubt that the challenges to the Annual Certification Process will grow over time – and the process needs to be made ready to address them.

There are at least three concerns about future confidence.

First, nuclear weapons age. Many materials used in nuclear weapons change chemically over time. Of greatest concern is the subsystem that is essential to nuclear weapon performance, its "pit." Due to its radioactivity, the pit changes in both composition and structure as it ages, a change that is slow but inevitable. The functional lifetime of a pit is not known accurately, but eventually all of the pits in weapons that remain in the stockpile will need to be replaced. Certifying replacements for aging pits will present a difficult challenge, because the industrial base to manufacture pits was eliminated with the precipitous closure of the Rocky Flats facility with no plan to transition the capability elsewhere.

The second reason for diminishing confidence goes to the future stewards themselves. There is concern that, whatever scientific progress is made, certification

challenges will also arise in transitioning leadership of the Annual Certification Process to future stewards. Certification methods will have to be adapted to assure the capabilities and experience of the new generation.

Third, there is always the possibility of "surprise." The surprise could be the emergence of a new threat technology or a military need that would require new capabilities to be added to the stockpile. It could also be the discovery of a previously undetected internal defect in a weapon system.

Given these challenges, the United States must remain ready to test nuclear weapons. Further, the Annual Certification Process must be capable of providing credible and compelling justification when and if the resumption of testing becomes essential. The needed changes to the Annual Certification Process are outlined in the following two sections.

1. Strengthening Annual Certification

As certification challenges grow, the Annual Certification Process will convey confidence only if national leaders are convinced that it aggressively seeks to identify and report problems with the stockpile. An "all's clear" report after a thorough scrubbing is the best that national leaders can hope for in ascertaining the safety and reliability of the stockpile. From their external perspective, they will want to know that experts have aggressively questioned the assumptions and conclusions of the stewards who are responsible for the day-to-day maintenance of the stockpile.

More incentives must be provided to aggressively seek problems and find solutions. If the goal is just to certify, then there is reason for concern that the process could, in the future, degenerate into a "looking-good" exercise, in which tough questions are not asked and risks are downplayed. Similarly, there must be no cost or penalty associated with delivering the "wrong" answer to the certification question from a political or other non-technical perspective. It must be clear to the assessors that the only criterion for correctness is the capability of the stockpile to meet military requirements without testing.

The needed changes in the Annual Certification Process are outlined here. Several specific aspects of the needed process are outlined in the following paragraphs.

<u>Recommendation 5</u>. Strengthen the Annual Certification Process so that it (a) more aggressively searches for potential problems, and (b) ensures the acceptability of certifying or not certifying a weapon.

- ***Laboratory Directors must ensure adequate resources and incentives to find potential failure modes in the stockpile***

- ***Successful certification means accurate certification, not necessarily favorable certification***
- ***The CINCSTRAT's Stockpile Assessment Team should be augmented with a small number of young experts in forensics, materials science, computing, and engineering***
- ***The Navy and Air Force should ensure that each and every Project Officer Group responsible for their nuclear systems has highly capable, experienced staff assigned, and is provided with adequate resources***
- ***Future certification reviews, reports, and letters should be classified.***

A stronger Annual Certification Process must be intensely focused on technical assessments that could result in either the certification or non-certification of a weapon on purely technical grounds. We have explored the possibility of setting forth a more quantitative analytic basis for certification decisions. We are encouraged by the fact that the laboratories have undertaken efforts to formulate such criteria. Nevertheless, expert judgment is, and will remain, an essential component of the Annual Certification Process. It is essential that non-technical or political issues, however important, not burden the subjective judgments of the experts. Those must be the exclusive provinces of the national leadership. In order to make their judgments, the political leaders must be sure that the technical judgments are just that: technical. Associated risks must be appropriately and accurately conveyed.

One area of concern is that the same detailed work underpins the certification reviews performed by the Secretary of Energy, the Nuclear Weapons Council, and STRATCOM. There is no detailed review of this work above the level of the military Services' Project Officer's Groups (POGs). In general, we believe a more thorough review of the technical basis for the Annual Certification Process is needed, and we will investigate options in our upcoming reports.

Among the Project Officer's Groups, there are differences in approach and in levels of expertise. The Panel is concerned that not all of the POGs responsible for total system performance meet the same standard for competence and experience, as do the best of them. The lack of experience within a POG sometimes weakens its role as an independent reviewer representing the military users' perspectives. The Panel believes the Air Force, in particular, should take steps to strengthen the POGs responsible for its weapons.

The Annual Certification Process also needs a greater degree of peer review and other independent assessments. Reviews provide a surrogate for the challenges to assumptions — and the risk of failure — which had been provided by nuclear testing. Fortunately, in maintaining Los Alamos and Lawrence Livermore as independent design

laboratories there already exists an environment where meaningful peer review can take place. Competition in the marketplace of scientific ideas is just as surely beneficial to the outcome as it is in the economic marketplace. For these benefits to be realized, a balancing of cooperation and competition is essential. This presents significant challenges to the DOE leadership, given the natural (and intended) internal tensions.

The Panel will also examine ways to ensure the same creative tension is sustained for the non-nuclear work performed by Sandia National Laboratories. Sandia systems need to be scrubbed as thoroughly as the nuclear laboratories' components, but without a sister laboratory, Sandia lacks the same kind of peer review as is provided for nuclear components. In addition, a weapon system cannot be examined only component by component; the integration of components and subsystems must be thoroughly scrutinized as well.

The STRATCOM Stockpile Assessment Team can play a stronger role in its independent review of the Annual Certification Process. We believe the team should begin to shape its approach for addressing the future challenges of annual certification. This presents an opportunity to begin to draw on a broader range of experts, and to bring younger scientists and engineers into the community, in order to introduce new perspectives and to challenge accepted practice and assumptions. The SAT should begin to enlist a small number of promising young experts in forensics, materials science, computing, and engineering to learn about and address Stockpile Stewardship issues.

Finally, it is also necessary to attend to unintentional aspects of the process that may create disincentives for reporting problems. One such example is the classification level of the certification documents. To date, all such documents have been provided through the Executive Branch, and by the President to Congress, at a level of classification consistent with their findings that no underground testing is required at this time. Had the findings been negative, a higher classification would have been required. This could, in the future, create a disincentive to report "bad news;" such disincentives need to be removed from the process.

2. Broadening Annual Certification

The Panel proposes a straightforward way to look at the intent and necessary scope of annual certification: it is to convey the information needed to instill confidence in the nation's nuclear deterrence capability. It is insufficient for that confidence – or lack thereof – to reside only with the weapons experts at the national laboratories; confidence needs to be instilled in the national leadership. In order for the stockpile to be the intended deterrent, possible adversaries must also believe the threat is credible. The

certification of confidence must convince the national leadership that everything necessary is in place to find and fix problems in the stockpile.

The current guidance for annual certification is too narrow to meet this broad requirement. Certification today focuses primarily on a snapshot review of the safety and reliability of individual weapons, and therefore does not address all of the elements of confidence. The Process needs to place more emphasis on reviewing more strategic issues for maintaining confidence in the stockpile. This requires that the process be expanded in a several ways.

Recommendation 6. Expand the Annual Certification Process to convey confidence in three dimensions:

- *The adequacy of people, tools, and methods for assessing future stockpile problems that may be outside the US nuclear test experience*
- *The capability of the weapons production and other facilities needed for identifying, assessing, and fixing problems*
- *The readiness of the complex to resume testing, if required, including test-readiness plans that identify the weapons that would be tested, the instrumentation, and an assessment of the potential value of such tests*

In the coming year, the Panel will explore mechanisms for conveying confidence in each of these areas. In effect, the annual certification report would be expanded to a report on confidence. It may be appropriate to address these issues in closely linked processes, and then to consolidate the findings in a report to the national leadership.

In the first area, we believe work must begin now to lay the groundwork for certifying changes to the stockpile. There already are processes and procedures in place for evaluating and approving recommended changes to the weapons in the stockpile. These procedures will need to be reinforced to handle future challenges, and they need to be integrated with the Annual Certification Process. In particular, technical criteria and review protocols should be elucidated on an *a priori* basis as to what changes can be made to the stockpile without recourse to testing. These criteria should be safeguarded and enforced by a standing panel operating within the weapons complex.

One approach that merits serious study is the use of first rate, test-experienced designers for review of proposed weapons changes. There are now possibly 150 test-experienced US designers, most of whom are retired. By 2020 there will probably be about fifty surviving, test-experienced designers. A corps of former designers with test experience should be formed and a formal seminar established to review advancements in weapon physics. The seminar would have three purposes: a broadening of the on going weapon research effort; keeping the former designers current on weapon subjects; and the benefit of exchange between new generations of stewards and experienced elders for an

extended period. A few of the top members of the corps could be used as reviewers of proposed changes in weapons.

Second, as emphasized in Section II, confidence in the stockpile hinges on the health and capability of the weapons complex. We can only be confident in the stockpile if we know that the complex is capable of fixing the inevitable problems that will arise in the weapons. Therefore, we will explore ways to incorporate an assessment of the complex into the Annual Certification Process.

Third, the Department of Energy's Test Readiness Report should be expanded. We are encouraged to learn that plans, resources, and staff are in place to maintain test readiness at the Nevada Test Site. Such infrastructure readiness should be augmented, however, with the development of scenarios and assessments examining the specific tests that would be performed if testing were to resume. Technical questions also should be addressed, such as how recent rapid advances in instrumentation technology can be leveraged to get more science out of underground tests. Test readiness also plays an important role in the Annual Certification Process. Having specific plans for testing can help rationalize the question of whether to test in a given circumstance by realistically appraising the relative benefits of alternate approaches.

Finally, the Panel supports the recommendation of the Defense Science Board on Nuclear Deterrence that a process be established for assessing whether the composition of the stockpile continues to meet deterrence requirements. Twenty to forty years from now, it is hard to imagine that the weapon designs of the cold war will continue to provide the best deterrent capability. The Nation requires a process that looks beyond assessing the existing weapons, to ask the broader question of whether we have the right stockpile to meet future needs.

Instituting this process is consistent with the broad intent of the President's requirement that the US maintain our nuclear deterrence capability. The emphasis since his August 1995 pronouncement has been almost exclusively on the technical aspects of the existing stockpile reliability and safety. In order to truly address deterrence and the supreme national interest, a rigorous and systematic parallel process needs to be put in place, involving the appropriate agencies, to examine what the appropriate nuclear stockpile for deterrence should include.

C. ADEQUACY OF CRITERIA FOR SCIENCE-BASED TOOLS

DOE is in the process of developing its proposed criteria, which the Panel will assess in next year's report.

IV. IMPLEMENTATION

We limit our recommendations in this initial report to those that we are confident are essential, urgent, and unambiguous. Recommendations requiring further study are deferred to future reports. In this section, we wish to call our recommendations to the attention of those whom we believe are best able to address them. Implementation of our recommendations will be a central concern over the balance of our Commission.

To the Secretary of Energy:

Recommendation 1: Immediately begin the conceptual design phase of a pit production facility adequate to meet national security needs.

Plutonium parts have a finite but unknown lifetime. Work on this problem is ongoing, but was too long in getting started and the pace remains too slow.

To the Laboratory and Production Complex Directors:

Recommendation 2: Accelerate efforts to understand and preserve test, development, and production data and insights.

So far most of this activity has proceeded largely as a support activity or to answer specific, immediate questions. It needs to be a focussed activity and proceed on its own merits. Emphasis should to be on long-term needs. The volatile test legacy data, production data, and surveillance and forensic data are of particular concern. This issue has long-term implications but is of immediate concern due to the volatility of the information and the institutional memory needed for their preservation.

To the Secretaries of Defense and Energy:

Recommendation 3: To hedge against future uncertainties, the Stockpile Stewardship Program should include the ability to replicate or design replacement nuclear weapons, for our most critical nuclear systems, that will

- *Have a long shelf life*
- *Be at least as safe as current weapons*
- *Provide a high degree of confidence that the weapons are acceptably reliable without full scale nuclear testing*
- *Be manufacturable*

Recommendation 4. Assign high priority and the appropriate FY 2000 and future year funding to support these urgent program:

- *Pit production planning*
- *Alternative, robust weapon designs*
- *Archiving*
- *Surveillance activities*

Recommendation 5. Strengthen the Annual Certification Process so that it (a) more aggressively searches for potential problems, and (b) ensures the acceptability of certifying or not certifying a weapon.

- *Laboratory Directors must ensure adequate resources and incentives to find potential failure modes in the stockpile*
- *Successful certification means accurate certification, not necessarily favorable certification*
- *The CINCSTRAT's Stockpile Assessment Team should be augmented with a small number of young experts in forensics, materials science, computing, and engineering*
- *The Navy and Air Force should ensure that each and every Project Officer Group responsible for their nuclear systems has highly capable, experienced staff assigned, and is provided with adequate resources*
- *Future certification reviews, reports, and letters should be classified.*

The goal of the process needs to be technical evaluation, unencumbered by political or other non-technical considerations. The motivation driving certification needs to be to find the problems, and appropriate incentives to do so are needed. Successful certification means correct certification, not favorable certification. The free flow of information must be guaranteed, and not be inhibited by the need to convey certification results in unclassified formats.

Recommendation 6. Expand the Annual Certification Process to convey confidence in three dimensions:

- *The adequacy of people, tools, and methods for assessing future stockpile problems that may be outside the US nuclear test experience*
- *The capability of the weapons production and other facilities needed for identifying, assessing, and fixing problems*
- *The readiness of the complex to resume testing, if required, including test-readiness plans that identify the weapons that would be tested, the instrumentation, and an assessment of the potential value of such tests*

Sustaining confidence requires more than the narrow technical declaration that there are no known problems that require testing during the upcoming year at this point. The full range of concerns that impact confidence should be addressed in some fashion in the annual certification report. The report in essence would become an assessment of the state of confidence in the capabilities supporting deterrence.

IV. PLANNED ACTIVITIES

In this year's report, the Panel has identified a number of concerns and a few recommendations. We intend to track and assess how our concerns regarding the pillars of certification are attended to. We will continue our engagement with the laboratories, as well as visit the production facilities. We will look for progress in:

- Attracting, retaining, and training the next generation of stewards. We will in particular attend to the implementation of the recommendations of the Chiles Commission.
- Meeting facilities requirements for production, research, development, and surveillance. Special focus will be placed on our recommendations for re-establishing plutonium pit production capabilities.
- Enhancing the base of knowledge through data archiving, revalidation, and the verification and validation of computer codes.
- Implementing effective and integrated management processes, which enhance the mission focus throughout the weapons complex.
- Demonstrations of commitment to sustaining nuclear deterrence from the national leadership.
- Support for a robust stewardship program. We will pay particular attention to the Campaigns and Metrics Project, and begin examination of funding requirements and resources.

The Panel will also continue to focus on implementation of the needed transformation in the Annual Certification Process. We will look for progress in:

- Transforming the Annual Certification Process to aggressively seek out and report problems in the stockpile through such mechanisms as incentives, competitive processes within the complex, and external reviews by the military customers.
- Strengthening the process for configuration management, to include the understanding and management of changes in weapon requirements and designs

Finally, we will review and report on the development of programmatic criteria.

The Panel will provide interim reports as events dictate.

APPENDIX A: THE STOCKPILE STEWARDSHIP PROGRAM AND THE ANNUAL CERTIFICATION PROCESS

Background

The United States conducted its most recent underground nuclear test in September 1992. In October 1992 President Bush signed the FY 1993 Energy and Water Appropriations Bill, which instituted a nine-month moratorium on nuclear testing and required the President to take steps towards achieving a multilateral ban on all underground nuclear weapons tests by 30 September 1996. There has been a unilateral U.S. test moratorium since October 1992.

In July 1993, President Clinton announced that he would continue the moratorium, while seeking agreement on a "zero-yield" international treaty to ban the testing of nuclear weapons. Two years later (August 11, 1995), he declared support for negotiation of the Comprehensive Test Ban Treaty (CTBT). In that statement, he called for specific safeguards that would define the conditions under which the U.S. would enter into the Treaty.

Negotiations on a CTBT began in January 1994 at the Conference on Disarmament. A draft agreement was concluded and opened for signature in September 1996. President Clinton signed the CTBT on September 24, 1996 and forwarded it to the Senate for advice and consent on September 22, 1997. By unanimous consent, the CTBT was brought to the floor of the Senate for debate and vote on October 8th, 12th, and 13th, 1999. Requiring a two-thirds majority for ratification, the Treaty failed to be ratified on October 13th (48 yeas, 51 nays, one member answering 'present'). The administration has apprised foreign governments that it intends to continue to seek ratification for the CTBT, and that it will abide by the Treaty's provisions. Four of the CTBT safeguards (A, B, C, and F, which are shown in italics in Table A-1) directly bear on the stockpile stewardship program and the annual certification process.

A. STOCKPILE STEWARDSHIP

The Stockpile Stewardship Program is the centerpiece of the Department of Energy's programmatic initiative to sustain confidence in the nuclear stockpile without underground testing. It includes:

- Operations associated with manufacturing, maintaining, refurbishing, surveilling, and dismantling the nuclear weapons stockpile;
- The activities associated with the research, design, development, simulation, modeling, and nonnuclear testing of nuclear weapons;

- The planning, assessment and certification of nuclear safety.[1]

Table A-1. CTBT Safeguards

Safeguard A: The conduct of a Science-Based Stockpile Stewardship Program to ensure a high level of confidence in the safety and reliability of nuclear weapons in the active stockpile, including the conduct of a broad range of effective and continuing experimental programs.
Safeguard B: The maintenance of modern nuclear laboratory facilities and programs in theoretical and exploratory nuclear technology which will attract, retain, and ensure the continued application of our human scientific resources to those programs on which continued progress in nuclear technology depends.
Safeguard C: The maintenance of the basic capability to resume nuclear test activities prohibited by the CTBT should the United States cease to be bound to adhere to this Treaty.
Safeguard D: Continuation of a comprehensive research and development program to improve our treaty monitoring capabilities and operations.
Safeguard E: The continuing development of a broad range of intelligence gathering and analytical capabilities and operations to ensure accurate and comprehensible information on worldwide nuclear arsenals, nuclear weapons development programs, and related nuclear programs.
Safeguard F: The understanding that if the President of the United States is informed by the Secretary of Defense and the Secretary of Energy (DOE)--advised by the Nuclear Weapons Council, the Directors of the DOE's nuclear weapons laboratories and the Commander of the U.S. Strategic Command--that a high level of confidence in the safety or reliability of a nuclear weapon type which the two Secretaries consider to be critical to our nuclear deterrent could no longer be certified, the President, in consultation with Congress, would be prepared to withdraw from the CTBT under the standard "supreme national interests" clause in order to conduct whatever testing might be required.

Essential to stockpile stewardship is a set of non-nuclear experiments and enhanced computational tools that will provide a better understanding of the critical phases of nuclear weapon detonation, fission, and fusion. The resulting tools and methods are intended to assess the weapons in the stockpile, and to fix problems that arise. The knowledge gained will augment the body of knowledge carried forward from the development and testing of current weapons to provide a stronger scientific and engineering basis for assessing the performance of weapons. The program will also help to challenge and train new generations of stockpile stewards.

Recently the Department of Energy refocused stewardship by adopting a new organizing framework based on “Campaigns.” These are summarized in Table A-2.

Table A-2. Stockpile Stewardship Campaigns

[1] Fiscal Year 2000 Stockpile Stewardship Plan Executive Overview, March 1999, U.S. Department of Energy, Office of Defense Programs, p. 3.

Primary Certification 2005 Dynamic Materials Properties Advanced Radiography Secondary Certification and Nuclear-System "Margins 2005" Inertial Confinement Fusion (ICF) Ignition & High Yield Certification in Hostile Environments Enhanced Surety Weapon System Engineering Certification	Enhanced Surveillance Advanced Design and Production Technologies (ADAPT) Defense Applications and Modeling Pit Readiness Secondary Readiness HE/Assembly Readiness Non-nuclear Readiness Tritium Readiness Material Readiness

Campaigns are intended to develop enabling product(s) to support stockpile certification and manufacturing activities. Campaigns, along with Directed Stockpile Work and Readiness in Technical Base and Facilities, comprise the overall program for stockpile stewardship. Directed Stockpile Work includes activities that directly support the maintenance, surveillance, refurbishment, product engineering, and certification of today's weapons stockpile. The Technical Base and Facilities Readiness component provides needed focus on the facilities and other physical infrastructure of the weapons complex.

The current proposed set of Campaigns is intended to develop capabilities that will be available by 2005.

The Panel has not yet assessed the Campaigns in detail, but the concept appears to provide a useful organizing framework. We are encouraged that several of the Campaigns focus explicitly on future certification challenges. We will review the implementation of the Campaign approach, and will consider how this new framework contributes to sustaining confidence in the stockpile.

B. THE ANNUAL CERTIFICATION PROCESS

The Annual Certification Process derives from the safeguard provision outlining the conditions under which the U.S. would return to nuclear testing. This process has direct relevance for Safeguard F -- The understanding that if the President is informed by the Secretary of Defense and the Secretary of Energy (DOE)--advised by the Nuclear Weapons Council, the Directors of the DOE's nuclear weapons laboratories and the Commander of the U.S. Strategic Command--that a high level of confidence in the safety or reliability of a nuclear weapon type which the two Secretaries consider to be critical to our nuclear deterrent could no longer be certified, the President, in consultation with Congress, would be prepared to withdraw from the

CTBT under the standard "supreme national interests" clause in order to conduct whatever testing might be required.

The reporting chain to the President established in Safeguard F provides the framework used for the Annual Certification Process. Figure A-1 summarizes its main elements, which are discussed in the following paragraphs.

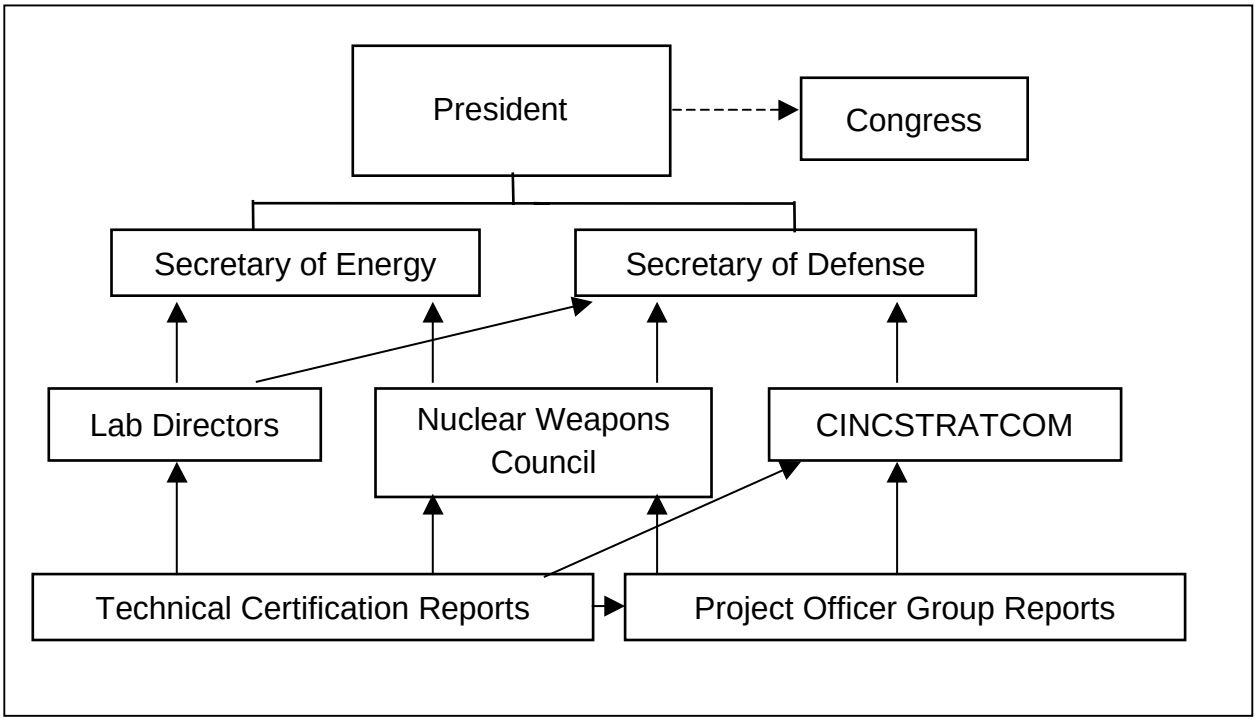


Figure A-1. Annual Certification Process

Technical Certification Reports

The Technical Certification Reports and briefings produced by the laboratories for each stockpiled warhead provide a basis for the annual certification process. The technical reports build on the continuing experience with each weapon, and incorporate new information derived from stockpile maintenance activities, experiments, and other sources. The weapons in the current stockpile have accumulated an extensive pedigree based on development testing, nuclear tests, and laboratory and flight tests. The team responsible for certifying each weapon includes many who are highly familiar with it, and possesses an extensive body of historical data and experience.

The laboratories (Sandia National Laboratories and either Los Alamos National Laboratory or Lawrence Livermore National Laboratory) draft a technical certification report (TCR) for each weapon type in the stockpile. The TCRs are compilations of information generated from ongoing Stockpile Stewardship Program (SSP) activities. Information from laboratory and flight tests conducted as part of the stockpile surveillance program, as well as data from computer simulations, hydrodynamic and subcritical experiments and other aspects of SSP, are essential in judging the safety and reliability of the nuclear weapons stockpile. Each TCR contains information about open Significant Finding Investigations (SFIs), which are initiated when a deviation or anomaly is discovered through routine surveillance or maintenance. They also identify areas where age-related degradation or other issues may eventually be cause for concern. The TCRs are reviewed in the preparatory phase by DOE Program Managers, and critiqued by personnel from the other nuclear weapons design laboratories.

Each report includes a section with statistics and a statement of the status of the weapon with respect to (1) safety, (2) reliability, (3) surveillance activities and associated investigations of findings, (4) yield, and (5) current configuration status and planned changes or life-extension initiatives. The assessed safety and reliability statistics are compared against the official requirements, known as Military Characteristics. The reports provide a snapshot of the status of each individual weapon type and discuss issues of concern. In addition to these data and assessments, each report provides a "Safeguard F Declaration." To date, these have stated that "the nuclear stockpile has no known safety or reliability concerns that require underground nuclear testing at this time."

The TCRs are extensively reviewed by laboratory management before their formal release.

Parallel Reviews

The review phase of the Annual Certification Process builds on the information provided in the Technical Certification Reports, augmented with other issues, information, and each reviewer's personal experience in assessing the status of the stockpile. As noted, the reviewers include weapons experts, technical representatives of the military user communities, and other senior government officials. Thus, a broad base of knowledge and experience within the nuclear community is engaged in the certification process. Three parallel reviews are formally undertaken.

The first of these is performed by the Laboratory Directors. After reviewing the TCRs and discussions with individuals directly involved in assessing the weapons, each Laboratory Director submits a letter to the Secretary of Energy and the Secretary of Defense. The Directors' letters assess overall safety and reliability of the stockpile and highlight overarching concerns or trends.

USSTRATCOM conducts a second review with the assistance of the Stockpile Assessment Team (SAT). The SAT is a subgroup of CINCSTRATCOM's senior advisors, primarily selected from the Strategic Advisory Group (SAG). The SAT is comprised of independent experts with laboratory, industry, and military backgrounds. This Team receives briefings on the Technical Certification Reports from the laboratories, and on Service activities by the Project Officer Groups with day-to-day responsibility for each weapon system. The Project Officer's Groups consider the Laboratories' Technical Certification Reports, but also look more broadly at operational issues and issues relating to delivery system hardware. The SAT prepares a report and briefs the CINCSTRATCOM and his staff on its findings. CINCSTRATCOM draws on this work in preparing his letter on the stockpile to the Secretary of Defense.

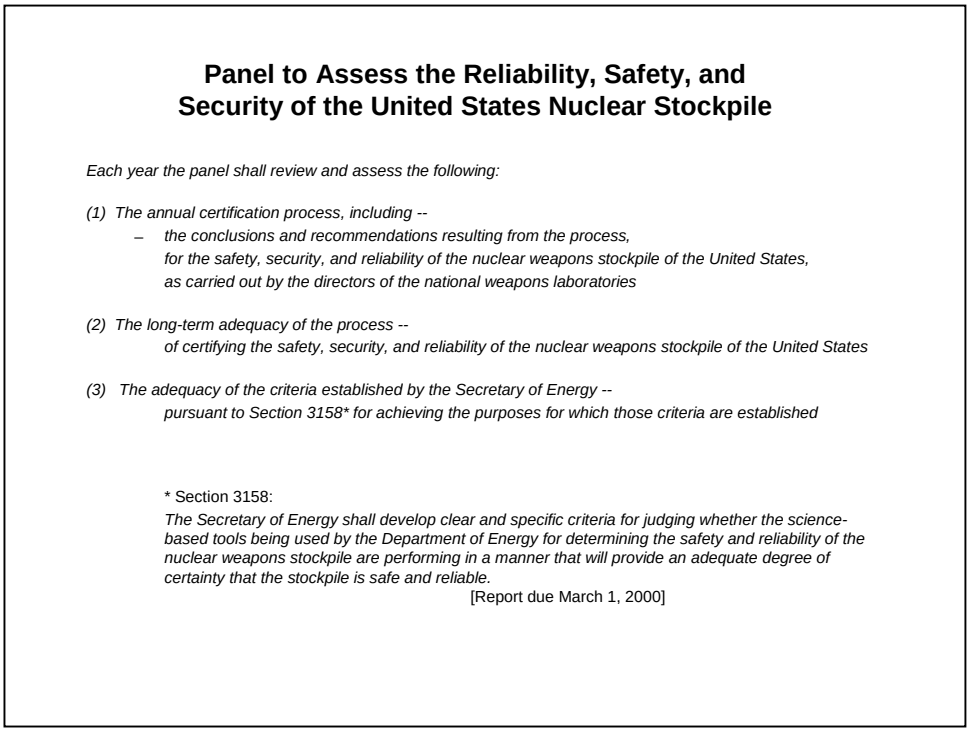
The Nuclear Weapons Council performs the third review, with staff support from its Standing and Safety Committee. The Nuclear Weapons Council is an interagency group with representatives from the Office of the Secretary of Defense, the Joint Staff, and the Department of Energy. It reviews the Laboratories' Technical Certification Reports, and also incorporates the findings from the Project Officer Groups. The Nuclear Weapons Council Report on Stockpile Certification covers these technical and operational issues from a interagency perspective, and prepares the Certification Letter to the President for signature by the Secretaries of Defense and Energy.

Certification Letters to the President

The final step in the Annual Certification Process, as shown in the Figure 1, is when the Secretaries of Defense and Energy transmit a memorandum to the President informing him of their assessment of the safety and reliability of the nuclear weapons stockpile. The memorandum to the President also declares whether there is a need to return to underground nuclear testing to resolve a safety or reliability issue.

The Laboratory technical certification reports and the POG reports are appended to the NWC Report on Stockpile Certification and forwarded to the President as background information. To date, the Nuclear Stockpile Certification memorandum to the President has informed him that the nuclear stockpile has no safety or reliability concerns that require underground testing at this time. Although not required, it is customary for the President to transmit to the Congress a letter stating that there are no safety or reliability concerns in the stockpile that necessitate a resumption of underground nuclear testing. In addition, the Congress receives supporting technical documentation from the laboratories and POGs.

APPENDIX B: THE PANEL'S CHARTER



Source: Sections 3158 and 3159 of The Strom Thurmond National Defense Authorization Act for FY 1999.