



Accountability
Performance
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The Nuclear Materials Management Safeguards System

NMMSS

2016

Annual Users Training Meeting

May 9-12, 2016 | New Orleans, LA

Historical and Contemporary Perspectives on Plutonium

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Outline

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- Introduction: You Can't Say That Anymore
- Cold War Era and Key Events
- Weapons Complex Production Era
- Impacts of Sudden End to the Cold War
 - Dealing with Cold War Production Era Legacy Pu-239
 - Disposition Plans for Multiple Tons of Excess Pu-239
- Conclusion



Introduction: You Can't Say That Anymore

- Recently, while discussing Pu-239 disposition plans with a group of younger DOE-HQ staff, I said "Prior to the end of the Cold War".
 - Immediately a senior level DOE executive said "You can't say that anymore, they don't know what you are talking about".
- Again, not long ago, while discussing the DOE weapons production era with a group of site nuclear material managers, some responded, "We wish we would have worked in the complex during that time".
- As I reflected on these related statements, I realized that Cold War and Production Era are nebulous terms to many in the DOE weapons complex today.
- We are going to take a 100+ year journey during the next 30 minutes to hopefully bring some perspective, context, and appreciation to these phrases by:
 - Highlighting some key events during the Cold War era (1945-1991)
 - Discussing the impacts of the sudden profound shift from weapons production to environmental cleanup within DOE with the end of the Cold War (1992-2016)
 - Examining options for the future disposition for multiple tons of excess Pu-239 (2017-2048)

- Cold War lasted from end of WWII until the collapse of the Soviet Union (1945-1991).
- Russia and United States were allies in WWII, but disagreed on how the post-war world should look:
 - U.S. and other democratic western nations believed in giving the Axis powers a chance to form democratic governments with free elections
 - Russia wanted to install communism in its zones of occupation
- U.S. felt threatened by Russia's expansionary policy of communism.
- Russia resented U.S. involvement in European affairs.
- Led to distrust between the two superpowers and commitment of each to demonstrate their philosophy was superior:
 - Military (Arms Race), Technology (Space Race), Athletics, etc.



Key Cold War Events

- February 1945 – Yalta Conference

Meeting for the purpose of discussing post war Europe's reorganization (Churchill, Roosevelt, Stalin).

Allies looked at it as temporary, until Germany denazified and demilitarized and was ready for a reconstituted government.

- July-August 1945 Potsdam Conference

Formally divided Germany and Austria into four zones, Berlin into four zones, and Korea into Soviet and American zones (Atlee, Truman, Stalin).

Truman learned of the Trinity success (Stalin knew) and had been trying to get Stalin to declare war on Japan. Truman did not trust Stalin.





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Key Cold War Events

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On August 29th, 1949, the Soviet Union detonated its first atomic bomb, at the Semipalatinsk Test Site in Kazakhstan. This event ended America's monopoly of atomic weaponry and launches the Cold War. In the 1950's, The **Arms Race** became the focus of the Cold War. America tested the first Hydrogen (or thermo-nuclear) bomb in 1952, beating the Russians in the creation of the "Super Bomb".



Key Cold War Events

- April 1949 NATO formed
 - North Atlantic Treaty Organization formed with member states including: Belgium, Canada, Denmark, France, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, United Kingdom, and United States to defend Europe against Soviet aggression.
- May 1955 Warsaw Pact
 - The Warsaw Pact was formed with member states including: East Germany, Czechoslovakia, Poland, Hungary, Romania, Albania, Bulgaria, and the Soviet Union as a military defense organization to counter NATO.



Key Cold War Events

- April 1961

Bay of Pigs Invasion

A force of 1,400 Cuban exiles trained by the CIA, aided by the U.S. government, attempted to invade Cuba from Guatemala and overthrow the Communist government of Fidel Castro (which Russia was assisting). 8 B26 bomber camouflaged as Cuban airplanes attacked Cuba, missing targets, and returned to U.S. Second flight mission was cancelled, leading to defeat.

- August 1961

Berlin Wall

During the early years of the Cold War, West Berlin was a geographical loophole through which thousands of East Germans fled to the democratic West. In response, the Communist East German authorities built a wall between East and West Berlin. It was thrown up overnight, on August 13, 1961. Two days after sealing off free passage between East and West Berlin with barbed wire, East German authorities begin building a wall—the Berlin Wall—to permanently close off access to the West.





Key Cold War Events

- October 1962 Cuban Missile Crisis

A U.S. spy plane reported sighting the construction of a Soviet nuclear missile base in Cuba. President Kennedy set up a naval blockade and demanded removal of the missiles. Soviet ships tried to run the blockade and stopped when warning shots were fired. War was averted when Russians agreed to remove the weapons and the U.S. agreed not to invade Cuba and to dismantle weapons in Turkey aimed at Russia. Along with being televised worldwide, it was the closest the Cold War came to escalating into a full-scale nuclear war. The following year a hotline was installed between Moscow and Washington to help defuse similar situations.





Key Cold War Events

- October 1957 The Space Race Begins

History changed on October 4, 1957, when the Soviet Union successfully launched Sputnik I. The world's first artificial satellite was about the size of a beach ball. While the Sputnik launch was a single event, it marked the start of the **space age** and the U.S.-U.S.S.R space race.

Yuri Gagarin, a Russian Soviet pilot became the first human to journey into outer space and return safely to Earth when his Vostok Spaceship completed an orbit of the Earth on April 12, 1961.



Key Cold War Events

- May 1961

Americans had the perception that the U.S. was losing the Space Race with the Soviet Union, which had successfully launched the first artificial satellite, Sputnik, and deepened when they put the first man in space, Gagarin. Convinced of the political need to make an achievement which would decisively demonstrate America's space superiority, on May 25, 1961, President John F. Kennedy stood before Congress and proposed that “this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth.

Kennedy made his “We choose to go to the Moon” speech at Rice University on September 12, 1962.



Key Cold War Events

■ May 1961

Alan Shepard became the first American in space when the Freedom 7 spacecraft blasted off from Florida on May 5, 1961. Ten years later, Shepard would leave Earth's atmosphere again to become the fifth man to walk on the moon — and the first one to play golf there.

■ February 1962

On February 20, 1962, John Glenn flew the *Friendship 7* mission and became the first American to orbit the Earth and the fifth person in space.

The Titan II Missile launched 12 Gemini space crafts between 1964-1967.





Key Cold War Events

- July 1969 Apollo 11 land on the Moon

“That’s one small step for **A** man, one giant leap for mankind”

Apollo 11 was the first space flight that landed humans on the Moon (July 20, 1969). Neil Armstrong was the first to step onto the lunar surface and Buzz Aldrin later followed while Michael Collins remained in the lunar module.





Key Cold War Events

- Summer Olympics 1980
 - United States boycotted the 1980 Summer Olympics in Moscow in protest to the Soviet invasion of Afghanistan.
- Miracle on Ice Winter Olympics 1980

The U.S. national team, made up of amateur and collegiate players and led by coach Herb Brooks, defeated the Soviet Union national team, which had won the gold medal in six of the seven previous Olympic games.
- Summer Olympics 1984
 - The Soviet Union boycotted the Summer Olympics in Los Angeles.





Key Cold War Events

- June 1987

Glasnost and Perestroika

Mikhail Gorbachev announced his intention to follow a policy of glasnost - openness, transparency and freedom of speech; and perestroika - restructuring of government and economy. He also advocated free elections and ending the arms race.

- November 1989

Fall of the Berlin Wall

The Berlin Wall was a barrier that divided Berlin from 1961-1989, completely cutting off (by land) West Berlin from surrounding East Germany until government officials opened it in November 1989. Its demolition officially began in June 1990 and was completed in 1992.



Key Cold War Events

- July 1991

Strategic Arms Reduction Treaty Signed

START (Strategic Arms Reduction Treaty) was a bilateral treaty between the U.S. and the USSR on the reduction and limitation of strategic offensive arms. The treaty barred its signatories from deploying more than 6,000 nuclear warheads atop a total of 1,600 inter-continental ballistics missiles (ICBMS) and bombers. START negotiated the largest and most complex arms control treaty in history.

- December 1991

End of the Soviet Union

The dissolution of the Soviet Union was formally enacted on December 26, 1991. The declaration acknowledged the independence of the former Soviet republics and created the Commonwealth of Independent States (CIS). Gorbachev resigned, declared his office extinct, and handed over its powers – including control of the nuclear missile launching codes to Boris Yeltsin. The Soviet flag was lowered for the last time.



Weapons Complex Production Era

- Hanford and the Savannah River were the two sites that produced Pu-239 for nuclear weapons.
- Hanford, as part of the Manhattan Project, broke ground in March of 1943:
 - By 1963 there were 9 reactors and 5 reprocessing plants
 - Most of the reactors were shut down between 1964 and 1971
 - The last operating reactor, N, ceased operations in 1987
- Between 1945 and 1987, Hanford reactors produced more than 67 MT of Pu-239.



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Weapons Complex Production Era

President Truman's Letter to Crawford Greenewalt

THE WHITE HOUSE
WASHINGTON

July 25,
1950

Dear Mr. Greenewalt:

The Atomic Energy Commission has informed me that it has requested the DuPont Company to undertake the design, construction and operation of certain new facilities for the atomic energy program.

The Commission advises me that the Company has within its organization technical, scientific, engineering, construction and operating staffs capable of handling a task of this magnitude. The great resources of your Company in these fields, together with the experience which it has acquired through the successful handling of the design, construction and operation of the Hanford Project during the War make it uniquely qualified to undertake this most essential task.

I want you to know that I consider this project as one of highest urgency and vitally important to our national security and defense.

Very sincerely yours,

W. Crawford H. Greenewalt
President, DuPont Company
10 Market Street
Wilmington, Delaware

RECEIVED

JUL 26 1950

L. H. GREENEWALT

In 1950, President Truman sent a formal letter to DuPont, specifically requesting their expertise for the design and construction of a new atomic project because of their leadership at the Hanford site.

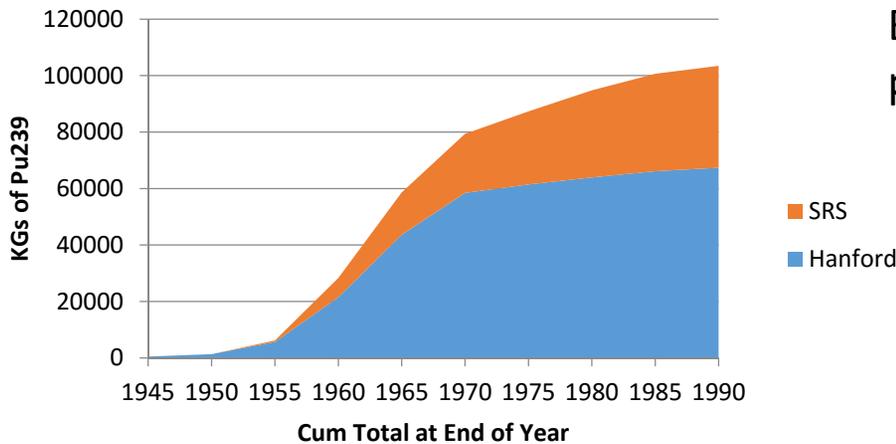
Between 1950-1955, 5 production reactors, 2 separations facilities, and a heavy water production facility were operational at the Savannah River Site.

Between 1955-1988, Savannah River Site reactors produced 36 MT of Pu-239.



Weapons Complex Production Era

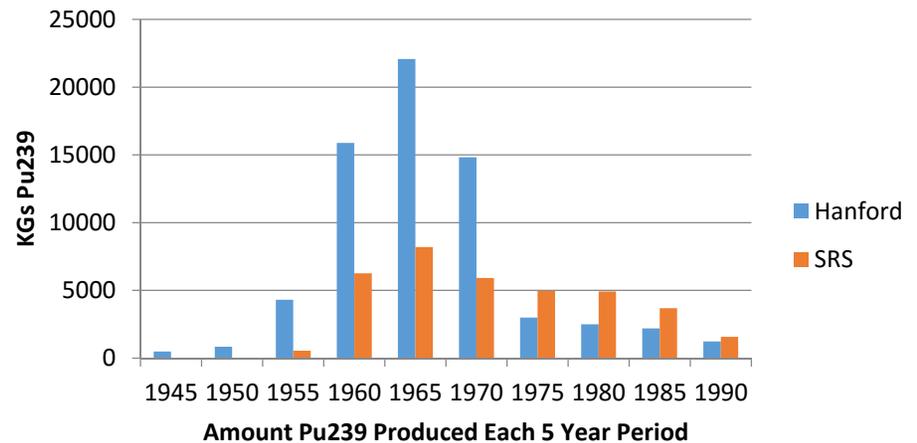
US Pu-239 Production (including FG)



Hanford produced 67 MT between 1945-1987 and SRS produced 36 MT between 1955-1988.

Between 1945 and 1988, the United States produced over 100 MT of Pu-239.

US Pu-239 Production (including FG)



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Weapons Complex Production Era



From 1952-1989, the primary mission of Rocky Flats was the processing and machining of plutonium into “pits” for nuclear weapons.

Plutonium buttons from Hanford, SRS, along with internal material recycle at Rocky Flats were the primary sources of Pu-239 for manufacturing “pits” to support DoD requirements.

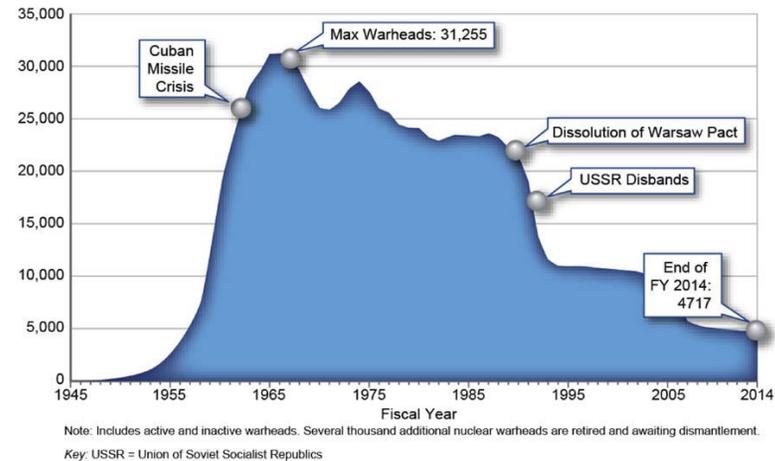
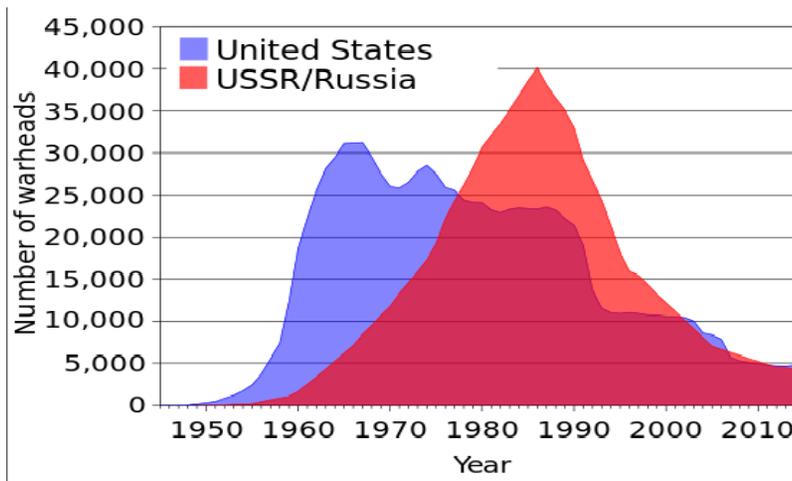


In 1989, Rocky Flats was raided by the FBI/EPA and production of the W88 was halted (never to resume) before sufficient pits were produced to meet stockpile surveillance requirements.





Weapons Complex Production Era U.S. Nuclear Weapons Stockpile 1945-2014



As of September 30, 2014, the U.S. stockpile of nuclear weapons consisted of 4,717 warheads (2017 SSMP) . This number represents an 85 percent reduction from the stockpile’s maximum (31,255) at the end of fiscal year 1967. Current stockpile is composed of two types of submarine-launched ballistic missile warheads (W76-0/1 & W88), two types of ICBM warheads (W78 & W88), several types of bombs (B61-3/4/10/7/11 & B83-1), and a cruise missile warhead delivered by aircraft (W80-1).



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Weapons Complex Production Era

Between July 1945-September 1992 there were 1,054 nuclear tests (DOE/VV-Rev16, September 2015). January 1951 the first nuclear test occurred at NTS.

210 were atmospheric, 839 underground, and 5 underwater.

The Sedan Crater (1962) was a test as part of Operation Plowshare to investigate the use of nuclear explosives for peaceful industrial applications (mining, cratering for harbors, mountain excavation, etc.).

Public concern about health affects and lack of political support lead to the abandonment of the concept.





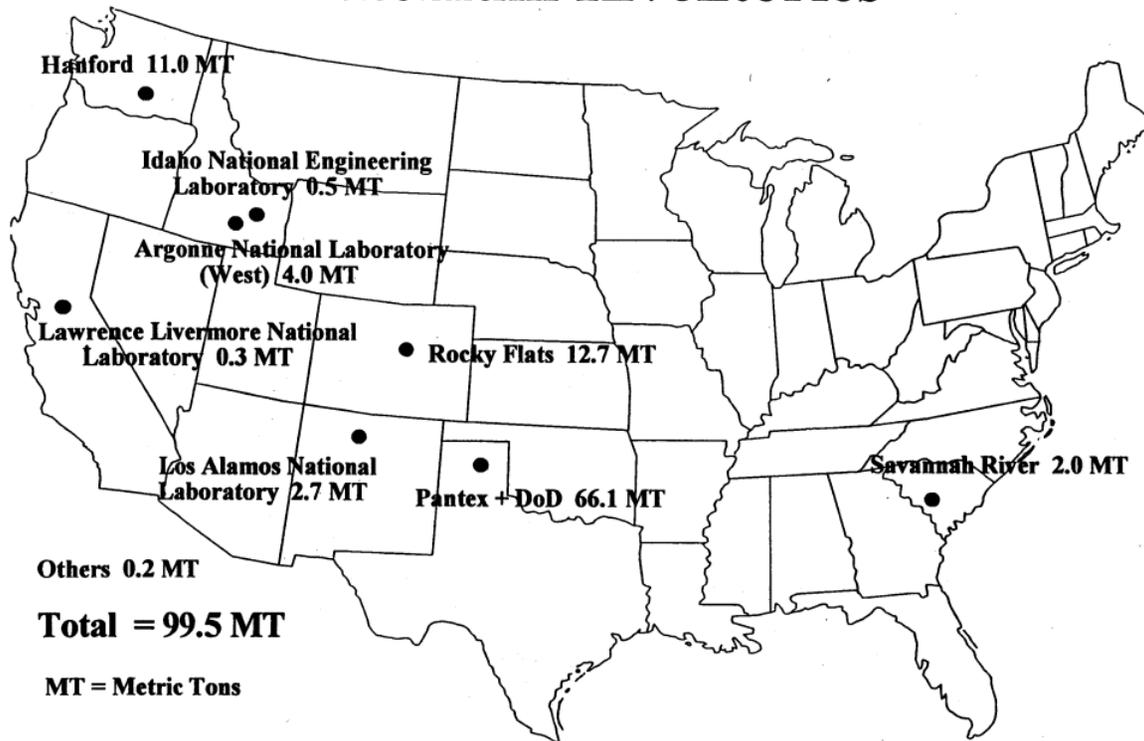
Impacts to Sudden End to the Cold War

- DOE Secretary Watkins directed that production of the W88 be halted permanently January 1992.
- Decision resulted in profound shift in DOE's mission from weapons production to environmental cleanup of Cold War legacy.
- U.S. nuclear nonproliferation policy resulted in multiple metric tons of Pu-239 being excess to National Security requirements.
- Much of the legacy plutonium was in forms and facilities not suited for long-term storage.
- Focus moved from production to tasks of **remediating hazards, removing material, and closing facilities.**
- Future U.S.-Russian agreements would lead to additional excess Pu-239.
- Need to **develop and implement consolidation and disposition plans** for excess Pu-239.



Impacts to Sudden End to the Cold War

Plutonium Inventories



Pu-239 by location at end of Fiscal Year 1994

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Impacts to Sudden End to the Cold War: Remediating Hazards

- Pu-239 Requiring Repackaging/Stabilization: 1994 Pu Vulnerability Study assessed the environmental and safety conditions of the U.S. inventory of separated plutonium
 - Storage packages were not expected to function for decades.
 - Long storage times led to deterioration from the effects of corrosion, radiation, and pressure buildup.
 - Handling necessitated by MC&A requirements increased risks to workers.



Impacts to Sudden End to the Cold War: Remediating Hazards

Pu-239 Requiring Repackaging/Stabilization



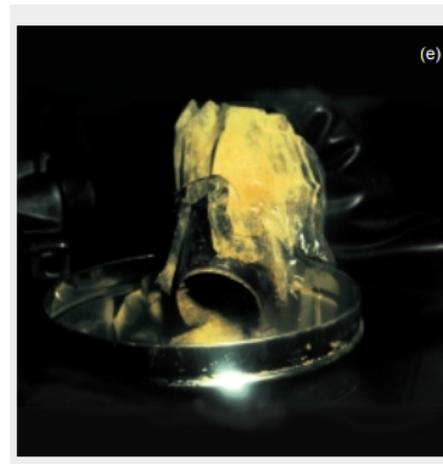
1,000's of white 55 gallon waste drums requiring repackaging



Corroded Drums



Tons of plutonium oxide requiring stabilization



Metal in contact with plastic requiring stabilization and repackaging

Impacts to Sudden End to the Cold War: Remediating Hazards

- Sites prioritized their repackaging efforts based on a risk-ranking.
- Sites successfully characterized, repackaged, and are disposing of excess Pu-239.
- Sites established and implemented a surveillance program that ensures the nuclear material storage container continues to meet its design criteria.



DOE-STD-3013 containers are some of the most commonly used storage containers in the DOE complex

Impacts to Sudden End to the Cold War: Removing Material & Closing Facilities

- Nuclear Weapons Complex Sites with Cat I/II SNM reduced from 13-5 sites
- Nuclear Weapons Complex Footprint reduced by more than 50% since 1990



Between late 1990's and mid 2000's, 12.7 MT of Pu-239 at Rocky Flats was shipped and consolidated or dispositioned to multiple sites including Pantex, LANL, LLNL, SRS, NTS, WIPP. The former Rocky Flats Plant is now managed by U.S. Fish and Wildlife Service who established the Rocky Flats National Wildlife Refuge.



Impacts to Sudden End to the Cold War: Disposition Plans in 1990's

- Yucca Mountain for HLW to be operational in 1998 (8 MT+)
- WIPP for transuranic waste to be operational in 1999 (6 MT+)
- Three prong approach at SRS baselined after award to Duke, COGEMA/Stone & Webster (PMDA no later than 12/07) (50 MT+)
 - MOX Fuel Fabrication Facility (MFFF) to begin producing fuel to burn in existing domestic commercial reactors in 2006
 - Pit Disassembly & Conversion Facility (PDCF) to convert pits and clean metal into oxide for MFFF and begin operations in 2006
 - Immobilization Facility for impure Pu-239 not suitable for MFFF or PDCF and prepare for disposal at a geological HLW repository beginning in 2007
- These plans would handle nearly all of the excess Pu-239



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Disposition Plans – Yucca Mountain

1982 NWPA directed DOE to construct and operate a geological repository for HLW. 1987 amends act to focus solely on Yucca. EPA had responsibility for developing radiation protection standards, NRC for developing regulations to implement the EPA standards.

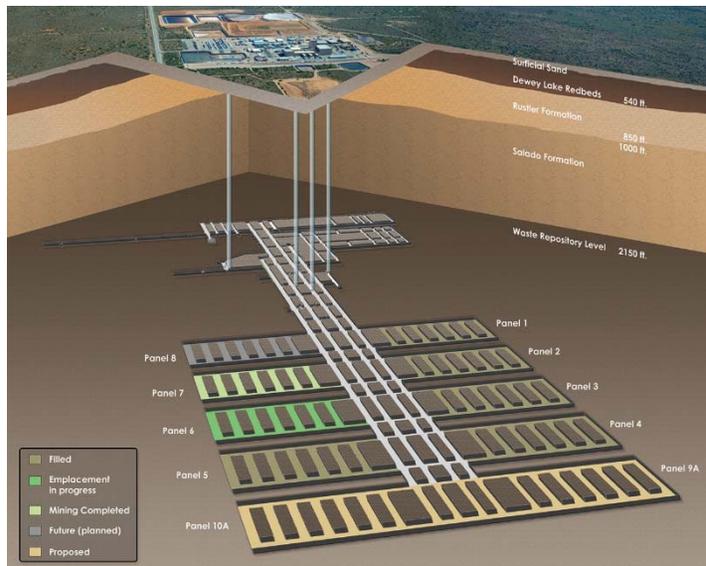


1998 to open but delayed by legal challenges. July 2006, DOE proposed 2017 as opening date. January 2007, Harry Reid became Senate majority leader and declared Yucca dead. 2011 federal funding ended for Yucca. 2013 Court of appeals ruled nuclear facilities could stop paying fees they had been paying for 31 years.



Disposition Plans – WIPP

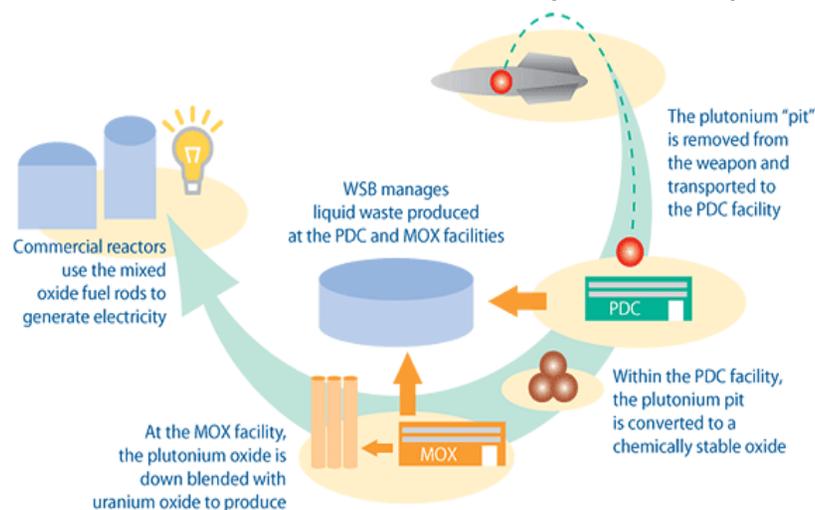
1979 Congress authorized the DOE WIPP facility. It became operational in 1999 to receive defense related transuranic waste. Prime regulators are EPA and New Mexico Environment Department.



WIPP has received nearly 6 MT of Pu-239. Two incidents in February 2014 resulted in the suspensions of operations at WIPP. Operations are expected to resume by December 2016.

Disposition Plans – 3 Prong Approach at SRS

- Planned to dispose of 50 MT+ of excess Pu-239
- The MFFF which is planned to convert 34 MT+ of Pu-239 into fuel for commercial reactors has been delayed from 2006 to 2016 to 2022+.
- The PDCF is no longer planned to be a stand alone facility, but instead will use existing facilities within the DOE.
- The Plutonium Immobilization Plant which was to dispose of up to 17 MT of impure Pu-239 was cancelled in 2002.





Impacts to Sudden End to the Cold War

- 2002 Strategic Offensive Reductions Treaty ("Treaty of Moscow")

Each nation would be limited to 1,700-2,200 strategic nuclear warheads, which the U.S. met in February 2009.

- 2010 New START Agreement

Replaced expired START Treaty of 1991 and reduced each nations deployed strategic nuclear warheads to 1,500 and deployed delivery vehicles to 700.





Impacts to Sudden End to the Cold War: Disposition Plans in 2016

- HLW geological waste repository to be operational in 2048 (BRC)
 - 2021 Pilot Interim Storage Facility – fuel from shutdown reactor sites
 - 2025 Consolidated Interim Storage Facility – fuel from operation at commercial reactors – had been paying fees 1982-2013
 - 2048 Geological Repository for HLW and used nuclear fuel
- WIPP to resume operations 12/2016
 - Recent ROD has 6 MT originally planned for immobilization, could be more
- MFFF to be operational by 2022+ and to meet 34 MT PMDA by 2035
- PDCF to use existing facilities in the complex (PF-4 at LANL, K-Area at SRS)
- **Uncertainty about facility availability leads to confusion and difficulty in developing integrated consolidation and disposition plans.**





Impacts to Sudden End to the Cold War: Disposition Plans in 1990's vs. 2016

Disposition Plans for Excess Pu-239

Facility/Location	Feed Source	Amount	Initial Plan Operational	Current Status	Current Amount	Planned Operational
Yucca Mountain	HLW	8 MT+	1998	Pilot Facility in 2021	8 MT+	2048
WIPP	TRUW	6 MT+	1999	Operations suspended in 2014	12 MT+	12/2016
MFFF	Clean Oxide	34 MT+	2006	70% Complete	34 MT+	2022+
PDCF	Pits & Clean Metal	25 MT+	2006	Existing Facilities PF-4 & K Area	25 MT+	2022+
PIP	Impure Pu	Up to 17 MT	2007	Cancelled	None	Cancelled



- The construction, production, and manufacturing of the U.S. nuclear weapons complex during the Cold War era (1945-1991) was **successful** in bringing “peace through strength”.
- The U.S. has **successfully** met most of the challenges of the Cold War legacy excess Pu-239 (1992-2016):
 - Remediated hazards, stabilized and repackaged “at risk” material.
 - Reduced the footprint of the weapons complex by consolidating material and closing facilities.
 - Supported US nuclear nonproliferation policy by permanently disposing of some excess Pu-239 and developing disposal plans for the remainder.
- The U.S. has **successfully** resumed pit production. Plan to have capability to produce 50-80 pits per year by 2030.
- The U.S. is **challenged** to finalize and implement disposition plans for many metric tons of excess Pu-239.

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- QUESTIONS???

