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## **Nuclear Weapons Complex Reconfiguration: Analysis of an Energy Department Task Force Report**

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## Report Documentation Page

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# Nuclear Weapons Complex Reconfiguration: Analysis of an Energy Department Task Force Report

## Summary

Congress annually funds the nuclear weapons complex (the Complex), those sites that develop, maintain, manufacture, and dismantle nuclear weapons. In hearings held in 2004, the House Appropriations Committee pressed the Secretary of Energy “for a systematic review of requirements for the weapons complex over the next twenty-five years.” The committee expressed its concern that the Complex is not well suited to the post-Cold War situation, and should reflect presidential decisions on the stockpile as well as issues of cost, security, and Complex size. In response, the Nuclear Weapons Complex Infrastructure Task Force of the Secretary of Energy Advisory Board prepared a report, released in final form in October 2005.

The report indicated that the Complex had redundant facilities, security concerns, high cost, excessive competition between the weapons labs, and inadequate equipment for the production plants. To redress these problems, the Task Force proposed restructuring the Complex. It would shift much production and some R&D to a new nuclear production center, probably close one or more plants, contract out some nonnuclear work, shrink the labs, consolidate facilities, and take steps to make governance more effective. It was concerned that current warheads, produced during the Cold War, are inappropriate for the current situation because they have more yield and efficiency than is needed, yet are more vulnerable to terrorist threats than is desirable, are hard to manufacture, are designed close to failure points, and will probably become harder to maintain. It recommends restructuring the nuclear arsenal by producing new-design Reliable Replacement Warheads (RRWs) with characteristics deemed more suitable to the current environment. The report links Complex and warheads: in the Task Force’s view, RRWs would be easier to produce and maintain, permitting a smaller, more efficient, and less costly Complex.

Observers familiar with the current Complex raise several concerns. From their perspective, closing Complex sites and facilities might meet fatal political opposition. They maintain that the report seems to downplay the value of investments in Complex facilities over six decades, and projects large cost savings through 2030 based on questionable assumptions. They fear that shifting key tasks that the nuclear weapons labs perform to other sites could disrupt the labs’ ability to do their work. The recommendation to proceed immediately with RRW deals with restructuring weapons rather than the Complex and, in this view, may go beyond the Task Force’s mandate. A Department of Defense official stated that a Department of Defense-Department of Energy agency did not approve the Task Force’s proposed 3-step transition to RRW, despite the report’s strong implication to the contrary. While any final decision on deploying RRWs must await completion of studies that might possibly reject RRW, the Task Force assumes RRW will proceed and does not examine how its restructured Complex would support current warheads. Some express concern that Task Force recommendations may be at odds with U.S. nuclear nonproliferation policy.

This report will not be updated.

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# Nuclear Weapons Complex Reconfiguration: Analysis of an Energy Department Task Force Report

## Background

The U.S. nuclear weapons complex (the Complex) consists of eight government-owned, contractor-operated sites (see Appendix) that study, maintain, and disassemble U.S. nuclear weapons. The National Nuclear Security Agency (NNSA), a semiautonomous part of the Department of Energy (DOE), manages it. Some in Congress have expressed concern that the U.S. nuclear stockpile and the Complex are becoming increasingly difficult and costly to maintain, that security costs are rising sharply, and that the Complex is not sufficiently responsive to the needs of its “customer,” the Department of Defense (DOD). Further, they maintain, it is difficult for Congress to judge the merits of various large expenditures for the Complex, such as for major research facilities, without a long-term road map. (In this report, “site” refers to an entire laboratory or plant, or the Nevada Test Site, while “facility” refers to a structure within a site, such as for production of a specific item or for experiments or computation.)

To address these concerns, the House Energy and Water Development Appropriations Subcommittee asked the Secretary of Energy to conduct a study of the Complex looking out 25 years, and to make recommendations on restructuring the Complex. The committee’s report stated:

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.<sup>1</sup>

In response, the Secretary of Energy in January 2005 had the Secretary of Energy Advisory Board (SEAB) form the Nuclear Weapons Complex Infrastructure Task Force (hereinafter referred to as the “Task Force” or “TF”). It issued a “draft final report” in July 2005.<sup>2</sup> After receiving comments, it transmitted the final report to SEAB on October 4 with no changes from the July version. A letter from David Overskei, Chairman of the Task Force, included clarifications on nuclear weapon storage and on production of a key component. Also on October 4, SEAB transmitted the report to the Secretary of Energy.<sup>3</sup>

### **The Task Force’s View of, and Vision for, the Complex**

The TF reported that there was no master plan guiding the Complex. Instead, it stated that there were redundant facilities within the Complex; excessive competition between the weapons labs; an imbalance between the labs, with state-of-the-art experimental facilities, and the production plants, with archaic equipment; and special nuclear material (SNM; see Appendix) at six of the eight Complex sites, increasing vulnerability to terrorist attack and raising security costs. The TF also found current warheads to have undesirable characteristics, such as designs offering less safety and less control over unauthorized use than DOD and DOE wanted, designs that approached too closely the point at which they would fail, components that were difficult to manufacture, excessive use of exotic or hazardous materials, and maintenance that would probably become ever more costly. These problems resulted in high costs. As a result, the Task Force concluded, “the status quo is neither technically credible, nor financially sustainable.” (ix) (Throughout this report, numbers in parentheses refer to pages in the Task Force’s report.)

The TF had a vision of a different Complex. “The Complex of 2030 should be an integrated, interdependent enterprise. The technical acuity and scientific

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<sup>1</sup> U.S. Congress. House. Committee on Appropriations. *Energy and Water Development Appropriations Bill, 2005*, H.Rept. 108-554, to accompany H.R. 4614, 108<sup>th</sup> Congress, 2<sup>nd</sup> Session, 2004, p. 111.

<sup>2</sup> U.S. Department of Energy. Secretary of Energy Advisory Board. Nuclear Weapons Complex Infrastructure Task Force. *Recommendations for the Nuclear Weapons Complex of the Future*, draft final report, July 13, 2005, xi + 33 p. + 14 appendixes; available at [<http://www.seab.doe.gov/publications/NWCITFRept-7-11-05.pdf>].

<sup>3</sup> Letter from Dr. David O. Overskei, Chairman, SEAB Nuclear Weapons Complex Infrastructure Task Force, to M. Peter McPherson, Chairman, Secretary of Energy Advisory Board, October 4, 2005, 1 p., and letter from Peter McPherson, Chairman, Secretary of Energy Advisory Board, to The Honorable Samuel W. Bodman, Secretary of Energy, October 4, 2005, 1 p.

innovation to meet unforeseen challenges and threats to the nation's security are sustained by a Complex operating interactively and continuously conducting research, nonnuclear testing and weapon modernization, production, and dismantlement.” (4) It would be responsive to the needs of its customer, DOD.

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 [nuclear weapon] in less than 36 months, and go into full production in less than 48 months, and perform an underground test at the [Nevada Test Site] within 18 months. By 2030 the Complex would be in equilibrium, producing and dismantling at a rate of 125 devices per year. (4)

The TF would restructure the Complex, closing some sites, building another, relocating some experimental facilities, and making other such facilities available for use by Complex personnel. It would dismantle all Cold War-era weapons (the current stockpile) by 2030. The replacement warheads and restructured Complex would, according to the TF, be safer, more secure, and less costly. The TF recommended proceeding briskly to implement this vision. “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.” (5)

## Main Recommendations of the Task Force

To remedy the perceived problems and implement its vision, the TF made two main, related recommendations. First, it created a master plan that would restructure the entire Complex. The plan has several key elements.

- A Consolidated Nuclear Production Center (CNPC) would produce all components in the “nuclear explosive package,” or NEP (see Appendix), including those made from uranium, plutonium, and high explosives, and would assemble complete nuclear weapons. While Pantex would dismantle current warheads by 2030, CNPC would dismantle the next generation of warheads. (vii, 4) CNPC would include a facility for fabrication of plutonium components; a separate facility for fabrication of uranium components; a materials research laboratory; a facility for machining and testing all the insensitive high explosive for the Complex, though the explosive itself might be procured from outside vendors or DOD; a building for weapons assembly and disassembly; areas to store plutonium and pits; another building to store uranium and secondaries; and several other facilities. (14-16) CNPC would not store deployed warheads.<sup>4</sup>

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<sup>4</sup> The Task Force “specifically wish[es] to point out that the Consolidated Nuclear Production Center is not proposed as a location to consolidate the storage of nuclear weapons that are in the deployed stockpile.” Letter from Dr. David O. Overskei, Chairman, SEAB Nuclear Weapons Complex Infrastructure Task Force, to M. Peter McPherson, Chairman, Secretary of Energy Advisory Board, Department of Energy, October 4, 2005, p. 1.

- The Y-12 Plant fabricates and stores uranium components, and assembles and stores secondaries. These functions would move to CNPC. It thus appears likely that Y-12 would close.
- Pantex could close. The TF states, “Upon dismantlement of the last of the Cold war weapons, Pantex, if not the site of the CNPC, could be decommissioned.” (19) While “dismantlement of the last Cold war weapon [is] envisioned to occur by 2030,” (4) the TF also emphasizes accelerating dismantlement. (E2)
- Kansas City Plant would not be part of CNPC. It would continue to produce nonnuclear components (batteries, fuzes, bomb casings, etc.), but “as many components as practical [would] be procured from commercial vendors.” (22)
- The labs would become smaller. The TF states:

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. (23)

Some large experimental and scientific facilities might move to CNPC or NTS, and duplicative facilities at more than one lab might be closed and the remaining facility of each type made into a user facility, i.e., available to staff of all labs. (viii, J1-J3) The TF raises the prospect that one of the two nuclear weapon physics labs — Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL) — might close: “the long-term requirement for two physics design laboratories will be determined through overall Complex performance and needs.” (4) Some lab facilities under consideration would move to CNPC. For example, the Chemistry and Metallurgy Research Replacement (CMRR) building at LANL for R&D on uranium and plutonium, for which construction began in January 2006, would instead be built at CNPC on grounds that other facilities to be placed in CNPC would have a similar capability. LANL would instead have a “‘CMRR lite,’ designed for only laboratory sample levels of material and amenable to commercial security.” (21)

- One lab would house high-end computing for the entire Complex, and Complex staff at other sites could use that site’s resources by remote connection (20).
- The Nevada Test Site might gain several experimental facilities (J1-J3), and is a possible site for CNPC.



- Governance would be made more effective, in the TF's view, so as to "enable the transformations needed for the Complex and the Stockpile." (25). DOD/NNSA Project Officers' Groups, which "are key elements in managing integration of a warhead with the weapon system throughout the entire life cycle," would have representation from the plants, (25) as is being done with the Reliable Replacement Warhead program described below; NNSA would have more independence within DOE (26); NNSA offices at Complex sites would report to the Deputy Administrator for Defense Programs rather than to the NNSA Administrator (27); business practices would change (27-32); and an Office of Transformation would be the "change agent" (viii) that would conduct risk-benefit and other analyses to support transformation of the Complex (33).

The problems that the TF found with the Complex are intertwined with the products the Complex supports. Accordingly, the second main recommendation of the Task Force is to proceed promptly with a "family" of warheads designed to meet a different set of requirements and constraints than current warheads. (For a detailed discussion of Reliable Replacement Warhead (RRW) program and the Life Extension Program (LEP), discussed in the balance of this section, see CRS Report RL32929, *Nuclear Weapons: The Reliable Replacement Warhead Program*, by Jonathan Medalia.)

Current warheads were designed and manufactured during the Cold War to meet Cold War requirements within the constraints of the time. DOD needed warheads with high explosive yield and that had high yield to weight, that is, they achieved their yield in the lightest package. They were also tightly constrained as to size and shape. To meet those goals, nuclear weapon designers used sophisticated design features, exotic and hazardous materials, and hard-to-produce components, and pushed designs close to points where they would fail. While these weapons are complex, nuclear testing gave designers confidence in their performance.

However, the last U.S. nuclear test was held in September 1992; the United States has observed a test moratorium since then. To maintain Cold War-era weapons without testing, the Complex undertakes LEPs. When certain key weapon components deteriorate or otherwise need replacement, an LEP seeks to remanufacture these components as closely as possible to the original specifications. The reason is that nuclear testing confirmed the safety and reliability of the designs; now, without testing, NNSA chooses to minimize loss of confidence in warheads that use remanufactured components by minimizing changes so as to keep the components as close to their original test-proven "pedigree" as possible.

There is considerable debate about whether LEPs will be able to maintain existing warheads indefinitely. Supporters argue that for nine years the Secretaries of Energy and Defense have been able to certify that the stockpile remains safe and reliable without resorting to nuclear testing. They have been able to do this because of the existing Stockpile Stewardship Program (SSP) and key parts of it, surveillance of warheads to monitor for defects and Life Extension Programs. These various programs have greatly increased knowledge of weapons performance and potential

problems, and knowledge of specific weapon types has likewise increased with experience. Supporters therefore believe that LEP should enable the United States to maintain warheads indefinitely without testing.

NNSA questions the long-term viability of LEP. According to Ambassador Linton Brooks, Administrator of NNSA, “it is becoming more difficult and costly to certify warhead remanufacture. The evolution away from tested designs resulting from the inevitable accumulations of small changes over the extended lifetimes of these systems means that we can count on increasing uncertainty in the long-term certification of warheads in the stockpile.”<sup>5</sup> LEP also, it is argued, imposes high costs on the Complex. The TF states, “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 problems. Thus, our current stockpile is extraordinarily expensive to monitor and to maintain.” (11)

Because of the costs and potential uncertainties associated with the types of warheads being maintained, Representative David Hobson, Chairman of the House Energy and Water Development Appropriations Subcommittee, proposed a new approach, the Reliable Replacement Warhead (RRW) program. The FY2005 budget request had included no funds for RRW, and other committee reports for FY2005 had not referenced it. Instead, RRW made its first legislative appearance in the FY2005 Consolidated Appropriations Act, P.L. 108-447, which provided \$9.0 million for the purpose. For FY2006, NNSA requested \$9.4 million for RRW and Congress appropriated \$25.0 million.

The RRW program would design warheads taking into account the great changes in requirements and missions affecting warheads since the end of the Cold War. There is less need for high yield or for a high yield-to-weight ratio. Accepting reductions in yield and yield-to-weight, it is argued, would enable weapon designers to move away from the complicated designs, hard-to-manufacture components, and exotic materials that characterized Cold War weapons. Instead, the TF recommends setting a number of design parameters, including “certification without [underground nuclear testing] ... inexpensive manufacture and disassembly ... ease of maintenance ... maximizing component reuse and minimizing life-cycle costs.” (8) The TF views “[i]mmediate design of a Reliable Replacement Warhead” as “the most important element for transforming the Stockpile.” (13)

RRW advocates believe that these characteristics would benefit the Complex. In their view, simpler, easier-to-manufacture designs could be made with simpler equipment, would use less floor space, and would have higher throughput. Reduction in hazardous and exotic materials would reduce the threat to worker and environmental safety, permitting a reduction in equipment and floor space. Designing nuclear explosive packages to incorporate use control and use denial

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<sup>5</sup> “Statement of Ambassador Linton F. Brooks, Administrator, National Nuclear Security Administration, U.S. Department of Energy, before the Senate Armed Services Committee, Subcommittee on Strategic Forces,” Apr. 4, 2005, p. 3.

features would reduce the amount of physical security required.<sup>6</sup> These factors would also be expected to reduce cost.

## Discussion of Task Force Recommendations

In the Task Force scenario, construction of a modernized Complex would be simpler and less costly with several facilities built at a single site. The TF anticipates that operating costs would be lower for a single new CNPC than for several facilities dating back a half-century or more. With security designed into warheads and facilities alike, rather than retrofitted, the TF projects that physical security costs would be lower. It holds that new equipment should be more efficient than a combination of new and old equipment, and that removing most fissile material from Los Alamos and Livermore should reduce their security costs. Making many experimental facilities into user facilities, to the extent that that differs from current practice, might reduce costs. Further, in this view, the shift to RRW could offer savings and increased confidence in design, production, maintenance, and certification. Yet some observers maintain that some TF recommendations may prove difficult or impossible to implement. The balance of this report discusses some of the Task Force recommendations.

**Reliable Replacement Warhead program recommendations.** The TF makes a recommendation that it believes “is the most important element for transforming the Stockpile”:

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. ... 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. (13)

Congressional language calling for the TF report stated that the report “should assess the implications of the President’s decisions on the size and composition of the stockpile ...”<sup>7</sup> These decisions were to be inputs for the TF, which would then determine how to restructure the Complex to implement them. Similarly, the Secretary of Energy, in a letter to the TF chair, wanted the TF to provide “options and recommendations by the end of April 2005 to modernize, consolidate, and where

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<sup>6</sup> According to Ambassador Linton Brooks, “If we were designing the stockpile today, we would apply new technologies and approaches to warhead-level use control as a means to reduce physical security costs.” “Statement of Ambassador Linton F. Brooks, Administrator, National Nuclear Security Administration, U.S. Department of Energy, before the Senate Armed Services Committee, Subcommittee on Strategic Forces,” Apr. 4, 2005, p. 4.

<sup>7</sup> U.S. Congress. House. Committee on Appropriations. *Energy and Water Development Appropriations Bill, 2005*, H.Rept. 108-554, to accompany H.R. 4614, 108<sup>th</sup> Congress, 2<sup>nd</sup> Session, 2004, p. 111.

possible, reduce costs of the infrastructure and facilities across the NWC [nuclear weapons complex] based on recent stockpile reductions and new security Design Basis Threat requirements.”<sup>8</sup> While the TF made numerous recommendations on the Complex, key recommendations concerned the stockpile itself — that NNSA proceed with RRW and that DOD change the characteristics it required of warheads in order to facilitate manufacture: “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.” (34) Some feel the TF may have exceeded its mandate by recommending how to redesign nuclear weapons. For example, SEAB noted concerns about the TF’s work on RRW: “A number of SEAB members believe that the issue of a Reliable Replacement Warhead (RRW) will need further study by the Department of Energy and the Administration.”<sup>9</sup>

On the other hand, Complex and warheads are linked. The goal of the Complex is to design and manufacture a product, and characteristics of the product will necessarily shape the Complex. A Complex intended to produce reliable replacement warheads would be expected to differ from one intended to conduct life extension programs. There is a case to be made for shaping the Complex to support RRWs. The TF finds “the status quo is neither technically credible, nor financially sustainable.” (ix) Further, Ambassador Linton Brooks, Administrator of NNSA, said that the current stockpile is the wrong one for today’s needs technically, militarily, and politically, and from the standpoints of longevity, cost, and physical security.<sup>10</sup> If current warheads are as problematic as claimed — though others disagree, as noted earlier — perhaps it makes sense to design a Complex to support an alternative warhead type.

Yet it may well have been appropriate for the TF to have shaped a Complex to support LEPs as well as RRWs, perhaps with a path for the Complex to transition to supporting only RRWs if Congress and the Administration later decide to proceed exclusively with that warhead type. While Congress and the Administration support RRW at this early stage, that is not the same as a commitment to deploy even one RRW type, let alone an all-RRW stockpile. It may turn out that the future stockpile will be all-RRW, but no final decision on whether to manufacture and deploy even the first RRW can be made for several years or more. Indeed, no choice among RRW design options is expected until November 2006.<sup>11</sup> If for some reason the Administration decides not to proceed with RRW, a likely fallback position would

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<sup>8</sup> Letter from Secretary of Energy Spencer Abraham to Dr. David Overskei, January 26, 2005, p. 1.

<sup>9</sup> Letter transmitting the Task Force report, from Peter McPherson, Chairman, Secretary of Energy Advisory Board, to The Honorable Samuel W. Bodman, Secretary of Energy, October 4, 2005, 1 p.

<sup>10</sup> “Statement of Ambassador Linton F. Brooks, Administrator, National Nuclear Security Administration, U.S. Department of Energy, before the Senate Armed Services Committee, Subcommittee on Strategic Forces,” Apr. 4, 2005, p. 2-4.

<sup>11</sup> U.S. Congress. Committee of Conference. *Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and for Other Purposes*, H.Rept. 109-275, to accompany H.R. 2419, 109<sup>th</sup> Congress, 1<sup>st</sup> Session, 2005, p. 159.

be to continue maintaining existing warheads using LEP. In any event, the Complex will probably conduct LEPs of current warheads for many years. It thus can be argued that it is premature to design a Complex based on the assumption that RRW will proceed.

The five-year cycle plan that the TF suggests could offer significant benefits for DOD and NNSA. Continuous design, certification, production, and deployment of nuclear weapons would exercise the Complex, provide real-world training to scientific and production staff, minimize age-related defects in weapons, and permit the introduction of new design features into the stockpile. Developing and maintaining skills would increase DOD's confidence in the Complex. Confidence that the Complex could produce warheads in time to respond to adversary efforts to develop threats to the United States — the responsive infrastructure that the December 2001 Nuclear Posture Review called for — would permit DOD to reduce the number of reserve warheads it maintains as a hedge to augment the force if needed. Confidence in the reliability of the new warheads would permit DOD to reduce the number of warheads it maintains as reliability backups in case problems emerge with deployed warheads. Reducing warhead numbers and incorporating new use-control features could reduce DOD's security costs, saving large sums.

In other ways, however, continuous design and production might impose high costs. (a) RRWs are supposed to be easier to maintain than current warheads. Replacing one generation of RRWs with another, as the TF suggests (7), rather than maintaining the first would appear to forgo the maintenance advantage while incurring large costs for designing and producing new warheads and dismantling those being replaced. (b) Some claim that RRW might permit a stockpile of fewer designs. While at least two warhead types are currently available for each type of delivery system, one RRW design might be used on more than one type of delivery system. That approach could save money by reducing the number of designs and spare units in the stockpile, simplifying production and maintenance, and permitting a smaller Complex. That advantage could be lost if a steady stream of RRW designs entered and left the stockpile. (c) First-generation RRWs would presumably incorporate large gains in technology made since the last warhead was designed two decades ago. If those RRWs meet the high standards required to be certified for the stockpile, though, technical gains from subsequent generations might be modest. (d) An ongoing production and replacement program would require a larger and more costly Complex than that needed to produce first-generation RRWs and maintain them for decades through LEPs. (e) Such a program might raise proliferation concerns, as discussed below.

The TF introduces a new element into the RRW program, a block transition.

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<sup>[12]</sup>, is based on the RRW concept. An RRW weapon design is

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<sup>12</sup> Author's note: The Joint Nuclear Weapons Council is a small DOD-DOE agency established by 10 USC 179 that coordinates nuclear weapons activities between the two departments.

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 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. (12-13)

Block 2 could provide a faster route to upgrading the stockpile than a move directly to Block 3. It would presumably incorporate features that were easier to design and manufacture, leaving more difficult ones for Block 3. As a steppingstone to Block 3, Block 2 would in effect function as a pilot project that would reveal potential difficulties in design and manufacture, thus facilitating design and manufacture of subsequent RRWs and lowering their costs. Block 2 would also be consistent with the TF’s proposal for an ongoing cycle of design and manufacture, with Block 2 warheads done in the first cycle and Block 3 warheads in the next.

It is, however, hard to know if these advantages would materialize because the TF does not provide a clear definition of Block 2. Even though Block 2 could involve billions of dollars for new warheads, the only references to it in the entire report are in the paragraph quoted above (along with a brief mention on page 34). Block 2 warheads would apparently include some features of current designs and some features of RRW designs, but it is not clear which changes would render a warhead “Block 2.”

- Warheads using components outside the nuclear explosive package, such as radars, that have been modified from the original design would probably not be considered as Block 2. Such components are tested extensively in the laboratory as part of existing LEPs.
- Warheads designed around newly-made pits of selected old designs might be counted as Block 2. Because the state of the art in design and manufacture has advanced considerably over the years, pit designs from several decades ago might be simpler to manufacture than current designs that press the state of the art. The fact that they have been tested would facilitate certification. On the other hand, they would not have some key RRW features and would divert resources from Block 3 RRWs.
- Warheads designed around old pits might be considered as Block 2, but in addition to the drawbacks noted above the warheads would have a short service life if the pits used were near the end of their service lives.

The most certain approaches to certifying a replacement warhead without nuclear testing are, at one extreme, to replicate the original design as closely as possible or, at the other, to create a new design that is simple enough to permit high confidence. In order to maximize yield to weight and achieve other design goals, all components of Cold War-era warheads are designed to work together with little performance margin to spare. With such tight design, small changes in materials or manufacturing processes can reduce confidence in performance. That is why the Complex goes to great lengths to minimize differences from original specifications when designing and producing replacement components. Despite the absence of nuclear testing, the labs have been certifying, for continued use in the stockpile, current warhead designs that incorporate replacement components that are not exact replications. At the same time, the labs believe that they will be able to certify RRWs without testing by designing in greater performance margins. In contrast, the labs have said nothing to indicate that they could certify anything between these extremes, such as Block 2 warheads. As a result, any potential advantages from a Block 2 replacement warhead might be lost owing to difficulty in certification or in acceptability to DOD. It might be argued that a surer path to confidence in replacement warheads would be to skip Block 2 and move to Block 3 directly.

Even if the three-block approach could be done successfully, it would apparently result in three distinct designs — one LEP, one RRW, and one in between — for each warhead type, for example, W76 Block 1, 2, and 3. Block 2 would be neither the original weapon, with which the Complex has extensive experience, nor the final RRW, which would be in the stockpile for years to come, but a transient, interim design. Sustaining, producing, and maintaining the three designs would appear to require far more Complex resources than would be required for one design per warhead type.

Steve Henry, Deputy Assistant to the Secretary of Defense for Nuclear Matters, in the Office of the Secretary of Defense, stated that the Nuclear Weapons Council voted to study the feasibility of a Reliable Replacement Warhead and, if the study proved successful, to endorse a transition directly from LEPs of current-design warheads to the RRW program. A Council study group considered other options, including Block 2, but did not recommend them to the Council because those options could not achieve critical RRW program goals such as enhancements to safety and use control. In addition, the study group was concerned that pursuing a Block 2 option would be costly and could delay the RRW program beyond the time when nuclear weapon designers with underground test experience would retire, raising certification difficulties.<sup>13</sup> Therefore, Block 2 is only a recommendation of the Task Force, not of the Nuclear Weapons Council.

**Cost issues.** To analyze costs of its recommendations, the TF set forth three cases.

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<sup>13</sup> The preceding information in this paragraph was provided in personal communications, November and December 2005.

- A baseline case with a flat budget in FY2005 dollars for the period 2006-2030. If the baseline budget is the FY2006 request for the Complex, the TF finds that the total cost for 2006-2030 would be some \$170 billion. The TF rejects this case because it would not lead to the TF's vision for the future Complex, "thereby representing a very high risk option for maintaining the nation's nuclear deterrent." (E1)
- A "Complex Transformation in Place" case involving minor changes to the Complex and the stockpile. There would be no consolidation of SNM, and no CNPC. Existing production facilities would continue in place. RRW begins, but most LEPs continue. Like the baseline, this case would not lead to the TF vision for the future Complex because "the physical plant, especially the production facilities, will not be transformed into the 21<sup>st</sup> Century." The TF states that this option involves risks, especially beyond 2020 when pit lifetime, warhead reliability, and dismantlement become issues. The TF calculates that this case would cost about \$5 billion more than the baseline case in 2005 dollars. (E1)
- A "Revolutionary Complex Transformation" case involving consolidation of SNM, maximum acceleration of CNPC, and implementation of the other TF recommendations. The TF finds this case would cost \$10 billion total above the baseline case for the period 2006-2015, but would save \$25 billion for 2016-2030, saving \$15 billion over the 25-year period. About half the extra \$10 billion is to accelerate dismantlement, and half to accelerate CNPC. The case would manage risk by having RRW proceed "on a responsive schedule." The results are sensitive to assumptions on the extent of LEPs, CNPC operating efficiencies, reductions in physical security costs, and efficiencies from improved business practices. Costs could be reduced by delaying the start of CNPC operations, closing some facilities, and reductions in force at the labs, etc., but the TF finds that such steps would increase risk. (E2-E3)

In its analysis, the TF judges that the baseline case involves high risks, that minor tweaks to the Complex in the Transformation in Place case increase cost and risk, that a large upfront investment would yield large savings some years from now, and that the calculated costs and savings depend heavily on various assumptions. Its Revolutionary Transformation case shows that proceeding with Complex modernization and RRW in tandem would reduce both cost and risk. The latter case makes a \$5 billion investment to accelerate dismantlement of warheads. The TF concludes that so doing "reduces the significant security and storage cost burden on the Complex." (24) Further, the TF would have Pantex dismantle existing weapons, and "Upon dismantlement of the last of the Cold war weapons, Pantex, if not the site of the CNPC, could be decommissioned." (19) Finding that savings from accelerating dismantlement would exceed the \$5 billion that the TF allocates to that purpose would be significant.



These cost and schedule estimates, however, could prove optimistic for a number of reasons.

- Because the TF plan would represent a major change to Complex sites, their operation, and their facilities, under current law DOE would have to prepare a programmatic environmental impact statement (EIS). Because the plan would affect facilities and missions of several sites, DOE would have to prepare site-wide EISs for sites with new facilities. DOE would also have to prepare site-specific EISs for individual facilities. Meeting the various requirements of the National Environmental Policy Act (NEPA) is time-consuming. DOE would also be required to comply with environmental laws of states in which facilities would be built,<sup>14</sup> which could lead to further delays.
- Lawsuits have been used to challenge EISs dealing with nuclear matters. A lawsuit over an EIS led to a preliminary injunction that halted construction of a major experimental facility at LANL (the Dual-Axis Radiographic Hydrotest Facility) from January 1995 to April 1996, for example.<sup>15</sup> Any lawsuits would add to the cost of the TF alternative, and would cause delays.
- The TF states, “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. This wide range calls into question the accuracy of estimates of CNPC cost, and thus of savings. The TF projects MPF [Modern Pit Facility; see “Pit Production Issues,” below] to cost in the range of \$14,400 to \$19,400 per square foot.” (H2) Estimating MPF cost at the bottom of the historical range of DOE construction costs seems highly optimistic given that it is probably the facility within CNPC that would have the highest requirements for safety and security, and produces one of the most difficult-to-manufacture components of a nuclear weapon.
- A combination of delays and cost growth would increase investment costs and shorten the period through 2030 in which operational savings could accrue, tipping the balance between investment costs and operational savings toward the former.
- The TF proposes reducing the footprint of MPF as one option to reduce cost. (H5) Much of the cost of a Complex facility is for planning, proceeding through the NEPA process, selecting a site,

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<sup>14</sup> For background on this point, see U.S. Congress. Congressional Research Service. *Enforcement of Environmental Laws at Federal Facilities: Legal Issues*, CRS Report 90-390 A, August 16, 1990, 18 p., by Robert Meltz.

<sup>15</sup> “Mello Attacks Test Facility Anew,” Associated Press Newswires, May 15, 1997.

obtaining the needed permits, designing the facility, and (especially for SNM facilities) providing the requisite security. If NNSA later needed to add capacity at MPF, it would be much more costly and time-consuming to secure any needed permits, perhaps repeat the NEPA process, redesign the facility, shut it down if construction so required, and finally undertake the construction, than it would be to build extra floor space at the outset and install equipment later if required. It is thus arguable that MPF should be built with more floor space than is needed initially, rather than the minimum.

- According to the report, “[t]he 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.” (xi) The FY2006 NNSA budget submission goes through FY2010; it seems an insufficient basis for estimating costs and savings going out a quarter-century. That document also appears to have limited value for estimating RRW expenses even for the period it covers. The projected RRW budget for FY2006-FY2010 in the FY2006 request simply uses the amounts that would have been allocated to the Advanced Concepts Initiative, a nuclear weapons research and study program that Congress terminated in the FY2005 Consolidated Appropriations Act (P.L. 108-447), because NNSA did not have sufficient time between the signing of that act in early December 2004, which contained initial funds for RRW, and the submission of the budget request in early February 2005 to prepare a detailed program and budget for RRW.

**Forgoing the value of sunk costs.** The Complex has developed over more than 60 years. During that time, it has accumulated many buildings and much equipment and infrastructure. Given that history, the Complex is probably far less efficient than a Complex of new design and construction would be. The Complex that the TF recommends would incorporate new facilities, eliminate redundant ones, and probably close some sites. These steps are predicted to reduce operational costs, including security. The TF anticipates that conducting manufacturing using modern processes, in new buildings, making easier-to-manufacture components for RRWs, would save large sums.

On the other hand, the United States has invested many billions of dollars in the Complex over the years. It could be argued that abandoning some of this investment — which has been built and is now operating — on the basis of an analysis showing reduced operating costs over the long run would be taking a budgetary risk. By closing some major facilities, and perhaps some sites, sunk costs would certainly be lost; whether reduced operating costs would exceed the costs of closing existing facilities and building new ones is less certain and, as the TF notes, depends heavily on the assumptions used. Following are examples of sites and facilities whose sunk costs might be lost under the TF plan.

- LANL has spent more than a decade to restore pit production operations at its Technical Area 55 (TA-55) facility. LANL delivered a certifiable pit in 2003 and expects to deliver a certified

pit for the W88 warhead in 2007. The TF estimates that TA-55 is operating at about 5 percent efficiency. (H1) It states, “Modern manufacturing techniques ... if applied rigorously could yield unprecedented reductions in TA-55 pit manufacturing costs and cycle time.” (H1) While the base rate is unclear, if TA-55 could produce pits at a 20-fold higher rate, should MPF be built? The TF would upgrade TA-55 for production, no doubt at considerable expense. Yet it appears that the TF would not use TA-55 for pit production once CNPC is operational. The SNM manufacturing facility at CNPC “will be ... the sole SNM production and manufacturing facility for the Complex” (15); “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 ...” (35); and “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.” (34) Bringing in a separate contractor to manage pit production at TA-55 (and CNPC), as the TF recommends (35), might disrupt ongoing pit operations. Once NNSA halted pit production at TA-55, more expense would presumably be incurred to convert its production space back to R&D.

- The TF envisions decommissioning Pantex after it completes dismantlement of Cold War weapons, unless Pantex is the site of CNPC. (19) But Pantex could still perform weapons assembly and disassembly. It also stores thousands of pits from dismantled weapons. Would any security and operations savings resulting from building a Pantex-like facility at CNPC outweigh the investment costs of that new facility, as well as the cost of decontaminating and decommissioning Pantex and moving pits stored at Pantex to CNPC?
- One type of experiment that LANL and LLNL perform is hydrodynamic testing, in which a pit using surrogate material instead of plutonium is imploded and measurements are taken using powerful high-speed x-rays and other types of diagnostic equipment. These experiments are conducted at two large, costly facilities: the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility at LANL and at the Contained Firing Facility (CFF) at LLNL’s Site 300, some 15 miles from the lab.<sup>16</sup> These sites conduct many smaller-scale experiments as well. “The Task Force believes that the NTS should become the only Complex site for combined HE and

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<sup>16</sup> See “Indoor Testing Begins Soon at Site 300,” *Science and Technology Review*, May 2001, and Carol Wilkinson, “Dual Axis Radiographic Hydrodynamic Testing: The DARHT Project,” September 9, 2003, 29 briefing slides, available at [[http://www.ligo.caltech.edu/LIGO\\_web/seminars/pdf/wilkinson.pdf](http://www.ligo.caltech.edu/LIGO_web/seminars/pdf/wilkinson.pdf)].

Category I and II SNM testing. Consolidation of both facilities [DARHT and Site 300] into one Hydrodynamic Testing User Facility at the NTS, incorporating containment and radiography ..., could save significant costs.”<sup>17</sup> (21) Having one facility instead of two would presumably yield savings in operations and security. Further, it could prove difficult to secure the permitting needed to conduct tests using plutonium at DARHT or CFF, should such tests be desired. On the other hand, the two facilities are integrated into the work of the labs, and have ample work conducting tests without plutonium. Moving a large, delicate experimental facility to NTS could prove difficult and costly. The sunk costs of the two facilities would be lost. The NEPA process and any attendant lawsuits could delay construction. The purpose of the two axes in DARHT, each of which would take x-ray photos of an imploding surrogate pit, is to have a time sequence of the implosion or a three-dimensional radiograph. This information would be of value for LEP or RRW. DARHT’s second axis is to be completed in 2008.<sup>18</sup> Halting work on DARHT and moving it to NTS threatens to delay pit experiments for years. A possible alternative, many years out, would be to build successor facilities to DARHT and CFF at NTS; even then, removing the existing facilities from their labs would make it harder for hydrodynamic experiments to draw on lab resources.

**Workforce issues.** Throughout the report, the TF recognizes the importance of a strong workforce for the Complex. It finds that the Complex is “rapidly losing experienced nuclear design experts.” (1) It “was delighted to find a generation of young people entering the Complex.” (3) It notes, “The enduring key to maintaining a safe, reliable stockpile of nuclear weapons is the quality of people ...” (22) Some of its recommendations are made with a goal of strengthening expertise. It stresses “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.” (23)

Several of its recommendations, however, might undercut this workforce, or seem to rely on a workforce that may not exist.

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<sup>17</sup> Category I and II refer to quantities of radioactive materials. Category I amounts are those for which “Hazard Analysis shows the potential for significant off-site consequences,” and Category II are those for which “Hazard Analysis shows the potential for significant on-site consequences.” U.S. Department of Energy. DOE Standard: “Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports,” DOE-STD-1027-92, December 1992, Change Notice No. 1, September 1997, p. A-2. The threshold for Category II for uranium-233, uranium-235, and plutonium-239 are 23,000 grams, 110,000,000 grams, and 900 grams, respectively, with the following major caveat: These values are “[t]o be used only if segmentation or nature of process precludes potential for criticality. Otherwise, use the criticality lists for U-233, U-235, and Pu-239 of 500, 700, and 450 grams, respectively.” Ibid., p. A-12.

<sup>18</sup> U.S. Department of Energy. Office of Management, Budget and Evaluation/CFO. *Department of Energy FY 2006 Congressional Budget Request*. Volume 1, National Nuclear Security Administration. DOE/ME-0046, February 2005, p. 98.

- The TF states that “as the Complex is transformed, it will need to develop a talent pool of personnel experienced in modern production technologies and processes. ... The Task Force believes that these personnel should come from a commercial high-tech background, not from within the Complex.” (23) The plants have modern equipment — and workers trained to operate it — as well as old equipment, yet the recommendation could be viewed as downplaying the value of the workers’ skills, many of which are unique to the Complex. Suggesting that workers’ skills may not meet current needs, and implying that existing workers will not be trained in the skills needed, could be seen as showing a lack of confidence in the workforce that could harm morale. Even RRW will require a workforce experienced in handling and machining SNM. It is also not clear that personnel with “a commercial high-tech background” would have the expertise to work on nuclear weapons production, or that they would want to do so, as the specialized skills required might be difficult to market in the civilian economy, narrowing their career options.
- The TF would locate CNPC in a sparsely-populated area in order to reduce the effect that a terrorist attack on the facility would have on nearby communities. It considers LLNL, LANL, Y-12, and Pantex “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 ... assets.” (19) If LANL, Y-12, and Pantex are considered too densely populated for safety, CNPC would have to be located in an even more rural area. Yet it could prove difficult to hire thousands of people in a rural area who “come from a commercial high-tech background,” and could take years to provide the requisite security clearances and training. The problem would be eased somewhat by the length of time needed to build CNPC.
- The TF envisions the Complex producing and dismantling 125 warheads per year, and states, “[a] second shift would provide surge capacity in pit production or weapon assembly should it be required.” (5) It does not indicate the source of workers to constitute the projected second shift, a potential problem in rural areas. Would the Complex train a second cadre of people with these skills, and then provide them with work sufficient to maintain these skills, so they would be available if needed? Manufacturing typically requires some depth of personnel to back up workers who are ill, on vacation, in training, etc., but it is unclear if these added personnel would suffice to operate an entire shift, especially for an extended time.
- The director of LANL suggests that establishing CNPC would likely encounter high costs, major technical risks, and delays, all of which “would severely disrupt skilled personnel across the complex and

could sharply curtail the ability of the complex to recruit and retain the next generation workforce.”<sup>19</sup>

**Implications for the nuclear weapons laboratories.** The role of the nuclear weapons laboratories and the resources they require have been perennially contentious issues. Some have argued for raising or lowering the amount spent on experimental facilities, for reducing funds for independent research, for limiting nonweapons work, and the like. Some are concerned that having two physics design labs, Los Alamos and Lawrence Livermore, results in excessive redundancy, cost, and competitiveness.

In this regard, the TF shows an ambivalence concerning competition and cooperation at the labs. Regarding competition: “the current Complex needs to initiate a design competition immediately for a family of modern replacement weapons,” (4) and “Each weapon design incorporated into a block change should be the result of a formal competition between LANL and LLNL, each supported by SNL [Sandia National Laboratories].” (34) Regarding cooperation: “Within the Complex, the physics design laboratories [LANL and LLNL] 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.” (vi) Regarding both: “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.” (19) Of particular concern,

The three design laboratories ... 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. (2)

The TF recommends a number of changes to the labs that seek to reduce redundancy, save money, and foster cooperation.

- It would eliminate many research facilities and capabilities from the labs in order to consolidate them. It would store all Category I and II quantities of SNM at CNPC (4), move R&D on Category I and II quantities of SNM to CNPC (15), close TA-55 as a pit production plant (15), move R&D on all but small quantities of explosives to CNPC or NTS (15), and consider consolidating the type of experiments done by DARHT and Site 300 at NTS. (21, J3)
- The TF proposes that “there be only one capability [i.e., high-end] [computing] machine location in the Complex. A single location would more effectively leverage staff and infrastructure. Users

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<sup>19</sup> Robert Kuckuck, Director, Los Alamos National Laboratory, letter to Richard Burrow, Deputy Director and Acting Executive Director, Secretary of Energy Advisory Board (AB-1), U.S. Department of Energy, September 27, 2005, p. 2.

would be, and should be, highly distributed. This would tend to enhance expertise and substantially reduce operating costs. ..." (20)

- The TF favors making some large facilities at a single lab into user facilities — that is, shared-use facilities — that would be run by the host lab but available to users from other labs. It proposes that “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 [LLNL’s National Ignition Facility], the Z-Machine [at Sandia], Omega [a laser facility at the University of Rochester]), as well as the facilities involved in such activities as hydrotesting (Site 300 and the DARHT facility), HE [high explosives] testing, SNM testing, and tritium research.” (28) Further, “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.” (20)
- The TF calls for “elimination of redundant non-weapons relevant research and testing.” (33)
- The TF accepts the prospect of smaller labs: “The weapons laboratories of the future will likely have smaller nuclear weapons program staff than they have today.” (19)

Critics of the TF report are likely to raise a number of issues concerning these recommendations.

- Regarding user facilities, some current laboratory facilities have been operated in this manner for many years. The labs treat major facilities such as NIF, Sandia’s Z Machine, and the Los Alamos Neutron Science Center as national assets. Because it would be too costly to replicate, maintain, and staff them at two or three labs, they are instead made available for use by Complex staff, and in some cases by academic and industrial researchers.
- The TF would have lab scientists travel to CNPC or NTS to do some work. This would result in additional effort, expenditure of time, and costs, and would separate work at those sites from other relevant equipment and expertise at the labs. It is also uncertain if these sites could provide the needed support. The TF states that CNPC would include a center for research on SNM as a user facility for laboratory staff, and “CNPC staff would provide all requisite equipment and technical support staff to support the design laboratories’ science and engineering users.” (15) But the existing facilities at the labs for SNM R&D have been developed over many years through scientific, administrative, budgetary, and political reviews and are integrated into the work of the labs. Critics believe it would be difficult to

bring the required support into being at CNPC, a new site whose prime mission would be production rather than R&D.

- As noted, the Chemistry and Metallurgy Research Replacement Building at LANL would conduct research on plutonium and uranium. LANL's director has expressed concern that limiting this building to Categories III and IV quantities of SNM, as the TF recommends, "will (1) eliminate the capability to do the necessary suite of actinide chemistry required to meet pit production mission requirements, (2) would not allow secure access to and storage of necessary quantities of SNM critical for interim pit manufacturing capacity, and therefore, (3) undermine the development and deployment of RRW."<sup>20</sup>
- LANL's director is also concerned about changes affecting key experimental facilities. "RRW design certification will push the limits of current predictive tools. The SEAB recommends that these critically important tools be consolidated, transferred or eliminated — putting RRW at risk."<sup>21</sup>

The TF approach raises more general issues as well. Regarding the labs' cooperation/competition relationship, LANL and LLNL cooperate in many ways, such as peer review of weapon designs, joint use of computational and experimental facilities, and collaboration on scientific research. At the same time, they are, by design and evolution, competitive in their most important strength, nuclear weapon design. During the Cold War, they created competing designs in response to military requirements for new weapons. In these competitions, Sandia's Albuquerque branch teamed with LANL, and Sandia's Livermore branch teamed with LLNL. This competition continues with the design for RRW. Many analysts believe that design competition is especially important now that nuclear testing is not available to check warhead performance. In this view, competitions require competitors; nuclear weapon design competitions require rival labs in order to explore differing approaches and to challenge competing design teams. Redundant facilities at the two labs help make competition possible by providing each lab with a similar base of resources. Some supporting the current laboratory system hold that if the TF wants competition, there must be redundancy because it would be difficult to have one without the other.

Even more than research facilities, the core strength of the labs is arguably their ability to bring many disciplines to bear on weapon problems. Each lab is a community with each member drawing on the skills of many others, and each contributing to the research needs of many others. Because of the complexity of nuclear weapons, solving a typical weapon problem draws on many skills resident at a lab, including physics, chemistry, metallurgy, computer operation, computer modeling, engineering (mechanical, chemical, electrical), instrumentation, and

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<sup>20</sup> Letter from Robert Kuckuck to Richard Burrow, September 27, 2005, p. 2. Actinides are chemical elements numbered 89-103, including uranium and plutonium.

<sup>21</sup> Ibid.



experimentation. Designing a weapon also draws on many skills. Similarly, research facilities support multiple areas of expertise. Only a few laboratory staff may operate an experimental facility, computer center, research laboratory building, and the like, but a single experiment may draw on many skills and may contribute data valuable to staff in many areas of the weapons program. Accordingly, some are concerned that removing one major scientific resource would be likely to disrupt work in a number of areas.

The TF would shift resources in a number of crucial areas of weapons science. It would remove a high-end computation facility from most labs, and would move much work on SNM and HE from the labs to CNPC and NTS. SNM, high explosives, experimentation, and computation are critical to nuclear weapon labs, and are often interdependent. A nuclear explosion requires HE and SNM. Experimentation provides data on the behavior of nuclear weapons. Computer modeling integrates data from experiments, scientific theory, and past nuclear tests to improve understanding of weapons performance and of the relevant theory. The TF would move Category I and II SNM to CNPC and NTS. Yet LLNL and LANL are currently conducting so-called accelerated aging experiments on plutonium to provide a better estimate of pit life, which is crucial for determining future pit production requirements. These experiments use more than Category II amounts of plutonium, so the TF plan would seem to bar that work from the labs. Both labs dismantle pits, which have a Category I quantity of SNM, to inspect them for age-related changes. The TF would apparently move pit production from TA-55 to CNPC, yet TA-55 could arguably be used to experiment with production methods and as a pilot plant, in addition to serving as a backup to MPF. Some believe that removing major scientific facilities from the labs could impair recruiting; laboratory staff have stated for many years that outstanding scientific facilities attract outstanding recruits. For example, a goal of the Laser Science-Based Stockpile Stewardship program at Los Alamos is to “[e]xploit excellent high-quality science in recruiting.”<sup>22</sup>

While the TF envisions the prospect of a smaller weapons program staff, critics of the TF report maintain that a nuclear weapons laboratory requires a certain set of skills regardless of stockpile size. They point out that staffing assumptions based on the more limited range of skills that the TF seems to believe may be required by the RRW concept implicitly rest on other assumptions: that the RRW concept will appear, after study, able to meet its goals; that the Administration and Congress will choose to replace many current warheads with RRWs; and that designing and engineering such new warheads will require a smaller skill set than is needed to maintain existing designs. They question whether such far-reaching assumptions should be a present basis for planning future lab needs.

Regarding the possible impact of improvements in computing on reducing numbers of laboratory staff, the TF states, “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

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<sup>22</sup> Los Alamos National Laboratory, “Inertial Confinement Fusion: Mission Statement,” available at [<http://www.lanl.gov/programs/icf/mission.shtml>].

laboratories.” (23) Improved computing has greatly increased the capability of lab staff so they are able to do better work, and presumably more work per hour. This does not necessarily mean that fewer people are needed. Laboratory staff state that a chemist cannot do the work of a weapon designer, a designer who specializes in a weapon’s primary stage cannot design a secondary stage, and computers cannot mentor new staff. They also question whether automated test equipment and enhanced computational capabilities would permit significant reductions in technical staff at the labs.

Having a high-end computer at each lab offers important benefits. It helps each lab recruit and retain talented computer specialists, who are attracted by the opportunity to work on such machines. Having top computation talent at each lab makes computer specialists more easily accessible to specialists in the many (if not all) disciplines who depend on high-end computing. It can be argued that providing high-end machines for all the labs permits them to try different approaches to computer and software design, and aids competition between the labs. A Complex relying on one high-end computer center could face the risk that connectivity to the labs would fail or become overloaded. Because it takes several years to design, program, and install high-end computers and make them operational, managers of a single high-end computer center serving the entire Complex might be unwilling or unable to introduce new machines very often. In contrast, supporters of the current laboratory system maintain that with each lab having its own high-end computers, which may phase in at different times, a high-capability computer is likely to be introduced into the Complex more often than would be the case with a single Complex-wide computation site. Clearly, supporting one location instead of four would save on procurement, operation, and maintenance; at issue is whether the savings outweigh the benefits of the current approach.

Laboratory staff have stated over the years that sharply curtailing non-weapons work, as the TF proposes, would harm the labs. The labs conduct much non-weapons research. Some is related to security, such as nonproliferation, conventional defense technology, and homeland security. For example, weapons scientists help interpret intelligence data relevant to nuclear proliferation and study how to disarm potential terrorist nuclear weapons.<sup>23</sup> The labs perform other work in areas such as energy, global climate modeling, the human genome, traffic flow modeling, and basic research. Such work aids recruiting. Interviews with laboratory staff suggest that few graduate students start out intending to do nuclear weapons work, but as postdoctoral fellows some come to the labs to work on non-weapons-relevant projects and then move to classified weapons work.<sup>24</sup> Permitting staff to do some work that they and their laboratory deem as having high potential value aids morale, skill development, and retention, as well as leading to useful new technologies. Critics maintain that removing non-weapons work could harm weapons work because the two often benefit from each other’s resources and efforts.

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<sup>23</sup> On the latter point, see Eileen Patterson, “Render Safe: Defusing a Nuclear Emergency,” *Los Alamos Research Quarterly*, Fall 2002: 22-23.

<sup>24</sup> Personal interviews, Los Alamos, Livermore, and Sandia staff.

**Implications for the plants.** The TF, many of whose members have over the course of their careers done some work in industry,<sup>25</sup> was sensitive to perceived problems at the plants. It “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.” (1) Congress and NNSA recognize these problems as well and have begun to address them by, among other things, directing part of the budget to the plants for specific purposes and including a Facilities and Infrastructure Recapitalization Program, for which \$150.9 million was appropriated for FY2006. CNPC proposes a more comprehensive solution, with CNPC for nuclear components and more contracting out for nonnuclear ones.

The industrial model that the TF applies to the plants, however, may have some deficiencies in dealing with nuclear weapons production. For one, as an organizing principle, cost has been accorded a lower ranking in the design and production of nuclear weapons than in other areas of industry. The TF states, “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.” (25) And, “aggressive cost goals are achievable on new weapon component designs, and a cost goal adds a healthy degree of discipline to the design process.” (9) Many would maintain that, when designing and manufacturing nuclear weapons, in contrast to many commercial products, only something close to perfection is good enough. During the Cold War, cost was much less important than warhead safety and reliability. While cost is a more salient consideration now, nuclear weapon experts hold that safety and reliability are, and will remain, of greater importance. The TF also suggests a design-to-cost model, which may not be appropriate to the Complex. “Upon DOD and NNSA acceptance of life-cycle cost estimates, ‘design/produce-to-cost’ metrics can be established for the Complex.” (14) Yet there is no design-to-cost equation for the Complex. CNPC is to perform specific tasks, many of which are at the state of the art and unique to the Complex, at the lowest price; if that price is greater than the targeted design cost, what happens?

The TF recommends outsourcing of nonnuclear components. “[T]he Complex is strongly encouraged to purchase these components and assemblies from commercial industrial vendors to the degree practical given classification and security requirements.” (14) While this has been done for years to a limited extent, expanding the scope of outsourcing could encounter many problems. Qualifying vendors — such as by assuring compliance with quality assurance standards, obtaining security clearances for workers, and installing security apparatus for facilities — would be burdensome to companies even if NNSA bore the monetary costs. Some nonnuclear components would be procured in small lots that would be economically unattractive to vendors. Some would be of old design, or would use nonstandard manufacturing techniques, so would not provide skills or equipment of value to the vendor in commercial work. Removing a substantial amount of work on nonnuclear components from the Kansas City Plant (KCP) could harm the operations of that

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<sup>25</sup> U.S. Department of Energy. Secretary of Energy Advisory Board. “Advisory Board Member Biographies.” Available at [[http://www.seab.energy.gov/sub/bios\\_nwcitf.html](http://www.seab.energy.gov/sub/bios_nwcitf.html)].

plant. KCP contracts out for some nonnuclear components, but is set up to produce the full range of them. If KCP's workload drops significantly, it would have difficulty maintaining a diverse set of skills. These problems could become significant: a large shrinkage of the plant could put production of certain nuclear weapon components at risk if a key vendor went out of business or chose not to continue its work.

One TF recommendation on outsourcing might be seen as a potential conflict of interest. In keeping with its approach to outsourcing nonnuclear components, the TF recommends outsourcing production of beryllium and beryllium oxide components "immediately if services can be obtained from quality commercial vendors" (22). A TF member is Director of Technology at Brush Wellman (iii); that company bills itself as "the only fully integrated producer of beryllium and beryllium oxide in the world."<sup>26</sup>

The TF would also outsource storage of components to save money on security. "For security cost savings, most of these [nonnuclear] components would be stored at the commercial vendor's location or another Complex facility but consistent with just-in-time commercial practices." (16) However, total security cost could arguably be higher if components were made at dozens of industrial plants, each of which would seemingly have to be secured, rather than at KCP, which has security in place. And elaborate procedures for accounting for these components as they work their way through the transportation system might hamper just-in-time deliveries.

The recommendations could affect Pantex. "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." (19) CNPC would contain facilities for the main operations now at Pantex: weapons assembly and disassembly, explosive component fabrication, and storage of pits. (15-16)

The TF would consolidate most if not all of Y-12's weapons work at CNPC, including a foundry for highly enriched uranium (HEU; see Appendix), a Uranium Production Facility, assembly of secondaries, storage of HEU and secondaries, and HEU R&D. (15-16) The TF would also move beryllium work from Y-12 and LANL to CNPC or would contract it out. (J1-J3) This consolidation would eliminate many if not all of Y-12's critical weapon functions, calling into question the rationale for retaining Y-12.

Potential consequences of closing existing plants and building a new CNPC could include political pressure from constituents on NIMBY (not in my back yard) and KIMBY (keep it in my back yard) grounds. CNPC would provide construction and operating jobs for the region chosen, but fear of many new nuclear facilities, even at an existing site, might lead to public protests. When NNSA sought public comments on siting MPF as part of the environmental impact process, the Office of

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<sup>26</sup> Brush Wellman website home page, [<http://www.brushwellman.com>].

the Governor of Nevada strongly opposed siting MPF at NTS.<sup>27</sup> Conversely, closing existing sites could arouse public opposition. Sites for the Complex were built in the 1940s and 1950s and are major employers.

**Pit production issues.** The “pit” is the fissile core of a nuclear weapon’s primary stage (see Appendix). The United States has been unable to produce pits certified for use in deployed nuclear weapons since 1989, when the only large-scale pit production site in the Complex, Rocky Flats Plant (CO), closed.<sup>28</sup> NNSA argues that pits deteriorate over time and must eventually be replaced. Critics believe that NNSA may be underestimating pit life, but do not dispute the need for eventual pit replacement.<sup>29</sup> Accordingly, NNSA seeks a way to produce pits on a scale sufficient to sustain the stockpile. At present, LANL is building a few pits at TA-55, which was designed for plutonium R&D. These pits have not yet been certified for use in the stockpile because development of the procedures needed to have high confidence in certification has not yet been completed. NNSA does not view TA-55 as having sufficient capacity for the long term; instead, NNSA has planned for a Modern Pit Facility, or MPF, with a capacity of 125 pits per year. The TF would locate all of MPF’s functions at CNPC. (15)

As discussed below, congressional actions have raised questions about the future of MPF. That facility might proceed; on the other hand, a decision not to proceed with it would call into question the future of CNPC because MPF would arguably be CNPC’s most important facility. The TF analysis of MPF and TA-55 is discussed here to cast light on the role of TA-55 and considerations involved in establishing a pit production program.

The schedule and capacity required for pit production hinge on several factors.

- Pit life: The TF states that the pits in the stockpile were made between 1978 and 1990 (actually 1989), and that the best current estimate of pit life from the weapons labs is a minimum of 45 to 60 years. (12) “Thus the entire stockpile may need to be ‘turned-over’ by 2035 to 2050 depending on the acceptable level of uncertainty in pit lifetime.” (12)

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<sup>27</sup> Letter from Robert Loux, Executive Director, Agency for Nuclear Projects, Office of the Governor, State of Nevada, to Jay Rose, NNSA, August 4, 2003.

<sup>28</sup> The TF uses a date of 1990 for when the United States made its last pit for the stockpile, but an NNSA report states: “In December 1989, DOE shut down production at the RFP [Rocky Flats Plant] due to environmental and safety concerns. Consequently, stockpile-certified pits have not been manufactured in the United States (U.S.) since that date.” U.S. Department of Energy. National Nuclear Security Administration. *Requirements for a Modern Pit Facility: Summary*, Report to Congressional Defense Committees Requested by the United States Congress in Public Law 108-375, Ronald W. Reagan National Defense Authorization Act, January 2005, p. 6.

<sup>29</sup> See, for example, Steve Fetter and Frank von Hippel, “Does the United States Need a New Plutonium-Pit Facility?,” *Arms Control Today*, May 2004: 10-14.

- Stockpile size: The TF analyzes the CNPC schedule needed to support a stockpile of 2,200 active and 1,000 inactive warheads. (17) It finds that to support that stockpile with a pit life of 45 years and a production rate of 125 pits per year, CNPC must be “functional” by 2014; with a pit life of 60 years, that date shifts to 2034. (17). Either case assumes that TA-55 produces 50 pits per year (17) from 2012 until a replacement pit facility came on line. (34) A larger stockpile would require that MPF have more capacity or (in theory) an earlier operational date.
- TA-55 capacity. NNSA plans to have TA-55 reach a capacity of 10 pits per year by the end of FY2007.<sup>30</sup> The TF envisions boosting that capacity to 50 pits per year by FY2012. (34) A higher capacity at TA-55 would permit a lower capacity at MPF or a delay in reaching a given capacity at MPF. Alternatively, it appears that the TF would close production at TA-55 when CNPC opens, as noted earlier; if TA-55 were kept open, then it and MPF could meet stockpile requirements more easily than MPF alone. Without MPF, TA-55 would require a very large increase in capacity to maintain a stockpile of 3,200 warheads.
- Ability to reuse pits. The TF states that “reuse of ‘young’ plutonium pits (less than 45 years old) and of canned secondary assemblies should be evaluated ...” (9) Reusing “young” pits would reduce the number of pits that would have to be made before then, perhaps permitting a delay in MPF until pit life and future weapon requirements became clearer. In contrast, if TA-55 is to be the sole U.S. pit facility, its capacity would have to be increased sharply even if “young” pits are used.
- Much more capacity is needed than simply enough to provide pits for direct stockpile use. Under the Moscow Treaty, the United States and Russia will each have 1,700 to 2,200 operationally deployed strategic nuclear warheads by the end of 2012; other warheads would be needed for tactical missions and for nondeployed reserves. The TF assumes a stockpile of 3,200 warheads. NNSA notes that additional pits must be manufactured because some units will be scrapped because of manufacturing defects, while others will be needed to meet requirements for (a) replacements for pits destroyed in the course of evaluating the condition of pits in the stockpile over many years, (b) pits reserved for later evaluation, (c) pits to prove manufacturing processes at the start of production of each type of pit, and (d) “pits built and destructively tested during steady-state production to assure product quality.”<sup>31</sup>

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<sup>30</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 6.

<sup>31</sup> *Ibid.*

In the TF plan, NNSA would select a site for CNPC “expeditiously” starting in FY2006, (23) and the entire CNPC would need to be “functional” by 2014 under assumptions noted above. (17) This plan, however, has several problematic elements.

First, it is not known whether Congress would support MPF or, by extension, CNPC. In the FY2004 conference report on the Energy and Water Development Appropriations Act, P.L. 108-137, conferees reduced the request for MPF by \$12.0 million, to \$10.8 million, on grounds that “until the Congress reviews the revised future Stockpile plan it is premature to pursue further decisions regarding the Modern Pit Facility.”<sup>32</sup> The conferees’ statement on P.L. 108-447, the FY2005 Consolidated Appropriations Act, included the following: “The conferees agree that funding for Modern Pit Facility cannot be used to select a construction site in fiscal year 2005.”<sup>33</sup> The House Appropriations Committee report on FY2006 energy and water appropriations stated, “The Committee continues to oppose the Department [of Energy]’s accelerated efforts to site and begin construction activities on a modern pit facility ... The Committee will consider a modern pit facility site and design only when the detailed analysis of the pit aging experiments and the concomitant capacity requirements tied to the long-term stockpile size are determined.”<sup>34</sup> The Senate Appropriations Committee report on FY2006 energy and water appropriations stated,

the Committee disagrees with the purported [Task Force] proposal to consolidate all of the nuclear material and the entire weapons manufacturing capability, including the construction of a Modern Pit Facility, at a single location. There are very strong opinions in Congress regarding the siting of a new pit facility or changing the military capability of the existing weapons. As such, the Committee believes it is unlikely that Congress would support such comprehensive reforms as currently proposed by the NNSA Complex study panel.<sup>35</sup>

The FY2006 Energy and Water Development Appropriations Act conference report stated, “The conference agreement provides no funding for the modern pit facility. The conferees direct the Administrator of the NNSA to undertake a review of the pit program to focus on improving the manufacturing capability at TA-55.”<sup>36</sup> On the

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<sup>32</sup> U.S. Congress. Committee of Conference. *Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2004, and for Other Purposes*. Conference report to accompany H.R. 2754. H.Rept. 108-357, 108<sup>th</sup> Congress, 1<sup>st</sup> Session, p. 158.

<sup>33</sup> U.S. Congress. Committee of Conference. Consolidated Appropriations Act, 2005. H.Rept. 108-792, to accompany H.R. 4818. Reprinted in U.S. Congress. Congressional Record, November 19, 2004: H10557.

<sup>34</sup> U.S. Congress. House. Committee on Appropriations. *Energy and Water Development Appropriations Bill, 2006*, H.Rept. 109-86, to accompany H.R. 2419, 109<sup>th</sup> Congress, 1<sup>st</sup> Session, 2005, p. 136.

<sup>35</sup> U.S. Congress. Senate. Committee on Appropriations. *Energy and Water Appropriations Bill, 2006*, S.Rept. 109-84, to accompany H.R. 2419, 109<sup>th</sup> Congress, 1<sup>st</sup> Session, 2005, p. 152.

<sup>36</sup> U.S. Congress. Committee of Conference. *Making Appropriations for Energy and Water Development for the Fiscal Year Ending September 30, 2006, and for Other Purposes*, (continued...)

other hand, Representative Hobson, who as Chairman of the House Energy and Water Development Appropriations Subcommittee has taken the lead on several issues on nuclear weapons and the Complex, said in an address of December 2005 that he focused on the need to define MPF rather than opposing that facility *per se*:

We'll probably build a modern pit facility, but we need to know what size we're going to build first and how many we're going to build. ... I'm not opposed to building a new modern pit facility, but this numbers thing drove me nuts and until we get there, we're just not going to do it.<sup>37</sup>

Consequently, the TF recommendation to greatly accelerate the current pit production schedule despite congressional opposition to MPF, unresolved concerns over MPF characteristics, and sharp constraints on capacity at TA-55 would appear problematic.

Second, it may be difficult to find a site for CNPC; for example, as noted earlier, the Office of the Governor of Nevada opposed siting MPF at NTS. Even if a site is found, it would take years to complete the NEPA process, obtain the needed permits, design and build the facility, and prepare it for operation. Lawsuits by national nongovernmental organizations or local groups could further delay site selection.

Third, the TF's estimates of capacity and schedule for MPF and TA-55 are at odds with those of NNSA. The TF states,

A classified Supplement<sup>2</sup> 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. (17)

[footnote 2 in text:] *Classified Supplement to the NWCITF Report Recommendations for the Nuclear Weapons Complex of the Future.*

In contrast, NNSA states, "A minimum production capacity of about 125 pits per year starting in 2021 ... is required to support a reduced stockpile as reflected in the June 2004 Stockpile Plan assuming a 60-year pit lifetime," and "The current NNSA planning approach for an MPF of 125 pits per year with production starting in 2021 is not sufficient for pit lifetimes of 40 or 50 years, or for larger long-term

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<sup>36</sup> (...continued)

H.Rept. 109-275, to accompany H.R. 2419, 109<sup>th</sup> Congress, 1<sup>st</sup> Session, 2005, p. 162.

<sup>37</sup> Representative David Hobson, "How Congress Changed Administration Policy on the Bunker Buster Bomb: a Case Study in Effective Oversight," address delivered at Center for American Progress, Washington, DC, December 14, 2005, p. 19, transcript available at [<http://www.americanprogress.org/atf/cf/{E9245FE4-9A2B-43C7-A521-5D66FF2E06E03}/HOBSON%20SPEECH%20ON%20THE%20BUNKER%20BUSTER.PDF>].



stockpiles.”<sup>38</sup> NNSA would start construction in 2012.<sup>39</sup> NNSA notes that more pits must be produced than the number headed for the stockpile, as discussed earlier. Some would be spares, or withheld to examine later for aging problems, or destined to replace pits that a detailed evaluation renders unusable. Others would be rejected because of manufacturing defects. The TF envisions an annual MPF production rate of 125 pits to the stockpile,<sup>40</sup> while NNSA envisions MPF producing 125 total pits per year. Thus the capacity of the TF’s MPF would be substantially larger than that of NNSA’s MPF. NNSA’s plan for MPF is to start construction in 2012 and full-scale production in 2021; the TF calls for an operational MPF with a capacity well beyond 125 pits per year 7 years ahead of NNSA’s schedule.

At the same time, the TF envisions modifying TA-55 to produce 50 pits per year by 2012. It is not clear that that is feasible. NNSA’s goal is to have TA-55 produce 10 pits per year by the end of FY2007,<sup>41</sup> and is planning to increase that figure to 30-40 per year “sometime after 2010,” according to a report of an interview with Ambassador Brooks.<sup>42</sup> Modifying TA-55 to produce 50 pits per year starting in 2012 would require a larger investment, and the schedule might prove difficult to meet.

As discussed under “Forgoing the value of sunk costs,” the TF would shut production at TA-55 when MPF opens at CNPC, which could (in the TF plan) be as early as 2014. If MPF proceeds, the logic of spending large sums to turn TA-55 into a production facility and then closing it for production after only 2 years is open to question on several grounds. Most of the potential value of the investment would be lost. After converting TA-55 so that its main mission was production, it might be desirable, at added cost, to reconvert it back to a research facility once production halted because plutonium facilities are extremely costly and TA-55 is the largest such facility in the Complex. If MPF were to open, TA-55’s production capacity would appear to be of potential value in many ways: as an engineering facility to test new production techniques, as a pilot plant to test and improve the producibility of new pits, as a surge producer in case the international situation called for added capacity, as a source of extra production to fix unanticipated warhead problems without disrupting MPF’s production schedule, as a “boutique” producer of small lots of pits for new or modified nuclear weapons, and as a backup production facility in case MPF must shut down so as to avoid a total halt to weapons production as occurred when Rocky Flats pit production ended.

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<sup>38</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 9.

<sup>39</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 9.

<sup>40</sup> The Task Force later reemphasized this point. When he transmitted the final TF report, Task Force Chairman David Overskei stated, “We [the TF] wish to clarify that pit production means pits produced and certified for the stockpile.” Letter from Dr. David O. Overskei, Chairman, SEAB Nuclear Weapons Complex Infrastructure Task Force, to M. Peter PcPherson, Chairman, Secretary of Energy Advisory Board, Department of Energy, October 4, 2005, p. 1.

<sup>41</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 6.

<sup>42</sup> John Fleck, “Nuclear Agency Looks to Expand LANL Pit-Making,” *Albuquerque Journal*, October 22, 2005: 1.

Finally, the TF raises the prospect that newer pits could be reused. If this is the case, then fewer new pits would be needed. As a result, the capacity required by a pit facility could be reduced or the pit production schedule extended.

**Security.** In the TF plan, CNPC would be the only site in the Complex for Category I and II SNM. (14, 15) This material would be moved from Pantex and Y-12 (assuming CNPC is not located at either site), and from LANL and LLNL. Part of the rationale is to reduce security costs. CNPC would probably achieve that objective. Whether it would “reduce the overall threat to the Complex” (vii) is less clear. It would reduce the number of sites and communities “that could be targets of terrorist attacks,” (24) but reducing the number of potential terrorist targets would seem to increase security only if there is concern about the possibility of an attack on multiple Complex sites at the same time. If terrorists could attack only one site, having more sites with fewer assets at each would make each site a lower-value target, which could reduce the risk of attack on any one site. Conversely, locating many facilities at a single site would seem to make that site a more attractive terrorist target. It is far from certain that any Complex site would rise to the top of a terrorist target list given that these sites are well defended and large in area.

A related TF goal is that “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.” (19) Of these four sites, only LLNL is located in a densely-populated area, yet the TF’s consideration of relocating plutonium R&D to LLNL (35) would require increasing the inventory of plutonium at that laboratory. For the threat of SNM release to occur as a result of terrorist attack on a Complex site, several steps would be required. Terrorists would have to attack the site, which would be difficult given site security. They would have to gain access to SNM, which additional security features would render very difficult. They would then have to seize and detonate a bomb, although there are few complete weapons in the Complex other than at Pantex and complete weapons are well protected. Alternatively, they might try to seize and disperse SNM as a dirty bomb, but SNM is a poor choice for a dirty bomb because it is very much less radioactive or accessible than such radioactive materials as cobalt-60 or cesium-137. Reducing risk to adjacent population thus seems a questionable rationale for CNPC.

**Nonproliferation.** Critics hold that the TF report might adversely affect U.S. nuclear nonproliferation efforts. The lead sentence of the report states that the goal of the nuclear weapons program has “shifted to sustaining existing warheads for the indefinite future,” (v) even though states party to the Nuclear Nonproliferation Treaty, including the United States, agreed in Article VI to “pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament.” The TF recommends continuous design and production on “a family of modular nuclear weapons.” (23) This might likewise be interpreted as inconsistent with the NPT. The TF says it is “confident that the Complex can now design a nuclear weapon that is certifiable without the need for underground testing.” (vi) This has been true since 1945; designers were so confident in the Hiroshima bomb that it was dropped without a test of its design. At

the same time, some who hope to reduce the number of U.S. nuclear weapons fear that the Stockpile Stewardship Program is intended to enable the United States to design weapons without testing;<sup>43</sup> the TF statement might be taken as support of this point. The TF recommends considering placing key SNM facilities underground (17), even though the United States has expressed concern about Iran's and North Korea's practice of hiding their nuclear facilities underground and has conducted research on a nuclear earth penetrator weapon to destroy buried facilities.

**Assessment of nuclear weapon issues.** Critics might call into question several TF statements on nuclear weapons, the nuclear weapons program, and the Complex.

The report states, "As weapon designs move away from the UGT [underground nuclear test] experience base toward high-margin, conservative designs, the issue of final stockpile certification becomes increasingly important." (10) Nuclear weapon experts maintain that "final" stockpile certification may become more or less difficult, but never more or less important, asserting that it has always been of the utmost importance.

"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." (H1) A high production rate, however, was not the goal of TA-55's pit production program. After Rocky Flats closed, DOE could have converted part of TA-55 to more efficient production by taking out existing equipment and installing new production lines, but that could have taken years and been expensive. Instead, DOE chose to utilize existing equipment and space at a loss of efficiency but with less expense and quicker time to begin limited production. TA-55 is a pilot plant installed in an R&D building to prove out the processes to make a certifiable pit. Until the processes can be shown to work, and pits can be certified, and a decision on MPF can be taken, and a decision reached on where to conduct plutonium R&D, and the type of pits to be produced (current or RRW designs) is decided, critics argue, there is little point in incurring the expense of redoing TA-55 for a 20-fold increase in production.

In trying to arrive at industrial benchmarks for production of plutonium components at MPF, the TF stated:

Since there is little commercial experience with plutonium, the Study Group [a TF subgroup] 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

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<sup>43</sup> See, for example, Christopher Paine and Matthew McKinzie, *End Run: Simulating Nuclear Explosions under the Comprehensive Test Ban Treaty*, Natural Resources Defense Council, Washington, 1997, Chapter V, "Conclusions and Preliminary Observations." Available at [<http://www.nrdc.org/nuclear/endrun/er5.asp>].

other than the forging and casting equipment, the machining and metrology equipment is virtually identical. (H1)

However, beryllium and plutonium are very different. Beryllium is light and stable, while plutonium is heavy and radioactive. Weapon scientists note other differences. Concerns over criticality (the possibility that too much plutonium in a small volume could lead to a small nuclear chain reaction) and security drive every aspect of planning a plutonium facility. Radioactivity dictates spacing between plutonium processing stations to limit worker exposure to radiation. Plutonium hemispheres must be joined together to form a pit; a LANL metallurgist stated that welding processes used to join beryllium components are very different than those used to join plutonium components. Equipment for forging and casting differs for the two metals, as the TF notes. (H1) Applications for commercial beryllium parts are not at all like those for plutonium components. Plutonium has different metallurgical characteristics at different temperatures and pressures; for example, like ice, plutonium increases in volume when it solidifies. Since plutonium is radioactive, leaks during handling can be detected constantly in real time, unlike beryllium, so that processes for handling the two metals are very different. Industrial methods for handling beryllium are not necessarily an ideal model. The *Toledo Blade* reported health and safety problems resulting from beryllium exposure at a plant in Elmore, Ohio, and elsewhere.<sup>44</sup>

The TF states, “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.” (28) Concern with these stated problems underlies many TF recommendations. Supporters of the current Complex, however, would raise questions about the TF’s statement. They would maintain that:

- LANL and LLNL have for decades competed on nuclear weapon design, as noted earlier. This institutionalized competition should not be characterized as a failure of teamwork.
- Despite this competition, there are many examples of teamwork between the labs. LANL and LLNL conduct peer review as part of the annual assessment process in support of weapon certification; this peer review will arguably be critical as the laboratories proceed with work on RRW. LANL teams with SNL/New Mexico, and LLNL with SNL/California, in developing warheads. Staff from the labs use each other’s experimental facilities, and cooperate in many aspects of weapons and non-weapons science.
- The labs partner much more with the plants than they did during the Cold War. Lab and plant staff frequently said that during the Cold

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<sup>44</sup> “Deadly Alliance,” *Toledo Blade*, March 28, 1999. This article is the introduction to a long series, and contains links to the other articles. It is at [<http://www.toledoblade.com/apps/pbcs.dll/artikkel?Dato=19990328&Kategori=SRDEADLY&Lopenr=908002&Ref=AR>].

War, the labs would design components with little regard for ease of manufacture and “throw the designs over the fence” to the plants, leaving the latter to make the components despite difficulties. Now, labs and plants exhibit much more concern about ease of manufacture. For example, the two design teams routinely consult with the plants on this topic, ease of manufacture is a goal of RRW, and plant representatives participate in the RRW Project Officers’ Group, the focal point of RRW activity.

- Redundancy has value in certain instances. For example, Rocky Flats Plant was the only site in the Complex that made pits for the stockpile. When production at Rocky Flats Plant halted in 1989, the Complex could no longer produce nuclear weapons. As a result, “Today, the United States is the only nuclear weapons power without a production-level capability to manufacture plutonium pits for the nuclear arsenal.”<sup>45</sup>
- Supporters of the current Complex maintain that there are many examples to counter the TF statement that the Complex is unable to solve problems: the ability of the Complex to create scores of warhead designs, and to produce many thousands of units, during the Cold War; the ability of the Complex to increase its understanding of nuclear weapon behavior through the SSP; and the ability of the Complex to maintain the nuclear stockpile after the Cold War so that DOE and DOD could certify its safety and reliability annually for nine years so far. Another example is the ability of the Complex to recapture the pit manufacturing process despite a long hiatus between 1989, when Rocky Flats manufactured the last “certified” pit, 2003, when LANL delivered the first “certifiable” pit, and 2007, when LANL is scheduled to deliver its first “certified” pit.<sup>46</sup>

The Task Force “found a Complex of varied strengths and weaknesses, with little evidence of a master plan.” (vi) Task Force critics acknowledge that there is no single, overarching, multi-decade master plan, but maintain that that lack is inevitable. From their perspective, the Administration’s Nuclear Posture Review of December 2001 sought a responsive infrastructure, and in fact the Complex has responded to, and been shaped by, many political and technical developments over the past six decades: World War II, the start of the Cold War, the prospect of developing the hydrogen bomb, Sputnik, the massive buildup and subsequent reductions of nuclear forces, the end of the Cold War, the development of modern information technology, and the global war on terrorism, to name a few. They note that the Administration and Congress have responded over the years by funding new programs and facilities at Complex sites to obtain capabilities needed at the time.

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<sup>45</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 6.

<sup>46</sup> Certifiable pits meet manufacturing and inspection quality assurance requirements but not performance requirements. When in addition NNSA completes analyses and nonnuclear experiments needed for pits to meet performance requirements, certifiable pits can be certified for use in the stockpile.

Just as the foregoing developments did not exhibit a master plan, so too were many responses necessarily *ad hoc*. At the same time, major facilities typically take years to build, so there has necessarily been some long-term planning as well.

According to the TF, “dismantlement ... 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.” (19) Yet there is no link between deterrence and dismantlement. In the long history of U.S. nuclear weapons policies and programs, U.S. arms control and weapon employment policies have focused on U.S. deployed forces, perceived U.S. will and intent to use them, and the potential to increase their numbers or capabilities, not on the ability to dismantle them. Similarly, the Nuclear Posture Review of late 2001 links infrastructure (such as the Complex) to deterrence, but this linkage results from the ability of the infrastructure to maintain existing warheads or make new ones, not from its ability to dismantle them.

Warheads are removed from deployed forces as a byproduct of treaties and other agreements that reduce deployed forces, as a result of a determination that certain types of warheads or their delivery systems are no longer needed, or, during the Cold War, because they were replaced by newer models. Some of these warheads are kept in an inactive status, available for use; others are retired. Stockpile size has dropped because fewer and fewer warheads are deemed necessary for deterrence or other military requirements. The end of the Cold War, for example, led to a sharp reduction in the number of potential targets and therefore in the number of weapons needed. By one analysis, the size of the U.S. nuclear stockpile has been falling steadily since 1966, and even more sharply since 1989.<sup>47</sup> This trend may continue. President Bush said, “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.”<sup>48</sup> Such reductions in deployed forces might lead to further stockpile reductions, though not necessarily in any precise numerical relationship.

While many retired warheads are dismantled, dismantlement is not required by treaty, but is more a housekeeping matter to reduce the cost and effort for maintenance, storage, and security. Current methods used at Pantex to dismantle “the Cold war stockpile” provide no physical basis for “demonstrat[ing] to the world that the overall number of nuclear weapons is being reduced, thereby reducing the nuclear threat” (24) because there is no transparency, such as international monitors observing dismantlement. If there were continuous production, as the TF suggests, dismantlement would demonstrate a net reduction “to [U.S.] citizens, the Congress, and the world” only if observers could monitor both dismantlement and new production and found that the former exceeded the latter. In contrast, the United

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<sup>47</sup> Natural Resources Defense Council, “Table of U.S. Nuclear Warheads,” last revised November 25, 2002; available at [<http://www.nrdc.org/nuclear/nudb/datab9.asp>].

<sup>48</sup> President George W. Bush, “Remarks by the President to Students and Faculty at National Defense University,” Fort Lesley J. McNair, Washington, D.C., May 1, 2001.

States has for decades demonstrated “threat reduction” through verifiable dismantlement of delivery vehicles and associated equipment (e.g., bombers, intercontinental ballistic missile silos, and missile submarines).

Moreover, there is no link between dismantlement and force reduction. Different stockpile sizes can support the same deployed force, and it is that force that figures in U.S. deterrent policy. Further, most current dismantlement is happening to warhead types totally removed from deployment over the last two decades, not to warhead types still deployed.

**Task Force assumptions.** The TF makes a number of assumptions on LEP and RRW that may prove correct, but further details are required to make the case convincingly. Accordingly, some would view it as premature to adopt recommendations based on them.

The Task Force assumes that the current method for repairing problems with existing warheads, the LEP, will be increasingly costly over the long term. (v) It notes that many warheads contain toxic materials, that the Complex must maintain materials and equipment no longer in current use, and that “[t]he 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.” (11-12) While it would be costly to maintain the stockpile using LEP, the TF does not show why it would be *increasingly* costly. An alternate possibility is that while the first LEP of a warhead type might be costly and difficult, second and subsequent LEPs of that warhead might be easier and cheaper. In that scenario, several things would occur between the first and second LEPs. SSP would learn more about weapons science in the intervening decades. The surveillance program would provide further information on the specific warhead. Details of conducting the LEP on that warhead type would be recorded, software instructions to production machines would be stored, and key equipment and materials would be stockpiled.

A related point involves the longevity of the stockpile under LEP. The TF argues that LEP “will sustain the viability of the Cold war stockpile for a while, but it will not achieve [a] future, sustainable stockpile ...” (12) Some are concerned that an accumulation of small changes with several LEPs could lead to insufficient confidence to certify warheads in the absence of nuclear testing. In this view, the very lack of adequate evidence on the future effectiveness of LEP, combined with the absence of a Complex with adequate capacity, poses a risk that an unexpected failure of a warhead type could undermine the deterrent force. On the other hand, if SSP, including surveillance and LEP, have been able to sustain the stockpile for about a decade, LEP supporters ask, why should it not be able to do so for longer? Indeed, NNSA’s goal for LEP is to extend warhead life by 20 to 30 years.<sup>49</sup> To that end, it has conducted an LEP of an intercontinental ballistic missile warhead (W87) and is conducting LEPs of a gravity bomb (B61), a submarine-launched ballistic missile

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<sup>49</sup> Department of Energy, *Department of Energy FY 2006 Congressional Budget Request*. Volume 1, p. 75.

warhead (W76), and a cruise missile warhead (W80)<sup>50</sup> — that is, an LEP for each major type of nuclear delivery system.

The Task Force recommends that the United States should proceed immediately with RRW. The recommendation rests on assumptions that the labs can come up with a workable design for RRW, that the weapon can be produced at acceptable cost and on an acceptable schedule, and that the design can be certified without nuclear testing. Further, the TF assumes that the cost of refurbishing existing weapons through LEP will exceed the cost of designing and certifying RRW, setting up new production lines to manufacture it, and producing thousands of newly-built units. The TF also assumes that the status quo is not “financially sustainable.” (ix) Clearly, the status quo is costly. It is one thing, though, to estimate that a particular course of action would cost a certain amount; to call it unaffordable appears to be a subjective judgment.

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<sup>50</sup> Ibid., p. 75-76.



## Appendix: Nuclear Weapons and the Nuclear Weapons Complex

This Appendix describes key terms, concepts, sites, and facilities as an aid to readers not familiar with them.

Current strategic (long-range) and most tactical nuclear weapons are of a two-stage design.<sup>51</sup> The first stage, the “primary,” is an atomic bomb similar in concept to the bomb dropped on Nagasaki. It provides the energy needed to trigger the second stage, or “secondary.”

The primary has a hollow core, often called a “pit,” made of fissile weapons-grade plutonium (with a high content of isotope number 239). It is surrounded by a layer of chemical explosive designed to generate a symmetrical inward-moving (implosion) shock front. When the explosive is detonated, the implosion compresses the plutonium, greatly increasing its density and causing it to become supercritical, so that it creates a runaway nuclear chain reaction. Neutrons drive this reaction by causing plutonium atoms to fission, releasing more neutrons. To increase the fraction of plutonium that fissions — boosting the yield of the primary — a neutron generator injects neutrons directly into the fissioning plutonium. In addition, “boost gas,” a mixture of deuterium and tritium (isotopes of hydrogen) gases, is injected into the pit; the intense heat and pressure of the implosion cause the gas to undergo fusion, generating a great many neutrons. The chain reaction can last only a moment before the force of the nuclear explosion drives the plutonium outward so that it can no longer support a chain reaction.

A metal “radiation case” channels the energy of the primary to the secondary stage, which contains lithium deuteride and other materials. The energy from the primary implodes the secondary, causing fission and fusion reactions that release most of the energy of a nuclear explosion.

The primary, radiation case, and secondary comprise the “nuclear explosive package.” Thousands of other “nonnuclear” components, however, are needed to create a weapon. These include a case for the bomb or warhead, an arming, firing, and fuzing system, and a means of linking the weapon to its delivery system.

The Hiroshima bomb used a simpler “gun assembly” design, in which one subcritical mass of highly enriched uranium (i.e., highly enriched in the fissile isotope 235) was shot down a gun barrel into another subcritical mass of highly enriched uranium, forming a critical mass and causing a nuclear explosion. Highly enriched uranium and weapons-grade plutonium are referred to as special nuclear material, or SNM.

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<sup>51</sup> U.S. Department of Energy, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Sept. 1996, summ. vol., p. S-4. This page contains further information on nuclear weapon design and operation.

Nuclear weapons were designed, tested, and manufactured by the nuclear weapons complex, which is composed of eight government-owned contractor-operated sites: Los Alamos National Laboratory (NM) and Lawrence Livermore National Laboratory (CA), which design nuclear explosive packages; Sandia National Laboratories (NM and CA), which design the nonnuclear components that turn the nuclear explosive package into a weapon; Y-12 Plant (TN), which produces uranium components and secondaries; Kansas City Plant (MO), which produces many of the nonnuclear components; Savannah River Site (SC), which processes tritium from stockpiled weapons to remove decay products; Pantex Plant (TX), which assembles and disassembles nuclear weapons; and the Nevada Test Site, which used to conduct nuclear tests but now conducts other weapons-related experiments that do not produce a nuclear yield. These sites are now involved in maintaining existing nuclear weapons. A federal agency, the National Nuclear Security Administration (NNSA), a semiautonomous part of the Department of Energy, manages the nuclear weapons program and the Complex.

Pit production is the most controversial aspect of nuclear weapons production, and the one most closely linked to the Reliable Replacement Warhead program. Rocky Flats Plant (CO) used to produce pits, but that work was halted in 1989 due to safety concerns. Since then, the United States has not made any pits that have been certified for use in stockpiled warheads. Once Rocky Flats pits were used up, the United States has been unable to make entire new warheads.

Los Alamos has established a small-scale pit production plant at its plutonium facility, Technical Area 55 (TA-55). TA-55 has produced several pits, but Los Alamos has not completed the work needed to certify them for use in the stockpile. NNSA anticipates that that work will be completed in FY2007, and that TA-55 will achieve a capacity of 10 pits per year beginning in FY2007. NNSA has plans to increase TA-55's capacity to 30-40 pits per year sometime after 2010.

NNSA, however, believes that that number is inadequate to support the stockpile, and proposes a new Modern Pit Facility (MPF) to provide more capacity: "A 125 pit per year MPF with full production starting in 2021 (on-time) is the minimum capacity to support the President's reduced 2012 stockpile assuming a 60-year pit lifetime."<sup>52</sup> In NNSA's view, because of the long lead time needed to design and build a pit facility, planning for MPF should continue as a hedge against unexpected problems with pits in the stockpile. Others challenge that plan, arguing that if pit lifetime proves longer than anticipated, or if the future stockpile declines more than anticipated, an expanded TA-55 would suffice, so that the United States should delay a decision on MPF until future pit requirements become clearer. The FY2006 Energy and Water Development Appropriations Act, P.L. 109-103, deleted funds for MPF; conferees on the measure directed NNSA to "focus on improving the manufacturing capability at TA-55." On the other hand, Representative David Hobson, Chairman of the House Energy and Water Development Appropriations Subcommittee and a key player on nuclear weapons issues, stated in December 2005 that he does not oppose MPF but wants to have it defined more clearly before proceeding. The future of MPF thus appears uncertain.

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<sup>52</sup> NNSA, *Requirements for a Modern Pit Facility: Summary*, p. 4.

## Glossary: Abbreviations

CFF	Contained Firing Facility
CNPC	Consolidated Nuclear Production Center
DARHT	Dual Axis Radiographic Hydrodynamic Test Facility
DOD	Department of Defense
DOE	Department of Energy
EIS	Environmental impact statement
HE	High explosive (chemical, not nuclear)
HEU	Highly enriched uranium
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
LEP	Life Extension Program
LLNL	Lawrence Livermore National Laboratory
MPF	Modern Pit Facility
NEP	Nuclear explosive package
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NTS	Nevada Test Site
R&D	Research and development
RRW	Reliable replacement warhead
SEAB	Secretary of Energy Advisory Board
SNL	Sandia National Laboratories
SNM	Special nuclear material
SSP	Stockpile Stewardship Program
TA-55	Technical Area 55
TF	Secretary of Energy Advisory Board Nuclear Weapons Complex Infrastructure Task Force