

# Does America Need A New Atomic Bomb Plant?

*A Preliminary Review of  
The Department of Energy's Plans to Restore  
Large-Scale Plutonium Pit Production*

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**BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE**

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## Preface

In the final month of World War II the United States exploded three nuclear explosive weapons, each assembled at Los Alamos under the Manhattan Project administration. The first explosion, on July 16, 1945, involved a test of the first assembled nuclear explosive device, at the Trinity site in New Mexico, 230 miles south of what is now called Los Alamos National Laboratory (LANL). Uncertainty about the device's actual explosive power characterized opinions of the design scientists. Even though the blast did not destroy the entire state of New Mexico, as a few scientists worried, the effects did cause surprises, such as the unexpected high readings of radioactivity in a nearby canyon.<sup>1</sup>

The next two bombs were dropped three weeks later. The first bomb, a "gun-assembly" design using highly enriched uranium (HEU) was dropped on the city of Hiroshima, Japan and its 250,000 residents on August 6. The second bomb, an "implosion" design using plutonium, was dropped on Nagasaki, Japan on August 9##events subsequently compared to dropping "a small piece of the sun." Both cities were destroyed in the instantaneous devastation that defied description. A week later Japan surrendered unconditionally.

Within a few weeks of the blasts, there were reports about "mysterious rays coming from the rubble," visibly uninjured people dying, and rescue workers with abnormally low blood counts. But the massive human health impact and loss of life from radiation damage was downplayed by Manhattan Project officials testifying to Congress.

No nuclear weapons have been used as an act of war since 1945, and no known inadvertent or accidental nuclear detonations have occurred. The fearsome and unthinkable nature of nuclear weapons and war has deterred their use, but not their development and production. The Cold War between the U.S. and the former Soviet Union was marked by the threat of nuclear war and annihilation. The nuclear arms began as an effort to deter conventional warfare between superpowers, but as more weapons accumulated, deterrence was more often equated as an insurance policy against massive nuclear attack. Eventually, the prevailing policy became Mutual Assured Destruction (MAD) and its apt acronym symbolized the policy of designing and producing tens of thousands of nuclear weapons of mass destruction that had to work but were unthinkable to use.

Following World War II, the U.S. produced 65 nuclear warhead types, deployed 116 weapon systems, and 70,299 individual warheads at an estimated total cost of six trillion dollars,<sup>2</sup> and anywhere from 20,000 to 30,000 warheads were deployed in the 60's, 70's, and 80's. Warhead production was suspended in the U.S. in 1989, and in June 1990 Presidents George H.W. Bush and Mikhail Gorbachev signed the START I arms reduction treaty, which was completed eleven years later, effectively cutting strategic nuclear weapon numbers in half.

The U.S. continues to deploy approximately 7,000 warheads and keeps a few thousand in reserve storage, while Russia is said to have about twice that many. The recent agreement between Presidents George W. Bush and Vladimir Putin call for a reduction to 1,700 to 2,500 "operationally deployed strategic warheads" on the U.S. side. Russia is said to have maintained much of its nuclear weapons production complex, while the U.S. has downsized and modernized much of its complex. Both nations, along with China, France, India, Israel, Pakistan, and United Kingdom,<sup>3</sup> have a national policy of maintaining nuclear arsenals and production and expertise capability into the indefinite future.

Type	Name	Launchers	Year deployed	Warheads x yield (kiloton)	Warheads (active/spares)
<b>ICBMs</b>					
LGM-30G	Minuteman III				
	Mk-12	150	1970	1 W62 x 170	150
	Mk-12	50	1970	3 W62 x 170 (MIRV)	150/15
	Mk-12A	300	1979	3 W62 x 335 (MIRV)	900/20
LGM-118A	MX/Peacekeeper	50	1986	10 W87 x 300 (MIRV)	500/50
<b>Total</b>		<b>550</b>			<b>1,700/85</b>
<b>SLBMs</b>					
UGM-96A	Trident I C4	168/7	1979	6 W76 x 100 (MIRV)	1,008
UGM-133A	Trident II D5	264/11			
	Mk-4		1992	8 W76 x 100 (MIRV)	1,728/156
	Mk-5		1990	8 W88 x 475 (MIRV)	384/16
<b>Total</b>		<b>432/18</b>			<b>3,120/172</b>
<b>Bombers*</b>					
B-52	Stratofortress	94/56	1961	ALCM/W80-1 x 5-150	430/20
				ACM/W80-1 x 5-150	430/20
B-2	Spirit	21/16	1994	B61-7, -11, B83-1 bombs	800/45
<b>Total</b>		<b>115/72</b>			<b>1,660/85</b>
<b>Non-strategic forces</b>					
Tomahawk SLCM		325	1984	1 W80-0 x 5-150	320
B61-3, -4, -10 bombs		n/a	1979	0.3-170	800/40
<b>Total</b>		<b>325</b>			<b>1,120/40</b>
<b>Grand total**</b>					<b>7,600/382</b>
ACM: advanced cruise missile; ALCM: air-launched cruise missile; ICBM: intercontinental ballistic missile (range greater than 5,500 kilometers); MIRV: multiple independently targetable reentry vehicles; SLCM: sea-launched cruise missile; SLBM: submarine-launched ballistic missile.					
* Bombers are loaded in a variety of ways depending on mission. B-52s may carry cruise missiles, gravity bombs, or a combination of both; B-2s carry only bombs.					
** An estimated 2,700 additional warheads are retained in the "inactive" stockpile.					

## Overview

Plutonium pits are the core of the primary nuclear explosive in advanced modern weapons and function to trigger the nuclear blast. There are presently more than 13,000 pits in storage at the Pantex nuclear weapons plant near Amarillo, Texas; and approximately 10,000 pits within deployed, reserve, or stored nuclear weapons.

The first weapon pits, often called “war-reserve” pits, were manufactured at Los Alamos during and shortly after the Manhattan Project. In the early days of the Cold War Hanford took over most production, and in 1953 the Rocky Flats plant began operating and manufactured pits until 1989. During that time Los Alamos continued to make pits for testing and development, while Hanford ceased making pits in 1965.<sup>#</sup> Today’s pit stockpile is considered entirely of Rocky Flats origin.

On September 23, 2002, the Department of Energy’s National Nuclear Security Administration (DOE) issued a Federal Register notice (FR 59577-59580) announcing its intent to replace the capability lost when DOE suspended plutonium pit recycling and fabrication at the Rocky Flats plant in Colorado in 1989, followed by termination in 1992. DOE now seeks a means for large-scale production, stating in its Notice of Intent its plan to:

“Prepare a Supplement to the Programmatic Environmental Impact Statement (EIS) on Stockpile Stewardship and Management (SSM) for a Modern Pit Facility (MPF) in order to decide: (1) whether to proceed with the MPF; and (2) if so, where to locate the MPF.”

The two questions posed by DOE can be rephrased as:

1. Should the United States re-establish the capability to manufacture large quantities of thermonuclear weapon triggers?
2. If the capability is necessary, which facilities should be located at which existing nuclear weapons production sites?

### Question One: Should the United States re-establish the capability to manufacture large quantities of thermonuclear weapon triggers?

The first question appears to be a foregone conclusion because the Notice of Intent answers *why* the Government considers it essential at this time. It states:

“While an interim capability is currently being established at the Los Alamos National Laboratory (LANL), *classified analyses* indicate that this capability will not suffice to maintain, long-term, the *nuclear deterrent* that is a cornerstone of *U.S. national security policy*.” (emphasis added) (FR59577, September 23, 2002)

This justification statement contains three phrases—classified analyses, nuclear deterrent, U.S. national security policy—that are a part of the Cold War political legacy; they often function as excuses to circumvent democratic processes. *They place an immediate burden on the process.*

*Classified analyses*, or government secrets, force people to judge need based on the federal government’s word despite lapses of honesty regarding nuclear weapon production,

testing, and deployment. Also, there are severe penalties in the Atomic Energy Act for revealing the information that justifies the need. The heightened secrecy of the early 21<sup>st</sup> century stands in stark contrast to DOE's openness policies of the 1990s.

*Nuclear deterrence* involves policy analysis and discussion that turns the world inside-out, as it is "the least understood by those not intimately familiar with the arcana of nuclear policy."<sup>4</sup> Whether the policymakers understand it is also subject to debate.

*U.S. national security policy:* Particularly in nuclear weapons plant communities, dissent is often stifled and questioning national security is not acceptable. People who dare to debate the issue are often labeled as unpatriotic, un-American, subversive, or, in modern parlance, "giving aid to terrorists." Even weapon designers, retired military officers, and veterans are subject to rhetorical attacks on their motives and patriotism. So here the issue of national security is raised to quash public debate.

### The Cold War Constant

George H.W. Bush was President when the weapons production work ceased. He signed the START I and START II treaties. Although President Bill Clinton signed the Comprehensive Test Ban Treaty, it was never ratified; he signed no new arms reduction treaties and he breathed new life into the weapons production complex with the Stockpile Stewardship program. Today, President George W. Bush is pursuing new nuclear weapons production and testing, as well as new designs. The only constant through the post-Cold War period is maintenance of the nuclear deterrent as a cornerstone of U.S. National Security Policy.

Even without access to secret information, we can resort to a vast base of unclassified information to judge whether or not a Modern Pit Facility is needed. New plutonium pit production is sought for reasons that are slightly less abstract than deterrence and national security: to maintain and modernize the U.S. nuclear weapons arsenal, commonly referred to as the "enduring stockpile."

Plutonium pits and other weapon components have not been dismantled, although Russia dismantled pits to make new ones. Of the 13,000+ pits at Pantex in Texas, between four and five thousand are considered a strategic reserve, while an indeterminate number are considered national assets. The strategic reserve subset of the national asset stockpile is re-usable in the existing stockpile, and a Product Re-qualification program is in place at Pantex to recertify up to 300 pits a year for the existing arsenal.

Plutonium pit production is a central component of the Stockpile Stewardship Program, a phrase used to describe nuclear arsenal maintenance, surveillance, refurbishment, and modernization. Stockpile stewardship is a six to seven billion dollar-a-year enterprise that also involves modernization of the once-sprawling nuclear weapons complex, and forms the springboard for new weapons design and production. Nearly one-fifth of this budget is spent on restoring pit production capability. Large-scale plutonium pit production remains the next to last step towards a modernized nuclear weapons production complex.

Pit reuse is a smaller portion of the program, reflected by its budget of only three million per year, and though deemed essential to stockpile stewardship, it functions as the stepchild to pit production. Pit reuse is viewed almost with disdain, like going to a junkyard for parts.

Other essential manufacturing capabilities have been achieved or are in progress. At the end of the Cold War nuclear weapon designers viewed the loss of tritium production as the greatest threat to the arsenal, and DOE is already on track to produce new tritium at TVA reactors. Building new weapon secondaries is another higher priority, and that capability is now in place again at Y-12 Oak Ridge. The last step is full-scale nuclear testing, and readiness for this is being maintained at the Nevada Test Site (NTS).

Determining how many pits are needed to sustain the arsenal can be gauged with simple arithmetic. At a rate of 150 replacements a year, which assumes all inspection units will need new pits, plus 20 pits per year of surveillance, 170 pits a year are needed for replacements. The strategic reserve of four to five thousand could provide enough for at least twenty to thirty years.

### New Designs for New Weapons

But the enduring stockpile is not the only issue. Although Stockpile Stewardship is allegedly not geared towards new weapon design and production, the Department further qualified its national security rationale for more pit production by invoking the option for new designs. DOE's September 23<sup>rd</sup> notice stated that plutonium pit production at Los Alamos National Labs effort lacked a characteristic that went beyond mere stockpile stewardship:

“However, classified analyses indicate that the capability being established at LANL will not support either the projected capacity requirements (number of pits to be produced over a period of time), or the agility (ability to rapidly change from production of one pit type to another, ability to simultaneously produce multiple pit types, or the flexibility *to produce pits of a new design in a timely manner*) necessary for long-term support of the stockpile.” (emphasis added) (FR59579, September 23, 2002)

This notice raises the new weapons issue. In the technical sense, the U.S. has not had new weapons designs since the Cold War ended. However, the U.S. has modified some existing weapons to create new capabilities. Specifically, the B61-Mod 3 was modified into the B61-Mod 11 Earth penetrator several years ago. The current trend is to develop a new wave of nuclear weapons for changing strategic requirements, beginning with advanced earth penetrators to destroy “hardened and deeply buried targets.”

### No Nuclear Stockpile Reliability Problems Identified

The issue of existing weapons' reliability is complicated and therefore is prone to political exploitation under the guise of national security. The DOE's Notice Of Intent continues:

In particular, any systemic problems that might be identified in an existing pit type or class of pits (particularly any aging phenomenon) could not be adequately addressed today, nor could it be with the capability being established at LANL. Although no such problems have been identified, the potential for such problems increases as pits age. NNSA's inability to respond to such issues is a matter of national security concern. NNSA is responsible for ensuring that appropriate pit production capacity and agility are available when needed, and this Supplement to the SSM PEIS is being undertaken to assist NNSA in discharging this responsibility. (FR 59579, September 23, 2002)

Aging issues are a subset of a larger issue, that of weapons reliability. The DOE is responsible for the safety and reliability of the U.S. nuclear weapons stockpile and the production

complex necessary to sustain that stockpile. Uncertainty characterizes the aging issue not only because it involves a chemically complex element—plutonium—but because it also involves the seemingly abstract notion of reliability. (See I—Reliability)

### Question Two: If the capability is necessary, which facilities should be located at which existing nuclear weapons production sites?

The second question in the Notice Of Intent regards where production should be located. This too appeared to have been settled just a few years ago, but new political realities leave the issue clouded. Furthermore, the question of where is complicated by the lack of information, raising doubts about the wisdom of choosing a site for a mission said to be seventeen years distant.

The plutonium pits now stored at Pantex were originally manufactured at the infamous Rocky Flats nuclear weapons plant near Denver, Colorado—where production work was suspended in 1989 following years of environmental crimes, and canceled entirely in 1992. The loss of pit manufacturing capability has been a subject for heated debate ever since.

The Department of Energy began pursuing relocation of Rocky Flats capabilities immediately after its suspension in 1989, with the Complex 21 process. In 1991 the DOE estimated a 10-year schedule and \$640 million cost for replacing Rocky Flats alone (Part II). When this was pushed aside the effort continued, with the Department publicly seeking pilot-scale capability at Los Alamos National Laboratory and privately pursuing large-scale production plans for manufacturing 125 to 500 new pits annually. This latter planning effort involved DOE contract employees who were also instrumental in another national security program, plutonium disposition.

#### Production Schedule Contradictions

According to the DOE Notice Of Intent published September 23<sup>rd</sup>, pit production will go online in 2019. However, this is contradicted by DOE’s budget request, which states in regard to a large-scale pit production facility that “such a facility will be needed around 2015.”<sup>5</sup>

Some new capabilities are scheduled to be in place much earlier. The Plutonium pit Disassembly and Conversion Facility (PDCF) is scheduled to begin operations in 2010 or 2011, while the Mixed Oxide Fuel Fabrication Facility (MFFF) is scheduled to begin in 2008. Both facilities are funded by nuclear nonproliferation funding as part of the surplus plutonium disposition program, but have dual capabilities for nuclear fuel and nuclear weapons.

#### Uncertainties About Size and Cost

According to the DOE’s Notice Of Intent, the cost of the facility ranges from two to four billion dollars. But according to DOE budget request information, the size of the facility depends on requirements which have yet to be determined. These requirements depend upon the “progress of arms control and on the results of a DOE effort to determine the maximum life of plutonium pits.” The latter study is ongoing. Depending on size and location, DOE estimates a cost of \$600 million to more than \$3 billion dollars.

Modern pit production consists of about twenty eight major operational capabilities, about half of them non-nuclear operations already in existence or planned. These can be



combined into six general categories:

- Pit recycling: disassembly, plutonium recovery and purification, and metal preparation;
- Pit fabrication: foundry, machining, and assembly
- Plutonium scrap recovery
- Non-nuclear component manufacturing and operations
- Support operations: maintenance, security, etc
- Waste management

It is unclear in the September 23<sup>rd</sup> Notice Of Intent which operations are even under discussion. Non-nuclear manufacturing and support operations are not likely to be an issue because that capability is easier to develop and is either already established or the capability is planned at Los Alamos, Y-12 Oak Ridge, or other sites.

### Ambiguity in the Site Selection Process

A 1997 study done by scientists at Lawrence Livermore, Los Alamos, and Sandia National Laboratories considered three sites for plutonium pit production:<sup>6</sup>

- Savannah River Site, the only one willing to undertake the entirety of the job
- Y-12 Oak Ridge, which showed interest in the plutonium fabrication aspect but was not interested in plutonium processing
- Pantex, which was not interested in liquid plutonium processing or the foundry work

The recommendation then was for SRS for do the whole job or for SRS and Y-12 to split the job, with SRS taking the front end recycling and Y-12 taking fabrication.

DOE screened seven sites for the mass production work this time, and eliminated Y-12 and Idaho National Engineering Laboratory (INEEL) for scoring too low on their screening method. Five sites are considered candidates for the entire job:

- Savannah River Site near Aiken, South Carolina, which was chosen in 1997 as the only single-site option;
- Pantex near Amarillo, Texas
- Los Alamos National Laboratory, which was already pursuing the pilot phase of pit production and whose operating contractor, the University of California, opposed the idea;
- Nevada Test Site north of Las Vegas, where nuclear weapons and test devices are tested and which has remained in a state of readiness if the U.S. decides to renew weapons testing;
- The Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico, which was built to dispose of much of the transuranic radioactive waste from the old weapons complex, but has never had a nuclear weapons production mission and is not a part of the DOE's National Nuclear Security Administration (NNSA).

These five sites were reportedly selected after a screening process based on “population encroachment, mission compatibility, margin for safety/security, synergy with existing/future plutonium operations, minimizing transportation of plutonium, NNSA presence at the site, and infrastructure. The first two criteria were deemed to be ‘exclusionary’ criteria; that is, a site either passed or failed on each of these two criteria. The sites that passed the exclusionary criteria were

then scored against all criteria.” This preliminary site selection process was flawed by several factors:

- The exclusion of Y-12 Oak Ridge, which in 1997 was recommended as the “technically superior” choice for pit fabrication operations
- The inclusion of WIPP, where the pro-pit argument is that “we aren’t contaminated”
- The inclusion of Pantex, where the only plutonium processing that has ever occurred was by accident, and where the open prairie environment and close proximity to private lands create security and safety considerations not found at other sites.

Another problem in site selection involves the overlap between pit production and the plutonium disposition programs. The front end of plutonium pit production is pit recycling, which was the domain of Rocky Flats but also performed along similar lines at Savannah River Site (SRS) and Hanford. The first pair of operations forming pit production###pit disassembly/conversion and metal preparation###are already in the late design stages at SRS.

### New Plutonium Operations Underway At Savannah River

The news that SRS is a candidate for a Modern Pit Facility is not surprising. SRS was the preferred site in 1997 for the front end work, as well as back end plutonium chloride and nitrate recovery. Why DOE’s NNSA refers to a modern pit “facility” instead of modern pit production “capability” is unclear. SRS is already en route to establishing new capabilities and there is a minimal probability that DOE is talking about one facility or plant. Plutonium pit production has always involved more than one facility and more than one site.

Step one in making new pits for the existing or new design nuclear weapons involves disassembling the pits, separating the plutonium from the other pit materials, and converting the metallic plutonium to a plutonium oxide powder. DOE selected SRS in January 2000 for a Plutonium pit Disassembly and Conversion Facility (PDCF). Design work is ongoing and the plant is scheduled to begin operations in 2010 or 2011.

Step two in the process is metal preparation, which purifies the plutonium oxide in a liquid acid solution, re-converts it to plutonium oxide powder, and finishes by casting a plutonium metal piece for further machining and refining. Savannah River Plant performed this job for nearly forty years in the F-Canyon. Except for the metal casting, the new Mixed Oxide Fuel Fabrication Facility (MOX) modernizes this capability at SRS. Late design work is ongoing and they hope to be operating in 2007 or 2008.

The PDCF and MOX plants were sold to the public as means to rid the world of the menace of surplus military plutonium, a noble nuclear nonproliferation goal for making the world a safer, more secure place. **But any plutonium facility can be used for peaceful commercial purposes or for weapons production work.** It appears that the swords-to-plowshares program could evolve or be entirely displaced by a swords-to-swords program. The weapon labs have already chipped away at any real or perceived division; for example, the diversion of surplus plutonium from the ARIES pilot line at Los Alamos National Labs to the weapons program for plutonium aging studies.

### What The Future Holds: A Renewed Arms Race?

According to *Managing the Nation’s Nuclear Materials: The 2025 Vision for the*

*Department of Energy*, synergy, integration, and uncertainty is the wave of the future for weapon complex sites. The report states:

“Each mission area must plan for great uncertainty in scope, capacity, and technology needs....Significant interrelationships exist within and between mission areas....The primary nuclear material production and handling functions are very inter-linked and critical to DOE success. These functions will remain constant, but will need to be utilized by multiple programs for various missions, perhaps even simultaneously. Redundancy will not exist....”<sup>7</sup>

The Department of Energy’s rationale for new pit production is contradicted by logic and sheer common sense. The 1990's was a period of arms reductions; the U.S. dismantled more than 10,000 weapons at the Pantex Plant. The threat of nuclear holocaust was no longer on the radar screen for most Americans. The U.S. remained committed to a nuclear deterrent and Russia maintained its downsized arsenal to compensate for reduced conventional military strength. Both countries retain enough nuclear explosive fire power to end civilization as we know it. But the pursuit of new nuclear weapons raises the specter of a renewed arms race, and a future in which nuclear war is more likely than ever.

While the question of whether to proceed with a modern pit facility appears to be prejudiced by DOE, we have before us the opportunity for a comprehensive public policy debate on the future of nuclear weapons. What we call for is full, frank discussion of the concepts of nuclear deterrence and national security, the obligations of international treaties and ethical principles, and the impact of nuclear weapons production on the people of the United States and the world.



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## References

<sup>1</sup> . Welsome, Eileen. 1999. *The Plutonium Files*. Dial Press. [The book covers the development of the first weapons as a precursor to the ensuing and long history of human radiation experiments sponsored by the U.S. Government. Highly recommended].

<sup>2</sup> . Schwartz, Stephen I. 1998. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*. Introduction. Page 22. [The book was a landmark study providing in-depth examination and detail on the economic and bureaucratic intricacies of the entire breadth of the nuclear weapons program. Highly Recommended]

<sup>3</sup> . For concise information on the complicated topic of nuclear arsenal stockpiles see the *Nuclear Notebook* at <http://www.thebulletin.org/issues/nukenotes/>

<sup>4</sup> . Schwartz, Stephen I. 1998. *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*. Introduction. Page 22

<sup>5</sup> .DOE Budget Request to Congress. FY2002

<sup>6</sup> . Jardine, L.J., (LLNL), P. Reardon (LANL), J. Grimley (SNL), and L. Bransetter (SNL). 1997. *Rapid Reconstitution of Pit Production Capacity: System Studies Assessment and Recommendation*. UCRL-ID-128655. August 1997. [Obtained in 1999 by Tri-Valley Cares through the Freedom of Information Act]

<sup>7</sup> .Christenson, D.C., K.B. Sorenson, T.L. Sanders, T.G. Surles, J.C. Tseng, A. Collins. 2000. *Managing the Nation's Nuclear Materials. The 2025 Vision for the Department of Energy*. LA-UR-00-3489.

## I. Plutonium Pit Reliability and Aging

Plutonium pits are the “triggers” in most nuclear weapons.<sup>#</sup> Pits are sealed, hollow-core weapon components containing plutonium and other materials and form the core of the primary nuclear explosive in modern thermonuclear weapons: “the portion of a nuclear weapon which generates the fission energy to drive modern thermonuclear weapons.”<sup>#</sup>

Early weapon cores were referred to as capsules and were inserted into the weapon only when weapon use was ordered. The U.S. produced and deployed approximately 15-20 weapon systems of this and a similar design prior to 1957.

In and around 1956 the sealed pit concept currently in use replaced the plutonium capsule design.<sup>#</sup> The U.S. designed and deployed nearly 65 weapon systems during this period,<sup>#</sup> of which 8 remain in the stockpile and about 37 are in storage.

One Los Alamos National Laboratory (LANL) researcher has described pits as “nested shells of materials in different configurations and constructed by different methods.”<sup>#</sup> In the case of sealed pits, the materials are metal-only, and the shells consist of the cladding, neutron tampers, the plutonium sphere, and often highly enriched uranium spheres.

Pits are surrounded by precision-machined high explosive spheres. In all plutonium bombs, detonation of the high explosives compresses the plutonium into a supercritical mass, a process called implosion that triggers the nuclear detonation. (Figure 1-1)

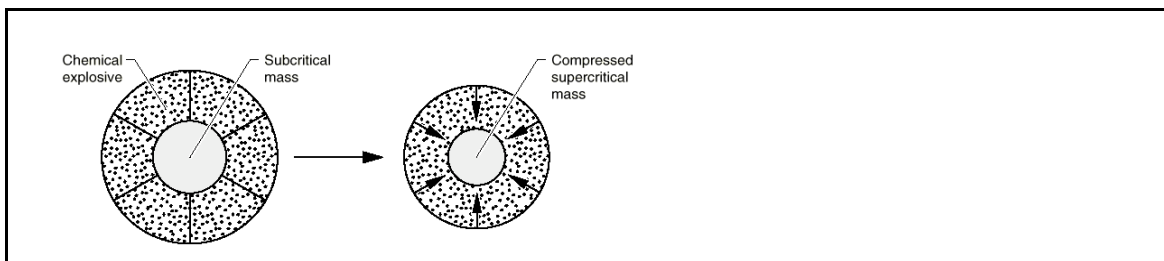


Figure 1-1

In fission bombs the immense energy from the implosion is the blast. With the advent of thermonuclear bombs, or hydrogen bombs, the pit functioned as the trigger to larger explosions. In two-stage weapons containing a primary and secondary nuclear explosive, the fission energy drives the massive fusion explosion created by the presence of lithium deuteride and/or tritium. In the case of tritium, a sealed pit tube functions to transfer deuterium-tritium gas—used to boost nuclear explosive power###from tritium canisters into the hollow-core of the pit. The condition of pit tubes in the existing arsenal is a matter of concern for the plutonium pit re-use program.

Pits are designed for storage and use, and must be safe and reliable. A safe plutonium pit is a pressurized storage vessel in which welds and cladding protect the interior parts. Hollow-core pits must not leak the inert gas, the cladding must not corrode to the point of being brittle, and the pit materials—particularly the plutonium—will not be exposed to air.<sup>#</sup> Reliable pits must function as designed, so that the nuclear explosive design yield is achieved—although thermonuclear weapons’ explosive reliability is much more a function of the secondary nuclear explosive.

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Plutonium stored in pit form is considered the safest and most reliable method of plutonium storage.<sup>#</sup> Pits are designed as storage containers within the weapon, functioning to provide a sealed environment, particularly for the plutonium shell but also other materials. The sealed environment, which also contains helium or another inert gas, is necessary to prevent exposure to air which would oxidize the plutonium metal into powder form, rendering the pit militarily useless and more dangerous from an environmental, safety, and health perspective.<sup>#</sup>

## **The Plutonium Pit Stockpile**

There are 48 different pit types and these are grouped into pit families based on one or more of the following factors:

- The presence or absence of highly enriched uranium; either as a separate shell or within a plutonium/HEU composite.
- The presence—either through contamination or by design—or absence of tritium in pits;
- The cladding material—beryllium, stainless steel, aluminum, or vanadium;
- Whether pits are “bonded” or “non-bonded;” and
- The shape, mass, and isotopic composition of the plutonium within the pit;

The United States nuclear weapons arsenal includes approximately 23,000 plutonium pits<sup>#</sup> containing about 70 metric tonnes (MT) of military-grade plutonium, an average of 3 kilograms of plutonium per pit. The pits are stored mostly at the Pantex Nuclear Weapons Plant near Amarillo, Texas or in deployed, reserve, or stored nuclear weapons at various locations. The stockpile is mostly divided between pits stored at Pantex or pits in deployed or stored nuclear weapons.

The end of the Cold War and the signing of START I resulted in dismantlement and pit consolidation taking over at Pantex, eventually resulting in an estimated 13,000 to 13,500 pits at Pantex from:

- A 1990 inventory of about 1,000 pits;
- Dismantlement of 11,000 to 11,500 weapons;
- 1200 pits left at Rocky Flats were moved to Pantex between 1997 and 1999;
- 60 strategic reserve pits were moved from SRS to Pantex in 1998.

Pantex has also shipped 20 pits a year to Los Alamos and Livermore for destructive surveillance, and up to 250 pits to LANL’s TA-55 for the Pit Disassembly and Conversion pilot program.

The existing stockpile of pits is divided into four categories.

1. 8,000-9,500 pits designated as “excess to national security needs,” stored in Pantex Zone 4 bunkers, and containing approximately 25 metric tonnes of plutonium. However, it is unclear whether or not DOE intends to recycle these pits for new weapons or to “dispose” of them through its plutonium disposition program.

2. 4,000 to 5,500 designated as “national security assets” planned for indefinite storage in Building 12-116, and containing approximately 12-13 MT of plutonium. National security assets (NSA) is a category concocted in 1998 and consists of:

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- Strategic reserve pits, including surplus pits considered defense program assets that can be recycled for new pits or re-used for existing weapons.
  - Enduring stockpile pits that belong to existing weapon systems;
  - Enhanced surveillance pits that may include surplus pits.<sup>#</sup>

3. Approximately 10,000 pits remain in deployed, reserve, or stored nuclear weapons, containing about 30-35 MT of plutonium. (see Figure 1 in preface).

4. An unknown number, roughly estimated at 100-200, of “not war-reserve like” pits located at Rocky Flats as late as 1998. Details about these pits are scarce and if they have been moved, the likely recipient was Los Alamos and/or Livermore.

Surplus pits are scheduled to remain in Zone 4 at Pantex until they are sent to a Plutonium Pit Disassembly and Conversion Facility (PDCF), scheduled to open later this decade at Savannah River Site (SRS). The PDCF is officially the front-end of the plutonium disposition program scheduled to convert 34 metric tonnes of military grade plutonium to a form that meets the spent fuel standard and is therefore difficult and expensive to re-use and essentially theft proof for 50-100 years. However, the PDCF will likely serve as the front end of any large-scale plutonium pit production complex, as identified in DOE reports such as the *Rapid Reconstitution of Plutonium Pit Production Capacity* report of 1997.

Plutonium pit disassembly and conversion refers to “the removal of the plutonium from the nuclear weapon pit and conversion [of the plutonium and other parts] to an unclassified form that is verifiable in the sense that, containing no classified information, the form can be examined by inspectors from other nations.”<sup>#</sup> Size, shape, mass and isotopic composition of the plutonium and other parts are considered traits in need of declassification at the PDCF.

## **The Future of Pits, New Pit Production and Weapons Reliability**

The U.S. arsenal has been an enormous undertaking, involving more than 1,000 nuclear explosive tests, the dedication of three national laboratories to weapons research, design, development, and testing, and a production complex sprawling across the continent. Keeping the arsenal safe, secure, and reliable is a constant task even without new pit production. It is technically correct that the United States cannot make new nuclear weapons of plutonium-based design, but it is equally correct that the United States can and does rebuild older weapons as a means to keep the arsenal relatively new. The United States still spends billions of dollars a year maintaining and refurbishing the nuclear arsenal.

One less publicized program is stockpile surveillance. Since 1958, “more than 13,800 weapons of forty-five types have been disassembled, inspected, and [non-nuclear parts] tested, and only 400 findings have been deemed ‘actionable.’”<sup>#</sup> About one hundred and fifty weapons still go through this process at Pantex each year. If problems are found with the pits, the reliable yield can be lowered or the pit can be replaced, although the latter necessitates a complicated requalification process. Many of these weapons are eventually disposed, while some are rebuilt.

Another program is refurbishment, in which weapons are disassembled, inspected, and then reassembled with original or replacement parts. The U.S. completes approximately 150 refurbishments annually at Pantex, and in recent years refurbishment has involved new designs of

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essential parts like neutron generators.<sup>#</sup>

Plutonium pits are also being described as having “limited lives,” which is a distortion of the common definition of “limited life components.” These components require replacement *by design*, and include parts like tritium reservoirs and neutron generators. In contrast, plutonium pits are robust components with a finite period of utility that is currently unknown and uncertain, but estimated at 30 to 100 years. From a longevity perspective, components such as plutonium pits, the high explosives surrounding pits, and secondary nuclear explosives were designed to last for a finite period of utility defined more by military policy and economics than physical requirements. Except for weapons with unsafe designs, pits were replaced as a matter of policy and practice, not necessity.

Many weapon scientists believe the pits are in no danger of reduced viability in the short-term. In a 1999 Mitre Corporation report commissioned by DOE, weapon experts wrote that “Pit lifetimes are now discussed as 60 or 90 years”<sup>#</sup> while cautioning that the uncertainties warranted pursuing pit manufacturing planning.

The existing nuclear arsenal and deterrent is not considered threatened by a lack of new pit production, at least in the short-term of up to 20 years. Even if pits are not replaced and allowed to age, weapons designers do not state that older pits would fail as the primary nuclear explosive. What the weapons labs, military strategists, and policy makers do worry about is the concept of reliability.

Reliability, in weapons jargon, is a vague and elusive concept even to some weapons designers. A University of California at Berkeley graduate student studying the phenomenon found that few weapon designers and stockpile stewards agreed on a common definition. Semantics aside, reliability generally means that nuclear weapons, when used, must produce nuclear explosive yields at or above their design yield. For example:

- A 400-kiloton nuclear warhead that produces “only” a 100 or 300 kiloton nuclear explosive yield is considered unreliable.
- A nuclear “dud” involves the high explosives detonating and plutonium dispersal without a nuclear explosion, or what is strangely referred to today as a dirty bomb.
- A nuclear weapon “fizzle” can involve a range of nuclear yields, but in all cases much below the design yield. A one-kiloton yield is often cited, although many nuclear weapons were designed for that much yield. A 1-kiloton blast would be 4,000 times more powerful than the Oklahoma City terrorist bombing in 1995.

The entire premise that a nuclear explosion five to ten times more devastating than the Hiroshima or Nagasaki bombs renders a modern weapon unreliable appears ludicrous, morbid, and a perversion of human logic and reasoning. The simple explanation is that when military planners say they need a 400-kiloton explosion to destroy a target, the labs and DOE must meet that demand and the weapons must function as designed.

As for making new era nuclear weapons, the U.S. has several options. Plutonium is not a necessary component for nuclear explosives, as the world learned after the first atom bomb was dropped on Hiroshima. According to a June 2000 report by then-director of Los Alamos nuclear weapons, Stephen Younger, the U.S. arsenal could rely upon HEU-based warheads of simpler, more rugged, and manageable design.



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As for the existing arsenal, there are up to 4,000 plutonium pits at Pantex designated as National Assets that function as a strategic reserve of replacement pits. In the early 1990's, Pantex successfully retrofitted one retired pit type for use in a newer design, providing a precedence for re-using old pit types in new designs.

Making weapons is much more complex than making pits, as it involves thousands of parts of more common design and purpose. Under the Stockpile Lifetime Extension Program (SLEP), the weapons complex is gradually retrofitting existing nuclear weapons with new parts, some of new design. By 2010 there will be 20-30 year-old nuclear explosive physics packages, containing pits of like age, but they will be within rebuilt weapons. The arsenal may be more functional in 2010 than it is today.

## Pit Aging

Aging of inanimate objects like pits refers to changes in material properties over time and can be chemical, physical, or mechanical in nature. Aging of non-nuclear components—detonators, etc—is a much higher concern than aging of plutonium, and pit problems are uncommon in the weapons surveillance program. However, several factors are dictating an early start towards renewed plutonium pit production:

- Plutonium is so physically and chemically complex that determining and predicting aging effects is extremely difficult;
- Manufacturing plutonium pits is one of the most complex, skillful, expensive, and dirty processes in nuclear weapons production; and
- Plutonium is so hazardous that robust, hardened facilities must be constructed over a period of several years to a decade .

However, the issue of plutonium aging occupies much of the discussion in part because the labs are fascinated by the problem. A recent technology assessment at Los Alamos National Labs states:

“Understanding the effects of aging or remanufacture on a weapon’s performance is far more challenging than designing new weapons.”<sup>#</sup>

References to “pit design life” and “pit lifetimes” are common in the debate. The authors of *Remanufacture* addressed the issue of design life, stating that “there is no such thing as a ‘design life.’ The designers were not asked to or permitted to design a nuclear weapon that could go bad after 20 years.”<sup>#</sup>

Plutonium aging effects weapons reliability in at least two ways, both of which are caused by the fact that plutonium is radioactive. Inside a weapon, radiation from plutonium can damage other essential weapon parts. Plutonium emits gamma, alpha, and neutron radiation. The alpha particle from plutonium decay damages surrounding metals and the plutonium itself over the course of decades. The impact of the neutron radiation, also renowned as a damaging agent in materials, is less discussed.

A second problem is radiation damage to other weapon parts, primarily from gamma radiation created by Americium. Scientists at Lawrence Livermore have written that:

“Organic materials are a particular concern. By their very nature, they can be less stable

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than many other materials. They have weaker bonds and tend to be reactive. They also are more readily damaged by the radiation that emanates from uranium and plutonium. Nevertheless, organics are an essential part of a weapon. Some serve chemical functions such as hydrogen "getters," which absorb damaging hydrogen in a weapon's hermetically sealed environment.”#

However, organic materials and other non-nuclear parts are relatively easy to replace. A more serious concern is the damage that plutonium does to itself.# Highest on the list of concerns are the collective impacts of alpha decay, which causes plutonium atoms to shift in ways that damage the metallic structure, and helium buildup in plutonium pits. This issue is described by Lawrence Livermore Laboratory as follows:

“When an atom of plutonium-239 (the isotope of plutonium used in nuclear weapons) decays, it splits into an alpha particle###a helium nucleus with two protons and two neutrons###and an atom of uranium-235. The heavy uranium atom recoils, displacing other plutonium atoms and disrupting the surrounding micro structure. Scientists are concerned that the buildup of gaseous helium atoms combined with other elements in the weapon's environment might gradually change the properties of the plutonium metal.”#

The more visible actor in this research is Los Alamos, where one of the lab's aging studies that was publicized in July, involves “spiking” plutonium 239 with plutonium 238 to accelerate the irradiation of the weapons plutonium. A lab newsletter reported on the results that:

“Aging in stockpile weapons has been subtle so far, but to understand the aging effects after 60 years, scientists can't simply multiply the effects they've seen in 20-year-old plutonium by three, the current age of the oldest weapons in the stockpile. This is because plutonium is the most inherently unstable of all the metallic elements, and some aging effects may appear suddenly after years of stable behavior.”

“As plutonium atoms decay, they break down into uranium atoms and helium nuclei, both of which are highly energetic. The helium nuclei eventually combine with other helium nuclei to form helium gas bubbles inside the plutonium metal. The newborn uranium atoms continuously knock plutonium atoms out of place; in fact, about one of every 10 plutonium atoms in a pit are knocked out of position by uranium atoms each year. Most return to their original locale, but some are permanently displaced.” #

Assessments on aging so far have not been alarming or disturbing, although if there were alarming information it would probably be kept secret. Livermore researcher Schwartz was quoted in a lab publication as stating “So far, so good. We haven't seen any issues or surprises with the pit samples we've viewed.”

A year later the assessment was the same, as Schwartz's boss—Livermore Lab Director Bruce Tarter who, along with Sandia and LANL directors is responsible for certifying the reliability of the stockpile—told Congress that, “data from our materials, engineering, and dynamic experiments show, so far, that pits are stable.”#

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## Aging and the Uncertainty Factor

If there is no problem, why the rush? Other than immense, unyielding political pressure from old and new Cold Warriors alike, and demands from Department of Defense generals, there is no evading the fact that uncertainty plagues the weapons labs. Livermore, Los Alamos, and Sandia's lab directors are all responsible for certifying the safety and reliability of the nation's nuclear arsenal. If there are problems that cannot be resolved, then the U.S. considers itself justified to resume nuclear testing. Being wrong on this issue is obviously not on the to-do list of the directors; so given the lack of aging knowledge about plutonium, they presume a modern pit manufacturing capability beyond the pilot-scale effort at Los Alamos is needed.

What is in question, if the U.S. is to maintain nuclear weapons indefinitely, is the size, capacity, and timing of the new pit plant—in spite of the assurances today of a 2019 start date. Five months ago the lab directors and DOE officials testified to Congress on the weapons program, and indicated uncertainties regarding time line, capacity, and requirements:

“Even though we will provide a key capability in a timely fashion, the Laboratory will not have sufficient capacity to meet envisioned future pit production requirements. We support NASA's pit production strategy, which is based on an assessment of pit lifetime and numbers of weapons projected in the stockpile, to reestablish industrial-scale pit production in the longer term.”# (John Brown, Los Alamos National Laboratory)

“The required capacity of the production complex depends on the anticipated lifetime of plutonium pits in the stockpile. An accurate assessment is necessary. If we underestimate the lifetime of pits, we may overinvest in facilities to remanufacture plutonium parts. If we overestimate the lifetime of pits, the nation could find itself critically short of capacity for plutonium operations when it is vitally needed.”#

Yet, the pit plant is proceeding despite little knowledge of future requirements, and prior to the completion of the aging experiments.

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## II. The Move to Rebuild the Weapons Complex

Rocky Flats production was suspended in 1989, for what then Secretary of Energy James Watkins described as “significant operational weaknesses.”# These weaknesses actually included environmental crimes and other violations that prompted the FBI to raid the plant in 1989. Within one year of the shutdown Congress was clamoring for reopening or a replacement. In response the Department undertook the *Nuclear Weapons Complex Reconfiguration Study*, also referred to as Complex 21, which it published in January 1991.# Complex 21 was a plan to reconfigure, preferably through consolidation, various nuclear weapons production capabilities.

A Federal Register notice was published in February 1991 declaring DOE’s intent to study the options presented in the study, and DOE went through the public hearing process required under the National Environmental Policy Act (NEPA), holding 15 meetings over the course of two years.

Complex 21 study was an effort to “assure that our nuclear weapons complex can meet future national security requirements, and “to assure that a safe, reliable, and efficient complex is available over the long term to support the nuclear deterrent. capability. The Secretary’s proposal to relocate nuclear weapons missions now carried out at the Department of Energy’s Rocky Flats Plant is a key part of this proposal to reconfigure and modernize the weapons.”# The schedule for modernization was long and the costs were high, with new pit production requirements most noticeable to at least one high-level reviewer:

“[T]he plutonium fabrication facility alone will require 10 years to construct and cost an estimated \$3.6 to 4.3 billion.”# (emphasis added)

DOE still expected to resume production at Rocky Flats while new capabilities were developed elsewhere. Congress allocated \$283 million in 1991 “for essential activities and to restart production operations at the Rocky Flats Plant.”# (see below: “When Rocky Flats Closed”). After Rocky Flats production was terminated in 1992, DOE tasked Los Alamos “to capture technology to build W88 pits,” and two years later LANL was “tasked to capture technology to build W87 pits.”# Rocky Flats had been producing pits for both weapons when operations were suspended, leaving a long-term shortfall in war-reserve replacement pits.

Complex 21 was greeted with harsh criticism for high costs and long schedules; and for proposing to maintain some version of the Cold War weapons production complex, particularly new production reactor(s).# After DOE decided to forego a new production reactor, Complex 21 was canceled. The Department followed by segmenting the reconfiguration scheme into several separate studies, two that directly pertain to new pit production:

- The *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (SSM PEIS) which focused on maintaining the nuclear arsenal (*stewardship*) and a downsized nuclear weapons production complex or industrial base (*management*).
- The *Storage and Disposition of Surplus Weapons-Usable Fissile Materials EIS* (S&D PEIS); which focused on long-term management of up to 50 metric tonnes of separated plutonium deemed as excess to national security needs.

Storage and disposition was presented as a nonproliferation program, while stockpile stewardship were presented as the logical continuance of DOE's military role, but the official overlap between the two was kept at an overlap.

### **When Rocky Flats Closed**

**Question: How would DOE meet their national security responsibilities if, as some have suggested, Rocky Flats was closed in the very near future?**

Answer: Should Rocky Flats be closed prior to a new facility being available to produce plutonium components (pits) in the quantity necessary to satisfy stockpile requirements, the Department of Energy (DOE) would be limited in its ability to provide new weapon builds. [DELETED]

**Question: Does the complex have the capability to process and produce weapons specification plutonium ready for manufacture into pits at sites other than Rocky Flats?**

Answer: The Department has operated plutonium scrap and residue recovery facilities at the Savannah River Site (SRS), Hanford and the Los Alamos National Laboratory as capabilities and schedules permitted. The types of plutonium scrap material that can be processed varies from site to site. [DELETED]

Disassembled plutonium components from weapon returns are currently being processed by the F-Canyon. When the New Special Recovery facility becomes fully operational in FY 1992, the SRS will have a capability to dissolve impure metal. [DELETED]

**Question: If DOE were directed not to restart the Rocky Flats facility, how would you meet the requirements of the stockpile memorandum?**

Answer: If the Department of Energy (DOE) were directed not to restart the Rocky Flats facility, DOE would not be able to meet the requirements of the stockpile memorandum. DOE could use interim measures, such as pit reuse, to meet some aspects of the stockpile memorandum. However, its ability to support fully the stockpile memorandum, meet safety improvements in stockpiled weapons, and maintain a knowledge base and capability for future weapon production requirements would be severely undermined.

**Question: What would it cost and how long would it take to provide an interim capability to replace Rocky Flats?**

Answer: Initial studies indicate a facility which could produce plutonium components requires a minimum time period of 10 years and a minimum of \$625 million dollars depending upon infrastructure available at the site chosen for the facility.

*Q and A between Senate Committee and DOE Defense Programs, June 1991. [deleted] indicates classified information.*

In terms of pit production, the SSM PEIS involved restoring the plutonium pit production *capability* lost at Rocky Flats, but not the *capacity*. Los Alamos and Savannah River Site (SRS) were evaluated for the job of *Pit Fabrication and Intrusive Modification Reuse*, defined as "all activities necessary to fabricate new pits, to modify the external features of existing pits (intrusive modification), and to recertify or requalify pits."#

Pit fabrication involved producing about 20 pits annually and the capability—now referred to as "agility"—to fabricate one pit of every pit type in the post-2005 stockpile, which would provide the capacity to fabricate 50 pits per year if operated full time.

In 1996 DOE announced its Record of Decision, choosing LANL over SRS to re-establish the capacity to produce 50 pits-a-year for 10 or more years. The estimated costs were \$310 million (in 1995 dollars) for construction and \$30 million a year for operations. This program would produce 20 pits a year to replace those destroyed during surveillance activities, and another 30 pits a year as replacements for the W88—which had a shortage of pits due to the unplanned shutdown of Rocky Flats.

### **Planning Behind Closed Doors**

Simultaneous with SSM PEIS, DOE secretly tasked nuclear weapons labs and production sites with conducting a systems study on options for “the rapid reconstitution of moderate to high capacity plutonium pit production in the U.S.”# with high capacity defined as 125-500 new pits per year. The directive was to “identify a plan for reconstitution of a higher production capacity within five years of an identified need.”#

#### **Proliferation-Nonproliferation Synergy-I**

One of the study team members—and lead author of the final report--was Dr. Leslie Jardine of Livermore, whose title was *Principal Deputy of the Fissile Materials Disposition Program*.

In his disposition program role, Jardine played a dynamic and often creative role in U.S. - Russian cooperative plutonium and spent fuel programs, including justifying the construction of a plutonium immobilization plant in Russia to handle waste from “future operations associated with maintenance of the Russian strategic weapons” at Mayak and Tomsk (Jardine, et al. 1999. *Status of Immobilization of Excess Weapon Plutonium in Russia*. UCRL-JC-133125.

Jardine was also a co-organizer and facilitator for several NATO nuclear safety workshops with strong U.S. and Russian participation, including one in Amarillo, Texas near the Pantex plant just two months after the January 1997 pit production meeting at Pantex.

Among the recommendations in the final rapid reconstitution report was:

“Develop a public relations education effort that gets people in the communities near Y-12 and SRS familiar with issues regarding both plutonium and manufacturing. An existing campaign at Pantex has been quite effective.”

However, the Pantex PR campaign involved the plutonium disposition nonproliferation program, not new weapons production. The perpetrator of that effort, the DOE-funded Amarillo National Resource Center for Plutonium (<http://www.pu.org>), lost most of its funding by 2001, but was recently resurrected as the University Research Alliance. (<http://www.ura.org>)

The four-person study team involved Lawrence Livermore (LLNL), Los Alamos (LANL), and Sandia (SNL) National Laboratories. A planning team was formed that consisted of the study team and representatives from DOE’s Albuquerque Operations Office, the Pantex plant, and the Savannah River Site. It first met in February 1996, and one month later Oak Ridge’s Y-12 plant was added to the team.

At a May 1996 workshop also attended by Department of Defense (DoD) and the Defense Nuclear Facilities Safety Board (DNFSB) representatives, a pit production strategy emerged:

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- Demonstrate the capability to make “certifiable” pits at Los Alamos;
  - Pursue making 20-50 pits/year at Los Alamos;
  - Prepare detailed plans for large-scale pit production capacity “should the need arise;” and
  - Perform science-based stockpile stewardship to “fully characterize the remaining stockpile and provide ample warning time should issues such as aging become important.”

The study remained secret and was never addressed in the SSM PEIS. One month after the SSM PEIS Record of Decision, the three pit production candidate sites received their questionnaires for assessing their own capabilities and infrastructure, and a January 1997 meeting at Pantex to review the results moved the process closer to the recommendation level.

January 1997 also marked the *Record of Decision* for the S & D PEIS, in which DOE decided to:

- Consolidate long-term (up to 50 years) plutonium pit storage in upgraded facilities at the Pantex plant;
- Consolidate long-term storage of separated non-pit storage at a new plutonium storage facility at the Savannah River Site, pending its selection for plutonium immobilization;
- Pursue a “dual-track” strategy to dispose of surplus plutonium by (a.) converting up to two-thirds (33 MT) of the surplus military plutonium into a form useable in plutonium [Mixed Oxide (MOX)] nuclear reactor fuel, irradiate the fuel in commercial nuclear power reactors, and bury the irradiated fuel in a geologic repository; or (b.) converting at least 8 MT and up to 50 MT of the surplus plutonium into an immobilized form, surround it with highly radioactive waste, and bury it in a geologic repository.

In May 1997 DOE announced its *Notice of Intent* to perform the *Surplus Plutonium Disposition Environmental Impact Statement* (SPDEIS), designed to choose plutonium processing facilities for plutonium disposition and to determine whether to pursue the dual-track or to pursue immobilization-only.

In the same month a coalition of groups filed suit against the Department of Energy for the SSM PEIS ROD, which came to be known as the Stockpile Stewardship Suit. The settlement terms for the suit included conducting a supplemental EIS if and when DOE decided to pursue large-scale plutonium pit production.

Three months later Lawrence Livermore published the report, but restricted access, stating: “this is an informal report intended primarily for internal or limited external distribution,” and classified it as UCNI: *Unclassified Controlled Nuclear Information*. The public was left out of the loop until Livermore watchdog group Tri-Valley CARES successfully sued DOE under the Freedom of Information Act, more than a year later.

## **Proliferation-Nonproliferation Synergy-II**

Whether immobilization or plutonium/MOX fuel was pursued, one absolutely necessary facility for plutonium disposition was the Plutonium pit Disassembly and Conversion Facility (PDCF), where pits would be disassembled, separating the plutonium from the other pit materials, and converting the metallic plutonium to plutonium metal or an oxide powder for subsequent storage or use. This is also the very first facility necessary for large-scale plutonium pit production capability. (See Part III)

The PDCF involves a group of new technologies collectively called ARIES (Advanced Recovery and Integrated Extraction System), which was originally conceived in 1992 at Los Alamos as a clean technology to replace some Rocky Flats pit recycle operations, but DOE Defense Programs stopped supporting the concept by late 1993.

When the plutonium disposition program began to emerge, Los Alamos, with the assistance of Livermore, successfully pursued inclusion as the primary pit disassembly and conversion technology for the disposition program.

(LANL. 1998. *Preconceptual Documentation for the ARIES Facility*. LALP-97-63. Revision 2. September 3, 1998. Obtained by BREDL through the Freedom of Information Act.)

The Livermore report, which contains only a classification redactions, showed that Savannah River Site was the sole party interested in all operations, and therefore the only technically feasible site for the entire job. While it was recommended for the entire operation *if* a single-site alternative was preferred, the single-site option carried a notice of caution:

“It should be noted that the single site alternative is far from ideal. It involves introducing a very difficult skill set into a facility on a short time scale. The operations involved have proven quite difficult to perform, and a rapid scale up to the required production quantities may prove to be impossible within the proposed time line.”

The study team clearly favored a multi-site alternative, one that divided the job between SRS and Y-12, and catered to site strengths—plutonium processing at SRS, and machining, fabrication, and assembly of nuclear weapon components at Y-12 Oak Ridge. On the basis of fifty years of experience machining highly enriched uranium and beryllium parts and fabricating and assembling secondary nuclear explosives called Canned Subassemblies (CSAs), Y-12 was considered the technically superior alternative to Pantex and SRS in terms of machining, fabrication, and weapon component assembly.

While Pantex was recognized for its manufacturing of the high explosive hemi-shells—that surround the pit in nuclear weapons—as well as intact plutonium pit handling, it’s lack of experience with loose plutonium metals and oxides left it out of the equation. A month after the recommendation, DOE’s Office of Fissile Materials Disposition secretly selected aqueous plutonium processing for converting plutonium oxide into use for Mixed Oxide (MOX) fuel.# (see Synergy-III sidebar).



### **Proliferation-Nonproliferation Synergy-III**

During the SPDEIS process, DOE presented the ARIES option as the only reasonable alternative for pit disassembly and conversion for use in MOX fuel. The Department stated that traditional liquid-acid based plutonium processing was not a reasonable alternative due to the large waste streams it produced.

In 1998 aqueous plutonium processing, or “polishing,” was presented as a contingency in the Draft and Supplemental SPDEIS, but was still not considered a reasonable choice. Not until the final EIS was issued in November 1999 did DOE announce that liquid acid plutonium process was preferred. In reality, the decision was made in 1997:

“A decision was made in 1997 that the plutonium oxide [resulting from pit disassembly and conversion] would be polished to remove impurities and to control the powder characteristics. Thus, gallium concentrations will be below ~1ppm.” (Norris, R.N. *A Brief Summary of the FMDP Gallium/Cladding Investigation*. Presented at MOX Fuel Meeting with the Nuclear Regulatory Commission. Oak Ridge, TN. December 2000.

Plutonium “polishing” at a MOX fuel plant would provide DOE with plutonium purification capabilities that are also necessary for pit production. (See Part III).

### **Proliferation-Nonproliferation Synergy-IV**

In June 1999 the National Nuclear Security Agency (NNSA) was formed to oversee DOE’s weapons, nuclear security, and nonproliferation programs, merging Defense Programs (weapons), the Office of Nuclear Nonproliferation, and the Office of Fissile Materials Disposition under one administrative entity.

## **Lessons from Los Alamos**

When considering large-scale pit production of more than 100 pits per year, the lessons from Los Alamos’ ten-year, billion dollar effort to establish a 20 pit per year capacity are instructive. In the early stages, LANL and DOE pursued a three-step approach:

“The first step is developing the capability through the pit rebuild program. This will allow LANL to capture the capability to fabricate pits in the enduring stockpile. The second step is developing an enduring capability. This will implement and enduring manufacturing capability of approximately 20 pits per year and will be limited to 1 pit type per year. The third and final step is limited manufacturing of 50 pits per year with a sprint capacity of 80 pits per year as described in the SSM-PEIS. The limited manufacturing mission will allow for the production of 2 different pit types per year.”#

Modern production activities are also mandated to be cleaner, safer, and more efficient to avoid a repeat of another Rocky Flats, to maintain comfortable relations with State governments and regulators, and even because it is the right thing to do. The Stockpile PEIS required “all wastes and residues will be recovered and put into an acceptable form,” something rarely

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performed at Rocky Flats.# Los Alamos calls its efforts to develop cleaner technologies “environmentally conscious plutonium processing,”# although the track record for the new technologies has had mixed results (see Part III).

Los Alamos developed its first developmental unit pit in February 1998, and “while not meeting the full certification requirements to enter the stockpile this pit did successfully demonstrate the first series of capabilities needed to produce a fully certified pit.”#

The Stockpile Stewardship and Management program enjoyed strong support during the Clinton administration, but also harsh criticism . Several groups, such as the Defense Science Board and the Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile led by former Livermore director John Foster, issued reports urging immediate planning for restoring large-scale pit production capacity.

Support for the weapons kept increasing. In President Bush’s February 2001 “Blueprint for America,” he committed to strengthen stockpile stewardship by stating:

“The Stockpile Stewardship Program maintains our nuclear arsenal. The program is an essential safeguard to our national security and is in significant need of reform and repair. The budget increases funding for activities in this area by five percent to approximately \$5.3 billion.#

In the FY2003 budget, overall funding for the NNSA increased 90 million dollars to 6.7 billion per year, although 110 million less than DOE’s budget request. Throughout this time pit manufacturing and certification earned a large slice of the pie. Between 1999 and the end of FY 2003, DOE will have spent more than a billion dollars on plutonium pit manufacturing and related programs, *and the pilot program still has four years of development remaining.*

Pit manufacturing and certification funding involves one directly funded program, or campaign, and several other campaign areas with closely related activities: 1) *Pit Manufacturing and Certification Campaign*, 2) *Advanced Design and Process Technology (ADAPT)*, 3) *Enhanced Surveillance Campaign*, 4) projects involving processing of plutonium and other special nuclear materials, and 5) *Plutonium Disposition Program*.

### The Pit Manufacturing and Certification Campaign

The pit manufacturing and certification campaign now costs nearly \$200 million per year and includes activities related to:

- *W88 manufacture*, which involves manufacturing W88 “development pits” until all processes are certified, followed by manufacturing of “qualification” pits for certification.
- *W88 certification*, which involves certifying pits for the stockpile without actual weapon testing;
- *Pit Manufacturing Capability* development for W87 and B61-7 war reserve pits;
- Planning for the “*Modern Pit Facility*” for large-scale replacement pits to meet long-term nuclear policy goals;
- The *Pit Initiative* at Livermore for the W87 pit (1999-2001)

While funding has risen and cost-overruns have disturbed Congress, the project objectives have been reduced. The objective in fiscal year 2000 (FY2000) was to “establish a

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long-term capacity for manufacturing up to 50 pits/year with a single shift of personnel. In the nearer term, we will achieve an annual capacity of 20 pits by 2007.”

Large scale production planning reportedly remained in the contingency phase until sufficient information from the Pit Rebuild Program and subsequent manufacturing of war reserve pits clarifies the processes and specific equipment for manufacturing.#

In FY2001 Los Alamos “manufactured development pits to support the manufacture of a certifiable W88 pit,# and the slow pace of the program helped provoke DOE to request an additional four million dollars from Congress for conceptual design work on the new pit facility.#

In Fiscal year 2002 the goal was to “Complete implementation of manufacturing and quality infrastructure required to fabricate a certifiable pit in FY 2003.” The House Armed Services Committee recommended a 20 million dollar budget increase for pit manufacturing and certification, raising it to 128.5 million dollars a year. The allocation came with harsh words though:

“The Department is currently unable to demonstrate that it has a viable plan to manufacture and certify pits on the schedule dictated by national security needs. The Department’s management and the national laboratory’s execution of this project have been quite deficient—the project is years behind schedule and hundreds of millions of dollars over the original cost estimate.” #

According to DOE’s FY2003 budget request####\$194.5 million####the goal for is to manufacture the first certifiable W88 pit.# The House Armed Services committee approved the request but wrote :

“The goal of the manufacturing campaign is to produce a certifiable W88 pit in fiscal year 2003, and establish a limited production capability of 10 pits per year at Los Alamos National Laboratory by 2007. The National Nuclear Security Administration intends to be able to certify a W88 pit without underground testing by fiscal year 2009, with a goal of sooner achieving this capability in 2007.”.#

In a matter of two or three years, the pit production goal decreased from 20 pits per year in 2007 to 10 pits per year in 2007, while the funding was doubling. The bill for pit production and certification is already rapidly approaching \$1 billion since 1998 when the first new pit was made. Yet, the NNSA puts a price tag on a massive new pit production capability at only 2-4 billion dollars. This price tag to date does not include pre-1998 work nor the hundreds of millions of dollars spent in closely related, if not directly related work in other Stockpile Stewardship programs, as discussed below.

#### Advanced Design and Process Technology (ADAPT)

The ADAPT campaign is designed to produce the capabilities to deliver qualified refurbishment products upon demand, and includes projects directly related to new pit production and/or pit certification:

- Agile manufacturing program
- Plutonium metal mold development

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The costs for these projects are difficult to distinguish from the overall program items, but likely involve tens of millions of dollars.

### Enhanced Surveillance Campaign

The Enhanced Surveillance Campaign is intended to provide the scientific and technical basis for determining when weapons components must be replaced, and include projects such as the plutonium aging study, designed to “perform pit aging experiments and modeling to determine whether pit lifetimes equal or exceed 60 years, which would enable substantial deferral or downsizing of a potential new pit manufacturing facility, and develop and implement new, nondestructive examination tools for early detection of potential flaws.”

The five year price tag for this project is an estimated \$128 million. [see Part I for summary of progress]. Preliminary results are due in 2003.

### Projects which involve processing of plutonium and other special nuclear materials

Several projects involve processing of plutonium and other special nuclear materials:

- *Special Nuclear Materials* activities that “support the development of advanced and automated processing, casting, dynamic testing and machining technologies for beryllium, plutonium, and uranium,” activities that correspond to plutonium pit fabrication. The cost for this program between 1998 and 2000 was reported at \$75 million.
- *The Materials Recycle and Recovery* portion of the *Readiness in Technical Base* campaign involves activities to “develop and implement new processes or improvements to existing processes for fabrication and recovery operations for plutonium and uranium, and for material stabilization, conversion, and storage; and recycle and recovery of material from fabrication and assembly operations, limited life components, and dismantlement/disposal of weapons and components# The cost for this project from 1998 to 2000 was reported at nearly \$300 million, and is another indication of the constant integration of proliferation and nonproliferation.
- The *Materials Readiness Campaign* designed to “provide the critical nuclear and special non-nuclear materials needed for both production and R&D in the nuclear weapons complex.”The 1999-2001 costs totaled \$117 million.
- Nevada Test Site nuclear testing readiness campaign, which supports “critical work necessary for pit certification.”#

### Plutonium Disposition Program

The plutonium disposition program is funding the probable front-end facilities for pit production, under the auspices of nuclear nonproliferation, constituting major hidden costs:

- DOE has spent an estimated \$250 million on research and development costs for the Plutonium pit Disassembly and Conversion Facility (PDCF), at SRS for which design is 90% complete. The total costs through construction is estimated by DOE to be \$700 million.
- DOE has spent \$325 million on research and development of the MOX fuel plant at SRS and an estimated \$100-150 million on design and licensing costs to date. The total cost through construction is estimated by DOE at \$1 billion dollars. #

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## Plutonium Pit Re-use

While DOE was spending hundreds of millions of dollars on pit production and support for future production, the pit reuse and requalification program for existing pits languished—even though it was a “must re-establish” technology on par with pit manufacturing, “vital in supplementing surveillance data and as input to the Stockpile Stewardship weapon modeling activities.”#

A pit re-use project occurred at Pantex in the early 1990's when Rocky Flats was shut down. This project allowed DOE to proceed to complete the W-89 weapon program by re-using W68 pits and converting them to fire-resistant pits by cladding them with vanadium. Heralded then as an innovative approach that avoided messy pit fabrication, the latest plan for pit re-use went unfunded in fiscal year 2000.#

The pit reuse project was renamed the *Special Nuclear Material Component Requalification Facility*. It's primary purpose is to “provide the Pantex Plant with Pit Recertification/Requalification capabilities as required for the W76 program and W80 future work,” but it is also intended to provide similar capabilities for Canned Subassemblies and other weapon components. Not until the FY2003 bill did the Pantex reuse project get funded for the first \$3 million of an estimated \$11 million dollar construction project.#

The funding and project startup are timely for Pantex pit production supporters, since the project will provide the plant with its first real plutonium pit mission that involves more than handling intact pits. Pit re-use at Pantex was always described as non-intrusive during the Environmental Impact Statement process. After Pantex was selected for the pit re-use mission, the mission was renamed “pit requalification” and changed from non-intrusive to intrusive because it included pit tube replacement and refurbishment:

“SNM Requalification at PANTEX for FY 98 has been as continuation of the original effort and has included an increase in scope to address pre-screening, tube replacement and reacceptance...tube replacement is a capability that was utilized at Rocky Flats. A similar capability is being supported as a part of the Pit Rebuild program at LANL”#

One of the sticking points regarding pit re-use involves pit tubes. Plutonium pit tubes are designed to carry the booster tritium gas from the tritium reservoir to the hollow core of the pit at the time of detonation.

Pit tube replacement was being advocated by Los Alamos prior to the funding cutoff for this program. Because pit tubes are bent to very specific configurations and there is no record of the number of times they have been bent, Los Alamos wanted to replace all pit tubes. However, a LLNL report discussing the stainless steel used in W87 pits reported that the tube would need to be bent at least ten times to pose a great risk of failing (Figure 2-1).#

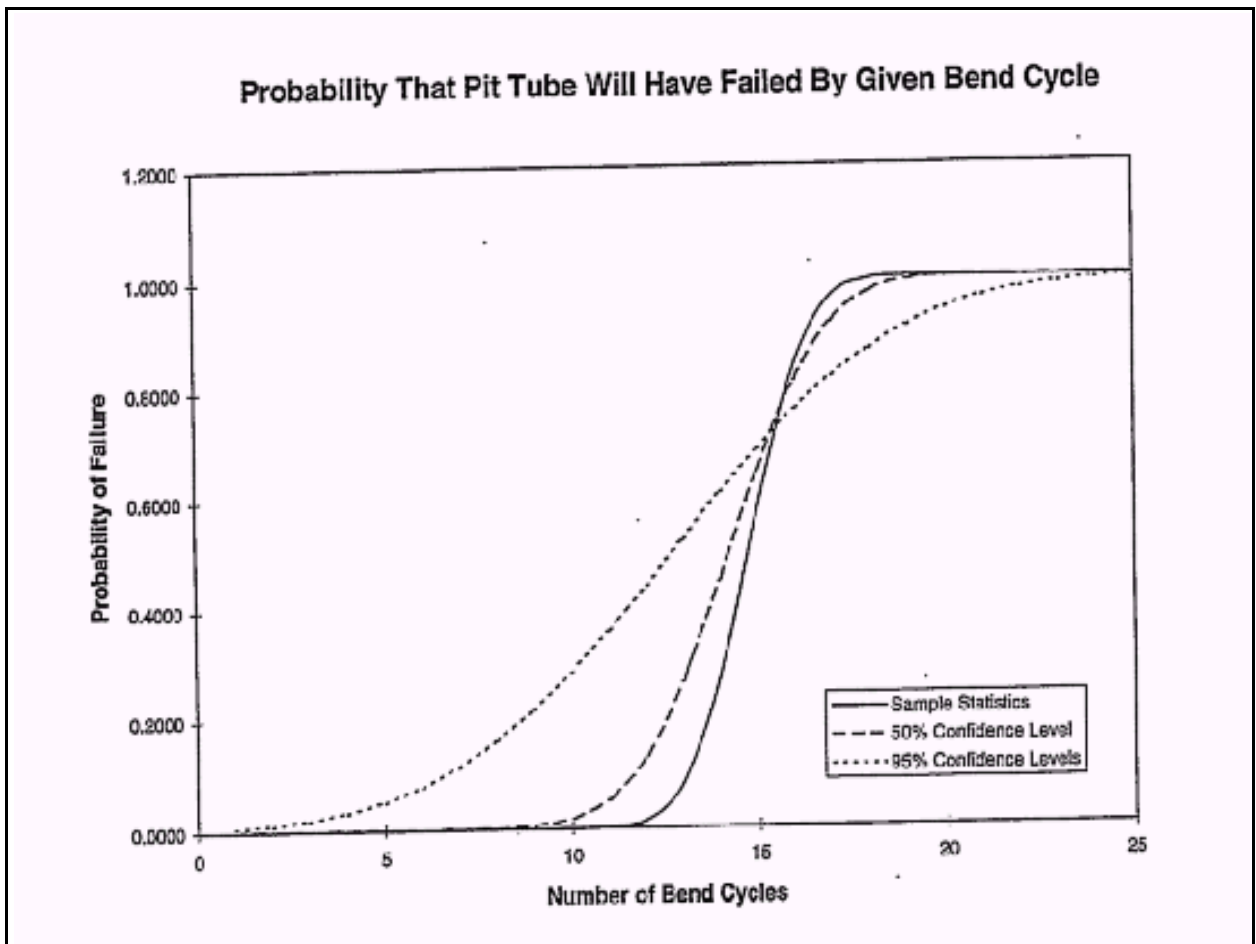


Figure 2-1

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## III. Producing New Plutonium Pits

A few years ago a powerful computer software company produced a television advertisement displaying three employees in a laid-back work atmosphere casually developing a software product. One employee discussed the company's product development process and philosophy. The ad ended with the punchline, "when the customer receives the product, it has to work." The ad did not last long, since most people expect expensive new products to do more than simply work, they should also, at a minimum, be reliable and safe.

As discussed in Part I, massive destruction and mass casualties can accompany a U.S. plutonium pit that merely works but is considered unreliable. Producing safe, reliable plutonium pits for nuclear weapons is the most complex, hazardous, dirty, rigorous, and difficult nuclear weapons production capability. It involves numerous disciplines applying basic industrial processes to very dangerous materials.

As long as nuclear testing is banned, insuring the reliability of the weapons requires "close collaboration between physicists, metallurgists, and chemists" in order to understand "mysteries of plutonium metallurgy."# The Chiles Commission considered "the machinist of materials unique to nuclear weapons" on a par with weapons designers among the jobs requiring "years of training to master requisite skills and develop technical judgement."#

Knowledge about pit production is necessarily limited by classification concerns, and since "specifics about the processes for pit manufacturing are considered classified,#" this section relies on estimates based on the best available unclassified and publicly available information.

### Modern Plutonium Pit Production

A modern plutonium pit production complex that avoids the disasters at Rocky Flats would include:

- Plutonium pit metal supply, focusing on plutonium pit recycling–disassembly, purification, and reduction to metal;
- Plutonium pit fabrication: foundry, machining, and assembling

New pit production involves dozens of operational capabilities. Restoring the large-scale manufacturing capabilities lost by when Rocky Flats production ceased involves twenty-eight distinct operations.# Capabilities that are essential include manufacture of highly enriched uranium (HEU) parts. This capability is already well established at Y-12 Oak Ridge, and was a key reason for that site being considered "technically superior" in the 1997 pit production study. Y-12 and Los Alamos also have beryllium and depleted uranium manufacturing capabilities.

### Existing Plutonium Supply

All plutonium is produced in nuclear reactors and then extracted plutonium (and uranium) from nuclear fuel using radiochemical separations, or reprocessing–the most common method being the PUREX process. Reprocessing operations accounted for 85% of the radioactivity in all nuclear weapons waste#, and the Department remains in the early stages of stabilizing the intensely radioactive liquid waste into a solid form. . During the Cold War the United States produced or acquired an estimated 111.4 metric tonnes (MT) of plutonium.# The

exact percentage of military-grade plutonium, more commonly referred to by the misnomer of weapon-grade, was not reported by DOE in its landmark report *Plutonium, the Last Fifty Years*. Today there is an estimated 85.1 MT of military-grade plutonium remaining in the nuclear weapons program, divided as:

- About 38.2 MT is currently declared as “excess to national security needs,” or *surplus*, and composed of plutonium in pits, irradiated fuel, metals, oxides, and residues.
- Roughly 46.9 MT is currently declared “programmatically use,” or *non-surplus*, and is primarily composed of plutonium in pits, both “war-reserve” and “not-war-reserve like.” As stated in Part I, an estimated 4,000 pits constitute the strategic reserve not presently in weapons, although it is unclear whether these pits are allocated to pit reuse or can be used in pit production.

With this much available plutonium, there is no need to produce any more military plutonium for weapons use because plutonium can be recycled. But whether the plutonium supply derives from reactor operations or recycling, the material must be within stringent purity limits prior to fabrication.

## **Plutonium Pit Recycling and Re-processing**

The objective of plutonium recycling is to provide pure plutonium metal meeting stringent specifications to the fabrication process. Recycling involved either recovering and purifying plutonium from scrap and waste or from plutonium pits. In either case, the plutonium has aged and contains Americium 241 ingrowth as well as various impurities that must be removed.

Plutonium pit recycling at Rocky Flats involved the following steps and processes:

- Pit disassembly with lathes or other machine shop technology
- Aqueous processing in which nitric acid, other solvents, and water are used to dissolve the metal, followed by either solvent extraction or ion exchange to separate the plutonium. This was probably necessary only for bonded pit types (as well as metal and oxide scrap material), which might account for references to although references to dissolution of pits;#
- Molten Salt Extraction (MSE) to remove the Americium-241 ingrowth, described by the GAO in 1992 as “mixing the metal with a combination of salts, such as sodium chloride, potassium chloride, magnesium chloride, or calcium chloride. This mixture is put into a crucible and heated in a furnace until the mixture of salts and metals becomes molten. While the molten mixture is being stirred, the americium reacts to the salts to form americium chloride. Then the plutonium metal, with the americium removed, settles to the bottom of the crucible. After cooling and removal from the surface, the crucible is broken to remove the contents. The plutonium metal is then separated from the hardened salts, which now contain the americium chloride and some residual plutonium. The leftover salts and the used crucible are saved and stored so that the plutonium can be recovered” from the plutonium chloride mix.
- Electro refining was also used to purify plutonium metal, although generally applied to scrap material and not relatively clean pit material. Electro refining uses a controlled electrical current in a salt mixture similar to Molten Salt Extraction, and involves similar equipment, and future plutonium chloride recovery .
- Direct oxide reduction can be used to convert pure plutonium oxide powder to a metal.



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In the case of impure non-pit metal, oxides, and residues, the process became increasingly more expensive, wasteful, and complicated until materials were classified as waste—determined by whether the cost of recovery was less than new production.

### Environmental Impacts of Recycling<sup>#</sup>

Plutonium recycle involved tremendously wasteful and dirty processes. Between pit recycling and plutonium metal, oxide, and scrap recycling; Rocky Flats produced hundreds of tons of transuranic waste. Hundreds of tons of the early waste, much of it from fires, was sent for burial at the Idaho National Engineering Laboratory near Idaho Falls, Idaho, where it threatens the Snake River Aquifer. Beginning in the mid-70's the Idaho bound waste was stored, and DOE intends to ship it to the Waste Isolation Pilot Plant (WIPP) for permanent burial while leaving most of the buried waste in place.

In 1994, DOE estimated there was 3.1 metric tonnes of plutonium in approximately 106 MT of total TRU waste materials remaining at Rocky Flats. In at least one report, DOE has suggested recovering and purifying the plutonium in this waste to increase the amount of weapon-grade plutonium, and thus gain bargaining power with Russia on plutonium disposition matters.<sup>#</sup>

Plutonium pit recycling at a modern pit production facility requires the same end product, which is pure plutonium metal, but will follow different processes. Los Alamos has spent a decade and hundreds of millions of dollars to develop more environmentally-friendly processes. However, it remains to be seen what new processes will be installed.

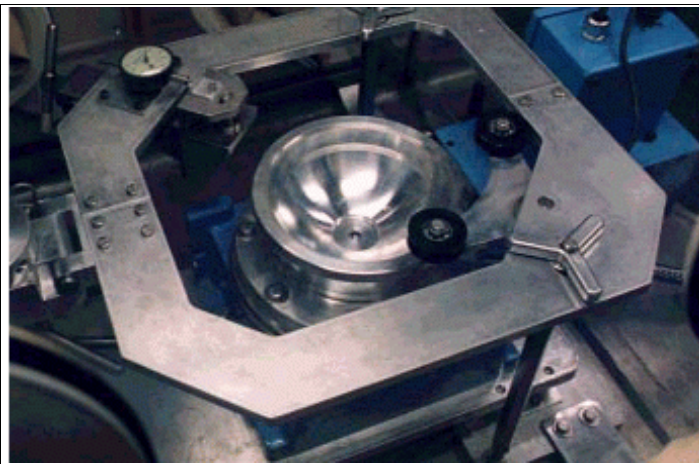


Figure 3-1

### Planned Capabilities

The 1997 *Rapid Reconstitution of Pit Production Capacity* report cited eight units for disassembly and five units for metal preparation. Disassembly involves:

1. Receiving;
2. Mechanical disassembly; (see Figure 3-1)
3. Surveillance activities and disassembly;
4. Hydride/dehydride, for converting plutonium metal to metal while separating other materials;
5. Special Recovery Line, for handling pits that contain tritium either by design or through contamination, although details about this operation are scant due to classification concerns;
6. Size Reduction (of HEU components);

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7. Non-nuclear component (such as beryllium) decontamination;
  8. Non-nuclear component size reduction;

The Plutonium pit Disassembly and Conversion Facility (PDCF) being designed for SRS will have all these capabilities. Making new pits for the existing or new design nuclear weapons involves disassembling the pits, separating the plutonium from the other pit materials, and converting the metallic plutonium to a plutonium oxide powder.

One complication is dismantling bonded pits, those pits that are “bonded to stainless steel, beryllium, or uranium,”# With un-bonded pits, the plutonium hemi-shells can be mechanically removed from the from the other parts. Bonded pits require chemical separation, either pyrochemically in the developing hydride-dehydride furnace or through aqueous processing.

Metal preparation is the traditional job at SRS and neither Pantex nor Y-12 was interested in this task in 1997, as it involves high-waste producing processes:

1. Molten Salt Extraction, expected to be an improved version;
2. Ingot casting
3. Electro refining
4. Plutonium chloride prep
5. Direct Oxidation Reduction

If the PDCF converts plutonium metal to an oxide, then molten salt extraction and Electro refining will be unnecessary. Capabilities being planned for SRS at the Mixed Oxide Fuel Fabrication Facility (MOX) include an aqueous plutonium oxide purification unit, including Americium-241 extraction. Late design work is ongoing and DOE hopes to have the plant operating in 2007 or 2008. The facility will also provide up to 400,000 square feet of hardened nuclear space, more than the original F-Canyon. It is possible that following construction of this facility, it will be allocated to weapons work instead of plutonium disposition.

## Plutonium Pit Fabrication

In the wake of the Rocky Flats closure, one government observer wrote this about pit production:

“The fabrication and assembly of nuclear weapons components is primarily a metals fabrication process... These include metal casting, rolling and forming operations, high precision machining of various shapes and assembly operations including a variety of welding techniques... Plutonium fabrication and processing activities are conducted in closed controlled environmental systems referred to as glove boxes....components and completed assembly must meet extremely tight tolerances on dimension as well as physical and chemical properties.” #

The first step in the fabrication process is **the foundry**, which involves melting, casting, and heat treating of plutonium metal to be machined and requires. The goal is to add gallium to plutonium and cast as plutonium-gallium metal ingots, and then cast the plutonium components in near-finished shape. The ten units involved are size reduction, blend metal charges, feed cast,

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final blend, shape casting, break out, oxide roast, heat treat, and density check.

Foundry capabilities are present at Y-12 Oak Ridge and to a lesser extent at Los Alamos. No other facilities under consideration for the project have this capability or the experience. Both SRS and Y-12 were interested in 1997, but Pantex expressed no interest.

**The second step in fabrication is machining**, which in simple terms means “removing extra metal from the cast part to the final dimensions”# but which requires a high level of precision. At Rocky Flats machining involved polishing the final product with oil and carbon tetrachloride###materials that LANL is attempting to replace###and plating with nickel carbonyl. The processes identified in the 1997 study were receive and inspect casting, casting preparation, machine OD; machine ID; inspection, mill tube hole turnings consolidation, density measurement, weighing, radiography, final inspection, and cleaning.

SRS, Y-12, and Pantex were interested in pit machining in 1987. Although none of the sites possess experience with plutonium pit machining, Y-12's extensive HEU and beryllium machining for finished weapon components made it the technically superior choice for this and foundry work.

**The third and fourth steps in fabrication is assembly and post-assembly**, where the plutonium hemi-shells formed during foundry and machining are assembled with HEU parts (if part of design) inside non-nuclear components, “followed by hermetically sealing the pit with a weld and post-assembly processing of the pits to the stockpile configuration.”#

Assembly of bonded pits is an elaborate process involving eleven subassembly unit steps and 20 assembly unit steps. In contrast, unbonded pit assembly requires four unit steps: “install chuck weld, downdraft and assembly, waist weld, and Mark.”

These are the processes that must be reestablished if pit production is to occur:

“Disassembly, metal preparation, and foundry, which primarily involve plutonium processing, can be conducted at a different site than machining, assembly, and post assembly work. However, the latter three must be completed sequentially at the same site...to ensure product quality.”#

Therefore, the Modern Pit Facility can be multi-site. SRS is likely to obtain the front-end due to planned capabilities and experience, but it remains to be seen which site will be chosen for the fabrication work.

## IV The National Security Factor

The U.S. nuclear weapons arsenal is considered a vital aspect of national security, and according to Stephen Younger, now head of the Defense Threat Reduction Agency, “Now is the time to reexamine the role and composition of our future nuclear forces.”# Whether Mr. Younger included the everyday public into this desire, the need for new plutonium pit production does offer the public a very good opportunity to do that.

As nuclear weapons advocates justify new pit production on urgent national security needs, it is important to remember that the very concept of national security is not scientifically derived. The concept is burdened with moral judgments and is not limited to national borders. U.S. national security policy, or “posture,” extends well beyond homeland defense and involves projections of military power, and what is referred to as “full spectrum dominance.” (Figure 4-1)

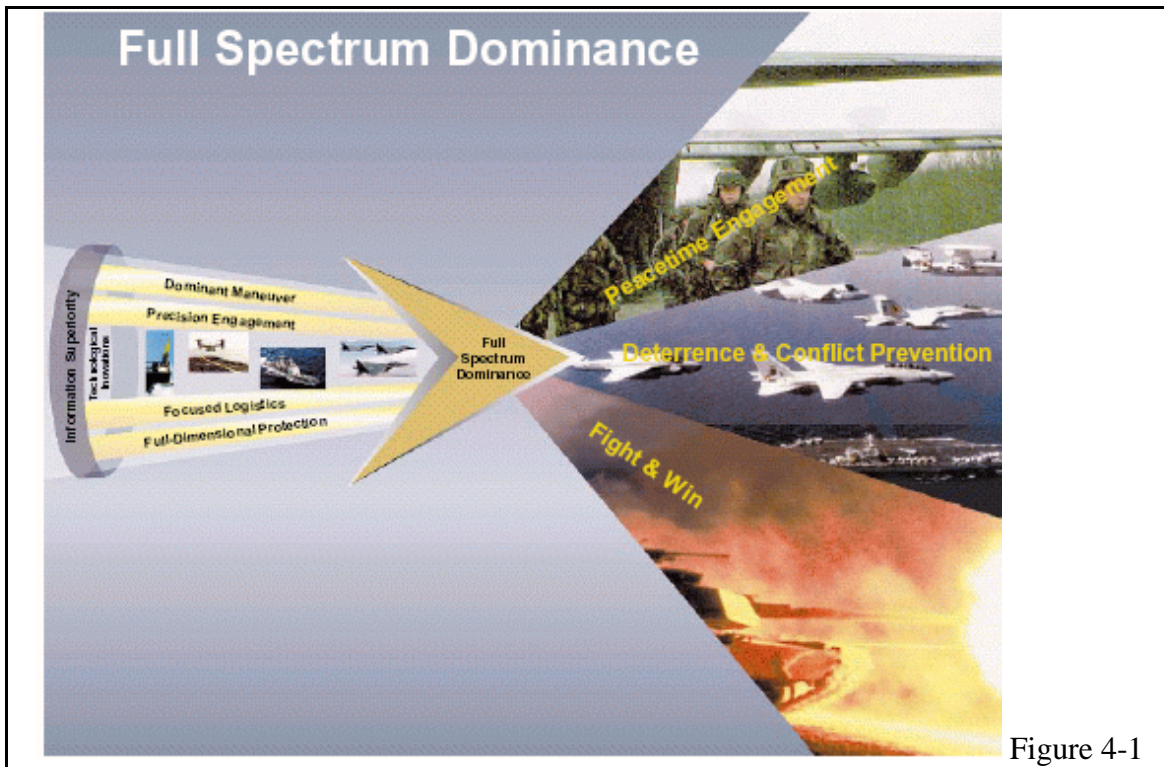


Figure 4-1

A lack of existing pit production does not negate the fact that the United States possesses massive military and economic strength and is considered the only superpower on Earth. The vast superiority of the US military in comparison to any other military force allows military analysts to focus on psychological aspects of war and conflict as much as on tactical aspects, a trend reflected by statements that “the firepower of nuclear weapons translates into adversary appreciation of its vulnerability.”#

An example of psychological warfare can be found in the June 2000 conference entitled *Out of the Box and Into the Future*, at which military strategists, scientists, congressman, and think tank representatives discussed “projecting the effects of science and technology on far

future military operations.” The goal of the two-day meeting was articulated by Admiral Harold Gehman of the U.S. Joint Forces Command (JFC) during a presentation of “near, mid, and far-term technologies and needed capabilities:”

“Draw the warfighters and the scientists, and all those who support the two groups, into a dialogue that illuminates our challenges and hastens the solutions...with a final goal to transform the U.S. military.”#

The challenges at hand were not a weakened military but preservation of dominance and superiority of what was described as, “most formidable military the world has ever known, precisely because of our technological advantage.” Among the far-term military requirements was an item called *Weapons of Mass Effects*.

### **Thinking The Unthinkable**

“We develop new weapons when they’re required to go and destroy other people’s weapons of mass destruction.” Stephen Younger, Director of the Defense Threat Reduction Agency, on his agency’s role. *National Radio* interview, March 2002.

“Counter Weapons of Mass Destruction (CWMD) provides the CINCs with counterforce capabilities to hold NBC targets at risk while minimizing collateral effects...for the foreseeable future, it will not be possible to physically defeat all NBC targets, particularly buried or otherwise hardened facilities, using standoff conventional weapons... Improved penetrating munitions are needed for counterforce missions” *Counterproliferation of Weapons of Mass Destruction (WMD) Joint Warfighting Science and Technology Plan Chapter 12.*

“Nuclear weapons might be more effective for convincing the adversary that its key assets are vulnerable than relying on conventional weapons. For example, the US military could more convincingly threaten hard and deeply buried targets (e.g., bunkers) or widely dispersed targets (e.g., mobile missiles). This approach recommends a wider variety of US nuclear weapons than in the Nuclear Retaliation approach. Although existing nuclear platforms could provide much of this capability sub-optimally, proponents of this approach suggest procurement of lower-yield or so-called mini-nukes. Such weapons precisely delivered could be more ‘usable’ than current, higher-yield nuclear weapons, since they would limit fallout and civilian casualties.” *U.S. Coercion in a World of Proliferating and Varied WMD Capabilities: Final Report for the Project on Deterrence and Cooperation in a Multi-tiered Nuclear World a Study for The Defense Threat Reduction Agency, Advanced Systems and Concepts Office, FEBRUARY 2001. DFI INTERNATIONAL/ SPARTA, Inc*

## **Deterrence, Nonproliferation, and Counter-proliferation**

Deterrence is generally defined to mean the reliance on the nuclear stockpile to deter others from using their nuclear weapons against us.# *Atomic Audit* co-Author and editor Stephen Schwartz wrote that there is evidence that “even the possession” of nuclear weapons coupled with “actual or presumed” nuclear weapon expertise can serve as a deterrent against aggression involving conventional military forces. On the flip side, there is “no evidence that a huge nuclear arsenal is more effective than a small one in deterring a conventional attack,” and nations with smaller nuclear arsenals can deter nuclear attacks by nations with larger arsenals.#

The concept of deterrence is intentionally vague and elusive, indicated by the policy of “calculated ambiguity,” which superficially sounds more like a poker-face than a national security strategy. In the coldest days of the Cold War, analysts calculated various nuclear war scenarios involving annihilation of entire cities and landscapes and massive loss of human life,

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and then strategists put the scenarios on the military drawing board.

Deterrence in its coldest terms means the willingness to go to nuclear war, even if it means destroying civilization and life as we know it. In its warmest terms, deterrence associates nuclear warfare with all things unthinkable, which functions as a means to reduce anxiety about the bomb. Weapons makers and scientists in particular commonly proclaim, at least in private that weapons are produced even though it is unthinkable to use them.

Explosive effects unique to nuclear weapons can also function as a self-deterrence to weapon states, at least on the battlefield. Electromagnetic radiation pulses can damage or destroy electrical instruments across entire continents;# thermal radiation can cause vision loss or impairment and skin burns, posing a great threat to troops.#

In today's deterrence dialogue, the thought of using nuclear weapons is thinkable and actively advocated in many situations, provoking strong debate on the U.S. nuclear posture. For several years military strategists in the Defense Department and in private think-tanks have worked mostly behind the scenes advocating new weapons development, particularly to destroy "hardened and deeply buried targets" (HDBTs) where weapons of mass destruction can be safely stored. Another faction advocates developing nuclear weapons to destroy incoming meteors.#

The February 2002 Nuclear Posture Review described a "major change in the our approach to the role of offensive nuclear offensive forces in our deterrent strategy and presents the blueprint for transforming our strategic posture." One response by a long time nonproliferation expert was:

"My concern is the extent to which the goal of the posture is changing from one of deterrence through secure retaliation to deterrence through ever-increasing war-fighting capabilities. Is America's nuclear posture becoming so driven by the pursuit of 'credibility' that it risks pulling us into the conflict it is intended to deter?" #

In *U.S. National Security Policy*, published in September 2002, President George W. Bush described the Cold War threat as one that "required the United States—with our allies and friends—to emphasize deterrence of the enemy's use of force, producing a grim strategy of mutual assured destruction," by relying upon our own nuclear stockpile.

Today deterrence is likely to involve counterforce strategies of counter-proliferation to prevent even the development of nuclear weapons or other weapons of mass destruction. This is part of the widely debated pre-emptive strike policy:

"The United States has long maintained the option of preemptive actions to counter a sufficient threat to our national security. The greater the threat, the greater is the risk of inaction— and the more compelling the case for taking anticipatory action to defend ourselves, even if uncertainty remains as to the time and place of the enemy's attack. To forestall or prevent such hostile acts by our adversaries, the United States will, if necessary, act preemptively. The United States will not use force in all cases to preempt emerging threats, nor should nations use preemption as a pretext for aggression. Yet in an age where the enemies of civilization openly and actively seek the world's most destructive technologies, the United States cannot remain idle while dangers gather...To support preemptive options, we will...continue to transform our military forces to ensure our ability to conduct rapid and precise operations to achieve decisive results."

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Right or wrong, these changes have instigated calls for modernization of the nuclear force, because the existing nuclear weapons arsenal was designed for Cold War threats and strategic doctrines, not modern or future threats and doctrines. Stephen Younger, former Los Alamos weapons boss and now head of the Defense Threat Reduction Agency (DTRA), wrote in a 2000 report entitled Nuclear Weapons in the 21st Century, that:

“The composition of our nuclear arsenal may undergo significant modification to respond to changing conditions, changing military needs, and changes in our confidence in our ability to maintain credible nuclear forces without nuclear testing or large-scale weapons production. Options for precision delivery of nuclear weapons may reduce the requirement for high yield. Lower yield weapons could be produced as modifications of existing weapons designs, or they could employ more rugged and simpler designs that might be developed and maintained with high confidence without nuclear testing and with a smaller nuclear weapons complex than we envision is required to maintain our current nuclear forces.” #

Development of modified pit designs and weapons have already been authorized to address the threat posed by hardened underground bunkers, referred to as hardened and deeply buried targets (HDBT). This year’s budget includes \$15.0 million “to begin formal design studies for a robust nuclear earth penetrator (RNEP),” a project expected to cost 46 million dollars. The new warhead “will involve repackaging of an existing stockpile warhead. The committee understands that RNEP is not a new design, is not a low yield ‘mini nuke’, and is not ‘clean’ in the sense that fallout and collateral damage can be contained. Consequently the committee does not believe that RNEP represents a significant departure from current stockpile weapons.”