
Does the United States Need a New Plutonium-Pit Facility?

Steve Fetter and Frank von Hippel

Each nuclear weapon in the U.S. arsenal contains a “pit,” a hollow shell of plutonium clad in a corrosion-resistant metal, which is surrounded by chemical explosive. When the weapon is detonated, the explosives compress the pit into a supercritical mass and a fission chain reaction is triggered. All the pits in the current U.S. nuclear weapons stockpile were manufactured at the Department of Energy’s Rocky Flats Plant in Colorado, which was shut down in 1989 because of flagrant violations of safety and environmental regulations.¹

During the Cold War, warheads were replaced by new designs well before the end of their design lifetimes. With the end of the Soviet-U.S. arms race, however, the need for new weapon designs also ended, and the longevity of the pits has become an issue. The pits in current U.S. warheads are expected slowly to deteriorate and at some point they will have to be replaced if the warheads are to remain in the stockpile.

To manufacture new pits, the Bush administration has proposed building a Modern Pit Facility (MPF) with a single-shift production capacity of 125, 250, or 450 pits per year, which would begin operation around 2020.² The total cost for design and construction is estimated at \$2-4 billion, with an annual operating cost of \$200-300 million per year. Leading the charge has been Linton Brooks, administrator of the Energy Department’s National Nuclear Security Administration (NNSA).³ Brooks has been supported by key lawmakers, particularly Senator Pete Domenici (R-NM), who chairs the Senate Appropriations Energy and Water Development Subcommittee and hopes to add the MPF to the other Energy Department nuclear facilities, which bring billions of federal dollars per year into New Mexico.⁴

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The need for such a massive and expensive new facility is highly dubious, however, unless the United States wants to maintain a Cold War-sized nuclear arsenal or launch a misguided effort to develop a new class of nuclear weapons. Otherwise, any need for replacement pits can be easily handled by adapting an existing facility at Los Alamos National Laboratory. Building an expensive new facility would be a waste of taxpayer’s money. It would also risk broader harm to U.S. interests, encouraging the United States to maintain a larger stockpile than is needed to protect our national security interests and to introduce new types of warheads, signaling to other countries that the United States believes nuclear weapons are more useful than they actually are.

The Clinton administration faced the same question about how to maintain the U.S. nuclear arsenal but came to a different conclusion. In 1996 the Energy Department decided to establish a capacity to fabricate pits in the PF-4 plutonium facility in Technical Area 55 (TA-55) of Los Alamos, with a maximum capacity of 80 pits per year. It judged such a capacity adequate to support the proposed START II force of 3,500 deployed strategic warheads.⁵ This is more

than the limit of 2,200 deployed strategic warheads agreed to by Presidents George W. Bush and Vladimir Putin in the U.S.-Russia Strategic Offensive Reductions Treaty (SORT).

The urgency of building the MPF has been challenged by congressional leaders as well as members of the arms control community. In July 2003, the House Appropriations Committee questioned the urgency of committing to the MPF and suggested that the rationale for the facility might disappear if the United States downsized its stockpile to a level appropriate to the post-Cold War security situation. The panel called the NNSA’s rush to build the facility “premature” and called on the NNSA “to plan and execute a program to support defense requirements based on what is needed rather than the continuation of a nuclear stockpile and weapons complex built to fight the now defunct Soviet Union.”⁶ In January, Brooks delayed issuing the final environmental impact statement on the MPF because of the need “to respond to concerns that some [congressional] committees have raised about its scope and timing.”⁷

In order to decide on the need of this expensive and problematic new facility, better answers are needed for at least two questions:

- How large a stockpile will the United States have in the future?
- How soon and how fast will the pits currently in the stockpile have to be replaced?

The Future Size of the U.S. Stockpile

The required plutonium pit production capacity depends upon the number of warheads that will need to be replaced, but the Bush administration has yet to decide whether or by how much to reduce the estimated 10,000 nuclear warheads (and 5,000

reserve pits) in the U.S. stockpile.⁸

If we were to use the 2002 SORT as a basis for decision-making, a stockpile of 3,000 pits should be more than sufficient. Such a stockpile would allow the United States to maintain a deployed force of 2,200 strategic warheads (the maximum number permitted under the accord in 2012), a reserve of several hundred strategic warheads, and a like number of nonstrategic warheads. A facility producing 100 pits per year could replace this entire arsenal over a 30-year period. That would be well within the capabilities of the Los Alamos TA-55 facility, which, according to NNSA, could be expanded to produce 80-150 pits per year operating only eight hours a day, five days a week.⁹ Therefore, if the United States determines that it needs a pit production capacity of 150 per year or less, the MPF may not be needed at all.

A stockpile of 3,000 warheads would still be very large. The nuclear Nonproliferation Treaty (NPT) requires reductions in the nuclear forces of the weapon states with the ultimate goal being zero. With others, we have argued that the United States and Russia should bilaterally agree to reduce their stockpiles to 1,000 warheads each.¹⁰ An av-

erage production rate of only about 25 pits per year starting in 2010 would be required if the U.S. stockpile were programmed to decrease to 1,000 warheads by 2050.

An arsenal that small could be handled by the production line currently being built at Los Alamos. Since the Clinton administration's 1996 decision, the New Mexico weapons laboratory has been developing an improved pit-production process at its TA-55 plutonium facility and, in April 2003, succeeded in producing a "stockpile certifiable" pit.¹¹ As of early March 2004, five such pits had been produced. The production line currently under construction in the TA-55 facility is to produce pits for the stockpile at a rate of up to 20 pits per year by 2007.¹²

On the other hand, if the goal were to be to maintain the entire current U.S. stockpile of pits for the indefinite future, then a larger pit-production facility would be needed. Indeed, it appears that, in the absence of a decision by the Bush administration to reduce the size of the U.S. stockpile, NNSA set the maximum production capacity of the MPF at a level sufficient to replace all of its current stockpile. At a single-shift manufacturing rate of 450 pits per year, the MPF could

replace the 15,000 existing U.S. pits in 33 years.

Such calculations are simple enough, but two other factors complicate the analysis: additional potential production requirements and the short period over which the pits currently in the U.S. stockpile were produced.

NNSA argues that a "minimum capacity requirement of 125 pits per year" is required to support even a 1,000-warhead stockpile.

The capacity of an MPF needs to support both scheduled stockpile pit replacement at end of life and any "unexpected" short-term production...to address, for example, a design, production, or unexpected aging flaw identified in surveillance, or for stockpile augmentation (such as the production of new weapons, if required by national security needs).¹³

Surge Capacity

The need for surge capacity to deal with unexpected problems, however, is substantially reduced by the fact that the United States plans to maintain a diversity of warhead types and considerable stockpiles of

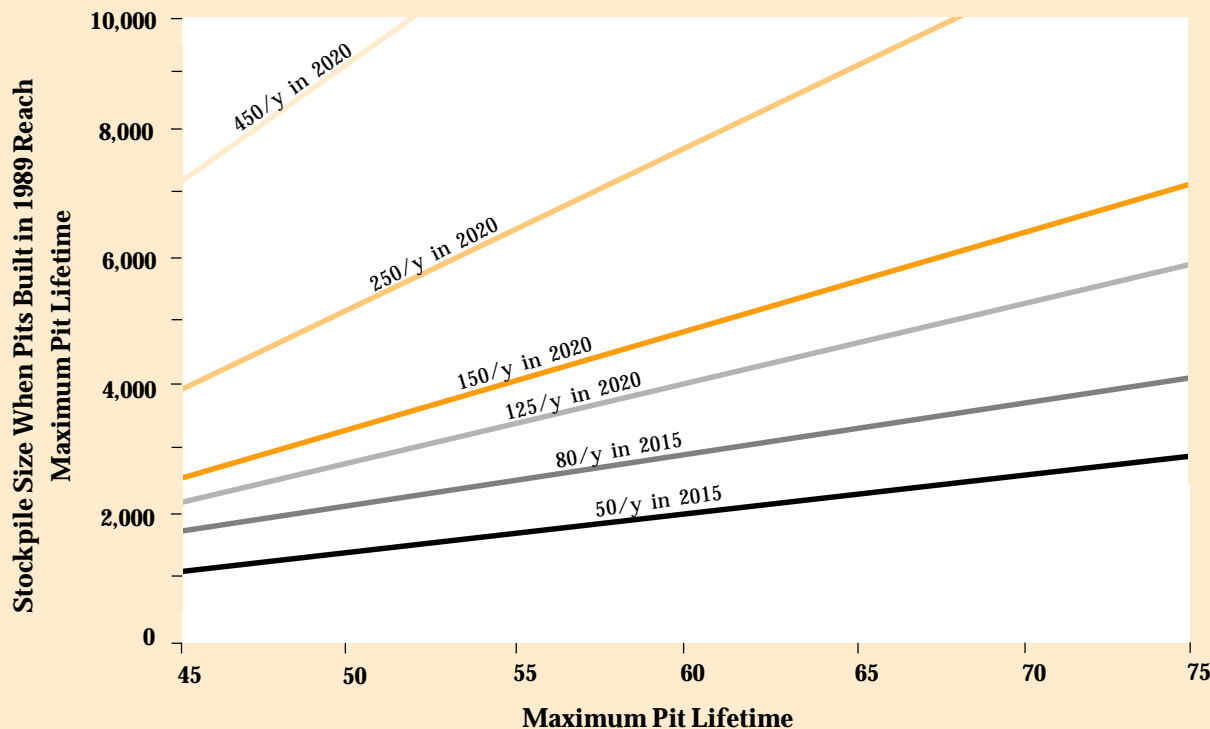
TABLE 1: APPROXIMATE PRODUCTION PERIOD AND TOTAL ESTIMATED INVENTORY (ACTIVE PLUS INACTIVE) OF WARHEADS IN THE CURRENT STOCKPILE.

| WARHEAD TYPE | SYSTEM | DESIGN LABORATORY ^A | PRODUCTION PERIOD ^B | NUMBER IN STOCKPILE ^C |
|--------------|----------------|--------------------------------|--------------------------------|----------------------------------|
| B61-3/4 | Tactical Bomb | LANL | 1979-89 | 1,100 |
| B61-7 | Strategic Bomb | LANL | 1985-90 ^D | 470 |
| B61-10 | Tactical Bomb | LANL | 1983-86; 1990-91 ^E | 200 |
| B61-11 | Strategic Bomb | LANL | 1985-90; 1997 ^F | 50 |
| W62 | Minuteman III | LLNL | 1970-76 | 610 |
| W76 | Trident II | LANL | 1978-87 | 3,200 |
| W78 | Minuteman III | LANL | 1979-82 | 920 |
| W80-0 | SLCM | LANL | 1983-90 | 320 |
| W80-1 | ALCMs | LANL | 1981-90 | 1,800 |
| B83-0/1 | Strategic Bomb | LLNL | 1983-91 | 620 |
| W84 | GLCM | LLNL | 1983-88 | 400 |
| W87 | Minuteman III | LLNL | 1986-88 | 550 |
| W88 | Trident II | LANL | 1988-89 | 400 |
| TOTAL | | | | 10,640 |

^ALANL = Los Alamos National Laboratory; LLNL = Lawrence Livermore National Laboratory ^BDates of warhead assembly. It is unlikely that the pits were produced much earlier than the first warhead. ^CNatural Resources Defense Council, available at www.nrdc.org/media/docs/020213a1.pdf. ^DThe B61-7, produced during 1985-90, is a modified B61-1 and probably contains an older pit. ^EThe B61-10 was assembled using the physics package from the W85, which was produced during 1983-86. ^FThe B61-11, produced in 1997, is a modified version of the B61-7.

FIGURE 1: THE RELATIONSHIP BETWEEN STOCKPILE SIZE AND PRODUCTION CAPACITY FOR VARIOUS PIT LIFETIMES OR REPLACEMENT PERIODS

The number of pits that could be replaced by the time today's youngest pits reach the maximum pit lifetime, assuming an interim capacity of 20 pits per year beginning in 2007 which is expanded to 50 to 80 pits/y in 2015 or 150 pits/y in 2020, or which is replaced by an MPF with a capacity of 125, 250, or 450 pits/y in 2020.



Source: Figures are based on Los Alamos estimates, reprinted in the draft environmental impact statement for the Modern Pit Facility (DEIS MPF)

spare and inactive warheads. If a warhead type develops a problem, there will in all cases be a substitute in the stockpile.¹⁴ (See Figure 1.)

Even after the scheduled retirement of the W62 warhead in 2009, the Minuteman III intercontinental ballistic missiles could still use two warhead types: the W78 and the W87. The Trident II submarine-launched ballistic missiles also could use two warhead types: the W76 and the W88. Furthermore, with modifications, it is likely that the Minuteman III warheads could be mounted on Trident II, or vice versa. Los Alamos has even suggested that the W80 and W84 cruise-missile warheads and the B61-10 nuclear bomb might be converted to backup warheads for the Trident II missile.¹⁵

The strategic bombers can use the W80-1 warhead for the air-launched cruise missiles (ALCMs) and two types of gravity bombs, the B61 and the B83. If needed, the W84 warhead recovered from the ground-launched cruise missiles (GLCMs) eliminated by the 1987 Intermediate-Range Nuclear Forces Treaty could replace the W80-1.

New Types of Pits

NNSA also asserts a need for extra capacity for “the production of new weapons, if required by national security needs.” Warheads with newly designed pits would require renewed nuclear testing, however, which would end the current worldwide testing moratorium, violate U.S. legal commitments as a signatory to the 1996 Comprehensive Test Ban Treaty, and profoundly undermine the NPT.

In any case, the only specific new weapon advocated by the Bush administration is the “robust nuclear earth penetrator,” which under the current plan would use an existing “physics package” inside a heavy penetrating shell and would therefore require no new pits. Any desire to deploy warheads with lower yields presumably could be similarly accommodated by adapting existing physics packages or by deploying simple and robust gun-type warheads that do not require either a plutonium pit or nuclear testing.¹⁶

Even if a new-type pit design were developed for a small number of special tar-

gets, it is difficult to imagine an argument for production of more than a few dozen devices. Any effort to justify the MPF with the possible production of new types of pits should therefore be subject to the most serious scrutiny and debate.

Block Obsolescence of Pits?

If pits were produced and retired at a constant rate, the required pit production capacity would be equal to the stockpile size divided by the pit lifetime. But nearly all of the warheads in the current stockpile (except the W62, which is programmed for retirement by the end of fiscal year 2009) were produced at the Rocky Flats plant in Colorado between 1978 and 1989 when it was shut down. A high production capacity would therefore be required to replace the entire stockpile over a similarly short 12-year period as these pits reach the end of their useful lives.

It is not necessary, however, to wait until a pit reaches a particular age to replace it. In order to level the production rate,

some pits could be replaced earlier and some later than average. For example, if pits produced in 1978 were replaced starting in 2018 when they are 40 years old and those produced in 1989 were replaced in 2049 when they are 60 years old, the rebuilding period would be increased from 12 years to 32 years. Including interim production at TA-55 (20 pits per year beginning in 2007), it would be possible to replace a stockpile of nearly 3,000 warheads with a production rate of 80 pits per year beginning in 2015, assuming a maximum pit lifetime of 60 years. Figure 1 shows the relationship between pit lifetime, production capacity, and the maximum stockpile size when today's youngest pits reach the maximum pit lifetime.

When Will Pits Have To Be Replaced?

The minimum expected lifetime of the pits is currently estimated by NNSA at 45-60 years.¹⁷ This is a broad range, however, and which end of the range is used for planning purposes leads to very different conclusions. NNSA has based its planning on the most conservative estimate. The MPF is slated to go into full production in 2020, when the oldest pits currently in the U.S. stockpile will be about 42 years old (see Table 1).¹⁸

However, NNSA expects by 2006 to be able to determine with much greater confidence whether the expected minimum durability of U.S. pits would be 60 years (see sidebar). In that case, the oldest pit would not need to be replaced until 2038. A study done by Los Alamos for NNSA found that, for an expenditure of \$500-700 million, it would be possible by 2014-2016 to have a production line in TA-55 that could produce all pit types in the U.S. "enduring stockpile," except for that in the B83 bomb, at a rate of 50-80 pits per year, operating 40 hours a week.¹⁹ Including earlier production, TA-55 could produce a total of 1,200-2,100 pits by 2038; adding production during the following 12 years until the oldest pit reached age 60, the facility could replace a stockpile of 1,800-3,000 warheads.

The same study also found that, for an expenditure of an additional \$700 million, a wing could be added to TA-55 and its production capacity increased so that it could produce by 2020 all the pit types in the enduring stockpile at a rate of 150 pits per year, including the capability of simultaneously producing two different types of pits. With a production capacity of 150 pits

PLUTONIUM PIT LIFE EXPECTANCY

How long will a plutonium pit be usable? The National Nuclear Security Administration (NNSA) has developed an elaborate research program to find out. Its Enhanced Surveillance Campaign monitors pits for any deterioration due to aging and attempts to understand the processes that cause them to age. This effort has thus far led to the conclusion that U.S. pits will not have to be replaced until they are at least 45 years old. An NNSA-commissioned review explains the basis for this conclusion:

[P]its have remained remarkably pristine and free of corrosion, especially since the adoption of modern cleaning and sealing methods...¹

Evaluation of the oldest samples of plutonium metal, both metal of oldest absolute age (40 years) as well as the oldest samples most directly comparable to the enduring stockpile (25 years), have shown predictably stable behavior. The many properties that have been measured to date, such as density and mechanical properties, have shown only small changes, and detailed microstructural studies have been correlated to these changes in properties. The response of each system to potential changes is specific to each particular design. Based on this assessment, current estimates of the minimum age for replacement of pits is between 45 and 60 years.²

To improve these estimates, a number of theoretical calculations and experiments, most notably an "accelerated-aging" experiment, are currently underway that will be used as a basis for joint laboratory assessment, due in 2006. The primary purpose of this work is to establish whether a minimum lifetime of 60 years can be attributed to some or all pit types. NNSA experts describe the "accelerated-aging" experiment as follows:

An alloy of normal weapon-grade plutonium mixed with 7.5% of the Pu-238 isotope will accumulate radiation damage at a rate 16 times faster than weapon-grade material alone. This is a useful tool to evaluate extended-aged plutonium (up to 60-years equivalent and possibly beyond) within a few years. Critically, acceleration of the input or radiation damage must be matched by acceleration of the subsequent annealing and diffusion of that damage. We accomplish this subsequent acceleration by raising the temperature at which the samples are stored. These processes are thermal in nature, and the activation energy (a term which describes the energy required to activate a process) is different for each specific mechanism. Unfortunately, there is no single temperature at which the thermal diffusion of this damage will be equivalently and perfectly matched to the initial acceleration of the damage input. As a result, the accelerated aging experiments are carried out at three different temperatures....

By early 2006, these samples will have reached an equivalent age of 60 years, and measurements of their properties (and comparison to aging models) [will] form a key milestone in our estimate of pit lifetimes.³

It is critical that adequate funding be provided so that this full program of experiments and analysis can be carried through. If they are, we will know much more in two years about the timing of the need for additional pit-production capacity than we do today.

NOTES

1. DOE EIS, p. G-63 ("Plutonium Aging: Implications for Pit Lifetimes").
2. Ibid., p. G-64.
3. Ibid., pp. G-62, G-65.

per year, TA-55 could replace a stockpile of more than 5,000 warheads, assuming a minimum pit lifetime of 60 years.

The report of the TA-55 upgrade study warned that the highest-capacity option was subject to “high execution risk...due to the possibility of an unforeseen event during the construction of new floor space that could disrupt both the upgrade and on-going TA-55 manufacturing and certification activities.”²⁰ If there is a need for such a high production capacity, the significance of this risk and possible strategies for its mitigation should be reviewed by an independent research organization such as the National Academy of Sciences or JASON group.²¹ This risk should also be compared with the risk of design failures and likely cost overruns at a new pit-production facility.

Conclusion

In 1999, when the Energy Department completed its previous comparison of the alternatives of expanding the capacity of TA-55 or constructing a new pit-production facility, it concluded that “the time required to build and start up such a [new] facility is extensive. There are no programmatic, environmental, or other advantages.”²²

These findings are more consistent with our analysis than the opposite conclusions of the 2003 NNSA study that we have reviewed here. At the very least, Congress should insist on waiting for the administration to provide lawmakers with better information on the expected lifetime of current U.S. pits in 2006.

What has changed since 1999 that would indicate the need to build more or different pits? At first blush, it would seem that the need for warheads—and pits—has only decreased with the 2002 signing of the SORT between the United States and Russia. That treaty limits to 2,200 the number of deployed U.S. strategic nuclear warheads vs. the START II limit of 3,500 assumed in the Clinton administration’s analysis.

Unlike the proposed START III, however, SORT did not set limits on the number of nondeployed warheads Russia and the United States could keep in their stockpiles. Beyond the retirement of the MX missile and four Trident submarines, the Bush administration plans to achieve the SORT-mandated reductions by readily reversible “downloading” of warheads from missiles and removal of nuclear bombs and cruise missiles from operational strategic bomber bases.

The requirement for a large pit-production capacity therefore may be due in

part at least to a desire to maintain large stocks of nondeployed warheads for possible redeployment. Indeed, the classified version of the Bush administration’s 2001 Nuclear Posture Review (NPR) states that, “in the event that U.S. relations with Russia significantly worsen in the future, the U.S. may need to revise its nuclear force levels and posture.”²³ The NPR also raised the possibility of the United States creating new classes of weapons.

Keeping excessive warhead stockpiles and proposals for the development of “more usable” nuclear weapons would make the United States less rather than more secure. At best, the proposed MPF is a potential white elephant. At worst, it may facilitate a misguided nuclear strategy. [ACT](#)

NOTES

1. U.S. Department of Energy (DOE) National Nuclear Security Administration (NNSA), “Draft Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility,” DOE/EIS-236-S2, May 2003, p. S-1 (hereafter DOE EIS).

2. *Ibid.*, p. 2-6.

3. See “The Bush Administration’s Views on the Future of Nuclear Weapons: Interview with NNSA Administrator Linton Brooks,” *Arms Control Today*, January/February 2004, pp. 3-8.

4. Office of Sen. Pete Domenici, “DOE Secretary Responds to Domenici Endorsement of Carlsbad as Site for Pit Production Facility,” July 31, 2003 (press release).

5. DOE Office of Technical and Environmental Support, “Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management,” DOE/EIS-0236, September 1996, ch. 3.1.1.1.

6. U.S. House Committee on Appropriations, *Report on the Energy and Water Development Appropriations Bill, 2004*, 108th Cong., 1st sess., 2004, H. Doc. 212.

7. DOE NNSA Press Release, “NNSA Delays Modern Pit Facility Environmental Impact Statement and Selection of a Preferred Location,” January 28, 2004.

8. According to nongovernmental estimates, the United States has approximately 10,000 nuclear warheads. In addition, 5,000 pits stored at NNSA’s Pantex warhead assembly/disassembly plant near Amarillo, Texas, reportedly have been designated as a strategic reserve. See “NRDC Nuclear Notebook: Dismantling U.S. Nuclear Warheads,” *Bulletin of the Atomic Scientists* 60, no.1 (January/February 2004), pp. 72-74.

9. S. T. Boertigter, D. E. Kornreich, and W. Barkmen, “Summary of TA-55/PF-4 Upgrade Evaluation for Long-Term Pit Manufacturing

Capacity,” in DOE EIS, p. G-54, available at www.mpfis.com/Vol_2/App_G.pdf (hereinafter TA-55/PF-4 Upgrade Evaluation). More detail on the current use of space in the TA-55 facility and an earlier analysis for the expansion of its single-shift production capacity to 50 pits per year (80 pits per year with multiple shifts) may be found in the “Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory,” DOE/EIS-0238, 1999 (vol. II, pt. II, “Enhancement of Plutonium Pit Manufacturing”).

10. National Academy of Sciences, *The Future of U.S. Nuclear Weapons Policy* (Washington, DC: National Academy Press, 1997); Harold Feiveson, ed., *The Nuclear Turning Point* (Washington, DC: Brookings Institution, 1999). One hundred survivable warheads would represent a formidable deterrent to first use of nuclear weapons.

11. Christine Kucia, “U.S. Produces First Plutonium Pit Since 1989,” *Arms Control Today*, May 2003, p. 35.

12. *Nuclear Warhead “Pit” Production: Background and Issues for Congress*, by Jonathan Medalia, Congressional Research Service Report #RL31993, March 2004.

13. DOE EIS, pp. 3-17, S-15.

14. Although the United States might also stockpile several hundred nonstrategic warheads and many thousands of reserve warheads and pits, there would be little or no need to replace these on an emergency basis should reliability problems be discovered.

15. Los Alamos National Laboratory, “The U.S. Nuclear Stockpile: Looking Ahead,” March 1999 (declassified briefing charts).

16. In an existing physics package, one could, for example, remove the secondary or the deuterium-tritium fusion boost gas, so that the weapon would give only the primary or unboosted primary yield. Alternatively, one could design and deploy a gun-type device using highly enriched uranium in which one could be highly confident without nuclear testing. The Hiroshima weapon was a gun-type device, as were South Africa’s nuclear weapons. None of these were tested.

17. DOE EIS, p. S-12.

18. *Ibid.*, fig. 2.1.3-1.

19. TA-55/PF-4 Upgrade Evaluation, p. G-54.

20. *Ibid.*

21. JASON is a group of academic experts that does studies of this type for the Departments of Defense and Energy.

22. *LANL Site-wide EIS*, vol. 2, pt. 2, January 1999, p. 16.

23. GlobalSecurity.org, “Nuclear Posture Review [Excerpts],” January 8, 2002, available at www.globalsecurity.org/wmd/library/policy/dod/npr.htm.