Report of the Nuclear Weapons Complex Infrastructure Task Force

Recommendations for the Nuclear Weapons Complex of the Future

July 13, 2005
Final Report

Secretary of Energy Advisory Board
U.S. Department of Energy

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DEDICATION

Ron Bentley

The Task Force members and supporting staff dedicate this Report in memory of Ron Bentley, who passed away unexpectedly while supporting this effort. Team members and staff eagerly sought Ron's advice and support, especially during the most trying phases of this effort. We truly miss Ron.

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PREFACE

Nuclear weapons still have a vital role to play in our security and that of our allies. We can, and will, change the size, the composition, the character of our nuclear forces in a way that reflects the reality that the Cold war is over. I am committed to achieving a credible deterrent with the lowest-possible number of nuclear weapons consistent with our national security needs, including our obligations to our allies. My goal is to move quickly to reduce nuclear forces.

President George W. Bush, May 2001

EXECUTIVE SUMMARY

With the end of the Cold war, the United States ended programs to develop and produce new nuclear warheads and shifted to sustaining existing warheads for the indefinite future. To this end, the Department of Energy (DOE) adopted a science-based Stockpile Stewardship Program that emphasized development and application of improved technical capabilities to assess and maintain existing nuclear warheads without the use of nuclear testing. That approach was modified by the December 2001 Nuclear Posture Review (NPR), which articulated goals for a "responsive nuclear weapons complex" which requires an appropriate balance between research and development and production capabilities to meet a range of plausible contingencies. The NPR gives a responsive infrastructure equal priority with offensive and defensive weapons in the "New Triad" of strategic capabilities.

During testimony to the House Appropriations Subcommittee on Energy and Water on March 11, 2004, the Secretary of Energy agreed to conduct a comprehensive review of the nuclear weapons complex (the Complex) in concert with changes in the stockpile, the security situation, and the nature of the world around us, as well as limitations in resources. In January 2005, the Secretary of Energy requested the Secretary of Energy Advisory Board (SEAB) to form the Nuclear Weapons Complex Infrastructure Task Force (NWCITF), a Task Force reporting to the SEAB. The objective of the Task Force was to assess the implications of Presidential decisions on the size and composition of the stockpile; the cost and operational impacts of the new Design Basis Threat; and the personnel, facilities, and budgetary resources required to support a smaller stockpile. This review would entail evaluation of opportunities for the consolidation of special nuclear materials, facilities, and operations across the Complex so as to minimize security requirements and the environmental impacts of continuing operations.

The NWCITF interviewed key personnel at the Department of Energy, National Nuclear Security Administration (NNSA), Department of Defense (DoD), Office of Management and Budget, National Security Council, Congress, and all eight of the current Complex sites. In addition, Task Force members reviewed the many previous DOE studies and received counsel from other experts who have had direct interaction with the Complex in the recent past.

Task Force Observations of the Current Complex

Although currently reliable, the Cold war stockpile does not have the surety controls nor the design margins that the DOE and DoD desire. The Cold war stockpile is sustained through an expensive Life Extension Program (LEP), resulting in old weapons with some new components, and generates a legacy that requires an extensive and ever-more-costly maintenance program.

The three design laboratories have been upgraded with state-of-the-art design and testing capabilities in advanced computing, simulation and non-nuclear component testing. These science-based Stockpile Stewardship Program investments have greatly increased our

understanding of nuclear weapons and the associated materials and physics issues. Because of these investments, the Task Force is confident that the Complex can now design a nuclear weapon that is certifiable without the need for underground testing. However, the Task Force found the production complex operating from World War II era facilities, lacking in modern-day production technology and striving to optimize performance with antiquated equipment and facilities. A DOE "modernization-in-place" plan sustains a mix of old sites (some 80 years old by 2030) and a few dispersed modern facilities, rather than a modern and thus more cost-effective 21st century production Complex.

In addition, this "modernization-in-place" approach would do little to reduce the distribution of special nuclear materials (SNM), which may be a target of interest for terrorists. Six of the current eight sites in the Complex contain significant quantities of SNM, exposing the Complex and the surrounding civilian population to risk. Years ago, when the Complex sites were remote and relatively easy to secure, this distribution of sensitive material was considered a way to enhance security. Today, residential and/or commercial communities border most of the sites.

From a management perspective, the Task Force determined that there is not a unified interdependent nuclear weapons enterprise vision or set of mission priorities. Instead the following was found:

- The DoD does not provide DOE with unified and integrated weapon requirements and the DoD does not appear to trust DOE's ability to respond with predictability.

- The DOE has burdened the Complex with rules and regulations that focus on process rather than mission safety. Cost/benefit analysis and risk informed decisions are absent, resulting in a risk–averse posture at all management levels.

- Within the Complex, the physics design laboratories aggressively seek independence rather than cooperative interdependence, resulting in redundant programs and facilities, increasing costs and reducing productivity; and the production sites are under funded.

In summary, the Task Force found a Complex neither robust, nor agile, nor responsive, with little evidence of a master plan. However, the Task Force did find a Complex with skilled and committed professionals who seek to carry out the NNSA's nuclear weapons mission. The Task Force was delighted to find a generation of young people entering the Complex because of their sincere desire to participate in sustaining an effective nuclear deterrence for the future.

Task Force Recommendations

The Task Force has a vision for the agile and responsive nuclear weapons Complex of the future. This requires that the Complex have a modern production center, which is embodied by the Task Force proposed Consolidated Nuclear Production Center (CNPC). But, agility and responsiveness reflect an attitude, an approach, and changes in the management of the Complex are required to achieve such a culture.

The Task Force submits that the implementation of the following recommendations will transform the Nuclear Weapons Complex into an agile, responsive organization, an organization capable of meeting national security needs for the foreseeable future. Furthermore, these recommendations will contribute substantively to two of the three elements of the New Triad.

Immediate Design of a Reliable Replacement Warhead (RRW)

To develop the sustainable stockpile of the future, the Task Force recommends the immediate initiation of the modernization of the stockpile through the design of the RRW. This should lead to a family of modern nuclear weapons, designed with greater margin to meet military requirements while incorporating state-of-the-art surety requirements. Within these military requirements, the RRW family of weapons will be designed for: 1) production, 2) utilization of readily available materials that do not pose undue hazards to the Complex workforce, and 3) reduced production, maintenance, and disposition costs over the weapon life-cycle. The Task Force recommends that a new version of the RRW, incorporating new design concepts and surety features, be initiated on planned five-year cycles. This family of weapons will form the basis of the sustainable stockpile of the future that will replace the current Cold war stockpile.

Consolidated Nuclear Production Center (CNPC)

To meet the responsive infrastructure aspects of the New Triad, the Task Force recommends that the NNSA immediately begin site selection processes for building a modern set of production facilities with 21st century cutting-edge nuclear component production, manufacturing, and assembly technologies, all at one location. This action will establish a cost effective modern production center that can achieve minimum production rates required by the DoD to be responsive and meet evolving nuclear weapon needs of the 21st Century. When operational, the CNPC will produce and dismantle all RRW weapons.

Consolidation of Special Nuclear Materials (SNM)

To reduce the security costs to the Complex, and reduce the overall threat to the Complex, the Task Force recommends consolidating all Category I and II SNM and weapon primary and secondary components to the CNPC. This will substantially increase Complex efficiency, and reduce Complex transportation, security, and other operating costs, while limiting the number of Complex sites and civilian communities contiguous to the Complex sites that could be targets of terrorist attacks.

Dismantlement as part of deterrence

To demonstrate that the U.S. is committed to arms reduction, the Task Force recommends that Pantex focus on the aggressive dismantlement of the Cold war stockpile, while the Complex begins replacing the Cold war stockpile with the sustainable stockpile of the future. Pantex has the authorization basis to assemble and disassemble weapons with conventional high explosives. Therefore, Pantex should also perform the LEP and

maintenance tasks for these devices during the period of transition to the sustainable stockpile. In support of this mission, the Device Assembly Facility at the Nevada Test Site should be dedicated to RRW assembly, surveillance, and other tasks supporting the production of the sustainable stockpile, in parallel with aggressive dismantlement, until the CNPC is operational.

The Office of Transformation

To achieve the responsive nuclear weapons complex of the future, the Task Force recommends that the DOE grant NNSA more independence and create an Office of Transformation to be the change agent, focused every day on transforming the Complex into the responsive element required in the New Triad. This office should be in place at least until the CNPC is under construction and the DoD regards the Complex as being responsive. Several proposed initiatives for the Office of Transformation to facilitate and monitor are:

Leadership: Gain the endorsement and ongoing support from the Nuclear Weapons Council and the Secretaries of Energy and Defense for the transformation to a responsive Complex and a sustainable stockpile.

Interdependence and Team Work: Contracting incentives (fee, deliverables, contract term, etc.) should be used to promote interdependence and teamwork. The Task Force recommends that all mission critical facilities in the Complex become user facilities and that redundant facilities be closed. Centers of excellence or lead laboratory designation for major technology areas should be encouraged.

Rationalizing operating decisions and management options: A risk-informed cost-benefit analysis should be performed on all programmatic, safety, and security recommendations. Rational decision-making should balance risks and benefits while implementing change.

The Consequences

The above recommendations are linked and should be implemented in concert. The Task Force performed an assessment of the impact of these recommendations on near term DOE nuclear weapons complex funding requirements and total Complex costs over the next 25 years. Implementing all recommendations now will increase near-term costs substantially, but with substantial future operating cost reductions after the CNPC is in full operation. This option includes accelerated dismantlement rates, no near-term staff reductions at the design laboratories, and no reduction in the currently supported stockpile. The near-term budget increases are dominated by the cost for the CNPC and accelerated dismantlement. The long-term cost savings are approximately twice the near-term cost increases. The Task Force considers this to be the lowest risk option.

Another option would combine some reduction in the efforts at the three design laboratories, closing all redundant facilities, and reducing one or more LEP programs to fund the transition to RRW type systems. The Task Force recommendations could then be implemented with nominal near term budget increases, largely to pay for the consolidation efforts, with substantial operating reductions after the CNPC is in full operation. The risks of this option are higher.

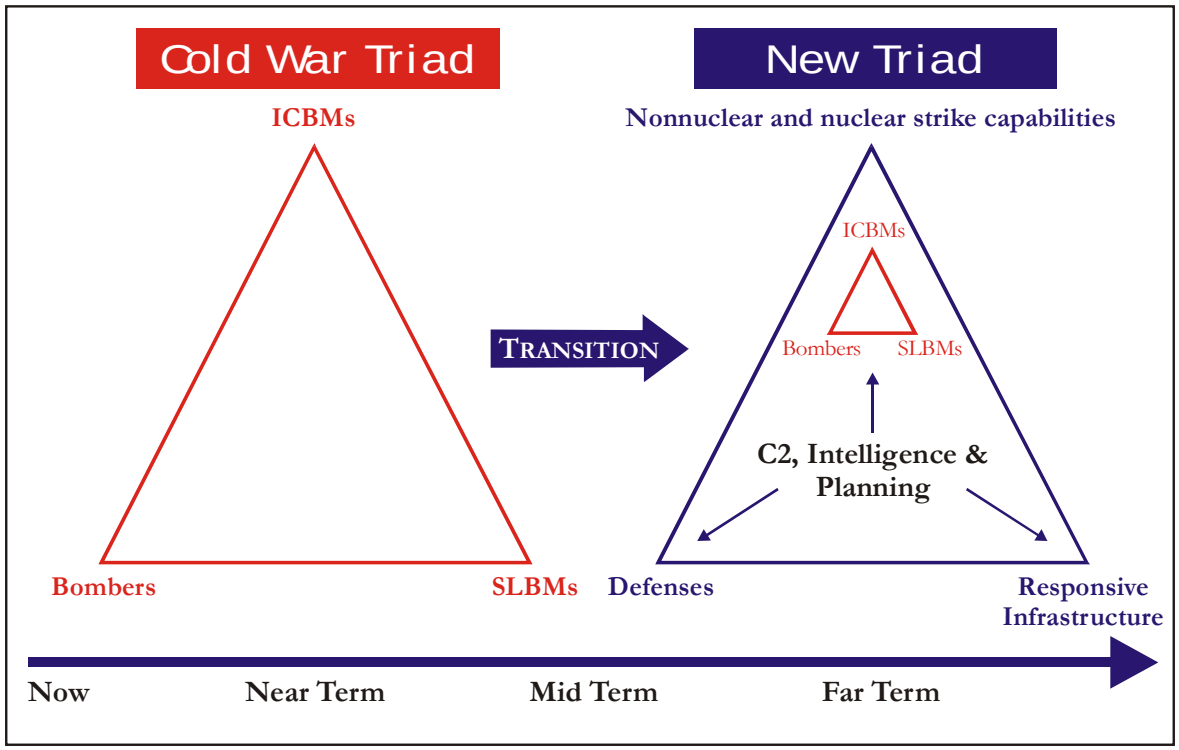
Between these two business cases lie a continuum of business case options, depending on the choice of independent variables. The financial analysis performed by the Task Force was not detailed and it is proposed that the Office of Transformation perform detailed budget, cost benefit analysis of the above recommendations, and other recommendations that are found in the body of the report. This office should then have the responsibility to implement any of the transformation actions that the DOE accepts.

In conclusion, the status quo is neither technically credible, nor financially sustainable. The Task Force offers a vision for a responsive and modern nuclear weapon Complex of the future. That Complex will be a critical element of the New Triad and our overall deterrence posture and capability. To reach the desired level of performance, the significant financial and experience investment in the three design laboratories must be leveraged by renewing weapon design initiatives and a long overdue investment in the Complex production capabilities must be made. This investment can be funded out of existing programs in exchange for acceptance of some risk to stockpile diversity or Complex capability. On the other hand, the Complex can be transformed with very little risk, but with near-term increased budgets.

Some action must be taken. The Task Force proposed paths that are technically credible; but each path will require leadership and crisp decisions for success. Any path is susceptible to political and financial realities.

INTRODUCTION

Nuclear weapons have been an integral part of our national defense and deterrence posture since the end of World War II. With the end of the Cold war, the United States ended programs to develop and produce new nuclear warheads and began a moratorium on nuclear testing. The main focus of the nuclear weapons program during the 1990s shifted to sustaining existing nuclear warheads for the indefinite future. To this end, the Department of Energy adopted a science-based Stockpile Stewardship Program that emphasized development and application of greatly improved technical capabilities to assess the safety, security, and reliability of existing nuclear warheads without the use of nuclear testing. The December 2001 Nuclear Posture Review (NPR) articulated goals for a “capabilities based” deterrence structure for the future. The NPR proposes that a responsive infrastructure is of equal priority with offensive and defensive weapons, forming the "New Triad" of strategic capabilities.



In light of the New Triad, DOE is responsible for components within two of the three triad elements, a "responsive nuclear weapons complex" that requires an appropriate balance between research and development and production capabilities to be able to meet a range of plausible contingencies, and a reliable nuclear weapon stockpile.

During testimony to the House Appropriations Subcommittee on Energy and Water on March 11, 2004, the Secretary of Energy agreed to conduct a comprehensive review of the nuclear

weapons complex (the Complex) in concert with changes in the stockpile, the security situation, and the nature of the world around us, as well as limitations in resources. The House Appropriation Report for FY 2005 recognized the Secretary's commitment and mandated a systematic review of the Complex. In January 2005, the Secretary of Energy requested the Secretary of Energy Advisory Board (SEAB) to form the Nuclear Weapons Complex Infrastructure Task Force (NWCITF), reporting to the SEAB. The objective of this Task Force was to assess the implications of Presidential decisions on the size and composition of the stockpile; the cost and operational impacts of the new Design Basis Threat; and the personnel, facilities, and budgetary resources required to support a smaller stockpile. This review would entail evaluation of opportunities for the consolidation of special nuclear materials, facilities, and operations across the Complex so as to minimize security requirements and the environmental impacts of continuing operations. The detailed Terms of Reference guiding the work of the Task Force are presented as Appendix A. A matrix correlating the specific study requirements reflected in the Terms of Reference with the applicable report sections is provided as Appendix B.

The NWCITF interacted with key personnel at the Department of Energy, National Nuclear Security Administration, Department of Defense, Office of Management and Budget, National Security Council, Congress, and all eight of the current Complex sites. In addition, Task Force members received counsel from many other experts. Details of the NWCITF data-gathering process are provided as Appendix C.

The Task Force used budget details from the FY 2006 NNSA Congressional budget submission (Appendix D) to form the basis of financial comparisons and estimates made within this report. Additional appendices provide important objective information used by the Task Force in forming recommendations and a listing of assumptions relevant to how that information was used or considered.

Section 1 summarizes the Task Force views of the current nuclear weapons complex. Section 2 expresses the Task Force vision for the nuclear weapons complex of the future. Section 3 presents the Task Force vision for the stockpile of the future. Section 4 presents the Task Force view of the Complex of the future. Section 5 is the Task Force view on how the Complex should be managed. Sections 3-5 contain the major transformation recommendations of the Task Force. Section 6 lists specific actions that the Task Force proposes as implementation steps to realize the transformation recommendations.

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1. SUMMARY OF THE TASK FORCE VIEWS OF THE CURRENT COMPLEX

The Task Force believes that nuclear weapons are an element of the U.S. defense capability and an important part of our current and future deterrence posture. A responsive Complex, with continually exercised capabilities, is an important part of the deterrence, and when properly constituted may permit a substantial reduction in the stockpile of deployed and reserved nuclear weapons. However, the Task Force did not find a robust Complex today. Rather, it found a Complex of varied strengths and weaknesses, with little evidence of a master plan.

The three design laboratories have been upgraded with state-of-the-art design and testing capabilities in advanced computing, simulation and non-nuclear component testing. This is a direct result of the investment in science-based Stockpile Stewardship Program (SSP); investment that has greatly increased our understanding of nuclear weapons and the associated materials and physics issues. Because of this investment, the Task Force is confident that the Complex can now design a nuclear weapon that is certifiable without the need for underground testing (UGT). The current design laboratory technical staff has a significantly improved understanding of the materials and physics of the various states of matter during the sensitive implosion phase of a nuclear weapon. Moreover, the nuclear weapons staffing level at the design laboratories are comparable to if not greater than that attained at the design laboratories during the peak period of activity in the mid 1980's. However, the Complex is rapidly losing experienced nuclear design experts and thus the design experience that has been validated by full weapon tests.

The Task Force found the production side of the Complex operating from World War II era facilities, lacking in modern-day production technology and striving to optimize performance with antiquated equipment and facilities. The production staff is aging and is a fraction of what it once was. A DOE modernization plan is in place, but it provides for a mix of many old sites (some 80 years old by 2030) and a few dispersed modern facilities, rather than a modern and more cost-effective state-of-the-art production center.

Of greater concern is the substantial financial liability, current and growing, that the Cold war stockpile, and its associated Life Extension Program (LEP) represents. Although currently safe and reliable, the Cold war stockpile does not have the surety controls nor the design margins that the DOE and DoD desire. The larger margins give greater confidence in overall weapon performance, and the surety controls are needed to protect against a nuclear accident or a potential adversary using one of our weapons or weapon components against our allies or us. The LEPs for the Cold war stockpile will eventually result in old weapons with some new components, a legacy that will require an extensive and ever-more-costly maintenance program.

Just as a lack of modern surety control in nuclear weapons increases the risk of unauthorized weapon or weapons material use, the broad distribution of special nuclear materials (SNM), such

as plutonium and highly enriched uranium (HEU), at six of the current eight sites in the Complex increases the number of potential terrorist targets within this country, exposing the Complex and the surrounding civilian population to risk. Years ago, this distribution of sensitive material was considered a way to enhance security. But the threats today are different. Furthermore, at the time of their inception, the Complex sites of today were remote and relatively easy to secure. Today, residential and/or commercial communities border most of our current sites, with the exception of the Savannah River Site (SRS) and Nevada Test Site (NTS). The primary method for dealing with the current (and future) terrorist threats to the Complex is through the application of guards, guns, and gates. Addressing the potential threat in this manner contributes nothing to the viability of our long-term nuclear deterrence or the productivity of the nuclear weapons complex, but increases costs with no apparent limit. With physical security costs approaching 15 percent of the budget, the benefits of SNM consolidation are substantial, both in terms of reducing capital and operating costs as well as reducing risk to the adjacent civilian populations.

The above describes our preliminary assessment of the current Complex Infrastructure, which was the focus of our charge. The Task Force determined that there is not a unified interdependent nuclear weapons enterprise vision or set of mission priorities. Instead the following was found:

- Within DoD, the Air Force and the Navy do not seem to consider the cost and schedule advantages to the DOE of leveraging a component or weapon already designed and perhaps accepting a modest compromise in military characteristics to realize substantial cost and schedule benefit. DoD appears wary of the DOE's ability to quickly address weapon issues as they arise, and the ability of the DOE Complex to resume production with any degree of predictability,
- Strict compliance with DOE rules and regulations is required regardless of cost, even where graded or commercial approaches of compliance and regulation would be appropriate and more supportive of mission objectives, and
- The three design laboratories, consumers of approximately 2/3 of the nuclear weapons budget, routinely compete with each other and set their own requirements as justification for new facilities and redundant research funding in the fear that one laboratory may become superior. The net result is that the Complex sites are competing for programmatic funds and priorities rather than relying upon their divergent and complementary strengths and thereby operating as a truly interdependent team, with shared success and rewards.

The Task Force found that the current NNSA management structure has separated program and compliance functions from Complex site contractors (even though that is a major part of the M&O management responsibility) and from the NNSA program managers. This has resulted in the evolution of a risk–averse posture at all management levels, steadily increasing costs and reducing Complex performance and an erosion of leadership.

Overall however, the Task Force did find a Complex with skilled and committed professionals who seek to fully and effectively carry out the Defense Programs' mission. And, the Task Force

was delighted to find a generation of young people entering the Complex because of their sincere desire to participate in sustaining an effective nuclear deterrence for the future.

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2. A VISION FOR THE NUCLEAR WEAPONS COMPLEX OF THE FUTURE

The Complex of 2030 should be an integrated, interdependent enterprise. The technical acuity and scientific innovation to meet unforeseen challenges and threats to the nation's security are sustained by a Complex operating interactively and continuously conducting research, non-nuclear testing and weapon modernization, production, and dismantlement. In order to realize this vision, the current Complex needs to initiate a design competition immediately for a family of modern replacement weapons that will incorporate surety systems demanded for protection against evolving world threats. This reliable replacement warhead (RRW) family of weapons will derive from current DoD requirements. Three design laboratories are currently needed to certify the RRW series without UGT. However, the long-term requirement for two physics design laboratories will be determined through overall Complex performance and needs. Continuous design activities and advances in simulation and non-nuclear testing capabilities will require fewer nuclear weapons professionals at the design laboratories in the future. In preparation for these design activities, the design laboratories should refocus on the research that is critical to national security and cannot be obtained from industry, leaving production and manufacturing to the commercial industry or production arms of the Complex.

Production of all sustainable stockpile weapons should be restricted to the Consolidated Nuclear Production Center (CNPC). The center should include manufacturing, production, assembly, and disassembly facilities employing cutting-edge technologies. In addition, the CNPC will store all Category I and II SNM and weapon components and dismantle the future RRW family of weapons. This will allow the design laboratories to operate under more economical industrial security, while substantially reducing the risk and associated security costs to the Complex. By 2030, if not sooner, one should be able to reduce the SNM locations to the CNPC (and the NTS if they are not synonymous), while greatly improving responsiveness and efficiency in both production and dismantlement. The CNPC should be designed to handle at least 300 weapons per year (125 production pits to the stockpile, 125 production weapon units, 125 weapon units for disassembly, 50 weapon units for maintenance or surveillance) in a single shift of operation. Non-nuclear components should be procured from commercial vendors, to the degree allowable, or manufactured at a location outside of the CNPC.

Aggressive dismantlement is a central element of our reduction of the nuclear terrorist threat or accident risk. It is anticipated that Pantex will focus on maintenance and dismantlement of the Cold war stockpile, at least all those weapons that use conventional high explosives (CHE). With dismantlement of the last Cold war weapon, envisioned to occur by 2030, all Complex production and dismantlement activities will be consolidated at the CNPC.

As a measure of responsiveness, the Complex will be designed to respond to any needed design change in less than 18 months, field a prototype in less than 36 months, and go into full production in less than 48 months, and perform an underground test at the NTS within 18

months. By 2030 the Complex would be in equilibrium, producing and dismantling at a rate of 125 devices per year. A second shift would provide surge capacity in pit production or weapon assembly should it be required.

All integrated SNM and high-explosive (HE) experiments will be conducted at the NTS, which will maintain the ability to conduct full underground tests as both a potential deterrent and to address weapon stockpile issues should they arise.

The Task Force is mindful of the budgetary impact that this vision of the 2030 Nuclear Weapons Complex entails and, in particular, the short-term budget implications prior to the realization of potential cost reductions from a smaller, more efficient Complex at some future date. Time did not permit detailed analysis of these budgetary impacts. However, the Task Force used simplified models (developed by LLNL and LANL) of near-term DOE Nuclear Weapons Complex funding requirements and total Complex costs over the next 25 years. These simplified models should be considered approximate only, and more detailed and accurate budget forecasts should be developed. However, the trends from the simplified analyses are meaningful, and are discussed in more depth in Appendix E, which compares: (1) a very high risk baseline case, consisting of an essentially flat Complex budget over the 25-year period and little, if any, progress toward achieving the 2030 vision; (2) a low risk business case that achieves the 2030 vision in a timely manner, with significant long-term cost reductions and near-term budget increases; and (3) a transformation-in-place business case that progresses at a modest rate toward achieving the 2030 vision, with considerably higher long-term risk and almost identical short-term budget increases. The Task Force vision is best achieved at the lowest risk to the nation's nuclear deterrent through an aggressive schedule for achieving the 2030 vision, with near-term budget increases resulting in substantially larger accumulated long-term budget reductions.

3. THE STOCKPILE AS AN ELEMENT OF THE NEW TRIAD

The U.S. nuclear stockpile is an integral part of the national deterrence posture and, as such will be constructed, deployed, and maintained in a way that reflects the needs and constraints of the current political and national security realities. As mentioned in the introduction, the New Triad places the nuclear stockpile as a major component of one of the three elements of the Triad. The DoD and the President set the stockpile requirements, whereas the stockpile characteristics are the result of a partnership between DoD and NNSA. Although the Complex capabilities define current stockpile characteristics, the requirements for the future stockpile define the Complex investments in infrastructure and human capital.

Coordination and oversight of the DoD-NNSA nuclear weapons partnership is the responsibility of the Nuclear Weapons Council, chaired by the Under Secretary of Defense for Acquisition, Technology, and Logistics. The Council establishes priorities and must approve all new weapons programs, life extension programs, and any major changes in stockpile configuration. It is also the body that provides policy guidance for overall stockpile management.

As the output of the Complex is the stockpile, stockpile metrics can be viewed as products of Complex performance. The development of such metrics within the policy structure and leadership of the Nuclear Weapons Council is essential to shaping a responsive 2030 Complex infrastructure. The Task Force suggests the following relationship between stockpile metrics and Complex attributes:

Stockpile Metrics	Complex Attributes
Reliability	Quality
Cost	Efficiency
Size	Responsiveness

In addition, a demonstrably responsive Complex is a hedge against unforeseen technical and political changes, and may allow for a smaller stockpile and thus reduced costs for maintenance and surveillance. As described in the 2001 Nuclear Posture Review (NPR), a nuclear stockpile that is inherently safe, secure, and reliable and a responsive Complex that can rapidly modify the nation's nuclear arsenal are two essential elements of deterrence in the New Triad.

3.1 Future Stockpile

While the Task Force cannot predict the precise content or characteristics of the 2030 stockpile, it should be sustainable in the long term and consistent with the broad vision articulated by the President. The Moscow Treaty set a goal of 1700–2200 operationally deployed strategic nuclear weapons (ODSNW) by the year 2012. The NPR of 2001 has identified an additional element of risk management in calling for a responsive infrastructure to support the nuclear stockpile. According to the NPR, by 2012 the Complex should be able to design and produce new weapon

types to respond quickly to evolving military needs, and to rapidly modify existing weapons to address deficiencies.

In particular, NNSA has stipulated, and this Task Force agrees, that a responsive Complex would:

- Resolve a stockpile issue in 12 months
- Adapt a weapon to a new requirement in 18 months
- Develop a weapon for a new requirement in 36 months
- Achieve full production in 48 months
- Be capable of conducting an underground nuclear test in 18 months

The Task Force also believes that the stockpile size in the future will be greatly impacted by the actual response times and could be reduced based upon demonstration of a Complex that is both responsive and predictable. In general, a responsive infrastructure supporting our military systems is a major element of the overall DoD deterrence strategy.

Specific operational military characteristics of the 2030 stockpile are not yet defined. However, the Task Force believes that the RRW is the first of a family of warheads that embodies all of the desirable characteristics of the sustainable stockpile. Furthermore, the Task Force envisions a stockpile that is continuously modernized through a series of design-production cycles that would allow the stockpile to meet an evolving or changing threat environment. Doing so regularly is consistent with a continuously exercised Complex and will result in a cost effective reliable nuclear weapon capability.

3.1.1 Size

The 2030 stockpile will be substantially smaller than today's both in deployed and reserve components. The President has defined the near-term lower limit of 1700 for Operationally Deployed Strategic Nuclear Weapons (ODSNW), and the reserves can be decreased as the Complex achieves the responsive infrastructure as a hedge against unforeseen events. From a strategic perspective, the actual number of warheads in various states of readiness will be determined by the real-time assessment of risk from external threats, and by the conventional, non-nuclear capabilities available and able to address those threats. Since the world situation is constantly changing, the nation must have significant flexibility in the stockpile and a capability to produce weapons at a rate sufficient to meet an evolving threat. The DoD also requires a reserve stockpile that can be relied upon in the event a problem in a weapons system reduces the reliability or margin of the weapon or if force augmentation is needed to meet an expanding threat. The DoD stockpile strategy thus addresses the risks of both changes in the perceived threat environment and technical problems with the weapons themselves.

3.1.2 Nuclear Weapon Safety

Nuclear weapon safety will continue to be a requirement of the highest priority. Scientific understanding and technology of weapons and explosives have progressed substantially since the

1970s, and this knowledge can and should be applied to achieve the highest levels of nuclear safety in future designs. A prime example is the conversion to insensitive high explosives (IHE) formulation for the entire stockpile. The majority of the current stockpile is based on conventional high explosive (CHE). Adoption of IHE would achieve a significant risk reduction to the Complex assembly, repair, and dismantlement personnel and a corresponding increase in production and dismantlement efficiency. Benefits to the Complex would be significant and immediate.

3.1.3 Nuclear Weapon Security (Use Control)

The security threats to our stockpile are quite different, more pervasive, and less predictable than they were when the present stockpile was designed. The ability to preclude unauthorized use of a nuclear weapon, or a component from a nuclear weapon, must be designed into the entire sustainable stockpile. This capability, one of the elements of surety, should be present from manufacture to dismantlement (end-to-end command and control). As in nuclear weapon safety, the designers can take advantage of 50 years of experience and the extraordinary technological advancement in the last 15 years to implement major enhancements to built-in use control. It is worth noting that it is difficult, if not impossible to retrofit, many existing weapons with the type of surety control desired and technically achievable today.

3.1.4 Design Parameters

The present stockpile was designed during a period when the major operational driver, particularly for submarine-launched ballistic missile (SLBM) and intercontinental ballistic missile (ICBM) weapon systems, was maximizing yield and minimizing weight and volume. Cost was not a primary driver. Technological advances in the current and future DoD nuclear weapons delivery systems do not require this same level of optimization in the actual weapon. Therefore, tradeoffs in weight and volume are now possible and give rise to a design space not accessible in the past, while meeting military needs, and permit other design parameters to become more prominent:

- Designs for certification without UGT
- Designs for inexpensive manufacture and disassembly
- Designs for ease of maintenance, surveillance, and disposition
- Designs for modularity (primaries, secondaries, non-nuclear) across systems
- Designs for maximizing component reuse and minimizing life-cycle costs

The generic stockpile characteristics and the stockpile metrics also set the capability requirements of the responsive infrastructure. Nuclear weapons that have manufacturability as one of their primary design parameters should have a shorter turnaround time (i.e., the time from design definition to manufactured unit). In case of stockpile problems or needed retrofits, ease of assembly and disassembly becomes crucial to responsiveness.

3.1.5 Reliability

The reliability requirements for nuclear weapons have always been high, however, there is likely to be even more emphasis on ultra-high reliability as the size of the active stockpile and the reserve stockpile are reduced. Fortunately, high margin designs that are simple to manufacture are consistent with very high reliability requirements.

3.1.6 Cost

It is expected that the RRW program will feature pit designs that are simpler to fabricate and thus conducive to low production cost and higher throughput. In addition, reuse of "young" plutonium pits (less than 45 years old) and of canned secondary assemblies should be evaluated as an element in the design-to-cost equation for the Complex.

Simplification of pit manufacture and disassembly is particularly important in any new design. Designing for manufacture and automated assembly and inspection will have great impact on Complex cost and throughput capacity. These modern pit manufacturing concepts need to be tested in the interim pit manufacturing facility in Technical Area 55 (TA-55) and then incorporated into the Modern Pit Facility (MPF) that will be located at the Consolidated Nuclear Production Center. The rate of transformation to the sustainable stockpile is limited initially by the production capacity of the interim pit facility in TA-55 at LANL, which does not have the efficiency or the throughput capability that will be designed into the MPF and needed to meet DoD requirements. More discussion is found in Section 4.

Another feature capable of substantially reducing cost is modularity. With several primary designs and two or three secondary designs, one could have a very flexible nuclear weapon program. With modular design systems, great efficiencies could be achieved via reuse of many of the non-nuclear components. In addition, the advancement and evolution of one component design could be incorporated into a larger suite of follow-on weapons with little additional cost. This would result in significant cost reductions and greatly enhance the responsiveness of the Complex.

Modern nuclear weapons of the sustainable stockpile should be designed in such a way that stockpile surveillance is simple, if not automatic and noninvasive. For example, some of the modern optical technologies and nonproliferation technologies may be applied to nuclear weapons to ascertain their condition and reliability without dismantlement. The Complex should strive to achieve this capability and aim for conducting surveillance functions by DoD in the field and send the data back to the Complex for analysis. This would result in a significant reduction in the transportation, security, and work process interruption, thereby greatly increasing Complex productivity.

Lastly, cost analysis of designs should extend from inception to disposition. Recent experience with the W76-1 arming, fusing, and firing system has shown that aggressive cost goals are achievable on new weapon component designs, and a cost goal adds a healthy degree of discipline to the design process. Aggressive cost goals can also force tradeoffs between

operational requirements and production costs without jeopardizing mission capability. Cost goals, if sustained, should have a salutary impact on the total life cycle cost of the stockpile: design, production, maintenance, surveillance, dismantlement, and disposition. Tools with which to determine and manage these costs must be developed within the Complex.

3.1.7 Certification

A basic premise of the future sustainable stockpile is that each nuclear weapon will be designed so that it can be certified without reverting to UGT. As weapon designs move away from the UGT experience base toward high-margin, conservative designs, the issue of final stockpile certification becomes increasingly important. A rigorous process that involves the best talents and tools from all three design laboratories is crucial. The non-nuclear components will still be testable in their final configurations, although with the smaller numbers and constrained budgets of the future, the statistics are likely to be more limited. Certification of nuclear components should include a formal process by both LANL and LLNL for each weapon as it enters the stockpile, similar to the dual revalidation for the W-76. Final certification of any weapon entering the stockpile must remain the responsibility of the lead design laboratories prior to being accepted for the stockpile by DoD. The metrics for certification should be set early in the development cycle when the military characteristics are set, along with a cost target.

3.2 Present Stockpile

The entire present stockpile was produced during, and in response to, the Cold war. As such, in addition to nuclear safety and reliability, great emphasis was placed on maximum yield within severe weight and volume constraints. When these weapons were designed, the assumption was that the only limited-life components were the neutron generators and the tritium gas transfer systems; all other components were designed with the intention that they would not be replaced over the entire stockpile life of the warhead (typically 20 years).

The post-Cold war U.S. moratorium on nuclear testing and suspension of weapons production substantially altered our priorities and thus the processes for maintaining the current stockpile. The first major impact was the cessation, in 1992, of design, prototyping, or production of any new nuclear weapons. Weapons presently in the stockpile are now scheduled to be there well beyond their originally planned deployment period. Accordingly, every component in every stockpiled weapon (deployed and reserved) must be monitored as a potential limited-life component and considered for replacement.

The second major impact was the science-based Stockpile Stewardship Program, initiated in 1993. This program has developed, and continues to develop, scientific tools by which the Complex is able to enhance its understanding of the operational condition of the stockpile without UGT. Some of the more powerful tools are computational modeling, non-nuclear experiments, refined analysis of past data from underground tests, and informed technical judgment on such matters as margins and uncertainties for components and warheads.

At present there are several types of weapon systems that have nuclear capability: ballistic missiles (submarine-launched (SLBM) and silo-launched (ICBM)), cruise missiles and aircraft delivered bombs. Currently, the nuclear warheads on these systems range in age from 15 years to greater than 30 years. Of these, the newest warhead, the W88 for the Trident SLBM, was designed in the early eighties and produced between 1989 and 1991; the oldest, the W62, was designed in the sixties and produced during the seventies. Therefore, the newest weapon in the stockpile is based on a design that is 20 years old and will be 45 years old in 2030.

Not only is the present stockpile aging, but it is also very complex and diverse, with many alterations to weapons even within a single weapon design. There are two warheads for the SLBM force and three for the ICBM force, six models of bombs (one in the inactive inventory), and a single warhead for cruise missiles (one in the inactive inventory). There is little interchangeability among warhead parts and subsystems, and many warheads contain materials that are toxic and a challenge to work with (e.g., beryllium) or are no longer available (e.g., unique plastics, vacuum tubes). To support this unique stockpile, the Complex must maintain parts, materials, processes, and even tools that are no longer in common use to ensure a capability to respond to any stockpile problem. Thus, our current stockpile is extraordinarily expensive to monitor and to maintain.

Weapon	Type	Status	Carrier
B61-3	Nonstrategic	Active	Dual-capable aircraft
B61-4	Nonstrategic	Active	Dual-capable aircraft
B61-7	Strategic	Active	Strategic bomber
B61-10	Nonstrategic	Inactive	Dual-capable aircraft
B61-11	Strategic	Active	Strategic bomber
W62	Strategic	Active	ICBM
W76	Strategic	Active	SLBM
W78	Strategic	Active	ICBM
W80-0/1	Nonstrategic/strategic	Active	Cruise missile
B83	Strategic	Active	Strategic bomber
W84	Nonstrategic	Inactive	Cruise missile but no current platform
W87	Strategic	Active	ICBM
W88	Strategic	Active	SLBM

Note: Even for active systems, some warheads and bombs are maintained in an inactive standby status subject to annual reliability and quality assurance monitoring.

To maintain this fleet of aging weapons, NNSA has launched a Life Extension Program (LEP) that provides for upgrading each weapon as it reaches the end of the original stockpile lifetime, thus allowing the weapon to remain as a stockpiled system for as much as 20–30 years beyond the original design life. As a specific system enters its LEP, it is returned to Pantex where some components are reaccepted for use, some are refurbished, and some are replaced with newly designed components. The result is that the weapon is returned to the stockpile with a lifetime

extended well beyond its original design life. The W87 has completed an LEP, and the B61, W76, and W80 are in various stages of LEP development and production engineering, with stockpile production scheduled to follow.

The LEP strategy requires that the Complex retain or re-acquire capabilities and processes that are necessary to refurbish weapons designed and built many years ago. Some of the technologies and materials used in these older designs are no longer available (sunset technologies) or the materials (e.g., beryllium compounds) are now subject to environmental, safety, and health restrictions that have arisen since the original materials were introduced into the stockpile. For example, of continuing importance to preservation of the existing stockpile are capabilities to work with and produce CHE. The LEP strategy indeed extends the life of the current stockpile, but the end result remains a very complex stockpile that was highly optimized for the Cold war.

As the current stockpile is drawn down to the President's goal of 1700–2200 ODSNW, a large number of weapons will be retired from service. These weapons will be stored and form a queue for eventual dismantlement. All dismantlement is presently accomplished at the Pantex plant. There is currently a sizeable backlog of weapons awaiting dismantlement, and planned retirements will add to that workload. Under current planning of dismantlement rates, it will take more than 20 years to work off this backlog. Dismantlements, LEP production, new production, and surveillance operations all compete for the same bays and cells at Pantex.

The present strategy for the nuclear stockpile is to enter into LEPs for the existing weapons and continue to assess annually their safety and reliability using the science-based stockpile stewardship tools and the historical underground test data. This path will sustain the viability of the Cold war stockpile for a while, but it will not achieve the future, sustainable stockpile described above. A change in direction is needed.

The plutonium pits in the current nuclear stockpile were manufactured between 1978 and 1990 so the "youngest" pit in the stockpile is 15 years old in 2005. The best estimates from the nuclear design laboratories are that pits will remain functional for a minimum of 45 – 60 years. Thus the entire stockpile may need to be "turned-over" by 2035 to 2050 depending on the acceptable level of uncertainty in pit lifetime. This issue is covered more completely in a classified Supplement[1] to this report.

A transition strategy emerging from the DoD would put the nation on a new path toward the sustainable stockpile. This strategy, already endorsed by the Nuclear Weapons Council, is based on the RRW concept. An RRW weapon design is responsive to an existing weapon mission, but moves the stockpile toward the sustainable stockpile of the future. Its introduction is made possible by segmenting the current LEPs into discrete "blocks." Block 1 would incorporate the current LEP design but would be truncated much sooner than normally planned and transitioned to the block 2 design (RRW-1), which would include some, but probably not all, attributes of the future stockpile. As soon as practical, block 2 would be transitioned to block 3 (RRW-2), which

[1] *Classified Supplement to the NWCITF Report Recommendations for the Nuclear Weapons Complex of the Future*

would incorporate all the attributes of the future stockpile. Implementation of this RRW block change strategy, system by system, would ensure a smooth transition to a sustainable nuclear stockpile, and eventually to a stockpile designed for modern deterrence. The Nuclear Weapons Council has endorsed a plan to apply this strategy to warheads. Once put into practice, this strategy will move the nation a long way toward the desired, sustainable nuclear stockpile of the future. In addition, the RRW will propel the transformation of the Complex into the agility and responsive Complex of the future.

3.3 Major Transformation Recommendation

In order to achieve our Vision for the U. S. nuclear weapons complex in 2030, the Task Force recommends the following action as a key building block for transforming the Stockpile:

1. Immediate design of a Reliable Replacement Warhead

The Task Force endorses the immediate initiation of the modernization of the stockpile through the design of the Reliable Replacement Warhead. This should lead to a family of modern nuclear weapons, designed with greater margin to meet military requirements while incorporating state-of-the-art surety requirements. Within these military requirements, the RRW family of weapons will be designed for: 1) production, 2) utilization of readily available materials that do not pose undue hazards to the Complex workforce, and 3) reduced production, maintenance, and disposition costs over the weapon life-cycle. The Task Force recommends that a new version of the RRW, incorporating new design concepts and surety features, initiated on planned five-year cycles. This family of weapons will form the basis of the sustainable stockpile of the future.

Although the Task Force believes that this recommendation is the most important element for transforming the Stockpile, an array of pathway actions will be necessary to drive the transformation. These actions are provided in Section 6 of this report.

4. THE AGILE AND RESPONSIVE NUCLEAR WEAPONS COMPLEX OF 2030

The NPR completed in 2001 identified a New Triad, based on strategic offensive forces (non-nuclear and nuclear weapons), defensive forces that meet military requirements, and a responsive infrastructure. The Complex described in this section is the Task Force's vision of how to fulfill the agile and responsive nuclear weapons production infrastructure, contributing to two of the three elements of the New Triad. This is the Complex that will deliver the sustainable stockpile described in the previous section of the report.

In Section 2, the Task Force presented its vision of the responsive Complex of the future. Responsiveness is the ability to meet the customer's (in this case, DoD) time requirements: 12 months to fix a problem, 18 months to develop a solution to a new military need, 36 months to prototype, 48 months to production, and capability to conduct an underground nuclear test in 18 months. We believe that the NNSA can meet or exceed these expectations with the appropriate Complex.

Agility refers to the Complex' ability to innovate, conceive concepts and feasible designs and quickly prototype solutions to unanticipated threats to national security, coupled with modern manufacturing capabilities.

Responsiveness is the ability to turn a design into a weapon, and to do so quickly at a modern production center which the Task Force calls the Consolidated Nuclear Production Center (CNPC). For the sustainable stockpile, the CNPC will perform all nuclear component manufacturing and production tasks, the assembly and disassembly of the nuclear weapons, and the maintenance and surveillance of weapons in the stockpile as well as the storage of all nuclear components and weapons not in the custody of DoD. It will also feature a state-of-the-art rapid prototyping shop capable of producing any article designed by the laboratories. The prototyping process will prove useful in establishing the baseline for the weapons life-cycle cost estimates to the DoD customer. Upon DoD and NNSA acceptance of life-cycle cost estimates, "design/produce-to-cost" metrics can be established for the Complex.

4.1 The Consolidated Nuclear Production Center

The CNPC will be the production site for the Complex. The physical site will manufacture, test, and store all Category I and II Special Nuclear Materials (SNM) required to support the current and future needs of the Complex. It is expected that the facilities devoted to the final disposition of SNM will be at the SRS. If deemed in the interest of the Complex, the possibility of constructing an SNM disposition facility at the CNPC should be explored. Appendix F addresses disposition of excess plutonium and uranium. Manufacture and production of the non-nuclear components should not be performed at the CNPC. As discussed later, the Complex is strongly encouraged to purchase these components and assemblies from commercial industrial vendors to

the degree practical given classification and security requirements. As envisioned, the CNPC will contain the following facilities:

1. **Special nuclear materials manufacturing facility.** This is the largest single facility, divided into three zones.

   The first zone will be designed to support a plutonium foundry, casting, machining, and assaying capabilities. All of the functions currently identified in the proposed Modern Pit Facility (MPF) will be located in this building, the only exception being the plutonium R&D capability, which will be housed in an adjacent building (see item 2).

   The second zone will contain a highly enriched uranium (HEU) foundry, as well as casting, machining, and assaying capabilities. All of the capabilities currently identified in the proposed Uranium Production Facility (UPF) will be located in this zone, except for the HEU research and development capability, which will be housed in an adjacent building, (see item 2 below). This will be the area in which the secondary components will be assembled into the canned subassemblies (CSAs).

   The third zone will contain support services, staff facilities, and offices, as well as common building HVAC facilities. It is assumed that, owing to the similar environmental and employee safety requirements for dealing with SNM, the uranium and plutonium facilities, though separated, could share common utilities, landlord services, and a technical support area. This would save substantially in operating expenses and would allow for significant crossover in employee expertise and capability.

   This will be the largest and most important building at the CNPC, and the sole SNM production and manufacturing facility for the Complex.

2. **A materials research, analytical chemistry, and production development laboratory**. This will be the only facility in the Complex that performs research on SNM at the Category I and II levels. This laboratory would be focused on SNM materials research that promotes production efficiency and manufacturing process improvement. Recognizing that the design laboratories may wish to perform basic materials research on SNM materials at Category I/II levels, a portion of the materials research center would be set up as a User Facility to support the design laboratories. The CNPC staff would provide all requisite equipment and technical support staff to support the design laboratories' science and engineering users.
3. **An IHE facility.** This will be the location for producing, machining and testing all of the IHE for the Complex. It may be possible, however, to procure the actual IHE material from commercial suppliers or DoD high-explosive production facilities. Safety and risk mitigation will be accomplished by having this IHE facility separated from the weapons assembly and disassembly areas. It is assumed that basic high-explosive R&D may still be conducted at the design laboratories, which will be authorized to work with small samples of high explosives (HE). Any work with large samples will be conducted at the CPNC or the NTS, discussed in more detail later.

4. **A weapons assembly and disassembly hall**. This will be the location where HE and SNM components for the sustainable stockpile are assembled as a unit. The assembly area will support primary assembly, integration of the primary with the secondary, and the installation of all non-nuclear components into the weapon assembly, as well as surveillance and disassembly of the sustainable stockpile.
5. **Plutonium and pit storage facility.** This building will house all the pits and plutonium raw material.
6. **An HEU and secondary canned assembly storage area.** This facility could be contiguous to the HEU production facility or the plutonium storage facility. This will house all HEU for production and the CSAs.
7. **Facility for secure transportation and shipping/receiving of nuclear weapons.** This facility will be devoted exclusively to shipment and receipt of weapons.
8. **Non-nuclear component assembly and storage.** This facility will be devoted to non-nuclear parts and components to support operation. For security cost savings, most of these components would be stored at the commercial vendor's location or another Complex facility but consistent with just-in-time commercial practices.
9. **Environmental reclamation and waste recovery facility.** This facility will perform all of the reclamation and processing of the plutonium and uranium waste streams. That material which can be recovered will be recycled within the production Complex; the remaining will be packaged for shipment to SRS, NTS, or other DOE disposal sites.

Equipment in the CNPC

The CNPC must avail itself of modern production techniques and practices, modern production equipment, quality assurance, and quality controls. We suggest that the facility use numerically controlled machines and non-contact quality assurance and quality control techniques to the degree such technology can be procured from the commercial sector. To the degree that the processes can be automated and human contact reduced, the quality and uniformity will go up, the environmental costs will go down, and risks to employees will be reduced. Overall, the modest increases in non-contact, numerically controlled capital equipment will more than pay for itself in environmental and production cost reductions. Of particular importance is the ability to do rapid prototyping and free-form fabrication integrated with the numerically controlled machine tools found in modern production plants. These technologies will be used for both low-volume production and the production of tooling, and of course the first-article prototype. The latter is an important element of the responsive character of the Complex.

The NNSA already has conceptual or detailed designs for most of the larger facilities such as the MPF, the UPF, and the Chemistry and Metallurgy Research Replacement (CMRR) building. Note that both the MPF and UPF have laboratory capability that is already identified in the CMRR, and constitute about two-thirds of the cost of the CMRR. By locating all of these at the CNPC, major savings in the elimination of redundant capital equipment and construction costs are realized.

Current designs envision above-ground structures. However, the Task Force notes that underground facilities will prevent an adversarial force from surveying the site or from targeting particular CNPC facilities with weapons of choice. Going underground will simplify and greatly reduce operating costs for security. Site selection alternatives should consider the total life-cycle cost of the facility, including the security and capital costs.

We recognize that the design-basis threat (DBT) will evolve over time as the character, methods, and actions of potential terrorist threats continue to evolve. Therefore, it is imperative that the site incorporates an inherent flexibility to meet future security requirements, preferably through technological innovation. Clear buffer zones and underground facilities would provide high degrees of flexibility for the future. Further discussion of the DBT is found in Appendix G.

A classified Supplement[2] analyzes the issue of timing for the CNPC for a stockpile of 2200 active and 1000 reserve and the expected pit manufacturing capacity of the future Complex. The conclusion is that if the NNSA is required to: 1) protect a pit lifetime of 45 years, 2) support the above stockpile numbers, and 3) demonstrate production rates of 125 production pits to the stockpile per year, the CNPC must be functional by 2014. If one accepts the uncertainty of pit lifetime of 60 years, the CNPC can be delayed to 2034. In either case TA-55 is assumed to be producing 50 production pits to the stockpile per year.

4.2 Industrial Benchmarks

We considered production perspectives that a commercial company, with experience in comparable materials, might have on the Complex pit production operations and facilities.

Since there is no commercial experience with plutonium outside the Complex, the Task Force had a study group look at pit production and future facility needs from a beryllium manufacturing perspective. Beryllium components are used in some current primary designs and have very similar machining requirements and tolerances to the plutonium pits. A number of the casting techniques are different, but not sufficiently different that the physical nature of the facility is altered. Rather, the hazardous nature of beryllium and plutonium make handling specifications and restrictions similar.

The Task Force feels that the Complex would benefit greatly from a greater reliance on advanced manufacturing tools, methodology, and experienced personnel drawn from the commercial state of the art manufacturing industry rather than a modernization of approaches developed 40 years ago within the Complex. The inclusion of such outside experts would likely have a great impact on cost of the CNPC and productivity of the future production complex. More detailed perspectives are included in Appendix H, including consideration of another commercial industry that also has developed highly efficient, secretive production approaches that may be relevant to the production complex of the future.

[2] *Classified Supplement to the NWCITF Report Recommendations for the Nuclear Weapons Complex of the Future*

4.3 Consolidation of SNM

The Task Force recommends all Category I and II quantities of SNM in the Complex be consolidated to the CNPC by 2030. (Note that the NTS will have SNM and an enduring capability to test SNM, therefore two locations for SNM may be necessary unless the CNPC is located at the NTS). There are four very compelling reasons for this consolidation.

First, consolidation will substantially reduce the SNM associated capital construction costs. Consolidating all SNM at one location removes the costly redundancy in facility capability already identified above with the CMRR, the MPF, and the UPF, combined at the CNPC. Pantex major facility upgrade requests for new assembly areas would be negated even if Amarillo would be the location of the CNPC. Construction funds from these facilities could thus be applied to the CNPC, thereby having a state-of-the-art SNM site designed for security. Deactivation, decommissioning, decontamination, and demolition of existing sites or major facilities are a substantial consideration and part of a Complex-wide consolidation of SNM and transformation to a CNPC. The Task Force provides a perspective of these "sunk" costs in Appendix I.

Second, consolidation would translate into a major reduction of security capital construction costs. Physical security is projected to approach 15 percent of the Complex operating budget in the near future, and other costs will accrue for major capital improvements to existing sites to meet the DBT. By focusing the DBT investments into a new site, the security capital construction costs go down, as there would be only one site to protect. In addition, a new site designed for security could incorporate mitigation and prevention technologies from the beginning instead of the expensive retrofit.

Third, the Complex operating costs would be greatly reduced:

1. **Security:** Other than the CNPC (and NTS if CNPC is not at NTS), by 2030 all of the sites in the Complex should be able to operate with an industrial security arrangement for the protection of classified information.
2. **Utilization of SNM-trained personnel:** All of the Complex experts trained in handling Category I and II SNM will be working at the same site. Greater efficiencies would be realized in cross training and multiplexing personnel that work with HEU and plutonium, as many of the environmental and safety rules and procedures are similar.
3. **SNM waste stream processing:** At present two of the eight sites are requesting major waste treatment upgrades. These upgrades can be reduced to accommodate laboratory levels of waste rather than Category I and II, saving capital and operating expenses.
4. **Transportation:** With SNM and nuclear component production and assembly at one location, there would be a substantial reduction in secure transportation costs. Some material and components would still have to be shipped to the NTS, but with all SNM located at the CNPC by 2030, transportation costs should be limited to those for transport to and from the DoD customer and nominal shipment to the NTS

Fourth, consolidation would result in reduction of risk to adjacent civilian populations. Currently, the LLNL, LANL, Y-12, and Pantex sites are sufficiently close to residential and commercial structures such that any partially successful terrorist attack on these sites may cause collateral damage to the surrounding civilian population and associated public and private assets. The risk to the civilian population at Livermore, Los Alamos, White Rock, Oak Ridge, and Amarillo (unless one of these sites becomes the location of the CNPC) owing to an SNM associated terrorist attack is significantly reduced.

4.4 Dismantlement as a Key Function of a Responsive Complex.

The Task Force strongly believes that dismantlement is a necessary part of a responsive Complex and is a central element in nuclear threat reduction and deterrence. As the Complex embarks on a continuous production strategy and replaces the Cold war stockpile, the nation needs to dismantle the retired Cold war weapons to demonstrate to its citizens, the Congress, and the world that the deployment of an improved sustainable stockpile is not the beginning of stockpile growth.

Given the number of Cold war weapons in the stockpile and in retirement, it is expected that Pantex could meaningfully focus on dismantlement of all Cold war weapons. Pantex is already authorized to perform such tasks and has the experience. Upon dismantlement of the last of the Cold war weapons, Pantex, if not the site of the CNPC, could be decommissioned. For the sustainable stockpile, the ongoing dismantlement of all future RRW based weapons would be conducted at the CNPC.

An additional motivation is that the dismantlement process is part of the entire life cycle of nuclear weapons, and will contribute to improved weapon design. In addition, it should be performed continuously, so as to prevent a backlog of retired weapons and to maximize the reduction of overall weapon life cycle costs.

While the evaluation of the disposition of excess SNM was not within the scope of this study, it is recognized as an important issue to be addressed, particularly for plutonium. Appendix F summarizes the disposition pathways under consideration for excess SNM. The Task Force does not see a defined path for final disposition of the large quantities of SNM associated with the weapons program. We suggest that research on more novel ways of directly converting these materials into energy be considered in addition to both the MOX and immobilization pathways. Unless a satisfactory disposition plan is developed for U.S. surplus SNM, an ongoing liability in SNM storage and related security costs will remain.

4.5 Defense Missions and Facility Consolidation at the Design Laboratories (LANL, LLNL and SNL)

The Task Force believes the three weapons laboratories are national assets. They should play an important role in future development of the cutting-edge, high-risk technologies for national security. These laboratories have tremendous science and engineering competence and have prominent roles in R&D for customers across many federal agencies. Nonetheless, the weapons

laboratories of the future will likely have smaller nuclear weapons program staff than they have today. Additional DOE and DoD national security R&D missions should be encouraged for these laboratories.

Transitioning today's aging weapons to safer, more secure, easier-to-manufacture-and-maintain 21st century weapons will require an integrated effort by all three laboratories. The challenges to the Complex will require competition for the best design concepts, followed by cooperation in implementing the winning design and cooperation in the certification.

It is worth noting that, over the last 12 years, the science-based Stockpile Stewardship Program has made an enormous investment in new capability and test facilities in the three design laboratories. The Task Force believes that these are valuable Complex assets and should be operated as assets for the benefit of the Complex, not the host site. The Task Force considers it advisable to operate such unique assets as User Facilities, for doing so would provide for a higher degree of teamwork and interdependency. Moreover, a User Facility mode of operations would tend to increase both facility utilization and the expertise of support personnel. A number of the redundant facilities could be shut down, some almost immediately, thus reducing operating costs. In Appendix J, the Task Force identifies a number of critical facilities and functions, some of which are redundant and should be considered for consolidation or outsourcing. A listing of various research and test capabilities/facilities follow that we suggest become User Facilities:

1. Computing Facilities

Several new computing facilities have been constructed and are operating at the design laboratories, including a new facility at Sandia-Livermore. This makes four facilities that compete for resources and new computer hardware. A plan should be developed that recognizes two general computing environments: (1) general capacity computing and (2) state-of-the-art capability computing.

Capacity computers provide computing cycles necessary for programmatic computing. These machines should be distributed throughout the Complex. It would also be most beneficial to use common operating systems for capacity computing such that programs can operate on whatever machines are available within the Complex.

Capability computers are the large, expensive state-of-the-art computers that make significant leaps in technology. They are typically used to test ideas and concepts and to simulate the more challenging problems. We propose that in going forward there be only one capability machine location in the Complex. A single location would more effectively leverage staff and infrastructure. Users would be, and should be, highly distributed. This would tend to enhance expertise and substantially reduce operating costs (e.g., costs of operating software, support personnel, facility requirements, vendor support, memory, and associated equipment), which can far exceed the capital cost. Development of secure, high-bandwidth fiber connectivity between all Complex sites is an enabling step that has already begun, and should be pursued aggressively.

2. High Energy Density Facilities

Three state-of-the-art facilities currently have the capability of supporting scientific experiments in such areas as high-energy density, equation of state, fusion boost, and radiation transport. These facilities, the Z–Machine at SNL, the Omega facility at the University of Rochester, and the NIF at LLNL should be managed as one capability. A Users Committee should be charged with assigning experiment time and determining which experiments get performed at which facility.

3. High-Explosive R&D Facilities

Pantex, LANL, LLNL, and SNL all have HE research, development, and testing facilities. There are advantages to having HE facilities at each site, but the Task Force sees no justification for the cost of maintaining duplicate facilities. Consolidating these capabilities for research, development, and testing activities makes sense economically and would save infrastructure resources. The selection of a center of excellence for HE research, development, and testing should be the responsibility of NNSA, and that selection should be made soon. One laboratory should be responsible for leadership and management of HE research; others can play support roles.

4. Hydrodynamic Testing Facilities

The Task Force believes that the NTS should become the only Complex site for combined HE and Category I and II SNM testing. The Complex should begin transferring hydrotesting resources to the NTS to develop a robust long term hydrotesting capability. It is strongly suggested that NNSA pursue this immediately. LANL has not yet received permission to perform dynamic experiments, which it has been seeking for many years. The Complex of the future is not reliable or responsive if an experiment, possibly critical to certification without UGT, cannot be performed because of a deficient Environmental Impact Statement or a delayed Authorization Basis approval. The Complex must have the assured capability to perform a combined HE and SNM test when and if it is needed. Until such time as the NTS has this capability, the Task Force suggests that both the Dual-Axis Radiographic Hydrotesting (DARHT) Facility and Site 300 be operated as User Facilities. Consolidation of both facilities into one Hydrodynamic Testing User Facility at the NTS, incorporating containment and radiography (either X-rays or protons), could save significant costs.

5. Plutonium and Highly Enriched Uranium R&D Facilities

A central theme to this report is the consolidation of all Category I and II SNM at the CNPC. The nuclear design laboratories should be reduced to operations with research-level quantities of SNM. This would significantly reduce the security costs. The new chemical and metallurgical research facility at the CNPC should be set up as a SNM User Facility for the entire Complex. This would not obviate the need for a new CMRR at LANL; rather, it would be a “CMRR lite,” designed for only laboratory sample levels of material and amenable to commercial security.

These are examples of some of the larger User Facilities that should be established in the Complex immediately. The operational aspects of running a User Facility are addressed in greater detail in Section 5.5.2.

4.6 Non-Nuclear Component Production

Developing commercial sources and expanding the process of outsourcing most of the production of non-nuclear components—save for a few sensitive (highly classified) items to be produced within the Complex—could significantly reduce in-house requirements. The Task Force recommends that as many components as practical be procured from commercial vendors. Additional discussion on related topics can be found in Section 5.5 and its subsections.

The LEP program for the Cold war stockpile may require the continued use of beryllium (Be) and beryllium oxide (BeO). The production of these components should be outsourced immediately if services can be obtained from quality commercial vendors. This would allow manufacturing facilities at LANL and Y-12 to close with immediate cost savings at the two sites. Assembly, disassembly and surveillance activities for weapon systems containing Be and BeO will continue to be required tasks in the Complex, but not production. Design approaches for the RRW family of weapons are not expected to incorporate Be and BeO materials currently used in the Cold war stockpile.

Given the recommended move to IHE in all future weapons systems, it is likely that fewer HE formulas will be required in the stockpile. Several options are available for HE production: commercial sources, the CNPC, and the DoD.

4.7 Human Capital

The Task Force charge focuses on physical infrastructure. However, "human capital" is what makes the infrastructure productive and is critical to the viability of the Complex. The enduring key to maintaining a safe, reliable stockpile of nuclear weapons is the quality of people who make the expert judgments and their sustained dedication to their work.

We considered several reports that evaluated the human capital issues of the Complex, including the 1999 Chiles Commission report, *Commission on Maintaining United States Nuclear Weapons Expertise*. The Chiles Commission emphasized the critical aspect of the Complex human capital assets and the attitudes of personnel toward the exacting complex tasks. Many of the recommendations of these past reports have not been acted upon in any meaningful way.

Throughout the Complex are functions that require years of training to master requisite skills and develop sound technical judgment. Included are nuclear weapons designers, machinists expert in the machining of materials unique to nuclear weapons, and nuclear test engineers who supervise emplacement of the nuclear explosive. In the past, the Complex has managed the training of these individuals primarily through mentoring and on-the-job training. In some critical skill areas this on–the-job training takes five or more years to gain sufficient experience, and such training may not even be possible in the future.

It is of particular concern that the last weapon to undergo a full test was designed in the early 1980s. Presumably, there remain only a few designers in the Complex with actual weapon-testing experience. This reinforces the absolute necessity of resuming design activities now, such that those who still have the benefit of real testing experience can mentor the next-generation designers in the Complex.

In addition, as the Complex is transformed, it will need to develop a talent pool of personnel experienced in modern production technologies and processes. The Complex of the future should greatly leverage modern production techniques. The Task Force believes that these personnel should come from a commercial high-tech background, not from within the Complex.

Technical staffing levels at the design laboratories can be significantly reduced as the Complex leverages the years of investment in new, automated test and computational capabilities at the design laboratories. Perhaps greater impact on Complex staffing levels will be the efficiency realized by personnel moving into continuous design, plus weapon production and manufacturing cycles, which evolve into a family of modular nuclear weapons. Given the current age of personnel in the Complex, the Task Force believes that the expected attrition in the next 10 years should be used to adjust the Complex skill mix and reduce the personnel costs to meet budget realities.

4.8 Major Transformation Recommendations

The Task Force suggests that the NNSA begin working the transition with current contractors to an integrated interdependent Complex and at the same time increase current Complex efficiencies. The intention is not to take work away from a specific site, but rather to make the best use of those facilities critical to the Complex in the period from now until the time that the CNPC is in full operation. It is assumed that the existing technical staff will continue to perform the work, except for those tasks that require unique skills and expertise. This process will also exercise the Complex in the functioning of User Facilities. The following are some recommendations for beginning the transition to the Complex of the future:

1. Consolidated Nuclear Production Center

A CNPC site must be selected expeditiously (recommend starting the site selection process in FY 2006). Once the CNPC is completed this is where the RRW weapons are produced and dismantled. The CNPC will consist of multiple facilities with 21st century cutting-edge nuclear component production and manufacturing technology. This action will establish a cost effective modern production center that can achieve minimum annual production rates (125 production pits to the stockpile, 125 weapon assemblies, 125 weapon disassemblies, 50 weapon surveillance or maintenance units) required by the DoD to be responsive.

2. Consolidation of SNM

All Category I and II SNM and weapon primary and secondary components should be consolidated to the CNPC. This will substantially increase Complex efficiency, reduce Complex transportation, security costs and other operating costs and reduce the number of civilian communities contiguous to the weapon Complex sites that could be targets of terrorist attacks.

3. Dismantlement as part of deterrence

Pantex should focus on the dismantlement of the Cold war stockpile to demonstrate to the world that the overall number of nuclear weapons is being reduced, thereby reducing the nuclear threat. In addition, reducing the number of Cold war weapons and associated components reduces the significant security and storage cost burden on the Complex.

Although the Task Force believes that these recommendations are the most important elements for transforming the Complex, the Task Force also believes that an array of implementing strategies will be necessary to drive the necessary transformation. A key implementing strategy would be the utilization of Device Assembly Facility (DAF) to support the Pantex mission.

The DAF has ~25 percent of the cells and ~15 percent of the bay capability within the Complex. Currently the Criticality Experiments Facility (formerly TA-18) mission is being installed at the DAF. The Task Force strongly believes that DAF should immediately be transitioned to RRW assembly and IHE dismantlement activities. This would effectively increase the throughput of the Complex by 25 percent with minimum Complex cost.

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5. MANAGING THE EVOLVING COMPLEX

Governance is an enabler for the Vision of the future. It is about leadership and management and the tools needed to do both effectively. Furthermore, for high performance organizations, it is also about attitude. Strong leaders and healthy organizations must have a commitment to success, not perfection. Successful businesses know when products and services are good enough, and recognize that cost is one of the metrics for excellent performance. The Complex must learn to balance quality, safety, security and cost in order to meet the needs of the nation in a cost-effective, appropriate manner. The right attitude, combined with the changes recommended herein will enable the transformations needed for the Complex and the Stockpile.

5.1 Nuclear Weapons Council-DoD-NNSA Interface

The definition and content of the nuclear weapons stockpile is the result of a partnership between the Department of Defense and the Department of Energy/NNSA. The Nuclear Weapons Council is where the nuclear activities of the two departments are coordinated and where DoD nuclear policy is translated into stockpile requirements. Specifically, the Nuclear Weapons Council, as specified in its Handbook, is "…responsible for the oversight of all matters relating to: nuclear weapons research; development and production; surety and maintenance; dismantlement; and allocation of nuclear material. It is the forum for resolving differences in priorities and reaching consensus on nuclear weapons issues."

Support for the transformation of the Complex should come from the Secretaries of Defense and Energy to Congress, but strategic leadership from the Nuclear Weapons Council is essential as the nation embarks on the transition to a sustainable nuclear stockpile and an agile and responsive Complex. In particular, the Nuclear Weapons Council must provide guidance and direction on the LEPs, the schedule and configuration of the RRW series, the content of the stockpile, determination of the Complex production capacities, and the tradeoffs between DoD requirements and the NNSA capabilities and budgets.

The Task Force recognizes the progress made in the function of the Project Officers' Groups (POGs). The joint DoD/NNSA POGs are key elements in managing integration of a warhead with the weapon system throughout the entire life-cycle. The POGs, in general, are charged with managing the coordination of requirements and joint maintenance, logistics, testing, reliability, safety and security issues for the nuclear weapon stockpile. During Task Force discussions with NNSA production agencies, personnel from several plants indicated that inclusion in the POG process would then allow them an opportunity to better understand weapon acquisition issues and allow insertion of production viewpoints into the process. For the future, the Task Force recommends that production representation from the Complex be included in every POG.

A responsive system is constantly changing and incorporating new ideas. Regular design initiatives, planned and budgeted in advance will allow the designers, production engineers, and the DoD customers to insert requests for improvements and modifications. This should be done

to a schedule, agreed to in advance with a specific date at which the design is frozen and goes into prototyping and engineering. Any future improvements would be incorporated into the next scheduled release. This will substantially reduce design and production costs and will establish procedures that will demonstrate to the DoD customer not only a rigorous process, but also a responsive system. This process can only be implemented with the active direction of the Nuclear Weapons Council.

Another issue that crosses the DoD-NNSA interface is the terrorist threat definition for facilities that house nuclear weapons and/or SNM. The potential vulnerability to terrorist attacks of the Complex may vary substantially from military installations. However, both DoD and NNSA have a common interest in evaluating intelligence estimates of threat capabilities and the selection of meaningful threat scenarios. The Task Force recommends that representatives from DoD and NNSA participate in a joint threat assessment aimed at anticipating evolution of the DBT for the facilities of both agencies, with the possibility of generating threat frequencies beyond DBT scenarios and more efficient means to meet the DBT scenarios.

5.2 DOE NNSA Relationship

The Task Force recognizes that the unique mission of NNSA requires a significantly different set of decision and management approaches from other units of DOE. This is embodied in the National Nuclear Security Administration Act, which created NNSA as a semiautonomous organization within DOE, and gave the NNSA Administrator the authority to create rules specific to the NNSA operation unless disapproved by the Secretary.

Many administrative orders and procedures designed for the DOE civilian research and science laboratories are not well suited to the product-oriented Complex. The NNSA mission requires clear deliverables and requirements for the nuclear weapons life cycle, achieved by design, testing, manufacturing, and production with materials that by their very nature embody risk. The current DOE-NNSA structure should permit NNSA to apply appropriate rules and regulations to the NNSA Complex in a graded fashion. For the present, the Task Force proposes that orders and regulations be issued on a risk-informed basis, with due consideration of potential costs weighed against benefits.

To make this process successful it is critical that the experts in the support organizations (e.g, DOE, NNSA and Field Offices) who issue the rules and regulations also assume some of the burden of helping the NNSA line organizations and contractors identify acceptable implementation solutions conducive to the efficient accomplishment of mission objectives.

Finally, the Task Force recommends that the Secretary of Energy support a greater independence of the NNSA, expanding the internal decision authority already granted to the Naval Reactors Program to the Complex, which has served DOE, NNSA, and DoD well.

5.3 Site Office Reporting

Bold changes are often easier to accomplish when they are accompanied by organizational changes that clearly align the responsibility and the management for the program. The Task Force is recommending that the Site Office Managers begin reporting to the Deputy Administrator for Defense Programs (NA-10) rather than the Administrator. Such a change is important to redirect the contractors' focus on the Complex. There are several reasons for this recommendation:

- NA-10 is the primary line manager with mission responsibility for work that is conducted at sites within the Complex.
- The line manager with mission responsibility is best positioned to make the risk-informed decisions that balance production goals and emerging requirements.
- The Site Manager, as Contracting Officer, would then work for the primary program manager.
- NA-10 would be empowered, by management responsibility, to invoke the numerous innovations required through use of contract incentives.

5.4 Decision Support

Design and production of nuclear weapons involves the efforts of many organizations, as well as the integration of thousands of components and tens of subsystems, all with highly precise interfaces. The Task Force proposes that a strong program systems integration capability in support of the NNSA decision-makers is required to effectively manage the multiplicity of Complex contractors, priorities and tasks.

A robust program systems integration capability should enhance the NNSA ability to:

- Coordinate the timely delivery of products from one site to another
- Manage design competitions
- Ensure that each complete system meets its design and cost objectives
- Perform objective analysis of life-cycle costs and benefits
- Plan for the future
- Record lessons learned from the past

The Task Force would expect program systems integration to be a mission assignment to one of the existing contractors within the Complex. While a new contractor could be used, this would tend to create unnecessary conflict with the tasks already contracted in the Complex. As a means for ensuring a robust program systems integration capability for the Complex, the Task Force believes that the program systems integration contractor should report directly to NA-10.

There is also a need for business systems integration, which could be performed by the same program systems integrator or through a separate integrator with recognized expertise in administrative solutions for Complex-wide business systems. Similarly, for program systems integration, an existing commercial contractor already familiar with the Complex mission would be most effective in performing this function. Suggestions for areas to include in business systems integration are discussed in the Section 5.5.3.

5.5 The Integrated Interdependent Enterprise Team

NNSA, in partnership with its contractors, should establish Complex-wide unifying business practices and processes, the objective being common perspectives and benchmarks for conduct of the work within the Complex, i.e., the national security mission. These common systems should apply to NNSA, as well as its contractors. The establishment of common practices will allow for contractor-to-contractor cost comparisons, which will be of great value when assessing performance metrics and is essential to create a meaningful project management system that integrates efforts across the Complex. Strong NNSA leadership will be required to instill this process and establish a spirit of interdependence between site contractors and NNSA program managers.

The current lack of teamwork and trust is manifested in unnecessary redundancy of missions and facilities at various sites and an inability to harness the talent of the Complex to solve critical problems. While competition in ideas is healthy, it must be tempered by overall efficiency of the organization and focused by an enterprise culture of common purpose. The leadership at NNSA must set the example, rewarding those contractors who perform as team members and replacing those who do not. Several specific recommendations for developing an integrated interdependent enterprise team follow.

5.5.1 Technology Area Leads

At some stage, single-point leadership will be needed to establish responsibility for decisions, execution, cost, and schedule. For major technology areas (e.g.; high explosives, fusing systems, arming systems, tritium systems, plutonium properties), the Task Force believes that NNSA should designate a lead contractor, accountable for managing the technology area, with other laboratories or production sites designated to provide support. Lead roles can change according to performance, this being one of the most effective means of rewarding excellence and meeting evolving Complex needs.

5.5.2 User Facilities

NNSA can reduce operating costs and promote teamwork by designating many of its facilities as User Facilities. Examples of such facilities are the high-energy density devices (e.g., the NIF, the Z-Machine, Omega), as well as the facilities involved in such activities as hydrotesting (Site 300 and the DARHT facility), HE testing, SNM testing, and tritium research. Similarly, capability computing should be developed and centralized at one laboratory, with other laboratories supporting the mission. This change would not affect the need for capacity computing, but would

focus new computing technology and associated operating system software development at one center of excellence, which becomes a resource for the Complex. The guiding principle is that redundancy is inherently expensive and should only be supported where critical to manage risk and ensure mission success.

Equitable operation of these User Facilities will be critical. Fair access must be assured on the basis of Complex-wide priorities, and cost models for operations will have to be created. There are two operating models that the Task Force recommends for consideration: (1) the DOE Office of Science's model for its User Facilities, and (2) the National Science Foundation model. Both models would provide for operations of the facility funded by the NNSA directly to the User Facility operator, which is typically the host site of the facility. The programs that support the users fund experiments; these funds cover user-specific equipment, time, and computer access, and possibly specific host efforts to meet the requirements of user-specific experiments. A sample charter currently used by the DOE Office of Science is included as Appendix K.

One outcome of designated User Facilities is the opportunity to close redundant facilities. Any designated User Facility will be required to support the needs of the entire Complex, and scientists will have to travel to that facility to conduct their experiments. However, it is our judgment that, with the advent of ever-more-sophisticated encryption technology and higher-bandwidth networks, many experiments, classified or not, can be effectively performed at remote locations. The operating costs for the Complex as a whole will decrease as the redundant facilities are closed, more than offsetting the incidental travel expenses.

5.5.3 Common Business Systems

Cost comparisons, full-cost recovery, and performance metrics across the Complex are currently complicated by the lack of common definitions, allocations, and business management systems. Integration of Complex-wide projects is more difficult when disparate systems must be reconciled. In many areas, Complex-wide requirements to adopt common accounting, procurement, project management, IT, enterprise resource planning, CAD, and other business systems would substantially reduce cost, promote better integration and teamwork, and make NNSA decision-making easier. Integration would be best achieved by designating a single contractor to provide Complex-wide business system integration. That contractor could also be responsible for developing recommendations, with input offered by the Complex contractors, then implementing the recommended systems and maybe even managing the business systems as an application service provider across the Complex. This could best be accomplished with the full involvement and implementation by all contractors affected by the system changes.

Fundamental to the above is the implicit requirement that NNSA Site Offices and Headquarters adopt and use the same business practices and procedures adopted by the Complex.

A second consideration is establishing a central authority for contractor purchases within the Complex. Common procurement items such as computers could be purchased in larger quantities with significant savings. Management of the procurement function by a central Complex

procurement office could improve consistency and efficiency and reduce overhead expenses, which in principal could then reduce the size of their procurement organizations. NNSA could learn more on this subject by evaluating DoD techniques.

5.5.4 Functional Contracting

One potential enabler of consolidation and efficiency would be functional contracting. Under this concept, contract awards for mission areas would be based on functional task leads as discussed in Section 5.5.1, without regard to geographic boundaries. For example, the pit production mission could be assigned to an industrial contractor who could be the production contractor at the CNPC as well as the pit production manager in TA-55 at LANL. Extending this logic further, once a decision is made to consolidate a mission at the CNPC, the CNPC contractor would be tasked to perform the mission at current sites and also to move the mission to the CNPC in an efficient manner. The contractor would assume the responsibility for retaining and relocating appropriate personnel to make sure that mission performance was not jeopardized. Combining the existing resources, both human capital and facilities, under one contract and rewarding the contractor for progress in consolidation would accelerate the transition, benefiting NNSA, DoD and the contractor.

5.5.5 Cost-Benefit Analysis

Among the principal obstacles to the transformation of the Complex are the multiple layers of oversight and responsibilities for compliance within the NNSA and in the parent DOE structure. Two major elements of that oversight/compliance structure are safety and security. In particular, the quasi-regulatory influence of the Defense Nuclear Facilities Safety Board (DNFSB) on the safety of Complex operations and the DOE Office of Independent Oversight and Performance Assurance on security matters within the Complex is substantial.

DNFSB recommendations are not requirements. However, their recommendations have the implicit status of requirements because of the current lack of a specific mechanism for implementation assessment. The fundamental issue is one of safety benefit versus the cost of implementation. As has been found at the Nuclear Regulatory Commission (NRC) over time, resulting in the “Backfit Rule,” if implementation costs and safety benefits are not balanced, all good ideas will be implemented, regardless of cost. Risk-informed decisions with respect to implementation costs and safety benefits should be a routine part of the evaluation process for DNFSB recommendations if the Complex is to be responsive to mission needs and budget constraints.

Within the area of security, the influence of the prescribed DBT has become a significant cost driver throughout the Complex. Appendix G describes the current approach for determining compliance with the DBT, as well as alternative strategies for: (1) minimizing the physical footprint to be defended against terrorist attack; (2) applying a risk-informed methodology for measuring the benefits of potential attack counter-measures and consequence mitigation systems against their costs; and (3) encouraging the use of technology, when appropriate, to supplement

or replace "guards, guns, and gates." Also provided in that appendix is a series of recommendations for the implementation of the risk-informed decision-making alternative.

Risk-informed decision making procedures also apply to cross-cutting issues of safety and security. For example, the safety risks to site personnel, as the result of terrorist attack countermeasures, can be evaluated by comparing the additional safety risks versus the reduction in security risks. The probabilities of inadvertent countermeasure actuation (and the cost of the safety consequences) are weighed against the probability of the terrorist attack and its reduced probability of success (and the reduction in the costs of attack consequences).

The same principles can be applied in modified form to other decisions to be made within the Complex. For example, all federal rules, regulations, and orders could be subjected to a risk-based analysis that weighs the benefits to the Complex from implementation against the costs of implementation, and which might encourage alternate forms of compliance. Another example might be the post-implementation review of federal rules, regulations, and orders. In this case, the question is the value achieved through previous compliance actions, and whether that value was appropriate for the implementation costs incurred. In addition, such decisions as make/buy and facility refurbishment versus shutdown can be informed by cost-benefit analysis. A modest complication in these applications is the need to quantify the benefits of some decisions, such as the value of a research facility to the NNSA mission.

The Task Force recommends that:

- All rules, regulations, and recommendations be subjected to a risk-informed analysis that weighs and balances costs, benefits, and risks. Ultimate resolution and risk acceptance must be approved by the senior line manager, which the Task Force believes should be the NNSA Site Manager at a site and the Deputy Administrator for Defense Programs for the Complex. Decision-making can be delegated in accordance with standards that NA-10 develops.
- A DBT is specified for the entire Complex, stipulating the number of adversaries and their capabilities but not the precise attack scenarios. Each of the various attack scenarios should be assigned a probability of occurrence based on the difficulty of its staging without early detection. Attack scenarios fairly simple to stage should have a probability of occurrence near unity; those requiring complex staging of attack personnel and weapons, and some potential for detection, during practice or actual event staging, would likely have a much lower probability. Sites that currently contain SNM, which will be expeditiously moved to the CNPC, should be exempted from full DBT implementation.
- The Task Force found that there are still complaints about the unwillingness or inability of NNSA to accept proposed changes from DOE rules and orders to commercial standards. The causes of this reluctance were not clear to the Task Force, but it is recommended that a solution could be to have a designated official evaluate all requests for application of such standards. In addition this official could function to assure uniformity of application from site to site. The official could be an ombudsman for application of commercial standards throughout the Complex.

5.5.6 Contract Incentives

Contract Consolidation

As the Complex consolidates, there could be fewer contracts. In principal there could be one system integration contract for the entire Complex, with all sites and missions operated under subcontracts to the system integrator. There also could be one design contract and one production contract, or one contract for landlord services at each site, the mission being performed by either the landlord or a specialty mission prime contractor. The contracting methods should evolve based on the predominant needs at the time. The Task Force believes that all contracts should be written in such a manner as to clearly stipulate deliverables, should crisply define deliverables and interdependencies between contractors, and link fee to the above so as to facilitate teamwork.

Contract Term

NNSA would be better served with longer-term contracts. While current law and congressional direction call for re-evaluating each contract every five years, the Task Force agrees with the prior laboratory study by the Secretary of Energy Advisory Board (SEAB) that the extend-compete decision should be based on the Federally Funded Research and Development Corporation expectation that re-competition will only be pursued when there is an obvious advantage to NNSA. A longer base term with the right to cancel should be pursued, provided it had the support of Congress. It would enhance stability and improve the ability to focus on the longer-term changes critical to transformation and modernization. On the other hand, the Department should be more willing to re-compete when performance is not to the highest standard and should be willing to terminate non-performing contractors.

Incentives

The Sandia contract has introduced new incentives for performance that the Task Force supports as a good step forward in making the contract a better tool for directing performance. The goal should be shared risks and rewards, where the contractors benefit from good performance. Specific incentives might include the sharing of savings cost avoidance, an award term extension (additional years) for excellent performance, and an award fee adjusted to specific performance metrics. Some additional recommendations for changes are included in Appendix L.

Interdependencies

One way to improve teamwork and efficiencies is to create shared goals, the achievement of which results in shared reward. Examples might be a common fee pool, where there is only one score for the particular Complex-wide goal, and all sites sharing that goal get a proportional share of the fee for its achievement. The Task Force appreciates that fee is not the only incentive and may not be uniformly important as an incentive across the Complex; therefore, NNSA should consider other motivators, such as laboratory-directed research and development funds and award term. This is best applied to goals that are easy to measure objectively, with the metrics of success clearly articulated and understood in advance. The concept is to establish a sense that success or failure is a shared responsibility.

5.6 Major Transformation Recommendations

In order to achieve our Vision for the U. S. nuclear weapons complex in 2030, the Task Force recommends the following action as a key building block for transforming the Governance structure:

1. The Office of Transformation

The NNSA should immediately establish an Office of Transformation to perform cost benefit tradeoffs and analysis of our primary and more detailed recommendations. In particular, there are numerous opportunities for Complex cost savings though consolidation, clear mission assignment, and elimination of redundant non-weapons relevant research and testing. This office should evaluate those considerations, including more effective ways of meeting requirements, such as the DBT, without compromising worker/public safety or Complex mission objectives. This is an office of analysis for change management, providing transformation implementation recommendations, and the Task Force proposes the office should expire not before CNPC site selection. The office can report to any level of authority from the Secretary, the NNSA Administrator, but not below the level of the Deputy Administrator for Defense Programs.

Although the Task Force believes that this recommendation is the most important element for transforming the Governance structure, we also believe that an array of pathway actions will be necessary to drive the transformation. These actions are provided in Section 6 of this report.

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6. PATHWAY ACTIONS

The framework for the Task Force's 2030 Vision of the nuclear weapons complex and the nation's nuclear weapons stockpile is provided by the five Major Transformation Recommendations described at the end of Sections 3, 4, and 5 of this report. In addition to that framework, the Task Force has developed a series of supporting steps that provide the implementation pathway actions for the Major Transformation Recommendations. It is the sense of the Task Force that most of these actions can be and should be implemented immediately.

Immediate design of a Reliable Replacement Warhead

- Each weapon design incorporated into a block change should be the result of a formal competition between LANL and LLNL, each supported by SNL. The criteria for selection and certification of the winning design should be formally documented and communicated at the beginning of the competition.
- NNSA should decide on the potential use of existing pits and CSAs for the 2030 stockpile prior to conceptual design for the CNPC.
- The DoD should work to relax the military characteristics of its nuclear weapons, in order to generate the design space necessary for NNSA to develop high-margin, manufacturable designs for the future stockpile.
- NNSA should develop cost metrics for all nuclear weapons, and use them with appropriate tools to manage, and control costs for, warhead development, production, operations and maintenance, and dismantlement (life-cycle cost targets).

Consolidated Nuclear Production Center

- NNSA should initiate the site selection process for the CNPC immediately.
- NNSA should commit to producing 50 production pits per year that go into the stockpile from TA-55 beginning in 2012 and continuing until a replacement pit production facility can meet the needs of the stockpile.
- NNSA should locate at the CNPC the currently planned new production facilities planned for other multiple sites.

Consolidation of SNM

- As soon as the CNPC becomes operational, NNSA should direct the laboratories to limit the on-site use of SNM to Hazard Category III and below, significantly reducing the costs of security within the Complex. This action may require NNSA to review and possibly adjust the threshold definition for Hazard Category III SNM, with the intent of improving research flexibility within the Complex, while maintaining the basis for industrial security.
- DOE/NNSA should collaborate with the DoD in a joint terrorist threat analysis study, with the intent of developing a common set of threat capabilities and, to the extent

possible, threat frequencies for a common set of threat scenarios, with the intent of preparing for future modifications to the DBT for both agencies.
- NNSA should specify that the NTS is the only site for all combined high explosive and Category I and II SNM testing. Until such time as the NTS has this capability, both the DARHT facility and Site 300 should be operated as User Facilities.

Dismantlement as part of deterrence

- NNSA should task the Pantex M&O contractor with using the DAF at NTS to augment the insensitive high explosive weapon assembly capacity at Pantex, thereby freeing up capacity at Pantex for an expedited Cold war weapons dismantlement program.

Managing the Evolving Complex and the Office of Transformation

- The Secretary of Energy should encourage and permit greater independence for NNSA, along the Naval Reactor Program model.
- The Nuclear Weapons Council should establish policy that requires representation from the production side of the Complex on each POG.
- NNSA Site Offices should report to the Deputy Administrator for Defense Programs (NA-10).
- NNSA should consider contracting on the basis of functionality within the Complex, as opposed to contracting on the basis of geographical location; in particular, NNSA should contract for the management of pit production at the new CNPC that also covers interim pit production at TA-55.
- NNSA should focus TA-55 on pit production until CNPC is fully operational, by making the following changes: remove Pu 238 to another location; relocate pit surveillance to LLNL SuperBlock, relocate plutonium R&D to SuperBlock or CMR, relocate gas gun efforts to Jasper.
- NA-10 should select a Complex contractor as lead for specific technology areas, with other contractors providing support to that lead contractor. An example would be the selection of a center of excellence for HE research, development, and testing.
- NNSA should outsource the production and procurement of all non-nuclear components, except for those involving classification sensitivity, for situations where qualified vendors are unavailable, or where clear cost-benefit analysis shows that production should remain within the Complex.
- NNSA should use a process of risk-informed cost/benefit analysis decision making prior to issuing new rules, regulations, orders, and recommendations, with the intent of balancing the costs and potential benefits of implementation, and encouraging creative implementation alternatives.
- NNSA should designate mission critical facilities as User Facilities to be managed equitably for the benefit of the entire Complex. For example, capability computing for the Complex should represent a User Facility, managed by a computational User Group. Another example is the combination of high energy density facilities (i.e., the Z-machine, the Omega facility, and the NIF, also managed by a User Group that prioritizes experiments.

- NNSA should utilize contractual incentives (many of which are already available) that encourage excellent performance, discourage and penalize poor performance, and promote interdependence and teaming within the Complex.
- NNSA should select a programmatic systems integration contractor to provide decision support and Complex-wide program systems integration functions.
- NNSA should select a business systems integration contractor whose function would be to develop and manage a set of modern, consistent business practices throughout the Complex. NNSA should then adopt those same business practices.
- NNSA should establish a centralized procurement system.

The Task Force submits that the implementation of the above recommendations will transform the nuclear weapons Complex into an agile, responsive organization; an organization capable of meeting the nation's national security needs for the foreseeable future. Furthermore, these recommendations will contribute substantively to two of the three elements of the New Triad.

The Cold war stockpile and the Complex have served the country well, but neither embodies the characteristics that are important to serve the nation in the future. The Cold war stockpile should be replaced by a new sustainable stockpile, produced by an agile and responsive nuclear weapons Complex. The centerpiece for the future is the Consolidated Nuclear Production Center (CNPC), which will complement the years of investment and capability in the design laboratories.

Agility and responsiveness also derive from an attitude and an approach in meeting a mission. The Task Force proposes several changes in the management of the Complex, the most important is that the Complex be in a continuous state of design, development, production, and dismantlement, thereby maintaining a constant state of readiness and capability. Other management recommendations are structural changes, largely exercising tools already available, but not utilized, to develop the agile, responsive culture. However, changing the structure does not replace leadership.

The status quo is neither technically credible, nor financially sustainable. Some action must be taken. The Task Force has proposed a path, which is very credible, but will require leadership and crisp decisions and must be molded to meet political and financial realities. The transformation should begin now.

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APPENDIX A
TERMS OF REFERENCE

Background

During testimony to the House Appropriations Subcommittee on Energy and Water Development on March 11, 2004, the Secretary of Energy agreed to conduct a comprehensive review of the Nuclear Weapons Complex (known as the "Complex" for purposes of this document) in concert with changes in the stockpile, the security situation, and the nature of the world around us as well as limitations in resources. The House Appropriations Report for FY 2005 has also established a requirement for a systematic review of the Complex. The Secretary's study will include the issues identified in the House Report.

The review requested by the House must assess the implications of Presidential decisions on the size and composition of the stockpile, the cost and operational impacts of the new Design Basis Threat (DBT), and the personnel, facilities, and budgetary resources required to support a smaller stockpile. The review will evaluate opportunities for the consolidation of special nuclear materials, facilities, and operations across the Complex to minimize security requirements and the environmental impact of continuing operations.

The following is the language in the House Energy and Water Development Appropriations Bill, 2005, page 111 concerning the Complex review:

> *During the fiscal year 2005 budget hearings, the Committee pressed the Secretary on the need for a systematic review of requirements for the weapons complex over the next twenty-five years, and the Secretary committed to conducting such a review. The Secretary's report should assess the implications of the President's decisions on the size and composition of the stockpile, the cost and operational impacts of the new Design Basis Threat, and the personnel, facilities, and budgetary resources required to support the smaller stockpile. The report should evaluate opportunities for the consolidation of special nuclear materials, facilities, and operations across the complex to minimize security requirements and the environmental impact of continuing operations. The Secretary should assemble a team of outside experts to assist with this review. Prior reviews have largely been conducted by insiders from the weapons complex, who produce the predictable but not very credible recommendation that the Department should preserve the status quo and maintain all existing facilities and capabilities. As part of the five-year integrated budget plan for the entire Department that is directed elsewhere in this report, the Secretary will have to balance NNSA requirements against competing needs for other DOE programs. This will require an objective review that is only possible with the help of independent experts who are not, and have not been, part of the NNSA weapons complex.*
>
> *The Committee directs the Secretary to submit a written report on his findings and recommendations on the NNSA complex to the House and Senate Committees on Appropriations and Armed Services not later than April 30, 2005.*

The delay in passing an Appropriations Bill may result in a modified submission requirement, but until that happens DOE will continue to work toward the April 30, 2005, date.

The NNSA maintains a Complex capable of R&D; engineering; design and manufacture/dismantlement of nuclear weapons; transportation; surveillance and maintenance of nuclear weapons in the Nuclear Weapons Stockpile, and will gather data, options and recommendations to support the Secretary. The effort will focus on developing an efficient integrated enterprise for the certification, manufacture/dismantlement, surveillance, maintenance and testing of stockpile weapons. The present eight Complex sites will be studied to find ways to reduce and consolidate infrastructure (primarily facilities within sites) or to modernize infrastructure where absolutely required to maintain mission capabilities as defined within the Nuclear Posture Review 2001 (NPR-2001), Nuclear Weapons Stockpile Plan, the Defense Programs Strategic Vision, the security Design Basis Threat (DBT), and other pertinent guidance. Particular attention will be paid to reducing duplicated capabilities among NNSA sites and examining DoD sites where duplication with NNSA sites may exist, but only to identify potential duplication of NNSA capabilities. DoD capabilities that provide support to the NNSA will also be identified.

The NNSA study will provide dual benefit: (1) information for the Secretary's review and (2) recommendations for NNSA's tactical and strategic planning efforts.

Assumptions

- Maintain a safe, secure and reliable nuclear weapons stockpile.
- Maintain a science and technology capability to support the nuclear deterrent.
- Minimize or, where appropriate, eliminate redundant capabilities while maintaining an integrated nuclear security enterprise consisting of R&D, engineering, test, transportation and production/dismantlement facilities and infrastructure that operates in a responsive, efficient, secure and safe manner.
- The Complex must support a total stockpile of 2000 – 6000 warheads during the transition to the post-2030 stockpile.
- The Complex must have the capability to produce a limited number of pits and secondaries to support future stockpile requirements.
- As the Complex plans for transforming the nuclear deterrent, reducing the cost will be a major operating principle.
- New and modified warheads will include new technologies and designs that allow for more efficient manufacturability, increased performance margins, increased safety and use-control, and improved longevity.
- The use of special or difficult to handle materials or processes will be minimized.
- The Complex will have the capability to produce all required nuclear components.

- The number of processes unique to the manufacture and support of nuclear weapons will be reduced.

Scope and Objectives

The goal of the study is to gather data, define options and develop recommendations that, if implemented, will create a smaller, modern Complex infrastructure that is responsive to post-Cold war mission requirements. By starting with a near clean sheet of paper, every site will likely be affected, some more than others.

Time Frame to Be Used for the Study

The study will consider mission requirements, and the supporting Complex, from 2005 through 2030. Near-term will be the next five years. Mid-term will be 2010 - 2020 and the long-term will be 2020 - 2030. Options and recommendations for the mid- and long-term changes in the Complex may require actions to start in the near-term.

Terms of the Study

The study will evaluate the infrastructure required to meet post-Cold war program mission deliverables. The major deliverables include weapon refurbishment activities, possible new weapons developments, maintenance actions, surveillance activities and dismantlements while developing and fielding the required core technical capabilities and capacities for the future. For at least the short-term (2005-2010), all existing sites will be maintained, but will be evaluated for consolidation to smaller footprints and reduced levels of activities. For the longer-term, radical changes in site missions may be recommended. The effectiveness and efficiency across the Complex while maintaining program mission capability as well as security and safety standards will be paramount. Initially, the focus of the study will be to identify duplicative capabilities within the Complex and examine whether or not this duplication is technically and scientifically justified and cost effective, but the study must go further. The study must address the question of how do we design, test, manufacture, maintain and ultimately dismantle weapons in the 21st century. This is the responsibility of the Complex.

Areas of initial focus based on known duplication within the Complex:

- High Explosive (HE) R&D and production.
- Pu and Highly Enriched Uranium (HEU) R&D and production
- Hydrodynamic testing
- Design and certification
- Tritium R&D and production
- Be and BeO production
- Non-nuclear component testing and production
- Non-nuclear and nuclear material R&D, testing and production
- Others TBD

The ability to engage the weapons design community to assess and implement design enabling changes such as Insensitive High Explosives (IHE) throughout the stockpile and elimination of special materials will be an important aspect of improving safety, security and cost effectiveness. The security aspects alone warrant many of these changes. The study will engage the Complex to change processes that drive costly infrastructure or facilities and will make recommendations for changes through design, manufacture or maintenance modifications.

Deliverables

A report will be developed outlining a set of options and recommendations based on the data gathered and analyses of information. The options and recommendations will be developed in conjunction with discussions with all sites in the Complex and NNSA HQ management. The comments from individual sites will be included in the report. An interim report will be issued by April 30, 2005.

Estimated Number and Frequency of Meetings

This Infrastructure study group shall meet as required. In order to enhance members' knowledge and understanding of the infrastructure issues, sites visits will be required. Additionally, the subcommittee may meet outside of Washington, D.C. as required to fulfill its mandate.

Membership

The Nuclear Weapons Complex Infrastructure Review Task Force shall have approximately five members. The members shall be drawn from fields important to the Nuclear Weapons Program, facility and construction management and shall represent a balance of viewpoints pertinent to the scope and objectives of the review. The Chairman of SEAB, in consultation with the Secretary of Energy, shall appoint the Chair and the members of the task force.

Duration and Termination Date

This subcommittee will serve for approximately six months, with most of the work occurring from January through April 2005.

Approved: January 26, 2005

APPENDIX B
SUMMARY OF NWCITF RESPONSE TO TERMS OF REFERENCE

1. The report should evaluate opportunities for the consolidation of special nuclear materials, facilities, and operations across the Complex to minimize security requirements and the environmental impact of continuing operations (2005 House Energy and Water Development Appropriations Bill language). Report Sections: 2, 4.1 and 4.3

2. The personnel, facilities, and budgetary resources required to support the smaller stockpile (2005 House Energy and Water Development Appropriations Bill). Report Sections: 2, 3.1.6, 4 and Appendix E

3. The present eight sites will be studied to find ways to reduce and consolidate infrastructure or to modernize infrastructure where required to maintain mission capabilities as defined within the Nuclear Posture Review 2001 (NPR-2001), Nuclear Weapons Stockpile Plan (NWSP), the Defense Programs Strategic Vision, the security Design Basis Threat (DBT), and other pertinent guidance (NWCITF Terms of Reference). Report Sections: 4 and Appendix G

4. The study will evaluate the infrastructure required to meet post-Cold war program mission deliverables (NWCITF Terms of Reference). Report Sections: 2, 3, 4 and Appendix J

5. One key focus area of the study will be to identify duplicative capabilities within the Complex and examine whether or not this duplication is technically and scientifically justified and cost effective. This is the responsibility of the Complex (NWCITF Terms of Reference). Areas of focus based on known duplication within the Complex: Report Sections: 4.5 and Appendix J

    a. High Explosive (HE) R&D and production.
    b. Pu and Highly Enriched Uranium (HEU) R&D and production
    c. Hydrodynamic testing
    d. Design and certification
    e. Tritium R&D and production
    f. Be and BeO production
    g. Non-nuclear component testing and production
    h. Non-nuclear and nuclear material R&D, testing and production
    i. Others TBD

6. The cost and operational impacts of the new Design Basis Threat (2005 House Energy and Water Development Appropriations Bill). Report Section(s): 4.1, 5.5.5 and Appendix G

7. The effort will focus on developing an efficient integrated enterprise for the certification, manufacture/dismantlement, surveillance, maintenance and testing of stockpile weapons (NWCITF Terms of Reference). Report Sections: 4 and 5.5

8. The study will engage the complex to change processes that drive costly infrastructure or facilities and will make recommendations for changes through design, manufacture or maintenance modifications (NWCITF Terms of Reference). Report Sections: 3,4,5 and 6

9. DoD capabilities that provide support to the NNSA will also be identified (NWCITF Terms of Reference). Report Section(s): 5.1, and 6

10. Particular attention will be paid to reducing duplicated capabilities among NNSA sites and examining DoD sites where duplication with NNSA sites may exist, but only to identify potential duplication of NNSA capabilities (NWCITF Terms of Reference). Report Sections: 4.5, 4.6 and Appendix J

11. The major deliverables include weapon refurbishment activities, possible new weapons developments, maintenance actions, surveillance activities and dismantlements while developing and fielding the required core technical capabilities and capacities for the future (NWCITF Terms of Reference). Report Sections: 4.1, 4.3, 4.7

12. Assess the implications of the President's decisions on the size and composition of the stockpile (2005 House Energy and Water Development Appropriations Bill). Report Sections: 1 and 3

13. The major deliverables include weapon refurbishment activities, possible new weapons developments, maintenance actions, surveillance activities and dismantlements while developing and fielding the required core technical capabilities and capacities for the future (NWCITF Terms of Reference). Report Section: 3

14. The study must address the question of how do we design, test, manufacture, maintain and ultimately dismantle weapons in the 21st century (NWCITF Terms of Reference). Report Sections: 3, 4, and 5

15. The present eight sites will be studied to find ways to reduce and consolidate infrastructure or to modernize infrastructure where required to maintain mission capabilities as defined within the Nuclear Posture Review 2001 (NPR-2001), Nuclear Weapons Stockpile Plan (NWSP), the Defense Programs Strategic Vision, the security Design Basis Threat (DBT), and other pertinent guidance (NWCITF Terms of Reference). Report Section: 4

16. The study will evaluate the infrastructure required to meet post-Cold war program mission deliverables (NWCITF Terms of Reference). Report Sections: 3, 4, and 5

17. Study period from 2005 to 2030. Near term 5 years, midterm 2010-2020 long term 2020-2030 (NWCITF Terms of Reference). Report Sections: 2 and 6

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APPENDIX C
TASK FORCE DATA – GATHERING ACTIVITIES

Data gathering by the Nuclear Weapons Complex Infrastructure Task Force (the Task Force) was multi-staged and iterative. It began with interviews of those organizations, agencies, and individuals viewed as stakeholders in the future of NNSA's nuclear weapons complex. In regard to nuclear weapons policy, the Task Force consulted with the staff of the National Security Council, the Nuclear Weapons Council staff and its Chairman, who is Under Secretary of Defense for Acquisition, Technology, and Logistics; and the Nuclear Weapons Policy office of NNSA. As to nuclear weapons stockpile requirements, Task Force members interviewed the Commander of the Strategic Command; the U.S. Air Force Executive Office, Nuclear; and the U.S. Navy Strategic Systems Programs. For a congressional perspective, members met with the staff of both the House and Senate Armed Services Authorization Committees, and with the Chairmen and staff of both the House and Senate Energy and Water Appropriations Subcommittees. On financial policy, the Task Force interviewed the OMB program examiner for NNSA. And on the issue of program implementation, the Administrator of NNSA (NA-1) and the Deputy Administrator of Defense Programs (NA-10) plus several of their direct reports provided presentations to the Task Force. A more detailed list of individuals and organizations contacted is presented in the table below.
The Task Force also reviewed previous reports and studies of DOE and the nuclear weapons complex, as well as the Ten Year Site Plans prepared by each of the three design laboratories, the Nevada Test Site, and the four production sites in the Complex.

With this background, the Task Force formulated a set of questions for each site visit. During those visits, separate meetings were held with laboratory and plant management; potential future leaders and managers of the Complex, as identified by plant and laboratory management; and local NNSA Field Office managers. Site interviews varied from one to two and one-half days, exclusive of travel time. Interviews were also held with other individuals who at one time had, or currently have, a stake in the Complex or stockpile.

At the conclusion of the interviews and fact-finding, the Task Force prepared a vision for the nuclear weapons complex and the desired stockpile of 2030. Members then proceeded to test the viability of that vision in consultations with stakeholders inside and outside the Complex. Lastly, the Task Force requested that LANL and LLNL run the independent financial models of the Task Force vision for the Complex and several major pathway choices to achieve that vision. It is noted that neither of these models have been validated and are still in development, but represent the only financial models within the complex. The models were of most value in assessing sensitivities, relative rather than absolute impact.

Organizations and Individuals Contacted by NWCITF	
DOE Headquarters	*Secretary of Energy* *Director, Office of Security and Safety Performance Assurance*
NNSA Headquarters	*NNSA Administrator*

Organizations and Individuals Contacted by NWCITF	
	Principal Deputy Administrator *Office of Policy Planning, Assessment, and Analysis* *Deputy Administrator for Defense Programs* *Principal Assistant Deputy Administrator for Military Application* *Associate Administrator for Defense Nuclear Security* *Associate Administrator for Infrastructure and Environment* *Assistant Deputy Administrator for Military Application and Stockpile Operations* *Assistant Deputy Administrator for Research, Development, and Simulation* *Assistant Deputy Administrator for Program Integration* *Assistant Deputy Administrator for Secure Transportation*
NNSA M&O Contractors	*Los Alamos National Laboratory Director and Staff* *Lawrence Livermore National Laboratory Director and Staff* *Sandia National Laboratory President and Staff* *Nevada Test Site General Manager (Bechtel) and Staff* *Oak Ridge Y-12 General Manager (BWXT) and Staff* *Pantex General Manager (BWXT) and Staff* *Kansas City General Manager and Staff* *Savannah River General Manager and Staff*
NNSA Site Offices/Field Support	*Site Office Manager, Kansas City* *Site Office Manager, Pantex* *Site Office Manager, Y-12* *Site Office Manager, Las Vegas* *Site Office Manager, Savannah River* *Site Office Manager, Livermore* *Site Office Manager, Los Alamos* *Site Office Manager, Sandia* *Service Center Manager, Albuquerque*
DoD	*Under Secretary of Defense for Acquisition, Technology, and Logistics* *Deputy Assistant Secretary of Defense for Nuclear Matters* *Assistant Secretary for Nuclear, Chemical, and Biological Defense Programs* *U.S. Navy Strategic Systems Programs* *U.S. Air Force Executive Office, Nuclear* *U.S. Strategic Command (STRATCOM)*
Congress	*Chair, House Appropriations, Energy and Water Subcommittee, and staff* *Chair, Senate Appropriations, Energy and Water Subcommittee, and staff* *House Armed Services Committee staff* *Senate Armed Services Committee staff*
Other Government Agencies	*Office of Management and Budget* *Defense Nuclear Facilities Safety Board* *Nuclear Regulatory Commission* *National Security Council*
Non-Governmental Organizations/Private Citizens	*Dr. J. Hamre* *Dr. V. Reis* *Admiral R. Mies (retired)* *General L. Welch (retired)* *Dr. H. Agnew* *T. Wade* *S. Guidice* *T. Palmieri*

APPENDIX D
DEFENSE PROGRAMS FY 2006-2010 BUDGET

The Task Force met with NNSA and Office of Management and Budget (OMB) personnel early in the information-gathering phase of the review and was given the following statistical budget table. This statistical budget table provides the detail budget categories based on the Defense Programs FY 2006 Congressional budget. The Task Force used this table whenever funding estimates were required. The Task Force is aware that changes to the funding estimates occur continually and this table does not include the latest changes but it has been and continues to be adequate for the Task Force to complete their review and to develop this report.

Appendix D

STATISTICAL TABLE
FY 2006 NNSA Congressional Budget Submission
FY 2004 - FY 2010
(Dollars in thousands)

	FY2004 Revised Adjusted Approp Comp'd to FY06	FY 2005 Adjusted Approp Net of Rescission Comp'd to FY06	FY 2006 Cong	FY 2006 Cong $ Chg from FY05 Comp'd	FY 2006 Cong % Chg from FY05 Comp'd	FY 2007 FY06 Cong	FY 2008 FY06 Cong	FY 2009 FY06 Cong	FY 2010 FY06 Cong
Weapons Activities Appropriation									
Defense Programs									
Directed Stockpile Work (DSW)	**1,290,525**	**1,277,154**	**1,421,031**	**143,877**	**11.3%**	**1,459,343**	**1,487,470**	**1,516,160**	**1,545,423**
Campaigns									
Science Campaign	**258,856**	**275,993**	**261,925**	**-14,068**	**-5.1%**	**263,853**	**263,853**	**263,853**	**263,853**
Engineering Campaign	**265,206**	**261,385**	**229,756**	**-31,629**	**-12.1%**	**172,487**	**181,685**	**165,487**	**165,487**
Operations & Maintenance	178,719	175,569	164,192	-11,377	-6.5%	165,487	165,487	165,487	165,487
Construction	86,487	85,816	65,564	-20,252	-23.6%	7,000	16,198	0	0
Inertial Confinement Fusion Ignition and High Yield Campaign									
Operations & Maintenance Total	362,652	406,932	318,505	-88,427	-21.7%	351,607	451,468	461,607	461,607
Construction									
96-D-111, National Ignition Facility (NIF), LLNL	149,115	128,972	141,913	12,941	10.0%	110,000	10,139	0	0
Inertial Confinement Fusion and High Yield Campaign	**511,767**	**535,904**	**460,418**	**-75,486**	**-14.1%**	**461,607**	**461,607**	**461,607**	**461,607**
Advanced Simulation & Computing Campaign									
Operations & Maintenance	678,236	693,545	660,830	-32,715	-4.7%	666,009	666,009	666,009	666,009
Subtotal, Construction	37,079	3,202	0	-3,202	-100.0%	0	0	0	0
Advanced Simulation & Computing Campaign	**715,315**	**696,747**	**660,830**	**-35,917**	**-5.2%**	**666,009**	**666,009**	**666,009**	**666,009**
Pit Manufacturing and Certification Campaign	**262,544**	**263,020**	**248,760**	**-14,260**	**-5.4%**	**250,716**	**250,716**	**250,716**	**250,716**
Readiness Campaign	**294,490**	**261,446**	**218,755**	**-42,691**	**-16.3%**	**220,001**	**220,001**	**220,001**	**220,001**
Operations & Maintenance	219,932	240,612	193,861	-46,751	-19.4%	220,001	220,001	220,001	220,001
Construction	74,558	20,834	24,894	4,060	19.5%	0	0	0	0
Total, Campaigns	**2,308,178**	**2,294,495**	**2,080,444**	**-214,051**	**-9.3%**	**2,034,673**	**2,043,871**	**2,027,673**	**2,027,673**
RTBF Operations & Maintenance	**1,389,309**	**1,511,295**	**1,388,339**	**-122,956**	**-8.1%**	**1,417,350**	**1,457,962**	**1,530,999**	**1,605,892**
RTBF Construction	**260,650**	**275,158**	**243,047**	**-32,111**	**-11.7%**	**328,172**	**359,152**	**384,828**	**394,212**
Total, RTBF	**1,649,959**	**1,786,453**	**1,631,386**	**-155,067**	**-8.7%**	**1,745,522**	**1,817,114**	**1,915,827**	**2,000,104**
Total, Secure Transportation Asset	**166,452**	**199,709**	**212,100**	**12,391**	**6.2%**	**222,705**	**233,840**	**245,532**	**257,809**
Subtotal, Defense Programs	**5,435,114**	**5,557,811**	**5,344,961**	**-212,850**	**-3.8%**	**5,462,243**	**5,582,295**	**5,705,192**	**5,831,009**
Use of Prior Year Balances	-92,589	-13,088	0	13,088	-100.0%	0	0	0	0
Total, Defense Programs	**5,342,525**	**5,544,723**	**5,344,961**	**-199,762**	**-3.6%**	**5,462,243**	**5,582,295**	**5,705,192**	**5,831,009**
Nuclear Weapons Incident Response	96,197	108,376	118,796	10,420	9.6%	124,736	130,973	137,522	144,398
Facilities and Infrastructure Recapitalization	**238,755**	**313,722**	**283,509**	**-30,213**	**-9.6%**	**289,463**	**295,542**	**301,748**	**308,085**
Environmental Projects and Operations	**181,652**	**192,200**	**174,389**	**-17,811**	**-9.3%**	**160,034**	**131,500**	**112,629**	**116,967**
Safeguards and Security									
Operations & Maintenance, Total	625,200	715,221	699,478	-15,743	-2.2%	676,402	752,097	806,977	840,285
Subtotal, Construction	3,661	36,708	41,000	4,292	11.7%	100,500	63,000	48,175	56,875
Subtotal, Safeguards and Security	**628,861**	**751,929**	**740,478**	**-11,451**	**-1.5%**	**776,902**	**815,097**	**855,152**	**897,160**
Offset for S&S Work for Others	-28,985	-30,000	-32,000	-2,000	6.7%	-33,000	-34,000	-35,000	-36,000
Total, Safeguards and Security	**599,876**	**721,929**	**708,478**	**-13,451**	**-1.9%**	**743,902**	**781,097**	**820,152**	**861,160**
Subtotal, Weapons Activities	6,580,579	6,924,038	6,662,133	-261,905	-3.8%	6,813,378	6,955,407	7,112,243	7,297,619
Offset for S&S Work for Others	-28,985	-30,000	-32,000	-2,000	6.7%	-33,000	-34,000	-35,000	-36,000
Transfer of DOD Appropriations		-297,600		297,600	-100.0%				
Use of Prior Year Balances	-104,435	-13,088	0	13,088	-100.0%				
Total, Weapons Activities	**6,447,159**	**6,583,350**	**6,630,133**	**46,783**	**0.7%**	**6,780,378**	**6,921,407**	**7,077,243**	**7,261,619**

Appendix D

STATISTICAL TABLE
FY 2006 NNSA Congressional Budget Submission
FY 2004 - FY 2010
(Dollars in thousands)

	FY2004 Revised Adjusted Approp Comp'd to FY06	FY 2005 Adjusted Approp Net of Rescission Comp'd to FY06	FY 2006 Cong	FY 2006 Cong $ Chg from FY05 Comp'd	FY 2006 Cong % Chg from FY05 Comp'd	FY 2007 FY06 Cong	FY 2008 FY06 Cong	FY 2009 FY06 Cong	FY 2010 FY06 Cong
Weapons Activities Appropriation									
Defense Programs									
Directed Stockpile Work (DSW)			0	0	–	0	0	0	0
Stockpile Research & Development	0	0	0	0	–	0	0	0	0
Stockpile Maintenance	0	0	0	0	–	0	0	0	0
Stockpile Evaluation	0	0	0	0	–	0	0	0	0
Dismantlement / Disposal	0	0	0	0	–	0	0	0	0
Production Support	0	0	0	0	–	0	0	0	0
Field Engineering, Training and Manuals	0	0	0	0	–	0	0	0	0
Life Extension Program									
B61 Life Extension Program	43,456	58,321	50,810	-7,511	-12.9%	44,762	46,784	3,508	635
W76 Life Extension Program	138,706	180,806	162,268	-18,538	-10.3%	137,680	112,084	140,990	135,747
W80 Life Extension Program	128,347	123,947	135,240	11,293	9.1%	134,446	134,856	127,616	121,212
W87 Life Extension Program	31,036	0	0	0	–	0	0	0	0
Total, Life Extension Program	341,545	363,074	348,318	-14,756	-4.1%	316,888	293,724	272,114	257,594
Stockpile Systems									
B61 Stockpile Systems	46,034	53,557	66,050	12,493	23.3%	74,729	113,291	113,486	147,013
W62 Stockpile Systems	11,568	5,145	8,967	3,822	74.3%	6,097	4,695	2,590	0
W76 Stockpile Systems	84,148	69,305	63,538	-5,767	-8.3%	52,982	62,879	54,082	57,606
W78 Stockpile Systems	30,207	25,363	32,632	7,269	28.7%	49,186	36,108	38,678	34,272
W80 Stockpile Systems	21,743	16,448	26,315	9,867	60.0%	31,906	31,449	36,656	38,300
B83 Stockpile Systems	33,551	27,436	26,391	-1,045	-3.8%	38,860	35,515	37,672	36,529
W84 Stockpile Systems	2,246	3,225	4,402	1,177	36.5%	1,021	1,020	1,051	1,023
W87 Stockpile Systems	48,760	44,154	50,678	6,524	14.8%	45,150	34,536	34,229	36,267
W88 Stockpile Systems	34,012	33,838	32,831	-1,007	-3.0%	36,968	35,149	37,538	36,053
Total, Stockpile Systems	312,269	278,471	311,804	33,333	12.0%	336,899	354,642	355,982	387,063
Retired Warheads Stockpile Systems	24,568	35,073	35,245	172	0.5%	30,156	29,776	30,188	29,304
Stockpile Services									
Production Support	257,339	264,413	267,246	2,833	1.1%	263,149	280,763	299,022	305,256
Research and Development Support	62,044	62,139	66,753	4,614	7.4%	82,818	69,350	70,313	69,001
Stockpile Services Research & Development Certification and Safety	173,510	155,754	211,727	55,973	35.9%	224,230	255,106	262,649	265,645
Stockpile Services Management, Technology, and Production	105,836	109,301	166,587	57,286	52.4%	176,428	189,696	196,339	202,596
Stockpile Services Advanced Concepts	6,000	0	0	0	–	0	0	0	0
Stockpile Services Reliable Replacement Warhead	0	8,929	9,351	422	4.7%	14,775	14,413	29,553	28,964
Stockpile Services Robust Nuclear Earth Penetrator	7,414	0	4,000	4,000	–	14,000	0	0	0
Total, Stockpile Services	612,143	600,536	725,664	125,128	20.8%	775,400	809,328	857,876	871,462
Directed Stockpile Work (DSW)	**1,290,525**	**1,277,154**	**1,421,031**	**143,877**	**11.3%**	**1,459,343**	**1,487,470**	**1,516,160**	**1,545,423**
Campaigns									
Science Campaign			0	0	–	0	0	0	0
Primary Assessment Technologies	44,634	46,450	45,179	-1,271	-2.7%	47,536	48,870	48,711	45,573
Dynamic Materials Properties	80,527	84,978	80,894	-4,084	-4.8%	85,060	86,500	87,400	87,400
Advanced Radiography	55,170	54,819	49,520	-5,299	-9.7%	42,717	39,483	38,742	41,880
Secondary Assessment Technologies	53,781	62,962	61,332	-1,630	-2.6%	63,900	65,000	65,000	65,000
Test Readiness	24,744	26,784	25,000	-1,784	-6.7%	24,640	24,000	24,000	24,000
Science Campaign	**258,856**	**275,993**	**261,925**	**-14,068**	**-5.1%**	**263,853**	**263,853**	**263,853**	**263,853**
Engineering Campaign			0	0	–	0	0	0	0
Enhanced Surety	32,137	32,791	29,845	-2,946	-9.0%	30,081	30,081	30,081	30,081
Weapon Systems Engineering Assessment Technology	26,590	26,997	24,040	-2,957	-11.0%	24,230	24,230	24,230	24,230
Nuclear Survivability and Effects	22,418	9,365	9,386	21	0.2%	9,460	9,460	9,460	9,460
Enhanced Surveillance	93,111	101,862	96,207	-5,655	-5.6%	96,965	96,965	96,965	96,965
Advanced Design & Production Technologies	0	0	0	0	–	0	0	0	0
Engineering Campaign Construction Activities									
Operations & Maintenance / Other Project Costs (OPC)	4,463	4,554	4,714	160	3.5%	4,751	4,751	4,751	4,751
01-D-108, Microsystem & Engr Sci Applications (MESA), SNL	86,487	85,816	65,564	-20,252	-23.6%	7,000	16,198	0	0
Subtotal, Engineering Campaign Construction Activities	90,950	90,370	70,278	-20,092	-22.2%	11,751	20,949	4,751	4,751
Engineering Campaign	**265,206**	**261,385**	**229,756**	**-31,629**	**-12.1%**	**172,487**	**181,685**	**165,487**	**165,487**
Operations & Maintenance	178,719	175,569	164,192	-11,377	-6.5%	165,487	165,487	165,487	165,487
Construction	86,487	85,816	65,564	-20,252	-23.6%	7,000	16,198	0	0

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STATISTICAL TABLE
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	FY2004 Revised Adjusted Approp Comp'd to FY06	FY 2005 Adjusted Approp Net of Rescission Comp'd to FY06	FY 2006 Cong	FY 2006 Cong $ Chg from FY05 Comp'd	FY 2006 Cong % Chg from FY05 Comp'd	FY 2007 FY06 Cong	FY 2008 FY06 Cong	FY 2009 FY06 Cong	FY 2010 FY06 Cong
Inertial Confinement Fusion Ignition and High Yield Campaign									
Operations & Maintenance	0	0	0	0	–	0	0	0	0
Ignition	68,766	68,889	75,615	6,726	9.8%	79,118	98,363	100,840	103,596
Support of Other Stockpile Programs	32,838	38,498	9,872	-28,626	-74.4%	0	20,394	31,129	27,605
NIF Diagnostics, Cryogenics, and Experiment Support	31,801	48,635	43,008	-5,627	-11.6%	45,367	67,426	68,597	73,902
Pulsed Power Inertial Confinement Fusion	8,740	10,940	10,111	-829	-7.6%	10,760	10,940	11,300	11,571
University Grants / Other Support	11,868	7,715	9,946	2,231	28.9%	11,302	12,774	13,636	14,371
Facility Operations and Target Production	57,413	62,264	54,623	-7,641	-12.3%	70,645	97,659	227,050	230,562
Inertial Fusion Technology	28,780	33,573	0	-33,573	-100.0%	0	0	0	0
NIF Demonstration Program	96,300	94,943	112,330	17,387	18.3%	132,415	136,912	0	0
High-Energy Petawatt Laser Development	26,146	41,475	3,000	-38,475	-92.8%	2,000	7,000	9,055	0
Operations & Maintenance Total	362,652	406,932	318,505	-88,427	-21.7%	351,607	451,468	461,607	461,607
Construction									
96-D-111, National Ignition Facility (NIF), LLNL	149,115	128,972	141,913	12,941	10.0%	110,000	10,139	0	0
Inertial Confinement Fusion and High Yield Campaign	**511,767**	**535,904**	**460,418**	**-75,486**	**-14.1%**	**461,607**	**461,607**	**461,607**	**461,607**
Advanced Simulation & Computing Campaign									
Operations & Maintenance	678,236	693,545	660,830	-32,715	-4.7%	666,009	666,009	666,009	666,009
Construction									
01-D-101, Distributed Information Sys Lab. (DISL), SNL	12,227	0	0	0	–	0	0	0	0
00-D-103, Terascale Simulation Facility, LLNL	24,852	3,202	0	-3,202	-100.0%	0	0	0	0
00-D-105, Strategic Computing Complex, LANL	0	0	0	0	–	0	0	0	0
00-D-107, Joint Computational Engr Lab. (JCEL), SNL	0	0	0	0	–	0	0	0	0
Subtotal, Construction	37,079	3,202	0	-3,202	-100.0%	0	0	0	0
Advanced Simulation & Computing Campaign	**715,315**	**696,747**	**660,830**	**-35,917**	**-5.2%**	**666,009**	**666,009**	**666,009**	**666,009**
Pit Manufacturing and Certification Campaign		0				0	0	0	0
W88 Pit Manufacturing	105,731	130,411	120,926	-9,485	-7.3%	139,870	129,925	120,337	121,779
W88 Pit Certification	88,948	60,478	61,895	1,417	2.3%	58,312	48,312	43,319	36,510
Pit Manufacturing Capability	10,687	13,393	23,071	9,678	72.3%	34,430	44,685	53,037	54,272
Modern Pit Facility	11,546	6,945	7,686	741	10.7%	18,104	27,794	34,023	38,155
Pit Campaign Support Activities at NTS	45,632	51,793	35,182	-16,611	-32.1%	0	0	0	0
Pit Manufacturing and Certification Campaign	**262,544**	**263,020**	**248,760**	**-14,260**	**-5.4%**	**250,716**	**250,716**	**250,716**	**250,716**
Readiness Campaign			0	0	–	0	0	0	0
Stockpile Readiness	35,173	39,095	31,400	-7,695	-19.7%	31,645	31,645	30,729	30,202
High Explosive Readiness / Assembly Campaign	19,415	33,879	17,097	-16,782	-49.5%	17,231	17,231	16,732	16,445
Nonnuclear Readiness	32,894	32,628	28,630	-3,998	-12.3%	28,854	28,854	28,018	27,538
Materials Readiness	0	0	0	0	–	0	0	0	0
Tritium Readiness									
Operations & Maintenance	59,221	58,264	62,694	4,430	7.6%	87,808	87,808	91,637	93,838
98-D-125, Tritium Extraction Facility, SR	74,558	20,834	24,894	4,060	19.5%	0	0	0	0
98-D-126, Accelerator Production of Tritium, VL	0	0	0	0	–	0	0	0	0
Subtotal, Tritium Readiness	133,779	79,098	87,588	8,490	10.7%	87,808	87,808	91,637	93,838
Advanced Design & Production Technologies	73,229	76,746	54,040	-22,706	-29.6%	54,463	54,463	52,885	51,978
Responsive Infrastructure			0	0	–	0	0	0	0
Applied Technology & Materials			0	0	–	0	0	0	0
Readiness Campaign	**294,490**	**261,446**	**218,755**	**-42,691**	**-16.3%**	**220,001**	**220,001**	**220,001**	**220,001**
Operations & Maintenance	219,932	240,612	193,861	-46,751	-19.4%	220,001	220,001	220,001	220,001
Construction	74,558	20,834	24,894	4,060	19.5%	0	0	0	0
Total, Campaigns	**2,308,178**	**2,294,495**	**2,080,444**	**-214,051**	**-9.3%**	**2,034,673**	**2,043,871**	**2,027,673**	**2,027,673**
Readiness in Technical Base and Facilities (RTBF)									
Operations & Maintenance			0	0	–	0	0	0	0
Operation of Facilities	1,142,357	1,272,379	1,160,783	-111,596	-8.8%	1,181,877	1,209,354	1,281,456	1,349,910
Program Readiness	111,452	103,542	105,738	2,196	2.1%	103,713	106,415	107,846	110,564
Special Projects	35,373	31,402	6,619	-24,783	-78.9%	6,848	7,420	7,634	7,817
Material Recycle and Recovery	67,018	65,366	72,730	7,364	11.3%	78,435	87,218	89,619	92,274
Containers	16,052	15,858	17,247	1,389	8.8%	19,970	20,874	16,936	16,899
Storage	17,057	22,748	25,222	2,474	10.9%	26,507	26,681	27,508	28,428
Nuclear Weapons Incident Response	0	0	0	0	–	0	0	0	0

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RTBF Operations & Maintenance	**1,389,309**	**1,511,295**	**1,388,339**	**-122,956**	**-8.1%**	**1,417,350**	**1,457,962**	**1,530,999**	**1,605,892**
RTBF Construction									
Unallocated			0	0	–	24,920	30,086	25,011	125,056
10-D-xxx			0	0	–	0	0	0	0
10-D-140 PED, ESA Fabrication Facility Replacement, LANL	0	0	0	0	–	0	0	0	3,000
10-D-140, PED, Complex Command Center, Y-12	0	0	0	0	–	0	0	0	4,000
10-D-xxx, NW Engineering & Product Support Complex, SNL	0	0	0	0	–	0	0	0	4,000
09-D-xxx	0	0	0	0	–	0	0	0	0
09-D-xxx, Quality Evaluation Relocation, Y-12	0	0	0	0	–	0	0	0	0
09-D-xxx, TA-55 Infrastructure Reinvestment, LANL	0	0	0	0	–	0	0	12,000	12,000
09-D-xxx, Enriched Uranium Life Extension & Manufacturing Facility, Y-12	0	0	0	0	–	0	0	55,000	90,000
08-D-xxx	0	0	0	0	–	0	0	0	0
08-D-xxx, TTRLI Tonopah Test Range, SNL	0	0	0	0	–	0	5,000	7,500	10,000
08-D-xxx, Component Evaluation Facility, PX	0	0	0	0	–	0	14,000	30,000	30,000
08-D-xxx, Consolidate/Renovate Computing Facilities, KCP	0	0	0	0	–	0	10,000	10,000	0
08-D-xxx, Support Services Consolidation, LANL	0	0	0	0	–	0	14,000	0	0
08-D-xxx, Test Capabilities Revitilization - II, SNL	0	0	0	0	–	0	20,000	35,600	0
07-D-xxx	0	0	0	0	–	0	0	0	0
07-D-xxx, DX High Explosives Characterization, LANL	0	0	0	0	–	0	0	0	0
07-D-xxx, High Explosive Pressing Facility, PX	0	0	0	0	–	10,000	15,300	3,550	0
07-D-xxx, NTS Replace Fire Station 1, NV	0	0	0	0	–	0	0	0	0
07-D-xxx, Replacement of Rad Liquid Waste Treatment Plant, LANL	0	0	0	0	–	15,000	18,000	17,000	0
07-D-xxx, Building 942 Renovation, SNL	0	0	0	0	–	5,000	18,180	0	0
07-D-140, PED, Quality Evaluation Relocation, Y-12	0	0	0	0	–	0	0	0	0
07-D-140, PED, Consolidate/Renovate Computing Facilities, KCP	0	0	0	0	–	2,000	0	0	0
07-D-140, PED, Enriched Uranium Life Extension & Manufacturing Facility, Y-12	0	0	0	0	–	0	0	0	0
06-D-xxx	0	0	0	0	–	0	0	0	0
06-D-140, PED, ESA Fabrication Facility Replacement, LANL	0	0	0	0	–	0	0	0	0
06-D-140, PED, TA-55 Radiography Facility, LANL	0	0	2,000	2,000	–	0	0	0	0
06-D-140, PED, Uranium Processing Facility, Y-12	0	0	5,000	5,000	–	35,000	30,000	0	0
06-D-140, PED, TA-55 Infrastructure Reinvestment, LANL	0	0	2,000	2,000	–	5,000	0	0	0
06-D-140, PED, Radioactive Liquid Waste Treatment Facility Upgrade, LANL	0	0	3,000	3,000	–	8,100	0	0	0
06-D-140, PED, Building 942 Renovation, SNL	0	0	2,113	2,113	–	0	0	0	0
06-D-401, Energetic Materials Processing Center, LLNL	0	0	0	0	–	0	0	0	0
06-D-402, NTS Replace Fire Stations 1 & 2 , NV	0	0	8,284	8,284	–	14,080	0	0	0
06-D-403, Tritium Facility Modernization, LLNL	0	0	2,600	2,600	–	7,900	0	0	0
06-D-404, Building Remediation, Restoration, and Upgrade, NTS	0	0	16,000	16,000	–	0	0	0	0
06-D-xxx, High Explosive Pressing Facility, PX	0	0	0	0	–	0	0	0	0
05-D-140-01, PED		0	0	0	–	0	0	0	0
05-D-140-01, PED. DX High Explosives Characterization, LANL	0	1,984	0	-1,984	-100.0%	0	0	0	0
05-D-140-02, PED, Test Capabilities Revitilization, Ph II, SNL	0	1,589	2,500	911	57.3%	3,100	0	0	0
05-D-140-03, PED, Component Evaluation Facility, PX	0	1,984	2,500	516	26.0%	6,627	0	0	0
05-D-140-04, PED, Transportation and Technology Center, TBD	0	5,952	0	-5,952	-100.0%	0	0	0	0
05-D-140-05, PED, Impact Resistant Bunkers, PX	0	4,960	0	-4,960	-100.0%	0	0	0	0
05-D-401, Bldg 12-64 Upgrade, PX	0	24,902	11,000	-13,902	-55.8%	0	0	0	0
05-D-402, Beryllium Capability Project, Y-12	0	3,598	7,700	4,102	114.0%	22,000	2,000	0	0
04-D-101, Test Capabilities Revitilization, SNL	36,450	0	0	0	–	0	0	0	0
04-D-102, Ext Comm Infrastructure Modernization, SNL	20,000	0	0	0	–	0	0	0	0
04-D-103, Project Engineering & Design, VL	3,543	1,488	2,000	512	34.4%	0	0	0	0
04-D-104, National Security Science Bldg, LANL	0	0	0	0	–	0	0	0	0
04-D-125, CMR Replacement, LANL	9,941	39,684	55,000	15,316	38.6%	122,422	160,586	168,011	116,156
04-D-126, Bldg 12-44 Upgrade, PX	9,886	2,579	0	-2,579	-100.0%	0	0	0	0
04-D-127, Capability for Advanced Loading Missions, SRS	2,734	0	0	0	–	0	0	0	0
04-D-128, Criticality Experiments Facility, LANL/NTS	3,768	0	13,000	13,000	–	22,000	22,000	21,156	0
03-D-101, Sandia Underground Reactor Facility, SNL	0	0	0	0	–	0	0	0	0
03-D-102, LANL Administration Building, (SM-43), LANL	0	0	0	0	–	0	0	0	0
03-D-102, National Security Sciences Building, LANL	49,705	37,100	0	-37,100	-100.0%	0	0	0	0
03-D-103, Project Engineering & Design, VL	15,545	15,154	29,000	13,846	91.4%	14,325	0	0	0
03-D-121, Gas Transfer Capacity Expansion, KCP	11,223	0	0	0	–	0	0	0	0

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03-D-122, Purification Facility, Y-12	0	0	0	0	–	0	0	0	0
03-D-123, SNM Component Requalification, PX	8,457	4,566	0	-4,566	-100.0%	0	0	0	0
02-D-103, Project Engineering and Design, VL	10,370	5,209	0	-5,209	-100.0%	0	0	0	0
02-D-105, Engr Tech Complex Upgrade (ETCU), LLNL	9,718	5,357	0	-5,357	-100.0%	0	0	0	0
02-D-107, Elect Pwr Sys Safety, Comm & Bus Upgrades, NV	2,870	0	0	0	–	0	0	0	0
01-D-103, Project Engineering and Design, VL	1,591	5,953	9,000	3,047	51.2%	0	0	0	0
01-D-107, Atlas Relocation and Operations, NV	0	0	0	0	–	0	0	0	0
01-D-108, Microsystem & Engr Sci Applications (MESA), SNL	0	0	0	0	–	0	0	0	0
01-D-124, HEU Materials Facility, Y-12	44,735	113,099	70,350	-42,749	-37.8%	10,698	0	0	0
01-D-126, Weapons Evaluation Test Laboratory, PX	2,821	0	0	0	–	0	0	0	0
01-D-800, Sensitive Compartmented Info Facility, LLNL	0	0	0	0	–	0	0	0	0
99-D-103, Isotope Sciences Facilities, LLNL	0	0	0	0	–	0	0	0	0
99-D-104, Protect Real Prop (Roof Recnstr - PH II), LLNL	3,479	0	0	0	–	0	0	0	0
99-D-106, Model Validation & Sys Cert Test Ctr, SNL	0	0	0	0	–	0	0	0	0
99-D-108, Renovate Existing Roadway, NV	0	0	0	0	–	0	0	0	0
99-D-125, Replace Boilers & Controls, KC	0	0	0	0	–	0	0	0	0
99-D-127, SMRI-Kansas City Plant II, KC	12,388	0	0	0	–	0	0	0	0
99-D-128, SMRI-Pantex Consolidation, PX	0	0	0	0	–	0	0	0	0
98-D-123, SMRI-Tritium Facility Modern. & Consolid., SR	0	0	0	0	–	0	0	0	0
98-D-124, SMRI-Y-12 Consolidation	0	0	0	0	–	0	0	0	0
97-D-123, Structural Upgrades, KC	0	0	0	0	–	0	0	0	0
96-D-102, Stockpile Stewardship Fac. Revit., Phase VI, VL	1,426	0	0	0	–	0	0	0	0
90-D-124, High Explosive Synthesis Facility, PX	0	0	0	0	–	0	0	0	0
88-D-125, High Explosive Machining Facility, PX	0	0	0	0	–	0	0	0	0
88-D-122, Facilities Capability Assurance Programs, VL	0	0	0	0	–	0	0	0	0
RTBF Construction	**260,650**	**275,158**	**243,047**	**-32,111**	**-11.7%**	**328,172**	**359,152**	**384,828**	**394,212**
Total, RTBF	**1,649,959**	**1,786,453**	**1,631,386**	**-155,067**	**-8.7%**	**1,745,522**	**1,817,114**	**1,915,827**	**2,000,104**
Secure Transportation Asset									
Operations and Equipment	127,241	142,736	143,766	1,030	0.7%	139,677	147,033	154,783	163,380
Program Direction	59,211	56,973	68,334	11,361	19.9%	83,028	86,807	90,749	94,429
Secure Transportation Asset	186,452	199,709	212,100	12,391	6.2%	222,705	233,840	245,532	257,809
Use of Prior Year Balances	-20,000								
Total, Secure Transportation Asset	**166,452**	**199,709**	**212,100**	**12,391**	**6.2%**	**222,705**	**233,840**	**245,532**	**257,809**
Subtotal, Defense Programs	**5,435,114**	**5,557,811**	**5,344,961**	**-212,850**	**-3.8%**	**5,462,243**	**5,582,295**	**5,705,192**	**5,831,009**
Use of Prior Year Balances	-92,589	-13,088	0	13,088	-100.0%	0	0	0	0
Total, Defense Programs	**5,342,525**	**5,544,723**	**5,344,961**	**-199,762**	**-3.6%**	**5,462,243**	**5,582,295**	**5,705,192**	**5,831,009**
Nuclear Weapons Incident Response	96,197	108,376	118,796	10,420	9.6%	124,736	130,973	137,522	144,398
Facilities and Infrastructure Recapitalization									
Operations & Maintenance	235,058	289,237	233,484	-55,753	-19.3%	221,506	211,220	236,090	267,585
Construction									
09-D-xxx, Upgrade Utility Distribution System, Y-12			0	0	–	0	0	0	0
09-D-xxx, High Pressure Fire Loop, Zone 11, PX	0	0	0	0	–	0	0	17,900	0
08-D-xxx, PED: High Pressure Fire Loop, Zone 11, PX	0	0	0	0	–	0	2,900	0	0
08-D-xxx, Potable Water System Upgrades, Y-12	0	0	0	0	–	0	20,500	14,400	0
08-D-xxx, Sewer Equipment Refurbishment, PX	0	0	0	0	–	0	7,100	0	0
08-D-xxx, Water Secondary Distribution, PX	0	0	0	0	–	0	15,000	15,000	26,000
07-D-xxx, PED: Sewer Equipment Refurbishment, PX	0	0	0	0	–	1,000	0	0	0
07-D-xxx, PED: Upgrade Utility Distribution System, Y-12	0	0	0	0	–	0	0	0	0
07-D-xxx, PED: Water Secondary Distribution, PX	0	0	0	0	–	6,500	0	0	0
07-D-xxx, Replace Main Switchgear, KCP	0	0	0	0	–	9,754	8,421	0	0
07-D-xxx, High Pressure Fire Loop, Zone 12S, PX	0	0	0	0	–	8,000	8,042	0	0
07-D-xxx, Electrical Distribution System Upgrade, Y-12	0	0	0	0	–	3,000	8,000	0	0
07-D-xxx, TA 1 Heating System Modernization (HSM), SNL	0	0	0	0	–	14,500	5,000	10,000	14,500
07-D-xxx, Steam Plant Life Extension Project (SPLEP), PX	0	0	0	0	–	0	0	0	0
06-D-160-01, PED, High Pressure Fire Loop, Zone 12S, PX	0	0	1,686	1,686	–	0	0	0	0

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06-D-160-02, PED, Replace Main Switchgear, KCP	0	0	1,025	1,025	–	0	0	0	0
06-D-160-03, PED, Electrical Distribution System Upgrade, Y-12	0	0	1,300	1,300	–	1,400	0	0	0
06-D-160-04, PED, Potable Water System Upgrade, Y-12	0	0	1,800	1,800	–	3,200	0	0	0
06-D-xxx, Replace Main Switchgear, KCP	0	0	0	0	–	0	0	0	0
06-D-601, Electrical Distribution System Upgrade, PX	0	0	4,000	4,000	–	4,100	0	0	0
06-D-602, Gas Main and Distribution System Upgrade, PX	0	0	3,700	3,700	–	0	0	0	0
06-D-603, Steam Plant Life Extension Project (SPLEP), Y-12	0	0	729	729	–	15,801	9,359	8,358	0
05-D-160-01, PED		0	0	0	–	0	0	0	0
05-D-160-01, PED, TA I Heating System Modernization, SNL	0	2,976	3,000	24	0.8%	0	0	0	0
05-D-160-02, PED, Steam Plant Life Extension Project (SPLEP), Y-12	0	2,976	7,644	4,668	156.9%	0	0	0	0
05-D-160-03, PED, Electrical Distribution System Upgrade (EDSU), PX	0	1,588	0	-1,588	-100.0%	0	0	0	0
05-D-160-04, PED, Gas Main and Distribution System Upgrade (GMDSU), PX	0	1,091	0	-1,091	-100.0%	0	0	0	0
05-D-601, Compressed Air Upgrades Project, (CAUP), Y-12	0	4,365	9,741	5,376	123.2%	702	0	0	0
05-D-602, Power Grid Infrastructure Upgrade (PGIU), LANL	0	9,921	8,500	-1,421	-14.3%	0	0	0	0
05-D-603, New Master Substation (NMSU), SNL	0	595	6,900	6,305	1059.7%	0	0	0	0
04-D-203, Project Engineering & Design, VL	3,697	973	0	-973	-100.0%	0	0	0	0
Future Years Construction	0	0	0	0	–	0	0	0	0
Subtotal, Construction	3,697	24,485	50,025	25,540	104.3%	67,957	84,322	65,658	40,500
Facilities and Infrastructure Recapitalization	**238,755**	**313,722**	**283,509**	**-30,213**	**-9.6%**	**289,463**	**295,542**	**301,748**	**308,085**
Environmental Projects and Operations									
Environmental Projects and Operations Program	162,443	173,887	156,504	-17,383	-10.0%	141,466	115,934	98,248	102,021
Program Direction	19,209	18,313	17,885	-428	-2.3%	18,568	15,566	14,381	14,946
Environmental Projects and Operations	**181,652**	**192,200**	**174,389**	**-17,811**	**-9.3%**	**160,034**	**131,500**	**112,629**	**116,967**
Safeguards and Security									
Operations & Maintenance		0	0	0	–	0	0	0	0
Physical Security	544,897	615,973	621,651	5,678	0.9%	595,380	670,849	720,540	734,808
Cyber Security	80,303	99,248	77,827	-21,421	-21.6%	81,022	81,248	86,437	105,477
Operations & Maintenance, Total	625,200	715,221	699,478	-15,743	-2.2%	676,402	752,097	806,977	840,285
Construction									
99-D-132, Nuclear Material S&S Upgrade Proj., LANL	3,661	0	0	0	–	0	0	0	0
05-D-170, Project Engineering & Design, VL	0	0	0	0	–	0	0	0	0
05-D-170, PED, Nuclear Materials S&S Upgrade Project, Phase 2, LANL	0	10,000	35,000	25,000	250.0%	0	0	0	0
05-D-170, PED, Security Improvements Project, Y-12	0	6,866	6,000	-866	-12.6%	0	0	0	0
05-D-701, Security Perimeter Project, LANL	0	19,842	0	-19,842	-100.0%	0	0	0	0
05-D-702, Perimeter Attrition System, Y-12	0	0	0	0	–	0	0	0	0
06-D-xxx, Security Improvements Project, Y-12	0	0	0	0	–	0	0	0	0
07-D-xxx, Security Improvements Project, Y-12	0	0	0	0	–	54,000	7,000	0	0
07-D-xxx, Nuclear Materials S&S Upgrade Project, Phase 2, LANL	0	0	0	0	–	45,000	50,000	44,000	44,000
07-D-xxx, Security PIDAS Upgrade, PX	0	0	0	0	–	1,500	6,000	4,175	12,875
Future Years Construction	0	0	0	0	–	0	0	0	0
Subtotal, Construction	3,661	36,708	41,000	4,292	11.7%	100,500	63,000	48,175	56,875
Subtotal, Safeguards and Security	**628,861**	**751,929**	**740,478**	**-11,451**	**-1.5%**	**776,902**	**815,097**	**855,152**	**897,160**
Offset for S&S Work for Others	-28,985	-30,000	-32,000	-2,000	6.7%	-33,000	-34,000	-35,000	-36,000
Total, Safeguards and Security	**599,876**	**721,929**	**708,478**	**-13,451**	**-1.9%**	**743,902**	**781,097**	**820,152**	**861,160**
Subtotal, Weapons Activities	6,580,579	6,924,038	6,662,133	-261,905	-3.8%	6,813,378	6,955,407	7,112,243	7,297,619
Offset for S&S Work for Others	-28,985	-30,000	-32,000	-2,000	6.7%	-33,000	-34,000	-35,000	-36,000
Transfer of DOD Appropriations		-297,600		297,600	-100.0%				
Use of Prior Year Balances	-104,435	-13,088	0	13,088	-100.0%				
Total, Weapons Activities	**6,447,159**	**6,583,350**	**6,630,133**	**46,783**	**0.7%**	**6,780,378**	**6,921,407**	**7,077,243**	**7,261,619**

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APPENDIX E
PATHWAYS BUSINESS CASE

The Task Force did not have the time to study in detail the financial implications of various Major Transformation Recommendations and Pathway Actions to achieve the 2030 Vision for the nuclear weapons complex. However, several sets of assumptions regarding the pace of both Complex and Stockpile transformation were examined in a simplified manner, supported by calculations from a pair of relatively new, and as yet unvalidated, financial analysis tools provided by LANL and LLNL. Three very different cases were analyzed.

The first case, referred to as the "baseline" case is represented, in financial terms, by a flat budget, in FY 2005 dollars, over the period from 2006 through 2030. If that flat budget is the proposed FY 2006 nuclear weapons complex budget, the total expenditures over the period of interest sums to about $ 170 billion, in FY 2005 dollars. It should be pointed out that the "baseline" case is not a valid business case, since it would not lead to the 2030 Vision for the Complex, thereby representing a very high risk option for maintaining the nation's nuclear deterrent.

The second case is a valid business case, referred to as the "Complex transformation in place" option. In this case, SNM is not consolidated, existing production facilities continue in place, and no CNPC is constructed. The RRW program is initiated, most of the LEP programs are maintained, and dismantlement continues to be a low priority. The stockpile is marginally transformed through the family of RRWs. However, the 2030 Vision for the Complex will not be achieved, because the physical plant, especially the production facilities, will not be transformed into the 21st Century. The risk of this option increases in the period beyond 2020, since the issues of pit production, warhead reliability, and dismantlement become major impediments to both Stockpile and Complex transformation in that time frame. The accumulated budget for the "Complex transformation in place" option from 2006 to 2030 sums to about $ 5 billion more than the "baseline" case, in 2005 dollars.

It can be concluded that "Complex transformation in place" is a very high risk option, although that risk is not apparent in the early years, while costing more than the flat budget baseline.

The third case is also a valid business case, referred to as the "revolutionary Complex transformation" option. In this case, site selection, environmental assessment, and construction of the CNPC are accelerated to the maximum extent possible. Consolidation of SNM and all of the other Major Transformation Recommendations and Pathway Actions are implemented. In addition, a large number of variations for this business case were also examined, in order to study sensitivities in the financial results to input assumptions. For example, the results are very sensitive to assumptions on: (1) the number and extent of LEP programs; (2) efficiencies of operation at the CNPC, relative to current efficiencies within the production side of the Complex; (3) reductions in the cost of physical security within the Complex, relative to currently

escalating costs; and (4) efficiencies realized within the Complex as the result of improved contractual and business processes.

The accumulated budget for the "revolutionary Complex transformation" option from 2006 to 2030 sums to about $ 15 billion dollars less than the flat budget "baseline" case, in 2005 dollars. These "savings" are the result of accelerated expenditures during the period up to 2015, about $ 10 billion dollars above the flat "baseline" budget, combined with a total reduction of about $ 25 billion dollars during the period from 2016 to 2030, in 2005 dollars. In other words, some $ 10 billion dollars of additional expenditures are used to generate $ 25 billion dollars in savings.

The "revolutionary Complex transformation" option is also considered as the least risk option, since the 2030 Vision of the Stockpile and Complex is achieved in a timely manner, while current risk is managed by continuing some level of warhead LEP. At the same time, the dismantlement of the Cold war stockpile is accelerated. In fact, the accelerated dismantlement program is considered to represent half of the $ 10 billion accelerated expenditures from 2006 to 2015, while the other half is largely represented by the accelerated schedule for siting, construction and early operation of the CNPC. This option manages future risk by having the RRW effort work its way through design, first production unit, certification, full production schedule, and deployment on a responsive schedule. At the same time, the schedule for the Complex transformation and Cold war stockpile dismantlement is not compromised in any way.

In order to examine the "revolutionary Complex transformation" option in greater detail, several variations were studied with different assumptions. A considerably higher net savings can be achieved by delaying the start of operations at the CNPC, by curtailing or eliminating elements of the LEP program, by assuming significant efficiencies in the production side of the Complex through the modern CNPC facility, and by eventually closing some existing facilities as their mission is completed. Other variations included taking relatively ambitious credit for reductions in physical security costs, outsourcing of most non-nuclear component procurement, reprogramming of a significant fraction of FIRP money, and – most painfully – a large reduction in force at the three weapons laboratories. However, as each of these additional cost savings variations are introduced, both the current risk (reduction or elimination of the LEP program) and future risk (transformation of the stockpile) are increased. A major increase in risk is associated with RRW certification combined with aggressive reduction in force at the weapons laboratories, especially as this reduction in force affects experienced weapons designers.

The detailed review of all of the variations, in order to optimize the risk-benefit profile, was beyond the scope of the Task Force. One of the tasks for the proposed Office of Transformation could be to revisit the business case analysis and the associated risks that accrue to certain combinations of business case assumptions.

APPENDIX F
PATHWAYS FOR DISPOSAL OF EXCESS WEAPONS-GRADE PLUTONIUM AND URANIUM

The Task Force has identified aggressive dismantlement of the existing Cold war stockpile as a Complex task that is important for arms control, in addition to the final step in removing the Cold war weapons from the stockpile. A direct consequence of dismantlement is a large quantity of weapons grade material that is very expensive to maintain and store in a manner that meets environmental and employee safety as well as Design Basis Threat requirements. Therefore, to minimize the significant expense of a long-term storage program, a Special Nuclear Materials final disposition pathway must also be in place.

Although disposition is not currently part of the nuclear weapons complex's responsibility, for the reasons identified above, disposition is a critical part of the nuclear weapon life cycle and must be addressed. We deem that disposition is an obligation of the DOE and needs to be addressed with the same degree of urgency that is afforded the transformation of the Complex.

The purpose of this appendix is to inform the reader that there are several disposition pathways under consideration. We believe that none of these is particularly optimized and further research into a cost effect solution is warranted. The following general information was compiled largely from the National Nuclear Security Administration and the Nuclear Threat Initiative.[1]

PLUTONIUM

The United States and Russia have pledged to eliminate excess weapons-grade plutonium in order to prevent its theft or diversion for illegal nuclear programs and to prevent its reuse in the two nations' weapons programs.

Several methods were considered. The first disposition method (MOX) is conversion to a mixed-oxide (MOX) fuel composed of plutonium and uranium oxides for use in currently operating light-water reactors. The spent fuel resulting from reactor irradiation would be in the form of a massive, highly radioactive fuel assembly containing low concentrations of plutonium. The radioactivity in spent fuel comes from by-products of the fission process produced in the fuel during reactor irradiation.

The second disposition method (vitrification) is immobilization of the plutonium at low concentrations (5 to 10 percent, as opposed to the 90 to 100 percent concentrations of plutonium in metallic and oxide forms) along with high-level radioactive waste (HLW) in a large, heavy glass or ceramic waste form. As with spent fuel, the main barrier to theft and recovery of plutonium from the immobilized waste is radiological. Most of the radiation is due to the cesium

[1] http://www.nti.org/b_aboutnti/b_index.html.

137 component of the HLW, which emits penetrating gamma rays and has a half-life of about 30 years.

In September 2000, the United States and Russia concluded the Plutonium Management and Disposition Agreement.[2] Under the agreement, the two countries will each dispose of 34 metric tons of surplus weapons-grade plutonium, enough for thousands of nuclear weapons. Disposal will involve fabricating the surplus plutonium into mixed-oxide (MOX) fuel for irradiation in existing nuclear reactors. This approach will convert the surplus plutonium to a form that cannot be readily used to make a nuclear weapon. Previously, DOE planned to immobilize a portion of the plutonium in a ceramic form surrounded by highly radioactive waste. However, Russia would not agree to dispose of its surplus plutonium if the United States were to adopt an immobilization-only disposition approach. The Russians consider immobilization unacceptable because the material can be recovered for reuse in weapons and it does not allow for recovery of any of the energy value of the plutonium. Additionally, many experts consider the MOX fuel approach to be superior because it is a proven technology—it has been in use for decades in Europe—while immobilization involving weapons-grade plutonium has never been proven.

Congress has mandated that U.S. plutonium disposition proceed only if Russian plutonium disposition proceeds in parallel. Thus, for the U.S. program to move forward, the Russian program has to move forward, and this is currently proving to be the greater challenge. Plutonium disposition programs in both countries are still in their early stages. The startup costs of plutonium disposition are extremely high, as neither Russia nor the United States has industrial-scale MOX fuel production facilities. The Russian program is currently estimated at $2 billion; the U.S. program, $3.8 billion. However, international funding for the Russian program has not yet been secured. In addition to remaining financial uncertainties about the Russian program, other implementation issues—e.g., verification, monitoring, licensing—must be resolved before the program in both countries can move forward. Given these challenges, the year 2007, agreed to in the September 2000 agreement as the start date for plutonium irradiation, seems unrealistic.

HIGHLY ENRICHED URANIUM

Highly enriched uranium (HEU) is one of the two fissile materials that can be used to make a nuclear weapon. In 1996, DOE announced plans for eliminating the proliferation threat from stockpiles of surplus HEU by down-blending the material to low-enriched uranium. In this form, the material is unsuitable for use in nuclear weapons and can be used as commercial nuclear reactor fuel to recover its economic value.

Surplus HEU is currently being stored at several DOE facilities, primarily the Y-12 National Security Complex in Oak Ridge, Tennessee. When ready for down-blending to low-enriched uranium, it is shipped to private-sector facilities in Erwin, Tennessee, or Lynchburg, Virginia, or down-blended in DOE facilities at the Savannah River Site (Aiken, South Carolina) and Y-12.

[2] http://www.nnsa.doe.gov/na-20/na26_index.shtml, under Plutonium Management and Disposition Agreement.

All shipments of surplus HEU are moved using the Department's special transportation system designed to ensure the safety and security of sensitive government material.

NNSA Activities as of 2005 include the following:

- Transferring 50 metric tons of surplus HEU to the United States Enrichment Corporation, which will down-blend it to low-enriched uranium nuclear reactor fuel
- Transferring 39 metric tons of surplus off-specification HEU (HEU needing extra processing before down-blending) to the Tennessee Valley Authority for down-blending for use in its reactors
- Down-blending up to 10 metric tons of surplus HEU for use as low-enriched uranium research fuel
- Planning for disposition of the remaining surplus U.S. highly enriched uranium inventory

It is imperative that NNSA request adequate funding and approvals to ensure it has in operation the processing pathways necessary for its excess weapons-grade plutonium and HEU materials. It is worth noting that both of these materials represent a tremendous energy source for the country. Any disposition path that would convert the plutonium and/or uranium to more useful energy would be of great benefit and very worthwhile.

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APPENDIX G
PHYSICAL SECURITY – THE DESIGN BASIS THREAT

Introduction

One of the major cost drivers for the current nuclear weapons complex budget is physical security -- in particular, perimeter security at the sites that process or store Hazard Category I and II Special Nuclear Material (SNM). Nearly 11 % of the Complex budget for Fiscal Year 2005 is comprised of physical security costs, including capital spending to improve perimeter security and the increasing fixed costs for maintaining a well trained and well armed guard force. That cost is expected to increase to almost 15 % of the budget by 2010, with no apparent limit to the increases. This trend is unsustainable.

The cost is driven in large measure by four factors: (1) the large number of sites with Category I/II SNM and the associated physical footprint at those sites to be defended; (2) the requirement to defend those footprints with complete denial of access to the Category I/II SNM; (3) the methodology that is used to estimate the risk of terrorist attack at the various Complex sites; and (4) the heavy emphasis on "guards, guns, and gates," rather than technology, to provide defensive capability.

The most effective way to reduce physical security costs is to reduce the footprint that is defended, through the consolidation of Category I/II SNM into one site, with as small a total physical footprint as practicable. This footprint reduction through SNM consolidation must have the highest priority. The other three factors can be addressed by using a different methodology for decision making in evaluating existing security risks.

The alternate methodology is based on formal risk analysis procedures to establish baseline risk and, thereafter, formal risk management procedures that evaluate and select countermeasures and consequence mitigation devices, especially those that are technology driven rather than guards, guns, and gates driven, based on cost-benefit analysis. In the following paragraphs, the alternate methodology is described.

Estimation of Risk

The estimation of risk from terrorist attack is comprised of the product of three assessments, as shown in the simplified basic risk equation:

$$\text{Risk} = P_A * (1 - P_E) * C,$$

where

P_A is the likelihood of initiating event (e.g., accident, natural disaster, or adversary attack),
P_E is system effectiveness and $1 - P_E$ is the likelihood of system failure (or adversary success), and
C are the consequences of the failure.

The actual risk equation may involve many potential initiating events, large numbers of potential event trees that examine system effectiveness, and potential consequences along each of the event trees. However, the simplified risk equation is useful for discussing concepts.

(1) **Likelihood of the initiating event.** The first step is the assessment of the likelihood of occurrence of the initiating event (finding P_A). In the risk equation, the likelihood of the initiating event – in this case, a terrorist attack – is treated as a threat frequency. In other words, the probability of an attack of this type on this type of asset, considering the number of assets in this class, is 1 in 200 per year. When the threat frequency is deemed to be of sufficient concern that protection of the asset is felt to be required, the threat is referred to as a Design Basis Threat (DBT) for the asset under consideration. For all intents and purposes, the threat frequency for a DBT is 1.0.

(2**) Likelihood of attack success**. The second step is the assessment of the likelihood of attack success, given that the postulated terrorist attack occurs (finding $1 – P_E$). In the risk equation, this step involves the estimation of defensive capability. For example, the baseline vulnerability can be measured for the existing security system, and cost-benefit analysis can be applied to any potential added countermeasures; i.e., the largest reduction in the probability of success of the terrorist attack should be sought for the least cost. The re-calculation of the likelihood of attack success following the implementation of any cost-effective countermeasures is referred to as residual likelihood of attack success. If the likelihood of success is calculated for DBT events, the modified terms are conditional baseline likelihood and conditional residual likelihood. The current approach within the nuclear weapons complex is to essentially deny success to the terrorists, so that the probability of a successful attack is required to be near zero.

(3) **Likelihood of consequences.** The third step is the assessment of consequences, given that a postulated attack occurs and given the degree to which it is successful (finding C). This step is not currently permitted within the Complex, since the basis for defense is complete denial of access. However, when the possibility of a partially or completely successful attack is permitted in the risk estimation process, this step estimates the consequences for various partially or completely successful attack scenarios, regardless of whether those consequences are expressed in terms of immediate lives lost (prompt fatalities), longer-term loss of life (latent fatalities), cost of facility damage and subsequent economic loss, cost of adjacent facility and property damage, or other suitable metrics. In some cases, all of the metrics may be reduced to a common basis, such as cost (monetizing consequences). Again, baseline consequences can be calculated for existing consequence mitigation systems, while residual consequences can be calculated for postulated mitigation measures that could be installed or implemented. For DBT events, these are referred to as conditional baseline consequences and conditional residual consequences. This methodology enables potential consequence mitigation measures to be evaluated through cost-benefit analysis; i.e., determining the mitigation measures that most greatly reduce the consequences at the lowest cost. Mitigation systems can include, but are not limited to, systems for rendering the space around Category I/II SNM lethal following an unacceptable breach in the protective security or devices installed in the Category I/II SNM devices to render them useless (and perhaps dangerous) to the terrorist.

Application of Technology

Once having identified the technologies, you can select appropriate attack countermeasures and consequence mitigation systems that are based, to a much greater extent, on the application of technology. It is in the areas of attack countermeasures and consequence mitigation systems where the cost-benefit of adding more guards, guns, and gates is weighed against the installation of technological devices that assist the defensive force in understanding the threat and applying appropriate defensive countermeasures at appropriate times. Many of the items that could be used in this context have already been developed and applied in relevant situations (e.g., sensors, airborne surveillance), while others are ready for trial use (e.g., battlefield management software). It has been widely estimated that the cost of physical security could be reduced by 50 % with the application of modern technology through relatively modest capital expenditures.

Specific recommendations to reduce the cost of complying with the DBT

1. Consolidation of Category I/II SNM. The number of sites in the Complex that need to be secured against the DBT should be reduced, most optimally to a single location. This process of consolidation of all Category I/II SNM within the Complex at a single, readily-defended site should be started immediately, while recognizing that – in the interim – more than one site will have to be defended against terrorist attack aimed at nuclear material diversion and harmful use. This action will gradually reduce the critical physical footprint to a more manageable size and will locate the sensitive material at a site more amenable to modern countermeasures and mitigation systems based on technology.

The consolidated site characteristics should include being suitable for construction of some critical sub-surface facilities that are both more difficult for the terrorist to target and more readily defended by the guard force. They should also include sufficient remoteness so that the ***detection*** footprint (e.g., many square miles) is many times the ***controlled*** footprint (e.g., one-tenth of a square mile), thereby permitting early warning and opportunity for redeployment of defensive assets. The site should also be suitable for unmanned aerial surveillance and the use of other long-range sensing devices over that large detection footprint. Remoteness also is a positive with respect to consequences of attack, especially if the nearest population centers are upwind of prevailing wind directions. Finally, if the remote site also has adjacent or co-located supplementary defensive or take-back assets, such as an active military installation, the potential for emergency response either prior to (alert status) or during an attack would be ideal.

It is recognized that -- for some interim period – more than one site will have to be defended against terrorist attack aimed at nuclear material diversion and harmful use, thereby temporarily reducing the cost savings that would accrue to Category I/II SNM consolidation. In such a case, one alternative is to provide an exemption from full DBT implementation during the interim, until the Category I/II can eventually be moved to the consolidated site. The basis for such an exemption would be the application of threat frequency principles, even though threat frequency is not currently part of the site defensive evaluation. However, if the threat frequency is hypothetically assumed to be 0.1 (one terrorist attack every ten years), and if six sites process or

store Category I/II SNM, then a site that has a temporary holding period of five to ten years can justify some amount of relief from DBT implementation.

2. Consolidation on Site: A significant reduction in the physical footprint at the Complex sites that process or store Category I/II SNM is the first priority for reducing the costs of perimeter security. This cost is composed of one-time expenditures for construction, such as those for a Perimeter Intrusion Detection and Assessment System (PIDAS), as well as the recurring expenditures for the formation and maintenance of a well-armed and well-trained guard force. PIDAS costs can be controlled by reducing the multiple footprints at a given site through consolidation of facilities in place or by departing from the current strategy of back-fitting perimeter security systems into an existing site to a strategy of consolidation at a site with appropriate defensive characteristics.

3. Application of Risk-Informed Decision Making. The third priority for modifying the current approach to site physical security is to take full advantage of available risk-informed decision making tools. One method is to introduce the concepts of a ***reduced baseline DBT*** for individual site evaluations, while establishing maximum threat level scenarios as ***beyond DBT events***. The individual sites would continue to provide complete denial of access for the reduced baseline DBT, while the responsibility for evaluating the probability of success for beyond baseline DBT events and the consequences of any partially successful attack would lie with NNSA Headquarters. The security professionals at NNSA Headquarters would work with the intelligence agencies to establish threat frequencies for the beyond baseline DBT events that would permit baseline risk analysis and cost-benefit evaluation of countermeasures and mitigation systems. Risk acceptance for beyond baseline DBT events would also lie with NNSA Headquarters, where the skill sets needed to carry out the necessary risk-informed decision making are presumed to exist.

The issue of threat frequency for the reduced baseline DBT can be handled in a similar manner. The baseline DBT would prescribe the number of adversaries, their weaponry, and their presumed capabilities, but would not necessarily assume that all threat scenarios had the same probability of occurrence. Then, should some sites require additional relief, threat scenarios using combinations of attackers, weaponry and capability would be postulated, with the likelihood of being able to plan and stage each scenario without early discovery or intervention assigned. Target attractiveness would also be a consideration. For example, at Site A, the likelihood of undetected aerial support for the attack might be deemed to be low, while the probability might be much higher at another site. At Site B, the likelihood of certain staged sequences of attack might be very low, but much higher at another site. Site C may present such an attractive target that all potential threat scenarios would have a threat frequency of 1.0 (complete DBT). Such scenario-based threat frequency estimates could provide considerable relief throughout the Complex.

Finally, relaxation of the complete denial of access requirement should be considered for sites that can demonstrate tolerance for some types of consequences. In such cases, cost-benefit risk analysis is the appropriate tool to evaluate cross-cutting issues with respect to safety and

security; i.e., the acceptable risks to safety that accrue to significant reduction in terrorist risk. For example, one site may choose to render the room or the building enclosing the SNM lethal to the attackers prior to an adversary's ability to "weaponize" the material. Again, because of the skill sets needed to perform this type of cost-benefit analysis, NNSA Headquarters may choose to centralize the evaluation of mitigation systems that affect safety.

4. Application of Technology. The nuclear weapons complex should aggressively provide assistance to individual sites on technology-based attack countermeasures and consequence mitigation systems. That assistance should be provided by an organization that is completely separate from the organization that provides the security enforcement function. Currently, two different groups – the Office of Security and Safety Performance and the Office of Security Technology and Assistance Support – report to the same point. That is, those responsible for assessment and compliance and those that provide technical assistance report to the same point. An aggressive technical assistance program should not be penalized by the contractor's perception that technical assistance represents a backdoor compliance or audit.

Recent experience has shown that risk-informed decision making has the potential to prove the value of technology in reducing the dependence on guards, guns, and gates; or to demonstrate the more effective use of those guards, guns, and gates through intelligent deployment. That experience is based on evaluating the event trees for individual threat scenarios and modifying the baseline risk from those event trees through the insertion of various technical applications at various steps. For example, a site with a large detection footprint, augmented with unmanned aerial surveillance and long-range sensor confirmation techniques, may be able to rapidly deploy fewer guards in a more optimal manner for initial intercession of the attack, while providing more time for supplementary defensive forces to be brought into play. The benefit of these advanced capabilities and the associated reduction in risk can be quantified and compared to the costs of deploying the technologies, including any potential reduction in costs associated with more optimal deployment of the defensive force.

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APPENDIX H
INDUSTRIAL BENCHMARKING

As part of the Nuclear Weapons Complex Infrastructure Task Force activities, a study group was assigned to evaluate the current pit production capability and processes and the proposed new facility (MPF). The Study group reviewed the current TA-55 pit production facility at LANL, the proposed plan and cost estimate for the Modern Pit Facility (MPF). We were looking for the perspectives that a commercial company, with experience in comparable materials, might have on operations and facilities for the task of making pits.
The conclusions are:

1) Using standard industrial approaches rather than DOE designs would substantially reduce the cost of the MPF facility with no compromise in capability.
2) The DBT drives the costs up substantially, and it is recommended that burial of the main processing facility would save substantially on the construction costs.
3) The TA-55 facility is not being run as a production unit, but rather as a research and compliance driven facility. Productivity is about 5% of what would be required and achievable of an industrial operation in the same facility with the same task.

Modern Pit Facility (MPF) Analysis

Since there is little commercial experience with plutonium, the Study Group looked at beryllium manufacturing. Beryllium components are used in current primary designs and have very similar machining requirements and tolerances to the plutonium parts. A number of the casting techniques are different, but not sufficiently different that the physical nature of the building is altered. Rather, the hazardous nature of Be and Pu make handling specifications and restrictions similar, thus a lot of the building requirements are similar, and other than the forging and casting equipment, the machining and metrology equipment is virtually identical.

The initial risk assessment for the MPF was completed in August, 2001. Since then, the project design team, headed by SRS, has been involved with conceptual design, having performed "Facility Configuration Alternative Evaluations", selected the "Preferred" alternative conceptual layout, and defined the final stages of plant and system level requirements. The Study Group feels that SRS is close to finishing the "Conceptual" design phase of this project.

SRS used a contingency factor of 40% in their cost estimates. This is in line with Class II in the industrial table, see page G-4. Additionally, SRS has included in their total project cost (TPC) estimate, all capital and expense type items. Industry would consider these to be total estimated costs (TEC), and as a capital project, it would include the following:

Detailed Design Engineering
Building
Equipment (Balance of Plant – BOP)
Land and land rights
Construction
Associated Project Management

Items SRS included as other project costs (OPC), which would be "expensed" in industry:

Conceptual Design
Design / Technology Development
Design Authority function
Operating Procedures, Operator Training, and Qualification
Startup Testing, Readiness Assessments, Operational Readiness Review
Associated Project Management

Typical capital requests in the private industry may require a contingency level, ranging from +/- 5% to +/-15% depending on the amount of unknowns involved in the project. SRS has estimated the cost of the MPF with a 40% contingency. That is acceptable for the current state of the project, but should come down as the design and engineering is completed.

Engineering and design cost contingency typically runs approximately 10% - 20% of the total cost of the project. SRS has used 22% - 26%. This may be a little high, but should come down in the future. Because the MPF spans multiple years, SRS has put in an "escalation" factor of 26%. They have also included a 5% overhead factor. SRS has also included additional TPC adjustments for commodity pricing, delays in the approval process internal to the Department of Energy (DOE), additional startup adjustments, and costs associated with site-specific costs adjustments. All contingency factors for the SRS estimate of the MPF currently add up to a range of 100% - 125%.

SRS benchmarked the MPF versus other projects within the DOE. Historically, DOE projects are either "under-estimated" or have "scope creep" that drive the projects above their budgeted estimates. Historical DOE completed construction costs are in the range of $13,900 to $33,000 per square foot of construction. The MPF is estimated to be in the range of $14,400 to $19,400 per square foot.

Summary of costs for MPF ($M)

	Low Range	High Range	
Building(s)	447	550	
Equipment	243	297	Balance of Plant (BOP).
Project Engineering	306	417	Includes construction management, design engineering, and project management.

	Low Range	High Range	
OPC – Direct Costs	330	450	Expense, operational type costs, NEPA, training, conceptual designs, startup and testing, etc.
Contingency	1,354	2,286	Escalation and other factors have been included.
Total:	2,680	4,000	

Brush Wellman Alloy Expansion Project (AEP), a "comparable" industrial facility

The Study Group is mindful that many arguments can be made as to the uniqueness of the production of Nuclear Weapons, and plutonium in particular. Nevertheless, the AEP is a modern industrial facility that handles a hazardous material, beryllium, with about the same total footprint of the MPF, and it does give an indication of areas where one might consider doing things differently. Beryllium is not radioactive and does not have criticality issues; however, beryllium is a very reactive metal and very hazardous to the workers.

The AEP building was 170,000 sf surrounded by an eight foot fence. The unit operations in the AEP beryllium facility are orders of magnitude larger than MPF i.e. the AEP melting furnace and semi-continuous caster is designed for 20 thousand kilogram per charging, in a similar manner the wrought processing, heat treatments, surface finishing, welding, and machining in the AEP beryllium facility require equipment orders of magnitude larger than the equipment proposed for the MPF. The AEP facility did not include the support facilities such as the analytical laboratory, waste handling, radiography, and material storage was bulk storage, out of the weather. (These support facilities were elsewhere available on the Brush Wellman plant site.) The handling of beryllium did require equipment enclosures and extensive air handling and filtration to address the beryllium emission regulations. The AEP facility was completed for less than $150 M in 1999. The building portion (~ 170, 000 sf) was ~ $30 M of the project. This is high for industrial buildings as it included extensive air handling and safety equipment needed to process beryllium. This cost only includes the cost of the building, flooring, and minimal utilities. Security, fire life safety, fencing, and process equipment add to this number. The capital equipment in the building (including design, engineering, and actual procurement of capital equipment) was ~ $120 M. (Note the equipment is must support larger throughput requirements than that proposed for the MPF.)

Comparisons between MPF and AEP

There are different guidelines in private industry that define the type of capital cost estimate for a major construction project. Each type of estimate has a specified accuracy range that requires a minimum level of project scope definition consistent with the level of accuracy and serves an evolving but distinct purpose in the commercial world…to give management confidence in the estimate and thereby obtain major expenditure approval. Listed below is a typical commercial guideline that has five types of estimates identified by class, name, accuracy range, and use:

CLASS in industry	CLASS in DOE	NAME	ACCURACY RANGE	PRIMARY UTILIZATION
I	CD-0	Order of Magnitude or Scoping	+40% to -25%	Screen business investments and researc develop projects. Engineering 2% comp
II	CD-1	Conceptual or Feasibility	+30% to -20%	Compare technologies and perform preliminary project economics analysis. Engineering 5% to 10% complete.
III	CD-2	Preliminary or Basic Engineering	+15% to -15%	Obtain initial project funding approval (complete detailed design and to make purchase commitments for long lead iter Engineering 20% to 30% complete.
IV	CD-3	Detailed	+10% to -10%	Obtain final project funding approval. Engineering 50% to 60% complete.
V	CD-4	Definitive	+5% to -5%	Engineering 80% to 90% complete.

The building is a major cost element of the MPF and the cost differential may be largely related to designing to meet DBT requirements related to SNM.

Obviously, highly technical equipment adds a considerable amount to the project. The following table compares the gross costs between the DOE designed MPF and the commercial AEP.

Project:	Square Feet	Cost($M)	Cost Cap Eq ($M)	Year	Cost per Sq. Ft.	Comments
MPF	206,000+	4,000	250	2005	**$19,400**	Based on most recent cost estimate and includes several buildings
BWI - AEP	170,000	150	120	1999	**$765**	Project completed in 1999

Some of this difference in the MPF included support facilities as discussed in the paragraph on the AEP above. Perhaps factoring in these additional facilities would bring the difference down to ten times, similar to the difference in the building cost.

Obviously, the industrial AEP building did not have gabion walls, bulwark, and a PIDAS. In the case of the MPF, the process building is $500,000,000 just for the one building. The building has six feet thick steel reinforced concrete flooring. The gabion walls are constructed of two feet steel reinforced concrete, five – six feet of granular fill, and another six feet of steel reinforced concrete constructed walls. The bulwark is continuous around the second floor of the process building. All of the above was designed to meet the DBT requirements.

Options for the MPF

Several ideas that should be considered before they are discarded, since the savings are large for each option, and several of the options could result in additive savings:

- Reduce the structure costs to meet the DBT by using (buying) more land, obtaining advantage of earlier detection and thereby denying approach.
- Consider placing the process building underground.
- Consider placing of the process building inside of a mountain.
- Review the DOE DBT and see if there are other technologies that can be deployed to reduce the cost of the building and still achieve the DBT requirements, but at lower capital and operating cost.
- The size of the MPF is scaled by the production rate of 125 per year. If that number could be reduced by ½ the footprint of the production building should scale, but not quite linearly.
- Reduce the types of pits to be produced. Designing for pits of the future rather than the unique and hard to make pits of the Cold war stockpile would save a lot of money.

It is the Study Group's opinion that the last bullet may have the greatest impact on capital cost reduction, from a technical perspective.

The DBT, which is not a technical requirement, also drives the cost. The Study Group believes that constructing underground, in a mine, or an equivalent, could be the cheapest method to address the DBT is burial. Traditional mining companies can profitably mine underground ore valued at $200/cubic yard. Thus, ~ $50 M should provide a substantially subsurface cavity to house a "thin walled" pit manufacturing facility or any other equivalent type work space.

SRS has utilized good engineering practices and teamwork in the MPF project to date. SRS developed a scope of work, a "model", and established a design criteria and production output level. SRS has designed the MPF given the current set of regulations, guidelines, DBT, safety considerations at today's standards. If these standards or other factors change, it will only make this facility more difficult to build and more costly, if it is done in the traditional DOE manner. It should also be recognized that construction raw material costs are escalating higher on a daily basis. This will also drive project costs higher. Consideration should be given to spend more time and effort on the "Design" phase to reduce contingency and uncertainty in the cost estimate.

TA-55 Operations Commentary

TA-55 is a remarkable facility. The attention to detail at every level of manufacture is to be commended. It is obvious that **processes have been laboriously developed** to provide a quality product safely. However, the manufacturing priorities appear to be: (1) Safety, (2) Security, (3) Quality. **The one missing element is: Productivity**.

Due to the nature of the processes, safety and security requirements must take a priority. This is obvious a given a facility of this critical nature. Unfortunately, the manufacturing operation at TA-55 is extremely inefficient when compared with any conventional manufacturing operation. There is little evidence of modern manufacturing techniques being employed. The fundamental process design is grounded in a seriously outdated "inspect quality in" mentality. Modern manufacturing techniques including Lean Manufacturing, Six Sigma, Design of Manufacturability and Assembly, and others, if applied rigorously could yield unprecedented reductions in TA-55 pit manufacturing costs and cycle time.

The enormous investment made in the TA-55 facility has not yielded anywhere near the productivity levels this facility should be capable of attaining. The process is operated with little sense of urgency. It appears that each manufacturing step is "an event" attracting numerous witnesses and visitors. The process of actually building a pit seems to be a secondary mission of the facility, not the primary focus.

At every phase of operation, there appears to be numerous opportunities to "lean-out" the operation. The current process follows 1950's "inspect in" quality methodology. As such, the vast majority of the time the plutonium material, raw or in the process of becoming a pit, is waiting to be inspected, to be tested, waiting for test results, etc. This is an incredible waste of time. This is not to say that quality inspection does not have its place, it does. But given the many years of pit manufacturing experience, we should know how to make these components by well characterized processes which should not require the current amount of sequential testing which absolutely kills productivity. At a minimum, a rigorous review to determine necessary testing requirements would be valuable. In addition, current analytical metrology techniques, if applied, should yield superior results in much shorter time frames.

Lean Manufacturing techniques such as Value Stream Mapping could easily be applied to the pit manufacturing process. Fundamentally, the pit facility produces one product, yet it appears that every pit produced is a "hand crafted individual object". This method of production yields process inefficiencies in **every** operation. Additionally, process automation at several steps of this process would be quite valuable. Currently available CNC machining centers, modified for the unique safety hazards would yield a wealth of productivity gains.

From a modern industry standpoint, world class productivity, quality, and safety can all be attained at the TA-55 facility by thorough and rigorous analysis and hard work on the production floor. The cursory analysis of the TA-55 facility yields a ratio of value-added to non-value-added work of perhaps 1:20 or much worse. This indicates a tremendous opportunity for improvement. The available productive capacity of this plant is being wasted by inefficient utilization of plant equipment and personnel.

In conclusion, the TA-55 facility is an expensive national asset, which has the opportunity to be a dramatically more effective and efficient facility if operated as a modern production facility, utilizing available automation and world class operations management techniques.

Another perspective (NASCAR)

The Study Group looked at a very different commercial operation that uses state of the art materials, engineering, is very competitive, very secretive, and produces unique products at the rate of about 100/year. A lot of the processes are similar, they use some prosaic and exotic material that is cast and then machined to very high precision. The main elements that impact performance are highly controlled and they are constantly searching for innovation. Nonetheless, the entire "package" is relatively "prosaic". The rules and requirements are stringent with concern for safety and constant inspections. The consequences of success are fame and fortune, the consequences of failure could be death to a driver and loss of substantial amounts of money.

The Study Group visited a medium to large successful NASCAR operation to see how they met their objectives. This organization has about 300 employees; about 50% of their workforce in direct production and the other 50% in overhead. Some of the points we thought especially relevant to the Complex are:

- They require strong central leadership and a clear mission the entire workforce is behind.
- They are very cost conscious with 20% of everyone's compensation tied to cost goals
- They incent performance by the division of prize money to all employees. "Even the janitor will see a thousand from a win".
- They out-source all but the most critical parts. As one of their managers said "You can't be good at everything and cost effective"
- They pay for quality in small quantities and have little trouble getting it from specialty manufacturers.
- The parts they manufacture are done with the latest in equipment and processes. "We use rapid-prototyping and rapid-manufacturing extensively but move to hard tools and conventional processes as fast as possible because SLAs (stereo lithographic apparatus: used to produce 3-D models) are expensive"
- Design for manufacturing and assembly is considered at every stage of development. As the Engine Manager said, "You must prevent the building of Walls"

In the NASCAR professional racing team activity we find 36 competitive events during the year, with numerous on track test sessions, that are located from coast to coast across the USA. This level of activity sets the parameters for team planning, organizing, and required build execution of vehicle body and chassis, power train assembly (e.g. transmission, final drive gear assembly), engine assembly, and final vehicle integration and testing.

A top level team with two to three cars entered per event will field approximately 300 total head count, with a distribution of 75 in engine related manufacturing, 75 in body and chassis related activity, and the balance in support related functions ranging from engineering, race track support, marketing, administration, and management functions. A typical NASCAR team of this size would also operate its own internal airline consisting of up to five aircraft with coast-to-

coast flight capability, necessary to get team personnel to the various areas of the country required on a day to day basis. It is not uncommon for two totally different support groups to be at different locations across the country on any given day. Extensive use of ground transportation for teams is also in place with several full sized over the road tractor trailer rigs. This is the primary method of vehicle, spare parts, and race support equipment transport for the US based activity. Some of the transportation staff provide dual roles such as driving the transport rigs to the events and then function in a support role at the event.

Safety equipment and its application are standard across all manufacturers, incorporated into the vehicle design, and rigidly enforced. Every component on a NASCAR race vehicle must be approved and is subject to random checks during pre-race technical inspection. All vehicles are subject to post-race final inspection and top finishers are scrutinized thoroughly for engine irregularities and or body modifications. These inspections are carried out by dedicated (full time) NASCAR tech inspectors and can involve the use of body templates (full body or partial), fuel analysis equipment, x-ray equipment, engine measuring and analysis equipment, as well as various other methods of determining compliance to rules involving use of materials and methods.

Innovative development is accomplished through component optimization using the latest CAD as well as computer simulation and analysis tools, rapid prototyping and in some cases actual components for testing prior to committing to hard tooling. Design for manufacturer and assembly is considered at every stage of development, and component new design innovation can take between 6 months and 1 year. Further component optimization with high tech materials, development in coating technology, and close working relationships with key component or sub system suppliers is very important. The typical NASCAR engineering, development, and race support groups tend to be extremely secretive as to their activities regarding component design, techniques, and methodology.

The NASCAR rules for these engines are well defined and limit the use of current production automotive engine technology in many areas, with the latest materials such as compacted graphite cast iron used in the cylinder block, and aluminum cylinder heads incorporate the use of Beryllium copper valve seat materials. Materials such as titanium alloys, some metal matrix composites, and copper beryllium are accepted, however Aluminum Beryllium, Inconell, and Beryllium are not accepted materials. Carbon fiber material and other advanced plastics are used in limited in application. Advanced surface coating of components is generally accepted and current use finds diamond like carbon, titanium nitrite, molybdenum disulfide, and several other proprietary coatings in use in current NASCAR engines.

Between schedules requirements for race day and testing activity the typical top-level team will have 150 engines in circulation at any given time with rebuild and update activity accounting for an additional 250 engines. To accommodate this activity the facility will have approximately 10 engine build rooms with dedicated engine assembly technicians. The supporting machine shop facilities for this engine build activity will include all current technology equipment as it relates

to engine component part processing. The machining centers are state-of-art with four or five machining centers in the facility.

Engine Parts

Approximately 500 parts make up a current NASCAR race engine. The majority of engine parts are purchased as individual components or subsystem assembly's from specialty automotive and aerospace level performance industry suppliers. These manufacturers tend to be specialty companies. There are several components that are developed and manufactured in house, as well as many assembly processes and preparation techniques. Procurement of parts is typically managed with two to three full time people: managing the purchase orders, tracking delivery schedules, and parts inventory. Six to eight week lead time is average for most components, one-off prototype capability infinitely variable with component design and material requirement (e.g., machined part vs. machined from a forging or raw casting). A forged crankshaft of new design may require a lead time of one year or more for a volume of 100 parts. Other long lead time components include cylinder block and head castings. NASCAR rules changes can have an effect if the team is required to change engine operating parameters and may take 6 months for recovery. Component part suppliers tend to be evaluated on the basis of quality, on-time delivery, and cost. Product development is often performed by performance product suppliers and brought to the teams for evaluation in an effort to continue the business activity. The successful long term supplier to a NASCAR team will have built a good working relationship with the organization.

Component parts are specified to the highest possible quality level in every case with many vendors being self qualified to some extent. Part order volume tends to be in the hundreds of components with orders issued on a monthly basis depending on total volume. These components are incorporated directly into the engine assembly, after inspection, in most cases with little or no modification. The team has an inspection department with state of the art equipment in place. The inspection activity is a key element in the engine assembly process where virtually 100% of components incoming receive inspection of some kind.

The business incentive

NASCAR teams are performance driven organizations. Typically 20% of team "employee" compensation is based on controlling cost and performance. There are additional bonus opportunities that are tied to winning performance on the racetrack. These can be in monies collected from race purse amounts, variable incentives that are put in place by NASCAR, and or sponsors. These monies go into a bonus pool that is distributed to everyone in the organization.

The organization is comprised of several different departments and the budget process for operating is not unlike other commercial companies. Performance against operating budget and meeting set goals are also a component of evaluation and a contributor to the bonus distribution process. It is not performance at any cost by any means. Strong central leadership with clearly defined goals is the backbone of the top NASCAR organizations.

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APPENDIX I:
DEACTIVATION, DECOMMISSIONING, DECONTAMINATION AND DEMOLITION

As the Task Force considered the cost of the Complex of the Future, it was felt that an assessment of the deactivation, decommissioning, decontamination and demolition (D, D, D&D) costs of facilities and or sites that may be closed should be considered. These are real expenses to the DOE, even though they may not be born by the NNSA at this time or in the future. The Task Force has considered this issue, even though it is outside the Terms of Reference. This issue is addressed to give the reader some indication of whether the proposed consolidation and modernization of the Complex carried with it significant D,D,D&D liabilities that would be accelerated because of the consolidation at a CNPC. The Task Force considered only those aspects of the site for which NNSA had direct D, D, D&D responsibility. The case "No CNPC " is modernization-in-place, certain new, modern facilities are constructed at current sites. There is no consolidation. The "CNPC" assumes completion, by 2015-2020, of the Consolidated Nuclear Production Center described in this report.
The following table evaluates the major D, D, D&D projects that appear to be associated with consolidation. The major cost variable is the potential closing of Pantex. Pantex is an old facility and will ultimately undergo D, D, D&D at some point, but unlikely before 2030 owing to the significant dismantlement obligations. The table represents best estimates of the Task Force, using information included in the Ten Year Comprehensive Site Plans provided by each of the eight sites in the Complex, and also drawing upon historical data from similar demolition projects (see footnotes on table for sources).

Our conclusion is that although the D&D costs are significant and real, the additional D&D costs to fully clean several sites after one does the consolidation is a small fractional increase over the cost to perform D&D of the sites to modernize in place. However, with modernization in place, the NNSA will have an old Complex with several new facilities dispersed around the Complex, an ongoing operating expense at eight sites, and no new centralized and efficient production capability.

Where is D&D Required?

Item		No CNPC	CNPC	D&D Project Start Date	Cost[3] ($millions)	Comments
KCP		Yes	Yes	2010	10	Assumption for Kansas City is that the building will be returned to GSA and will not be demolished. Even if modernization in place is proposed, there is already action to reduce space and consolidate. It is expected to lead to a new location, independent of other decisions.
LLNL	Site 300	Yes	Yes	2015	80 -120	Assumes that after start of CNPC LLNL facilities D&Ded or remediated to laboratory levels of SNM. Site 300 is ~ 400,000 sq ft. D&D will deal with remnants of HE, Be contamination raising the D&D cost to $200 -$300/sq ft*.
	Bldg 332	Yes	Yes	2020	75- 100	Building 332 is ~100,000 sq ft of contaminated space. Using the ~$750 - $1000 / sq ft escalated cost for the D&D of the Omega West Reactor at LANL completed in 2003 as the basis for the D&D cost estimate. (In 2003 the Omega West Reactor and Facilities were D&Ded for $670/sq ft.*)
LANL[4]	Chemical and Metallurgical Research Facility (CMR)	Yes	Yes	2015	415 - 550	Analysis assumes TA-55 will be retained for laboratory R&D if the CNPC is constructed. CMR is ~ 550,000 sq ft of highly contaminated space. Using the Omega West Reactor at LANL as the basis for the D&D estimate – including escalation ~$750 - $1000/sq ft* (see above).
	TA-18	Yes	Yes	2006	20 - 40	Assumes that other facilities at LANL are D&D or remediated to laboratory levels of SNM. TA-18 occupancies ~74,000 sq ft of facility space. The D&D cost estimate range is within the $200 -$300/sq ft* range since the contamination is less than a reactor or SNM R&D/processing facility.

[3] Sources: "Disposition Scorecard," a listing of actual D&D costs of buildings at Los Alamos from 2001 to the present.; Rocky Flats Closure Project—costs to completion as furnished by the Rocky Flats Plant management (used for Y-12); Y-12 demolition estimates from Y-12 plant management. The first reference, Disposition Scorecard, shows costs per square foot from $20 to over $600 per square foot of building for D&D. It was used to calibrate estimates for all sites except Y-12. For Y-12 both Y-12 demolition estimates and Rocky Flats closure Project experience were used as a basis for the estimate.

[4] TA-55 D&D costs are not included. The assumption is that the TA-55 buildings will continue to be utilized for R&D after production is moved to the CNPC.

Where is D&D Required?

Item		No CNPC	CNPC	D&D Project Start Date	Cost[3] ($millions)	Comments
NTS		No	No	After 2030		Analysis assumes Test Site will be retained indefinitely.
Pantex		No	Yes	After 2030	750 - 1500	Pantex has ~3M sq ft of facilities. These facilities are contaminated but not as heavily contaminated as reactors or SNM R&D/processing facilities in the Complex. ~$250 - $500/sq ft* D&D cost.
Sandia		No	No			Analysis assumes retention indefinitely, with only minor cleanup from SPUR. Assumes SNLL will be retained through 2030 at a minimum and would only operate with laboratory levels of SNM.
SRS		No	No	After 2030		Analysis refers to NNSA activities only. MOX facility is to be retained indefinitely
Y-12		Yes	Yes	2015	5000	Retained facilities are slightly different in the two alternatives, but cost differences between D&D in place with modernization at the site would be minor compared to full D&D given overall scope of the area to be remediated. Y-12 has ~7.6M sq ft of facilities and 650 buildings. Assuming ~$1000/sq ft D&D costs average for the entire site is ~$8B.
Total with no CNPC					**~ 5600 - 5800**	Numerous old sites that still need D&D at some point.
Total with CNPC					**~ 6300–7,300**	Several sites fully remediated and fully released.

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APPENDIX J
SEAB TASK FORCE CRITICAL FACILITIES LIST

The major Complex critical facilities have been reviewed as candidates for consolidation with and without the construction of the CNPC and for potential outsourcing to industry. The outsourcing decisions could be based on make/buy decisions using a cost/benefit analysis by NNSA. We note that the Complex contractors typically perform a consolidation or make/buy decision based on incremental cost. That is adequate for the contractor, but does not meet the needs of the NNSA or the Complex. Rather the appropriate analysis needs to incorporate the cost to maintain the entire capability within the Complex. When considering this true life cycle, maintenance cost, one has a more accurate basis to judge the consolidation and outsourcing options. With this type of analysis, the Task Force believes that consolidation and/or outsourcing would realized significant savings and recommends consideration of these actions regardless of the decision on CNPC. The table below shows each facility and the results of the review by the Task Force.

Production Facility Function	Site Location	Candidate for Consolidation at CNPC	Candidate for Consolidation Even with No CNPC	Candidate for Outsourcing
Tritium production and R&D	SRS, LANL, SNL, LLNL	Production: No R&D: No	Production: No R&D: Yes But, NIF tritium processing must remain at LLNL	No
HEU production and storage (Bldgs 9201, 9204, 9212, 9215, 9815, 9980, 9981)	Y-12	UPF replacement HEUMF replacement	Yes Yes	Yes
Pu R&D and Production	LLNL, LANL	Yes, Cat I/II	Yes	No
Bays and cells for assembly, disassembly, and dismantlement	Pantex, NTS	Yes	No	No
Waste processing and storage	LANL, LLNL, Y-12, NTS	Yes, including required waste-processing facilities at CNPC	Yes, where possible	No

Production Facility Function	Site Location	Candidate for Consolidation at CNPC	Candidate for Consolidation Even with No CNPC	Candidate for Outsourcing
		Keep waste processing as needed at other sites		
Beryllium production	LANL, Y-12	Yes	Yes	Yes
HE staging and storage	Pantex, NTS, LLNL, LANL	Yes	Yes	No
SNM component staging and storage	Pantex, Y-12, SNL, LANL, LLNL, NTS	Yes, Cat I/II	Yes	No
HE production	Pantex, LANL, LLNL	Yes	Yes	Yes
HE testing	Pantex, NTS, LLNL, LANL	Yes	Yes	No
SNM component NDE and testing	Y-12, LANL, LLNL, Pantex	Yes	Yes	No
Non-nuclear component production	SNL, KCP, LANL	No	Yes, if not commercially procured	Yes
Non-nuclear component NDE and testing	SNL, KCP, LANL	No	Yes, if not commercially procured	Yes
Non-nuclear component staging and storage	KCP	No	Yes	Yes
Neutron generator production (Bldg 870)	SNL	No	No	Yes
Detonator production	LANL	No	No	Yes
Warhead non-nuclear system testing	SNL	No	Yes, possibly with DoD	No

Science/Lab Facility Function	Site Location	Candidate for Consolidation at CNPC	Candidate for Consolidation Even with No CNPC	Candidate for Outsourcing
HEU laboratories (Bldgs 9202, 9203, 9995)	Y-12	Yes, HEU/Pu lab space	Yes	
Supercomputing facilities (capability and capacity)	SNL, LLNL, LANL	No	Capability: Yes	No
HE R&D labs	Pantex, LLNL, LANL	No	Yes	
Subcritical testing (U1a Complex)	NTS	No	No	No
JASPER	NTS	No	Yes	No
Device Assembly Facility (DAF)	NTS	Yes	Yes	No
Test readiness facilities, equipment, diagnostics	NTS, LANL, LLNL, SNL	No	Yes	No
Pulsed-power Research (Z-Machine, Atlas)	SNL, NTS	No	Yes	No
High-energy density physics	LLNL	No	Yes	No
Non-nuclear component manufacturing design research, applied science labs	SNL, LANL, KCP	No	Yes	Yes
Engineering research and test facilities	SNL, LANL, LLNL	No	Yes	Yes
Hydrodynamic test facilities (DARHT, CFF, LANSCE)	LANL, LLNL	No	Yes, potential consolidation to NTS	No
Environmental testing facilities (temperature, shake, drop, etc.)	SNL, LANL	No	Yes	Yes
Microsystems (MESA, CINT)	SNL, LANL	No	Yes	Yes
Chemical and Metallurgical Research facility (CMR)	LANL	Yes	Yes	No

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APPENDIX K
USER ACCESS POLICY – VERSION 2.3

General Policies and Procedures for User Access to Synchrotron Radiation Facilities

1. Preamble

The mission of the Department of Energy (DOE) synchrotron facilities is to support users in doing outstanding science. To this end, each facility must have:

- An *accelerator* that delivers synchrotron radiation with high reliability
- An *array of beamlines* and end-stations that are state-of-the-art
- A *skilled staff* to support the accelerator, beamlines and users

but above all

- A **user** *scientific program* that can keep pace with and innovate new developments

This document addresses the policies and procedures for user access to the synchrotron facilities. The intent is to have general policies that are uniform across all four DOE facilities while providing flexibility for each facility to tailor the detailed procedures to its own particular circumstances.

2. Peer Review and Advisory Bodies

The key to delivery of outstanding science is rigorous peer review that is fair, clear, expedient and sensitive to the needs of users. We envisage advisory committees of the following kind:

2.1 Scientific Advisory Committee (SAC)

Each facility will have a SAC or equivalent body that advises the facility Director and/or Laboratory Director on policies related to the optimization of the quality and quantity of the scientific productivity of the facility. It will provide guidance on issues such as the terms of the Partner User Agreements (PUAs) between the facility and its Partner Users (PUs), whether the Partner Users are fulfilling the terms of their PUA and maintaining the highest quality of research and utilization of beamtime, facility budget priorities, and the conduct of performance evaluations. The SAC will be composed of distinguished scientists from both inside and outside the synchrotron radiation community. Appointments to the SAC will be made by the facility Director and/or Laboratory Director based on nominations from the user community, the facility management, and its advisory bodies.

2.2 Users' Executive Committee (UEC)

Each facility will have a UEC or equivalent body that is elected by the user community at large. The UEC will serve as the official voice of the user community in its interactions with the facility management. The UEC will elect its Chair and Vice-chair from among its own members, and the UEC Chair will automatically have an *ex officio* seat on the SAC.

2.3 Proposal Review Panels (PRPs)

Evaluation of General User (GU) proposals will be carried out by appropriately constituted Proposal Review Panels. The rank order of scores generated by the PRPs will be the primary input in the allocation of General User beamtime. The PRP will also provide feedback to the investigators on the quality of their proposals and, where relevant, on perceived weaknesses. The PRP will consist only of external scientists (without affiliation to the synchrotron or its associated contracting organization) with expertise in various research fields using synchrotron radiation. Appointment to the PRPs will be made by the facility Director or designate based on nominations received from the user community and suggestions from the facility management.

3 Evaluation Criteria

The evaluation criteria used in the peer review procedures will take as their starting point the criteria proposed by the International Union of Pure and Applied Physics (IUPAP) in its recommendations on the operation of major user facilities (http://www.iupap.org/statements.html#facil). These are:

- Scientific merit
- Technical feasibility
- Capability of the experimental group
- Availability of the resources required

These criteria may be supplemented with additional requests, for example to justify the need for the higher performance of an undulator beamline. The paramount criterion will be scientific merit.

4 Modes of User Access

To deliver outstanding science, there must be access modes that are sufficiently flexible so as to be responsive to user needs. There are two basic modes of user access, General User access and Partner User access, each with variable scope.

4.1 General User Access

General Users are individuals or groups who need access to beamtime to carry out their research, using existing beamlines and supplying samples and perhaps custom endstations or instrumentation for the duration of their experiment. General Users apply for access by submission of a proposal that is evaluated by one of the PRPs. The scope of a General User beamtime proposal can vary from a single experiment proposal to a program proposal (valid for

multiple visits and substantial beamtime on one or more beamlines extended over a multiple year lifetime) to a "special" proposal (i.e. rapid access, feasibility studies, or other means which have been developed by each facility based on their particular needs). A minimum of 25% of the beamtime on every beamline in a facility must be available to General Users.

4.2 Partner User Access

Partner Users are individuals or groups who not only carry out research at the beamlines but also enhance their capabilities or contribute to their operation. Typically they develop the facility instrumentation in some way, bringing outside financial and/or intellectual capital into the evolution of the beamlines, or contribute to the operation of the beamlines. These contributions are also made available to the General Users and so benefit them as well as the facility. In recognition of their investment of either resources or intellectual capital and in order to facilitate and encourage their involvement, Partner Users may be allocated a substantial percentage of beamtime on one or more beamlines over a period of up to three years, with the possibility of renewal.

4.2.1 Partner User Agreement

A Partner User Agreement (also known as a Memorandum of Understanding) describes the terms of the partnership between the facility and the Partner Users, including all privileges and obligations of both parties. Items covered by a PUA might include allocation of beamtime and/or real estate to Partner Users, the obligations of the Partner User to maintain or operate a beamline or endstation, to make certain improvements in facilities, etc, as well as the lifetime of the agreement. The scope of the PUAs is negotiated on a case by case basis and is subject to review by the SAC, as is the performance of the Partner User. The scope spans a continuum in order to provide maximum flexibility to tailor the agreement to the merit and needs of the contribution by the Partner Users. At the extreme of *comprehensive* scope are PUAs whereby the Partner Users bring in external funds to build, maintain, staff and operate a beamline, receive typically 75% of the beamtime on a beamline, and support General Users accessing the beamline for the remaining 25%. PRTs and CATs are examples of Partner Users for whom the PUA often has comprehensive scope. However, the scope PUAs of PRTs and CATs may also be less than comprehensive scope, that is they have *tailored* scope, in both their privileges as well as their obligations. Approved Program (AP) is another term used at some facilities to refer to Partner Users with PUAs of tailored scope.

In the early stages of facility development, there are typically more Partner Users and their scope is typically comprehensive. As a facility matures, it is expected that the number of Partner Users and the scope of their PUAs will diminish. However, in order to remain vital, it is critically important that facilities always encourage and accommodate PUs with PUAs of limited scope in order to promote continual innovation through involvement of outside users.

5 Proprietary and Nonproprietary Research

Users of the facilities include academic, industrial and government scientists and engineers. While the vast majority of user research should be in the public domain, and so must be

disseminated by publication in the open literature, there may be access for a reasonable percentage of proprietary research which utilizes these unique facilities to benefit the national economy. Users conducting proprietary research may access beamtime as either General Users or as Partner Users. Full cost recovery will be obtained for proprietary research, and efforts will be made to secure appropriate intellectual property control for proprietary users to permit them to exploit their experimental results.

6 Beamtime Allocation, Scheduling, and Recording

Allocation of beamtime for General Users will be done by a Beamtime Allocation Team (BAT) based on the rankings provided by the PRPs. Partner Users will manage their own scientific program and allocate beamtime among their members. Scheduling of beamtime will be centralized in the facility User Office using expert input from facility beamline staff and Partner User representatives. The facility management will have ultimate responsibility for effective and efficient utilization of beamtime on all beamlines. The User Offices will maintain records of actual beamtime usage for the purposes of reporting to the DOE.

APPENDIX L
CONTRACTING OPTIONS

Contract incentives can be used to encourage performance that enables a faster and smoother transition to the Complex of the future envisioned herein. This appendix will discuss some of those methods for stimulating performance. Summarized, they are:

First, use the contract incentives available from the recent NNSA Model for Improving Management Performance (March 2004). This includes sharing of cost savings, use of award term (additional years) for excellent performance; and closely tying award fee to specific performance metrics.

Second, exercise available authority to reduce frequency of competition for contracts when performance is excellent and there is not a clear advantage to the Government from re-competition. This has been discussed in other Secretary of Energy Advisory Board[5] reports and would enhance continuity as the Complex transitions.

Third, utilize the authority of Section 161(u) of the Atomic Energy Act of 1954, as amended, to permit construction of facilities by private industry with reimbursement by NNSA when the facility is used for the benefit of the NNSA. This authority would enhance the attractiveness of private construction of the facilities needed to convert appropriate operations from Government-owned to Contractor-owned. This Section of the Atomic Energy Act could be used to accelerate the closing of certain NNSA production sites that are underutilized or need major modernization, being replaced by more efficient, "commercialized" production plants, such as those envisioned in the CNPC.

The Task Force reviewed the following reports that, to varying degrees, addressed the contracting challenges associated with managing the NNSA Complex and provided valuable analyses and recommendations for the preparation of this report:

- Kansas City Plant Work Processes Study, Requested by Robert W. Kuckuck, Acting Principal Deputy Administrator, NNSA Prepared by Honeywell Federal Manufacturing & Technologies, LLC dated January 14, 2002
- Management Best Practices for the National Laboratories, Report of the External Members Best Practices Working Group, The Laboratory Operations Board, dated September 9, 2003

[5] "Competing the Management and Operations Contracts for DOE's National Laboratories, Report of the Blue Ribbon Commission on the Use of competitive Procedures for the Department of Energy Labs," November 24, 2003

- Competing the Management and Operations Contracts for DOE's National Laboratories, Report of the Blue Ribbon Commission on the Use of Competitive Procedures for the Department of Energy Labs dated November 24, 2003
- National Nuclear Security Administration Model for Improving Management and Performance dated March 2004
- Alternative Approaches to Contract Oversight, Study of the NNSA Kansas City Site Office Prepared for Ambassador Linton Brooks, NNSA Administrator – Chartered by: Ev Beckner, Deputy Administrator for Defense Programs, Steve Taylor, Kansas City Site Office Site Manager dated December 2, 2004.

The Task Force reviewed the Kansas City contract, since it had been the subject of two recent studies and analyses. Furthermore, as a small, but vital and instructive task consistent with the "NNSA of the Future"[6], Administrator Brooks tasked NNSA with looking at whether there is a fundamentally different way in which to interact with the Kansas City Plant.[7] That opportunity may not apply to all NNSA contracts, but it is instructive in options that should at least be considered.

The Kansas City Plant is operated by Honeywell Federal Manufacturing & Technologies, LLC (HON) for the National Nuclear Security Administration under a Cost Plus Award Fee Management and Operating contract. The plant's primary purpose is the production and procurement of electrical, electronic, mechanical, electro-mechanical, plastic, and metal components and hardware for nuclear weapons. The contract scope is comprehensive in that the purpose of the contract is to perform all necessary operational functions as well as management functions to manage a major industrial facility and perform the National Defense missions that are assigned to the facility.[8]

There are many factors that hinder the contractor's and NNSA's ability to deliver on the Administrator's vision of a responsive nuclear weapons complex infrastructure. Chief among them is the charge to maintain the existing NNSA plant of approximately 3.1 million gross square feet in Kansas City, Missouri. The current contract has a goal of reducing the Kansas City plant footprint to approximately 2.3 million gross square feet through 2006. It is widely acknowledged within the DOE that the KCP, with its excess capacity and aging equipment is overcapitalized, and is thus not positioned to take advantage of modern manufacturing and process improvements. This assessment is tempered by the opinion, also widely held within DOE that the KCP's reputation for effective support to its customers within the Complex is well deserved.

The incentive measures in the KCP contract's Performance Evaluation Plan (PEP) do not reward the contractor for increased productivity. In fact, during the period FY98 through FY02, between

[6] The National Nuclear Security Administration Strategic Plan dated November 2004

[7] Email Request from Ambassador Brooks to Steve Taylor, KCSO, dated June 24, 2004.

[8] Task 3.0, Section C, Part I, Contract No. DE-AC04-01AL66850

28% and 57% of the total fee was associated with incentives related to administrative functions[9]; resulting in an emphasis on administration rather than the primary mission.

The DOE contract clauses prescribed for M&O contracts, overlaid by DOE Orders, create a culture whereby the contractor is unable and unwilling to assume normal business risks. These regulations and requirements result in performance execution that is in diametric opposition to the NNSA's stated desire to shift from specifying "how" a program is accomplished to "what" is delivered.[10]Imposition of proscriptive ES&H, property, security, and personnel requirements contributes further to the focus on "low value added" risk reduction activities rather than productivity improvements.

The current contracting rules, for example the Honeywell contract for the Kansas City Plant, clause H.1of the "Work Authorization System", afford the NNSA significant latitude in encouraging the contractor to make changes such as to prepare transition plans, manufacturing and site recommendations and closure recommendations. The change period would also be useful to build "buy-in" from the affected stakeholders. The change period must be thoughtfully constructed to avoid or mitigate any potential for an organizational conflict of interest with the follow-on production contract. These "transition" tasks could be authorized under the contract SOW requirement 2.1, Defense Programs Strategic Planning Process, third bullet, "Readiness in Technical Base and Facilities", requirement 2.2 " Technology and Business Integration", that tasks the Contractor to utilize the best available technology and management practices from both government and commercial sources to improve and achieve excellence; requirements 4.2 and 4.3," Advanced Design and Production Technologies Campaign" and "Non-Nuclear Readiness Campaign", respectively. The Kansas City Site Office has also included an outsourcing incentive in the HON FY2005 PEP.

The DOE has before used incentives in contracts to facilitate change and transformation. Reference Contract DE-AC24-03OH20152, a Cost Plus Incentive Fee contract to CH2M Hill Miamisburg, includes cost and schedule performance incentives to provide motivation to achieve accelerated closure of Mound. Language in Section B of this closure contract may prove useful to implementation of change in the NNSA contracts or extensions thereof.

The NNSA should also apply clauses from the NNSA March 2004 Model. The Model was developed to "implement a simpler, less adversarial contracting model that capitalizes on the private sector expertise and experience of its contractors while simultaneously increasing contractor accountability for high performance and responsiveness". This model was used for the Sandia contract renewal.

In addition, the NNSA should exercise the authorities granted in NNSA Policy Letter NAP-5, "Standards Management" and NAP-1, "Establishment of a Policy Letter System for Managing Policy, Directives, and Business Practices within the National Nuclear Security Administration"

[9] Kansas City Plant Work Processes Study dated January 14, 2002

[10] NNSA Model for Improving Management and Performance dated March 2004

to replace DOE directives with NNSA specific directives, e.g. ES&H. Note also recent regulatory action (70 Fed. Reg. 21,818, 4/27/05) that transferred worker safety and health authority from DOE to OSHA for a portion of land leased to the private sector for construction and operation of a Laboratory at Argonne. The above would have a salutary affect on the contractors and their performance.

NNSA Policy Letter BOP-003.0501 dated January 10, 2005 provides a deviation to the DEAR whereby NNSA may negotiate more effective fee arrangements for its M&O contracts and award additional years to a contract's term; this added term incentive is an adequate and appropriate incentive to the current contractor to continue performance under the one or two year extended KCP contract term provided that the Performance Evaluation Plan outcomes are mutually established and properly administered.

The last question we considered is how to structure a component and hardware procurement program that would encourage private industry to invest in construction of a manufacturing plant that would also be in the best interests of the NNSA nuclear weapons complex. While some have speculated on selling NNSA production plants to a contractor, the complications of jurisdiction (General Services Administration is actually the landlord for the Government), the age of the facilities, and the liability in remediation of many current production sites. Section 161(u)(2) of the Atomic Energy Act allows the Atomic Energy Commission to enter into contracts for such periods of time as the Commission deemed necessary or desirable for the purchase or acquisition of any supplies, equipment, materials, or services required by the Commission whenever the Commission determines that: (i) it is advantageous to the Government to make such purchase or acquisition from commercial sources; (ii) the furnishing of such supplies, equipment, materials, or services will require *the construction or acquisition of special facilities by the suppliers or vendors thereof.* If an RFP were issued by NNSA for construction of a any new production site, which we recommend, there is precedence in the Atomics Energy Act for charging the amortization to the Government at section 161 (u)(2)(A)(iii) if: "the amortization chargeable to the Commission constitutes an appreciable portion of the cost of contract performance, excluding cost of materials; and (iv) the contract for such period is more advantageous to the Government than a similar contract not executed under the authority of this subsection. Such contracts shall be entered into for periods not to exceed five years each from the date of initial delivery of such supplies, equipment, materials or services or ten years from the date of expiration of the contracts excluding periods of renewal under option." This benefit, along with the contract for the components, and the potential of providing components for the entire Complex and other commercial customers, will likely offer reasonable return on investment for a private company. If NNSA decides to pursue this course, a broad solicitation could be issued to solicit industry's comments and recommendations before an RFP is released.

Although this Appendix has focused on the Kansas City Plant contract for purposes of example, all of the recommendations except use of "Special Facilities" could be applied throughout the Complex. "Special Facilities" provisions however, can be considered whenever outsourcing to private industry is desirable. It is incumbent on NNSA to tie incentives to desired performance

and allow the initiative of its contractors to assist the NNSA in transforming the Complex for the future. The incentives should be clear and achievable. The contract will determine the performance of the Complex contractors and employees. The NNSA has many vehicles available to achieve the desired result, they just need to utilize them.

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APPENDIX M
GLOSSARY

Advanced Simulation & Computing (ASC) Program: A NNSA program to provide simulation tools and computational power to weapon designers for assessment and certification of weapons in the nuclear stockpile.

application service provider (ASP): is an organization (entity or company) that offers individuals or enterprises access over the Internet to application programs and related services that would otherwise have to be purchased and located on site in their own personal or enterprise computers.

Authorization Basis (AB): A DOE requirement to obtain approval of facility design basis and operational requirements that are considered to be important to the safe operation of the facility when certain functions are performed at the facility. The authorization basis is described in documents such as the facility Documented Safety Analysis, the Technical Safety Requirements, DOE-issued safety evaluation reports, and facility-specific commitments made in order to comply with DOE Orders or policies.

canned subassembly (CSA): A term used in the nuclear weapons complex for a subassembly consisting of one or more parts contained within (canned) a hermetically sealed (by welding) thin metal container usually made of stainless steel or aluminum alloy. Within the weapons complex, this is a term-of-art synonymous with the secondary.

Chemistry and Metallurgy Research Building Replacement (CMRR): A proposed construction project currently planned for LANL for a new research facility that will consolidate SNM analytical chemistry, material characterization, actinide research and development capabilities, and SNM storage capabilities.

Consolidated Nuclear Production Center (CNPC): The center proposed by the Task Force that will contain all of the nuclear weapons manufacturing, production, assembly, and disassembly facilities and associated weapon surveillance and maintenance activities for the sustainable stockpile weapons. The CNPC will embody 21st century cutting-edge technologies and will store all Category I and II special nuclear materials and weapon components.

Criticality Experiments Facility (CEF formerly TA-18 at LANL): An in-progress project to relocate from LANL to NTS the equipment and SNM to perform general-purpose nuclear materials criticality and handling experiments and related training.

Defense Nuclear Facilities Safety Board (DNFSB): An independent federal agency established by Congress in 1988. The Board's mandate under the Atomic Energy Act is to provide safety oversight of the nuclear weapons complex operated by the Department of Energy (DOE).

design-basis threat (DBT): The formal identification and characterization of potential adversary threats to DOE assets, which in turn forms the basis for planning, developing and implementing requirements for safeguards and security programs.

Disassembly: The process of taking a nuclear weapon apart into subcomponents or smaller units, typically performed on weapons destined for subsequent component testing and evaluation or weapons dismantlement. This activity currently occurs at the Pantex Plant.

Dismantlement: The disassembly of a nuclear weapon into major assemblies, subsystems, and smaller components, which are then sent to storage or destroyed.

disposition: The last step in a dismantlement program, which may consist of demilitarization and/or sanitization of components/hardware.

Enterprise Resource Planning (ERP) system: A business management system comprised of software applications that integrates all business administrative functions and information management functions of a business.

Facilities and Infrastructure Recapitalization Program (FIRP): A program to address an integrated, prioritized series of repair and infrastructure projects focusing on eliminating deferred maintenance of Complex wide facilities, thereby significantly increasing the operational efficiency and effectiveness of the NNSA nuclear weapons complex.

Highly Enriched Uranium Materials Facility (HEUMF, at Y-12): HEUMF is a capital project (already under construction) for long term secure storage of highly enriched uranium materials.

inertial confinement fusion (ICF): The process of using the energy from high power lasers or charged particle beams to compress a high-density pellet or target, containing surrogate materials and DT fusion fuel, to the densities and temperatures whereat the DT fuel undergoes fusion, thereby releasing a large quantity of energy in the form of alpha particles and neutrons. Called inertial confinement since the process of compression occurs so rapidly, that the material fuses before it can explode owing to the release of the fusion energy, which pushes back on the compression process.

insensitive high explosive (IHE): High Explosive that requires a shock of more than usual strength to cause detonation; this relative insensitivity contributes to weapon safety. An explosive that has negligible probability of an accidental initiation or detonation from: sparks, heat, flame, or compression such as dropping. The use of IHE significantly improves the safety of munitions, weapons, and results in a safer weapon assembly/disassembly work environment for personnel.

Life Extension Program (LEP): The refurbishment of a nuclear weapon, parts and components, to extend the weapon deployment life.

life-cycle design: Incorporation into the design process the requirements of other functions over a product's life-cycle, i.e. design for manufacturability, assembly, surveillance, maintenance, disassembly, upgrade or repair, disposition, etc.

limited-life component: A component that retains its design characteristics only over a specific time period, and then must be replaced.

Microsystem & Engineering Science Applications (MESA) facility: The capital construction project (at Sandia National Laboratory, Albuquerque) to build a state-of-the-art Complex that will provide for the design, integration, prototyping and fabrication, and qualification of microsystems that may be used in weapon components, subsystems, and systems within the stockpile.

Mixed Oxide (MOX) fuel production facility: A facility to fabricate a mixed-oxide, plutonium and uranium oxide, fuel for use in currently operating light-water power reactors.

Modern Pit Facility (MPF): A proposed project that will process plutonium feedstock (old pits), manufacture plutonium components, and assemble complete pits for nuclear weapons.

Moscow Treaty: A Treaty between the United States and the Russian Federation on strategic offensive reductions. The Treaty requires the United States and Russia to reduce and limit their operationally deployed strategic nuclear warheads to 1700-2200 each by December 31, 2012.

National Environmental Protection Act (NEPA): A law enacted by Congress in 1970, amended in 1975, codified at 42 U.S.C. 4321-4347 (1988) containing "action-forcing" provisions for Environmental Impact Statements, Environmental Assessments, or Categorical Exclusions.

Nuclear Posture Review (NPR): An Executive Branch document that provides guidance to the DOE as to the nuclear weapons characteristics and the requirements of the nuclear weapons complex to meet the U.S. national security needs.

nuclear weapons complex: The collection of DOE design laboratories (LANL, LLNL, SNL), production sites (Kansas City, Pantex, SRS, Y-12) and the Nevada Test Site involved in the design, production, and testing of nuclear weapons.

Nuclear Weapons Complex Infrastructure Task Force (NWCITF): Formed by the Secretary of Energy as a task force reporting to the Secretary of Energy Advisory Board and tasked to perform per the Terms of Reference contained in Appendix A of this report.

Nuclear Weapons Council: A joint DoD/DOE body established in 1987 by law (Section 179 of Title 10 of the U.S. Code) to provide oversight of all matters relating to nuclear weapons research, development, production, surety, maintenance, dismantlement, and the allocation of nuclear material. The NWC is the focal point of all joint DoD/DOE activities to maintain and sustain the U.S. nuclear weapons complex and the stockpile.

Office of Engineering and Construction Management (OECM): An office within the DOE to provide corporate processes for and oversight of DOE projects and real property assets.

Office of Independent Oversight and Performance Assurance (OA): An office within the DOE to provide independent assessment of the effectiveness of policies and programs in safeguards and security; cyber security; emergency management; environment, safety and health (ES&H); and other critical functions of immediate interest to the Secretary, the Deputy Secretary, or the Administrator of the National Nuclear Security Administration (NNSA).

Operationally deployed strategic nuclear warheads (ODSNW): Reentry vehicles on intercontinental ballistic missiles in their launchers, reentry vehicles on submarine-launched ballistic missiles in their launchers onboard submarines, and nuclear armaments loaded on heavy bombers or stored in weapons storage areas of heavy bomber bases.

Pit: The central core of a primary assembly, usually refers to the plutonium shell.

primary: A fission device that is the source of energy that is used to compress the secondary stage to yield conditions.

Readiness in Technical Base and Facilities (RTBF) program: A program within the NNSA to manage the physical infrastructure and readiness activities across the Complex, required for the scientific, computational, engineering, and manufacturing activities of the Stockpile Stewardship program at the design laboratories, production sites, and the Nevada Test Site.

Reliable Replacement Warhead (RRW): The program initiated by Congress in FY 2005 to study developing replacement components for existing weapons, trading off features important in the Cold war, such as high yield and low weight, to gain features more valuable now, such as lower cost, elimination of some hazardous materials, greater ease of manufacture, greater ease of certification without nuclear testing, and increased long-term confidence in the stockpile.

responsive infrastructure: The ability of the nuclear weapons enterprise to anticipate innovations by an adversary and to counter quickly to maintain our deterrence posture is degraded, while continuing to carry out the day-to-day activities in support of the stockpile.

secondary: A nuclear subassembly physically separate from the primary and usually provides the weapon yield requirements. Radiation energy from the primary explosion compresses the secondary to the densities required to obtain fission/fusion yield.

Secretary of Energy Advisory Board (SEAB): An independent board that provides advice and recommendations to the Secretary of Energy on the Department's basic and applied research activities, economic and national security policy, educational issues, laboratory management, and on any other activities and operations of the Department of Energy as the Secretary may direct.

special nuclear materials (SNM): As defined under the U.S. Atomic Energy Act of 1954, SNM is plutonium and uranium enriched in the isotope uranium-233 or the isotope uranium-235. SNM does not include source material such as natural uranium or thorium.

Stockpile Stewardship: The science and technology aspects of ensuring the safety, security, performance and reliability of the stockpile, including research and development to provide the technologies required for stockpile management, and development of required experimental capability.

Surety: A term that encompasses nuclear weapon safety, security, and use control.

sustainable stockpile: Used by the Task Force to describe a future nuclear weapon stockpile that has been specifically designed for certification without underground nuclear testing, and is designed for maximum surety, manufacturability, modularity, cost effectiveness and ease of surveillance, and dismantlement.

Uranium Processing Facility (UPF): A planned capital construction project for Y-12, which will support the following enriched uranium operations: (1) disassembly and dismantlement of returned CSAs; (2) assembly of subassemblies from refurbished and new components; (3) quality evaluation to assess future reliability of weapons systems in the stockpile; (4) product certification (dimensional inspection, physical testing, and radiography); (5) enriched uranium metalworking (casting, rolling, forming, and machining); and (6) chemical processing including conversion of scrap and salvage enriched uranium to metal and other compounds.

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APPENDIX N
INITIALISMS AND ABBREVIATIONS

B61	bomb type that includes strategic and nonstrategic versions
Be	Beryllium
BeO	Beryllium Oxide
CAD	computer-assisted design
CHE	conventional high explosives
CMRR	Chemistry and Metallurgy Research Building Replacement
CNPC	Consolidated Nuclear Production Center
CSA	canned subassembly
DARHT	Dual-Axis Radiographic Hydrotesting (facility)
DBT	design-basis threat
DNFSB	Defense Nuclear Facilities Safety Board
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
HE	high explosive
HEU	highly enriched uranium
HVAC	heating, ventilation, and air conditioning (system)
ICBM	intercontinental ballistic missile
IHE	insensitive high explosive
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
LDRD	laboratory-directed research and development
LEP	Life Extension Program
LLNL	Lawrence Livermore National Laboratory
M&O	management and operating (contractor)
MPF	Modern Pit Facility

NA-1	Administrator (NNSA)
NA-10	Deputy Administrator for Defense Programs (NNSA)
NIF	National Ignition Facility
NNSA	National Nuclear Security Administration
NPR	Nuclear Posture Review
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
NWCITF	Nuclear Weapons Complex Infrastructure Task Force
ODSNW	operationally deployed strategic nuclear weapon
R&D	research and development
RRW	reliable replacement warhead
SEAB	Secretary of Energy Advisory Board
SRS	Savannah River Site
SSP	Stockpile Stewardship Program
SLBM	submarine-launched ballistic missile
SNL	Sandia National Laboratories
SNM	special nuclear materials
TA-55	Technical Area 55 (Los Alamos National Laboratory)
UGT	underground testing
UPF	(Highly Enriched) Uranium Processing Facility
W62	strategic warhead for U.S. Air Force ICBM
W76	strategic warhead for U.S. Navy SLBM
W80	warhead for U.S. Air Force/U.S. Navy Cruise Missile
W87	strategic warhead for U.S. Air Force ICBM

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