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Title: Introduction to Pits and Weapons Systems (U)

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Introduction to Pits and Weapons Systems (U)

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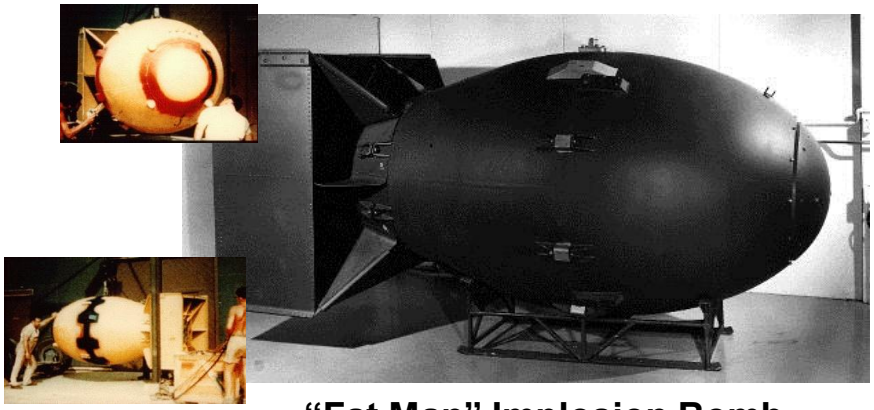
UNCLASSIFIED

Acknowledgment

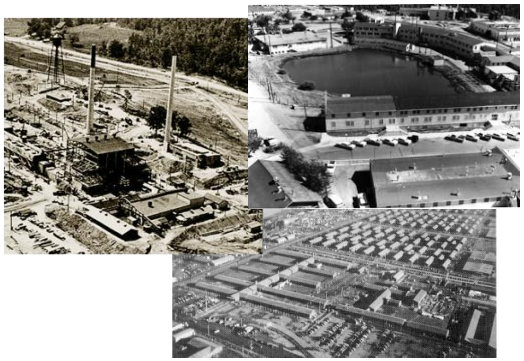
- **Dwight Jaeger pulled the weapons and NWC slides together for a tutorial for previous students and they are an excellent overview of these subjects**

Nuclear weapons — and the complex that supports them — have undergone a great evolution since 1945



“Fat Man” Implosion Bomb
~10,300 lbs

B83 Modern Strategic Bomb
Megaton-Class

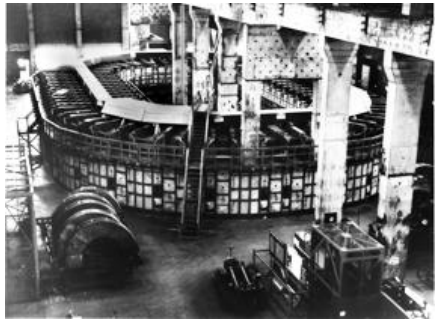


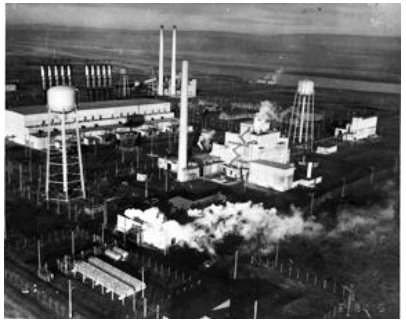
1945
Los Alamos + 2 plants

Peak Complex
~50 sites

Today
8 sites

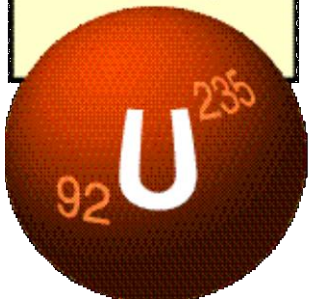
Nuclear Weapons Complex (NWC) in 1942





September 1942

Oak Ridge*
(Enriched Uranium)



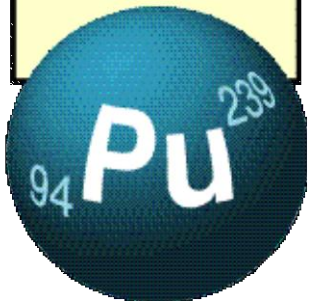
November 1942

Los Alamos
(Design and Production)

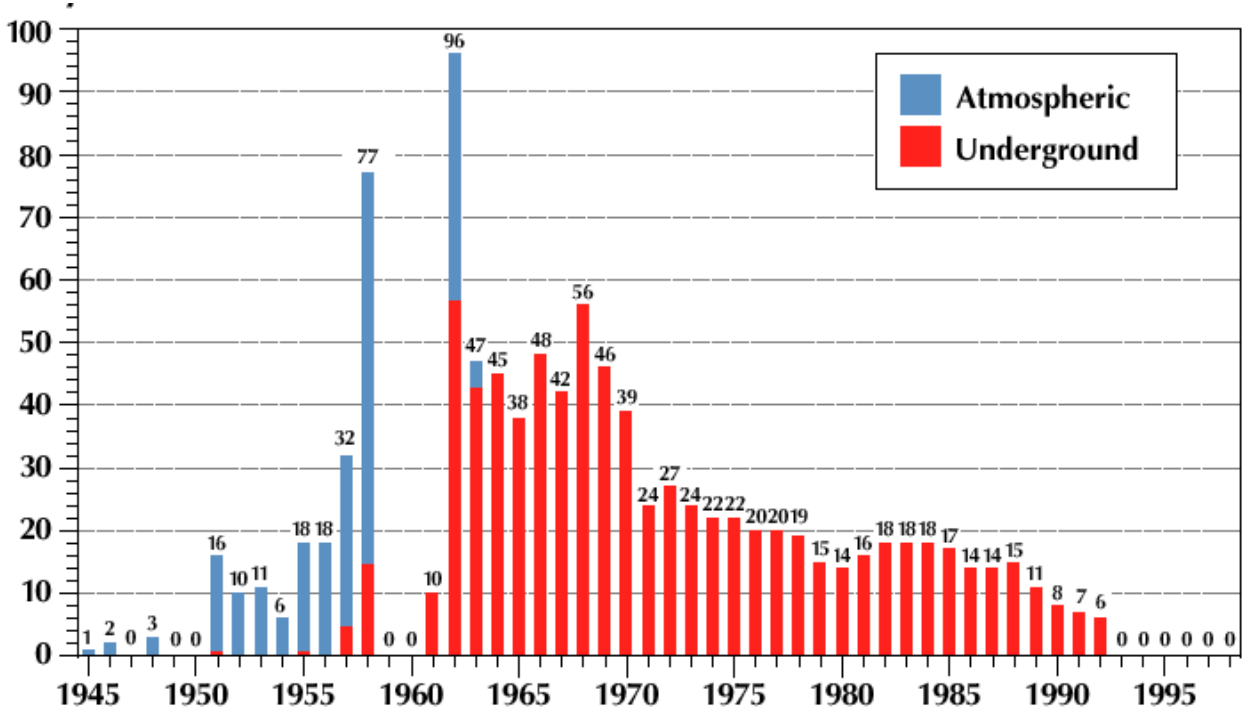
- **Scientists began arriving in March 1943**

December 1942

Hanford
(Plutonium)



The U.S. conducted 1054 Nuclear Tests (July 1945 – September 1992

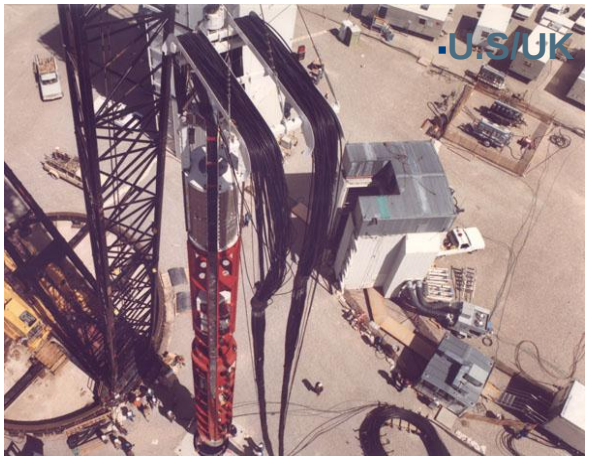


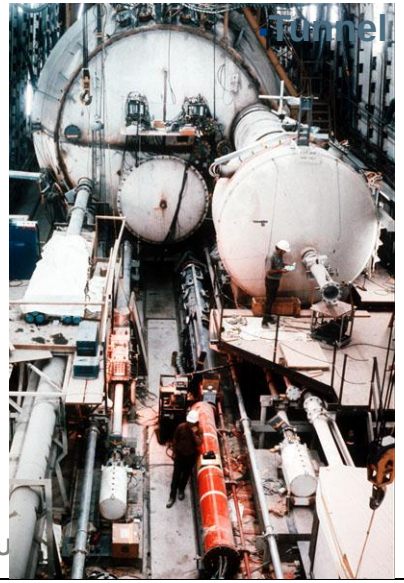
Nevada Test Site - 62 tests had simultaneous detonations
Rifle, Colorado - 1 test had a simultaneous detonation

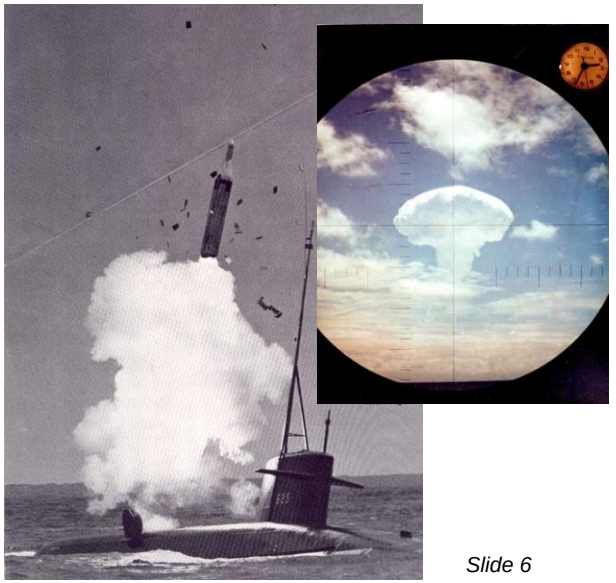
Location	Number of Tests	Number of Detonations
Total South Atlantic	**3**	**3**
Bikini	23	23
Christmas Island	24	24
Enewetak	43	43
Johnston Island	12	12
Pacific	4	4
Total Pacific	**106**	**106**
Alamogordo, New Mexico	1	1
Amchitka, Alaska	3	3
Carlsbad, New Mexico	1	1
Central Nevada	1	1
Fallon, Nevada	1	1
Farmington, New Mexico	1	1
Grand Valley, Colorado	1	1
Hattiesburg, Mississippi	2	2
Nellis Air Force Range	5	5
Rifle, Colorado	1	3
Total Other	**17**	**19**
Atmospheric	100	100
Underground	828	921
Total NTS	**928**	**1,021**
TOTAL	**1,054**	**1,149**

The U.S. has conducted Nuclear Tests for many purposes

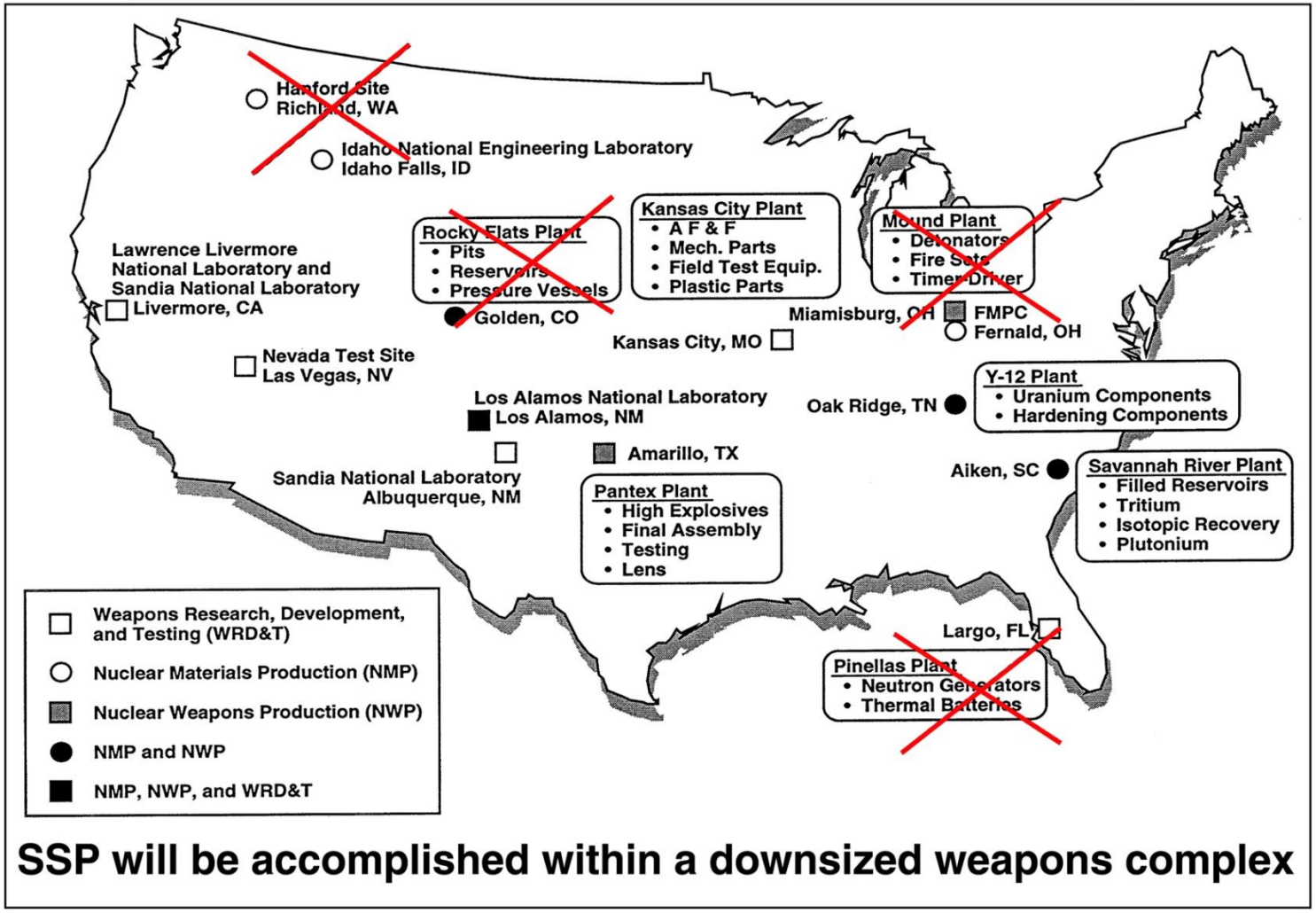
Purpose	Detonations
Joint US-UK	24
Plowshare	35
Safety Experiment	88
Storage-Transportation	4
Vela Uniform	7
Weapons Effects	100
Weapons Related	891
TOTAL DETONATIONS	**1,149**







The nuclear weapons complex today



SSP will be accomplished within a downsized weapons complex

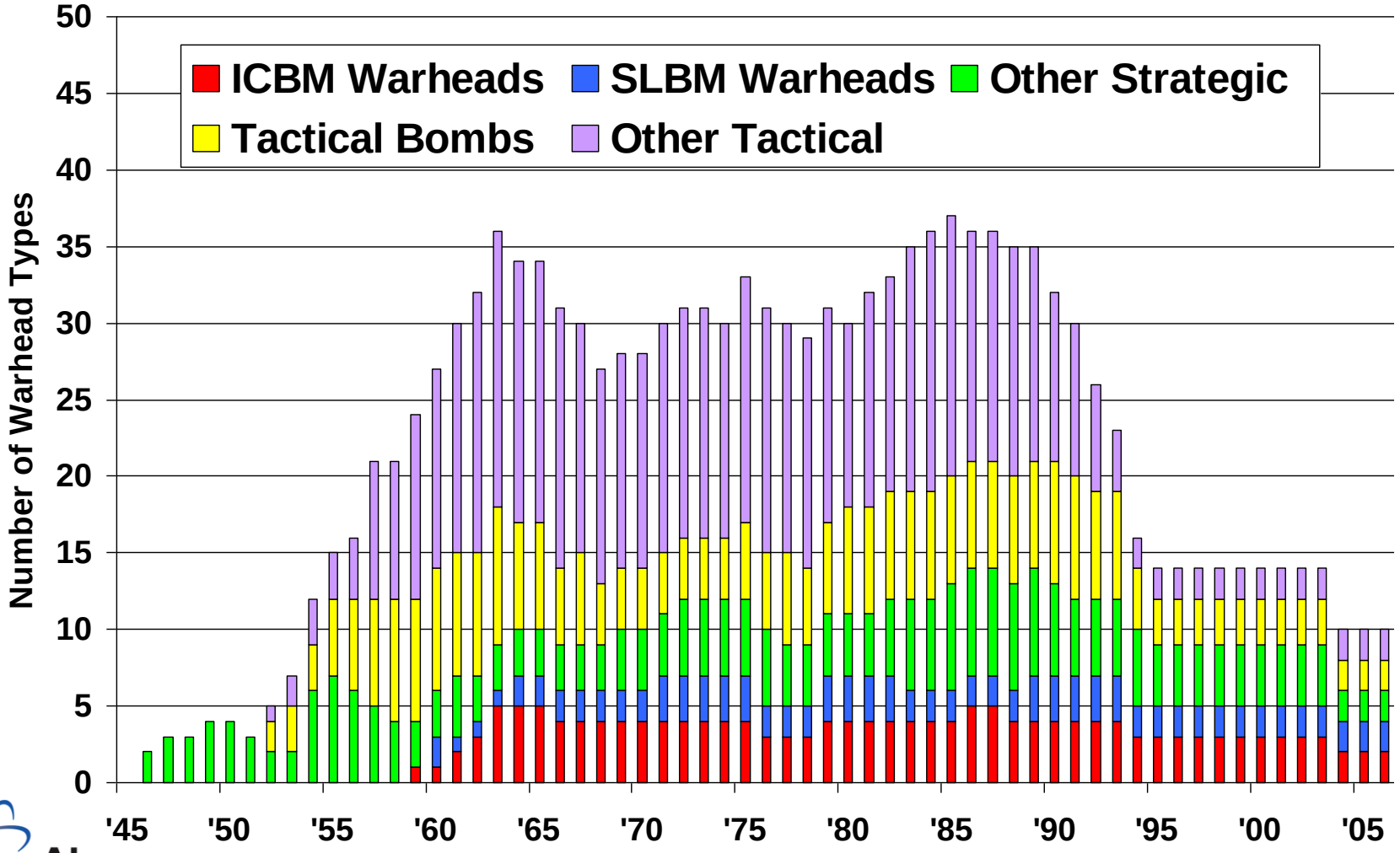
The NNSA has recaptured the technology to manufacture and certify pits at LANL

Coater

Plutonium Glove Box

The manufacture and certification of the pits represents a microcosm of the entire Stockpile Stewardship Program.

The Number of Weapon Types in the Stockpile has Dramatically Decreased Since 1989



Nuclear Weapons are complex devices, requiring a broad range of engineering and scientific expertise

- Nuclear Explosive Package
- Radars
- Impact fuzes
- Shock absorbers
- Casing
- Detonators
- Firing sets
- Transverters
- Capacitors
- Switches
- Switch tubes
- Rectifiers
- Programmers
- Neutron generators
- Reservoirs
- Stronglinks
- Batteries
- Timers
- Spin generators
- Parachutes
- Ejector systems
- PAL controllers

B83 Strategic Bomb - Total parts = 6,519

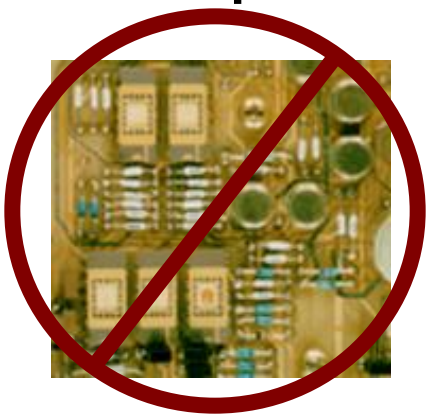
Science and Technology Foundations

MATERIALS AND PROCESSES | **COMPUTATIONAL SCIENCES** | **DYNAMIC MATERIALS – HYDRODYNAMICS** | **MICROELECTRONICS** | **ENGINEERING SCIENCES**

Stockpile Refurbishments Require Modern Technologies and Components

Several factors prevent us from rebuilding the stockpile in exactly the same manner that the original weapons were built.

For example:

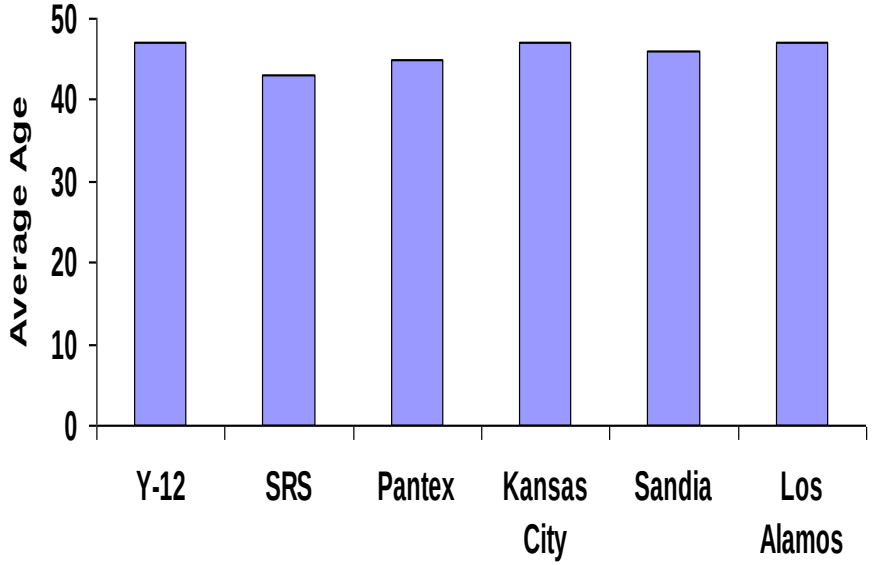


Sunset electronics no longer are available (e.g., SA 1388)

High-reliability, weapon-specific processes are no longer available (e.g., CN plating)

Original materials are no longer acceptable (e.g., carcinogenic epoxies)

The real issue is people.

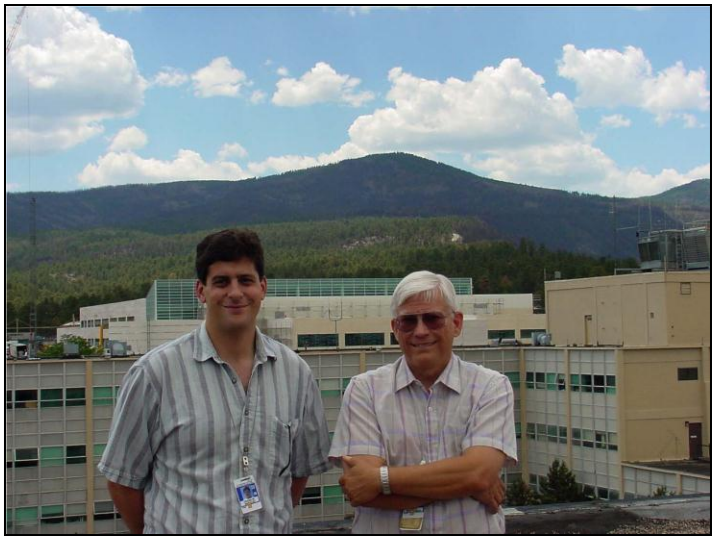


Without the integrated test (UGT), knowing how to replace and certify "irreplaceable" parts is a major challenge

- Sunset technologies
- Loss of Vendors
- ESH restrictions (e.g., Be metal)

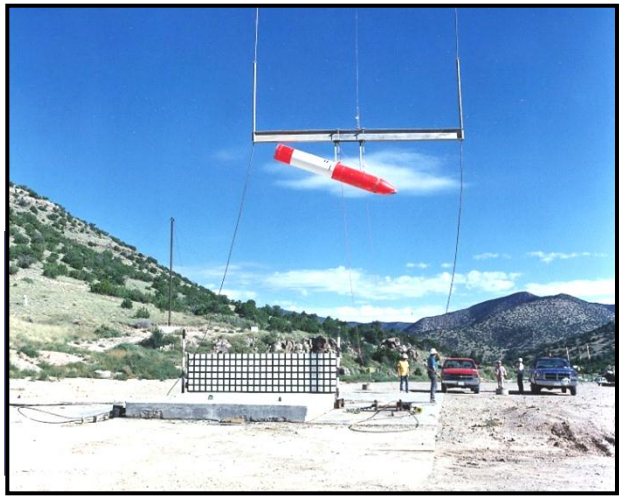
Years of highly developed techniques and acquired skills are lost or disappearing

- Plutonium machining
- Welding and brazing
- Special Polymers
- High Explosives



Testing Capabilities and Activities we can do are important for the Reliability of the Deterrent

Drop Tower



B-2 & B61-11

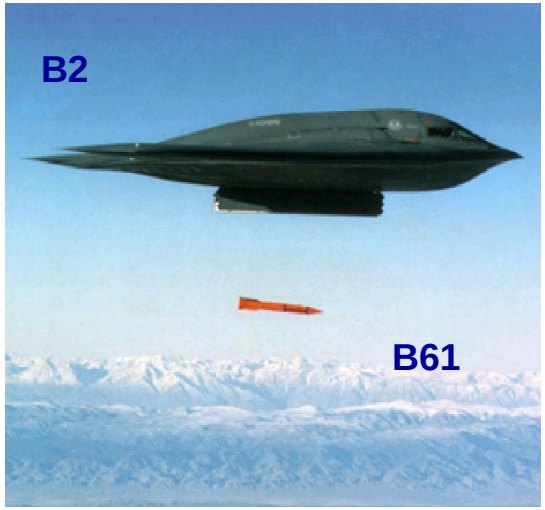
Centrifuge

Mechanical Insult

Electrohydraulic Shaker

Sled Track

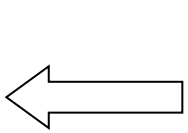
Today's nuclear stockpile provides flexibility to respond to changing geopolitical conditions

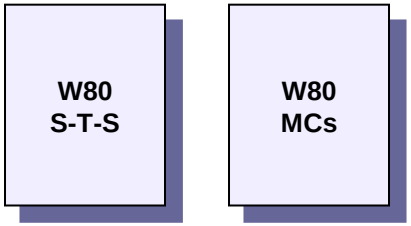


How are Requirements Established?
Requirements flow from the MCs and STS

Requirements Validation

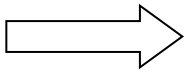
-Interpret requirements at system level
-Translate requirements to component level





Systematic Review

-Full System
-Subsystems
-Components



Requirements	Qualification by: Test	Modeling	Model Valid. Test	Other
Reliability				
Vibration	X	x		
Shock	X	x		
Temperature	X	x		
Etc.				
Safety				
Drop	x	X	x	
Crush	x	X	x	
Impact	x	X	x	
Fire	x	X	x	
Etc.				
Surety				X

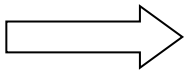
Qualification Method Decision

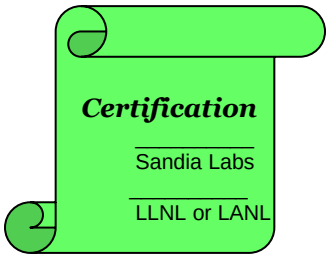
Test vs Modeling (or Other) decision tradeoff

Qualification Plan Goal

An integrated program of testing and modeling that in a cost and time efficient manner:

1. **Qualifies against all requirements**
2. **Minimizes design risks**
3. **Understands failure modes**
4. **Estimates design margins**



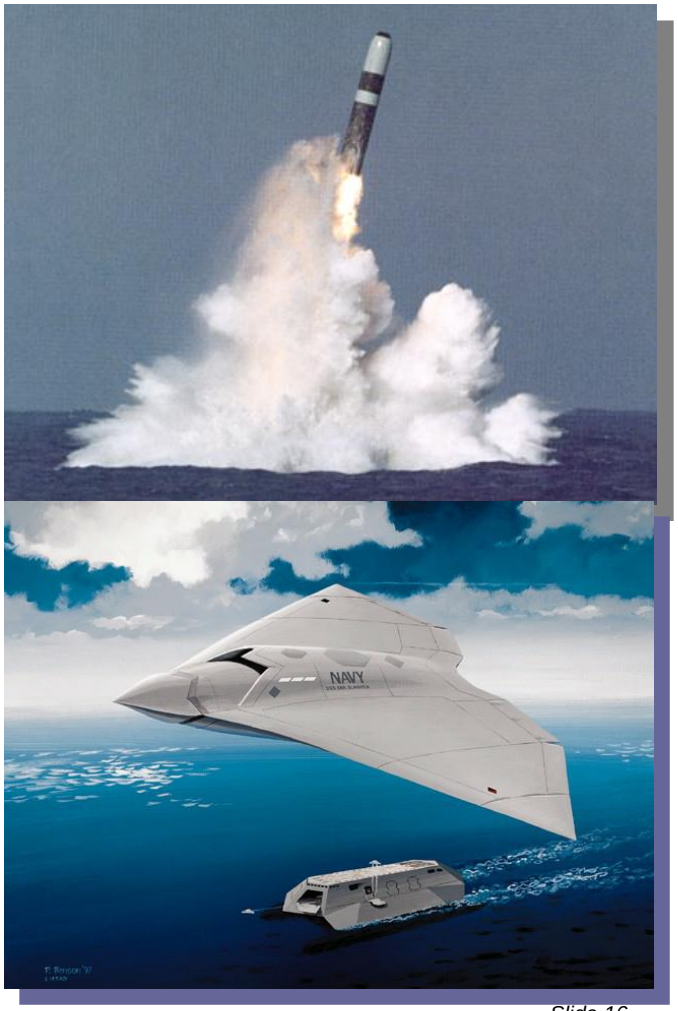


"Warhead Certification with Confidence"

We must be sufficiently modern, agile, and flexible to respond to changing threats

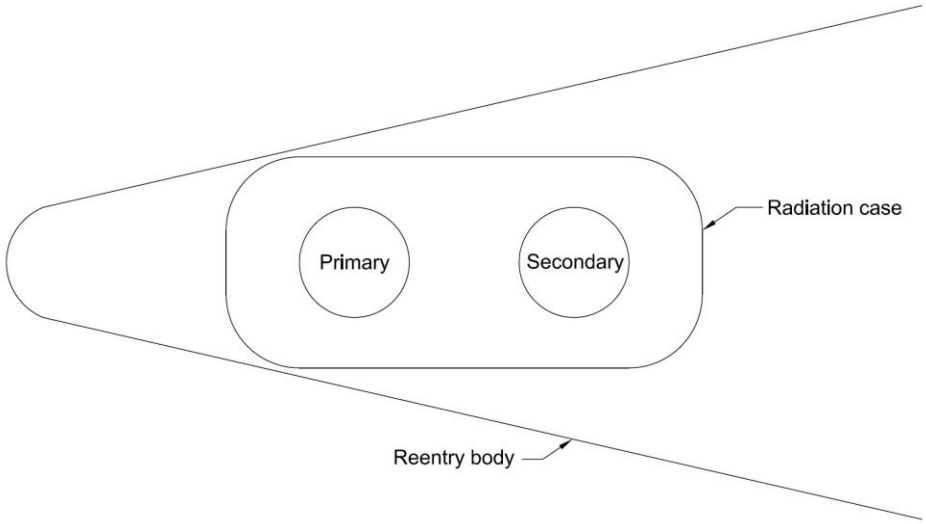
Deterrence is related to both capability and credibility

- **The United States developed highly optimized special-purpose weapons systems that won the cold-war**
- **In the future --**
  - Weapon systems need to be more modular and flexible
  - New threats may require modified weapons



What is a NEP

- **A Nuclear Explosive Package includes the Primary, Secondary, Radiation Case and related components**
- **This is the part of the weapon that produces nuclear yield**
- **Converts mechanical energy into nuclear energy**



The Pit

- **The pit is composed of materials that allow mechanical energy to be converted to electromagnetic energy**
- **Fabrication processes used are typical of any metal fabrication facility:**
  - Casting
  - Forming
  - Machining
  - Welding
- **Some of the materials used in pits include:**
  - Plutonium
  - Uranium
  - Stainless Steel
  - Beryllium
  - Titanium
  - Aluminum

Why use gloveboxes

Gloveboxes are used for three reasons:

- Protect workers and public from easily transported, finely divided plutonium oxides
  - Plutonium is very reactive and produces very fine particulate oxides
  - While not the “Most dangerous material in the world” of Manhattan Project lore, plutonium is hazardous to health of workers if not properly controlled
- Protect plutonium from reactive materials
  - Plutonium is extremely reactive at ambient conditions with several components found in air: oxygen, water, hydrogen
  - As with most reactive metals, reactions with these materials may be violent and difficult to control
  - As with most fabricated metal products, corrosion may significantly affect the mechanical, chemical, and physical properties of the product
- Provide shielding from radioactive decay products: α, γ, and η are commonly associated with plutonium decay, as well as highly radioactive materials such as ^{241}Am and ^{238}Pu

Summary

- **Hopefully this presentation has given each of you a clearer picture of how your particular skill set fits into the big picture. If not, raise your hand and let's discuss now.**
- **Nuclear weapons and our work here is important both militarily and politically.**
- **The bottomline from a world perspective**

Nuclear weapons have shaped war and the world