Description of document: Presentations at the Department of Energy's (DOE) Historical Restricted Data Reviewer course (records appear undated)

Requested date: 03-May-2021

Release date: 12-September-2022

Posted date: 26-Septmber-2022

Source of document: FOIA Request Service Center
1000 Independence Avenue, SW
Mail Stop MA-46
Washington, DC 20585
Fax: (202) 586-0575
Email: FOIA-Central@hq.doe.gov
DOE Headquarters FOIA Request Form

Department of Energy
Washington, DC 20585

September 12, 2022

Via email

RE: HQ-2021-00602-F

This is a final response to the request for information that you sent to the U.S. Department of Energy (DOE) under the Freedom of Information Act (FOIA), 5 U.S.C. § 552. You requested:

> A copy of the syllabus, the outline, and the presentation slides from the Department of Energy's Historical Restricted Data Reviewer course.

Your request was assigned to DOE's Office of Health, Environment, Safety, & Security (AU), to conduct a search of its files for responsive records. AU started its search on May 3, 2021, which is the cut-off date for responsive records. AU completed its search and identified three (3) documents responsive to your request. These documents are being provided to you as described in the accompanying index.

Upon review, DOE has determined that certain information contained within the documents should be withheld pursuant to Exemptions 3, 6, and 7(E) of the FOIA, 5 U.S.C. § 552 (b)(3), (b)(6) and (b)(7)(E).

Exemption 3 protects from disclosure information "specifically exempted from disclosure by statute (other than section 552(b) of this title), if that statute (A)(i) requires that the matters be withheld from the public in such a manner as to leave no discretion on the issue; or (ii) establishes particular criteria for withholding or refers to particular types of matters to be withheld[.]" 5 U.S.C. § 552(b)(3). The Atomic Energy Act of 1954 (AEA), 42 U.S.C. § 2011, is one such statute that falls within the coverage of Exemption 3. Sections 141-146 of this Act (42 U.S.C. 2161-2166) and/or section 148 of this Act (42 U.S.C. 2168) prohibits the disclosure of information concerning atomic energy defense programs that is classified as either Restricted Data (RD) or Formerly Restricted Data and/or determined to be Unclassified Controlled Nuclear Information (UNCI) pursuant to the AEA, as amended.

The portions deleted from the subject document pursuant to Exemption 3 contain information about weapon design that has been that has been classified as RD and/or nuclear materials that has been safeguarded as UCNI. Disclosure of the exempt data could jeopardize the common defense and the security of the nation and/or have a significant adverse effect on the health and safety of the public.

Exemption 6 is generally referred to as the "personal privacy" exemption; it provides that the disclosure requirements of FOIA do not apply to "personnel and medical files and similar files the disclosure of which would constitute a clearly unwarranted invasion of personal privacy." 5 U.S.C. § 552(b)(6). In applying Exemption 6, the DOE considered: 1) whether a significant privacy interest would be invaded; 2) whether the release of the information would further the public interest by shedding light on the operations or activities of the Government; and 3) whether in balancing the privacy interests against the public interest, disclosure would constitute a clearly unwarranted invasion of privacy.

The information withheld under Exemption 6 consists of personal names. This information qualifies as "similar files" because it is information in which an individual has a privacy interest. Moreover, releasing the information could subject the individuals to unwarranted or unsolicited communications. Since no public interest would be served by disclosing this information, and since there is a viable privacy interest that would be threatened by such disclosure, Exemption 6 authorizes withholding the information. Therefore, we have determined that the public interest in the information's release does not outweigh the overriding privacy interests in keeping it confidential.

Exemption 7 protects from disclosure "records or information compiled for law enforcement purposes" that fall within the purview of one or more of six enumerated categories. To qualify under Exemption 7, the information must have been compiled, either originally or at some later date, for a law enforcement purpose, which includes crime prevention and security measures, even if that is only one of the many purposes for compilation.

Exemption 7(E) provides that, "records or information compiled for law enforcement purposes" may be withheld from disclosure, but only to the extent that the production of such documents "would disclose techniques and procedures for law enforcement investigations or prosecutions, or would disclose guidelines for law enforcement investigations or prosecutions if such disclosure could reasonably be expected to risk circumvention of the law."

The information withheld under Exemption 7(E) consists of information that would provide insight into the relative sensitivity of still-classified information or would materially assist efforts to compile sensitive information through the association of declassified information and/or publicly released information. The release of this information could impair the Department's ability to enforce the laws regarding classification and is therefore exempt from disclosure. Because the redacted portions of the enclosed document contains information about DOE's investigative techniques that could be used by an individual to obtain classified or sensitive information on DOE networks without authorization or details of personnel security techniques, we are withholding this information pursuant to Exemption 7(E).

This satisfies the standard set forth at 5 U.S.C. § 552(a)(8)(A) that agencies shall withhold information under FOIA "only if (I) the agency reasonably foresees that disclosure would harm an interest protected by an exemption…; or (II) disclosure is prohibited by law…" 5 U.S.C. § 552(a)(8)(A) also provides that whenever full disclosure of a record is not possible, agencies shall "consider whether partial disclosure of information is possible…and (II) take reasonable steps necessary to segregate and release nonexempt information." Therefore, we have determined that, in certain instances, a partial disclosure is proper.

Pursuant to 10 C.F.R. 1004.6(d), Nicholas G. Prospero, acting Director, Office of Classification, Office of Environment, Health, Safety and Security, is the official responsible for the denial of the DOE classified information.

Pursuant to 10 C.F.R. §1004.1, DOE will make available records it is authorized to withhold under the FOIA whenever it determines that such disclosure is in the public interest. With respect to the information withheld from disclosure pursuant to Exemption 3, DOE has no further discretion under the FOIA or DOE regulations to release information currently and properly classified as Restricted Data under the AEA.

Pursuant to 10 C.F.R. § 1004.7(b)(2), I am the individual responsible for the determination to withhold the Exemption 6 and 7E information described above. The FOIA requires that "any reasonably segregable portion of a record shall be provided to any person requesting such record after deletion of the portions which are exempt." 5 U.S.C. § 552(b). As a result, a redacted version of the documents is being released to you in accordance with 10 C.F.R. §1004.7(b)(3).

This decision, as well as the adequacy of the search, may be appealed within 90 calendar days from your receipt of this letter pursuant to 10 C.F.R. § 1004.8. Appeals should be addressed to Director, Office of Hearings and Appeals, HG-1, L'Enfant Plaza, U.S. Department of Energy, 1000 Independence Avenue, S.W., Washington, D.C. 20585-1615. The written appeal, including the envelope, must clearly indicate that a FOIA appeal is being made. You may also submit your appeal by e-mail to OHA.filings@hq.doe.gov, including the phrase "Freedom of Information Appeal" in the subject line (this is the preferred method by the Office of Hearings and Appeals). The appeal must contain all the elements required by 10 C.F.R. § 1004.8, including a copy of the determination letter. Thereafter, judicial review will be available to you in the Federal District Court either (1) in the district where you reside, (2) where you have your principal place of business, (3) where DOE's records are situated, or (4) in the District of Columbia.

You may contact DOE's FOIA Public Liaison, Alexander Morris, FOIA Officer, Office of Public Information, at 202-586-5955, or by mail at MA-46/Forrestal Building 1000

Independence Avenue, S.W., Washington, D.C., 20585, for any further assistance and to discuss any aspect of your request. Additionally, you may contact the Office of Government Information Services (OGIS) at the National Archives and Records Administration to inquire about the FOIA mediation services they offer. The contact information for OGIS is as follows: Office of Government Information Services, National Archives and Records Administration, 8601 Adelphi Road-OGIS, College Park, Maryland 20740-6001, e-mail at ogis@nara.gov; telephone at 202-741-5770; toll free at 1-877-684-6448; or facsimile at 202-741-5769.

The FOIA provides for the assessment of fees for the processing of requests. *See* 5 U.S.C. § 552(a)(4)(A)(i); *see also* 10 C.F.R. § 1004.9(a). In our October 19, 2021 letter, you were advised that your request was placed in the "other" category for fee purposes. Requesters in this category are entitled to two (2) free hours of search time and are provided 100 pages at no cost. DOE's processing costs did not exceed $15.00, the minimum amount at which DOE assesses fees. Thus, no fees will be charged for processing your request.

This is the final response that you will receive from this office regarding your request. You may contact me or Jennifer Goldsmith of my staff with any questions about the processing of your request or this letter at:

MA-46/ Forrestal Building
1000 Independence Avenue, S.W.
Washington, DC 20585
(202) 586-5955

I appreciate the opportunity to assist you with this matter.

Sincerely,

Alexander C. Morris
Digitally signed by Alexander C. Morris
Date: 2022.09.12 11:08:01 -04'00'

Alexander C. Morris
FOIA Officer
Office of Public Information

Enclosures

INDEX

Request #: HQ-2021-00602-F

Final response to request for:

> **A copy of the syllabus, the outline, and the presentation slides from the Department of Energy's Historical Restricted Data Reviewer course.**

DOE's Office of Health, Environment, Safety, & Security (AU) has completed its search and identified three (3) documents responsive to your request.

- One (1) document *is being released in its entirety.*

- One (1) document *is being released, in part, pursuant to Exemption 3.*

- One (1) document *is being released, in part, pursuant to Exemptions 6 and 7(E).*

HISTORICAL RECORDS RESTRICTED DATA REVIEWERS COURSE DESCRIPTION

Duration: 4 Days

Designed For: All individuals in agencies and subagencies subject to section 3.3 of Executive Order 13526, "Classified National Security Information," who are conducting page-by-page reviews for Restricted Data (RD) and/or Formerly Restricted Data (FRD) in the course of reviewing their agency's documents.

Description: RD and FRD are distinct categories of classified information controlled by the Atomic Energy Act. RD can only be declassified by DOE. FRD must be jointly declassified by DOE and the Department of Defense (DoD). Other agency reviewers may encounter unmarked RD and/or FRD during the declassification reviews of documents containing National Security Information. This course provides a historical background and technical overview designed to give students the ability to recognize potential RD and/or FRD information in documents for the purpose of tabbing and setting them aside. The course consists of 17 modules, each of which concentrates on a different area of potentially classified information.

Module A	-	Introduction
Module B	-	Nuclear Science and Related Terms
Module C	-	History of U.S. Nuclear Energy Program
Module D	-	History of DOE Facilities
Module E	-	The Classification System and Related Issues
Module F	-	Nuclear Weapons I
Module G	-	Nuclear Weapons II
Module H	-	Safing, Arming, Fuzing, and Firing
Module I	-	Nuclear Weapon Use Control
Module J	-	Nuclear Weapon Outputs and Effects
Module K	-	Vulnerability and Hardening
Module L	-	Military Utilization of Nuclear Weapons
Module M	-	Isotope Separation
Module N	-	Production Reactors and Related Technologies
Module O	-	Naval Nuclear Propulsion Information
Module P	-	Report to Congress/Lessons Learned
Module Q	-	National Security Information E.O. 13526

The course uses review aids, examples, and practical exercises extensively and a final examination is given at the conclusion of the course. To pass this course, students must correctly identify all documents containing potential RD or FRD. Numerous handouts are provided along with copies of all unclassified slides used. Handouts and slides provide ready reference material for the student.

Goal: Successful completion of the course will enable reviewers to recognize nuclear information appearing in records not marked as containing RD/FRD which should be identified as potential RD/FRD and set aside. DOE will certify successful students as Historical Records Restricted Data Reviewers.

Clearance Level Required: DOE "Q" **OR** DoD Final Secret or Top Secret with Critical Nuclear Weapons Design Information (CNWDI) certification. **Please note that attendees from other agencies must submit all clearance paperwork 15-working days before the training begins.**

Prerequisites: None

~~SECRET/RD~~

D00052359

REDACTED COPY

(U) Module G: Nuclear Weapons II

~~**Restricted Data**~~

~~This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Unauthorized disclosure subject to Administrative and Criminal Sanctions.~~

~~Classified By: Randy Grimm, Sr. Trainer, DOE, AU-61~~

~~Derived From: CG-W-5 dated 10/16/95 DOE OC~~

~~DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW~~

1st Review Date: 06/17/2021	DETERMINATION (CIRCLE NUMBER(S))
Authority: ☐ DC ☒ DD	1. CLASSIFICATION RETAINED
Name: Carl Sink	2. CLASSIFICATION CHANGED TO:
2nd Review Date: 06/21/2021	3. CONTAINS NO DOE CLASSIFIED INFO
Authority: DD	4. COORDINATE WITH:
Name: R.L. Shankle	5. CLASSIFICATION CANCELED
	6. CLASSIFIED INFO BRACKETED
	7. OTHER (SPECIFY):

~~CRITICAL NUCLEAR WEAPON DESIGN INFORMATION~~
~~DoD DIR 5210.2~~

~~SECRET/RD~~

20210015161

Types of Fission Weapons

- Gun-assembled
- Implosion-assembled

Why Two Designs?

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- Availability of material

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Gun-Assembled Weapons

- Advantages:

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- Disadvantages:

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Gun-Assembled Weapons

Warhead	Dates	Delivery System
Little Boy (LB)	WWII	B29 & B36
T4	12/53 - 12/63	ADM
D8	1/51 - 8/56	Aircraft
W9	9/50 - 5/57	280 mm
B11	6/56 - 3/60	Aircraft (AF&N)
W19	4/53 - 7/63	280 mm
W23	4/55 - 10/56	16 in. gun (N)
W33	8/56 - 9/92	8 in. How.

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DELETED Implosion-Assembled Weapon

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- Advantages:

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- Disadvantages:

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Pit Development

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Pit Types

- Capsule
- Sealed-pit

Capsule-Type Pit

- Capsule

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Sealed Pit

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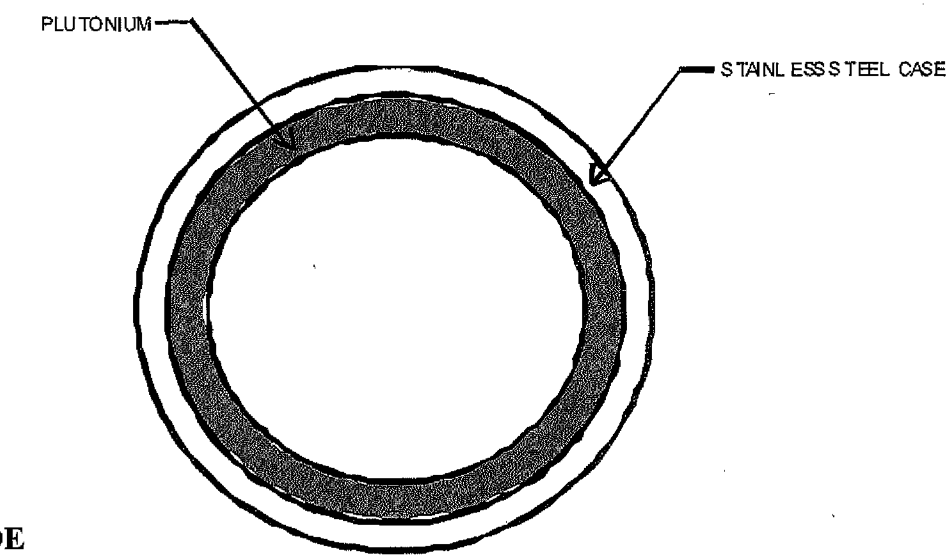

- Not accessible for pit removal or exchange

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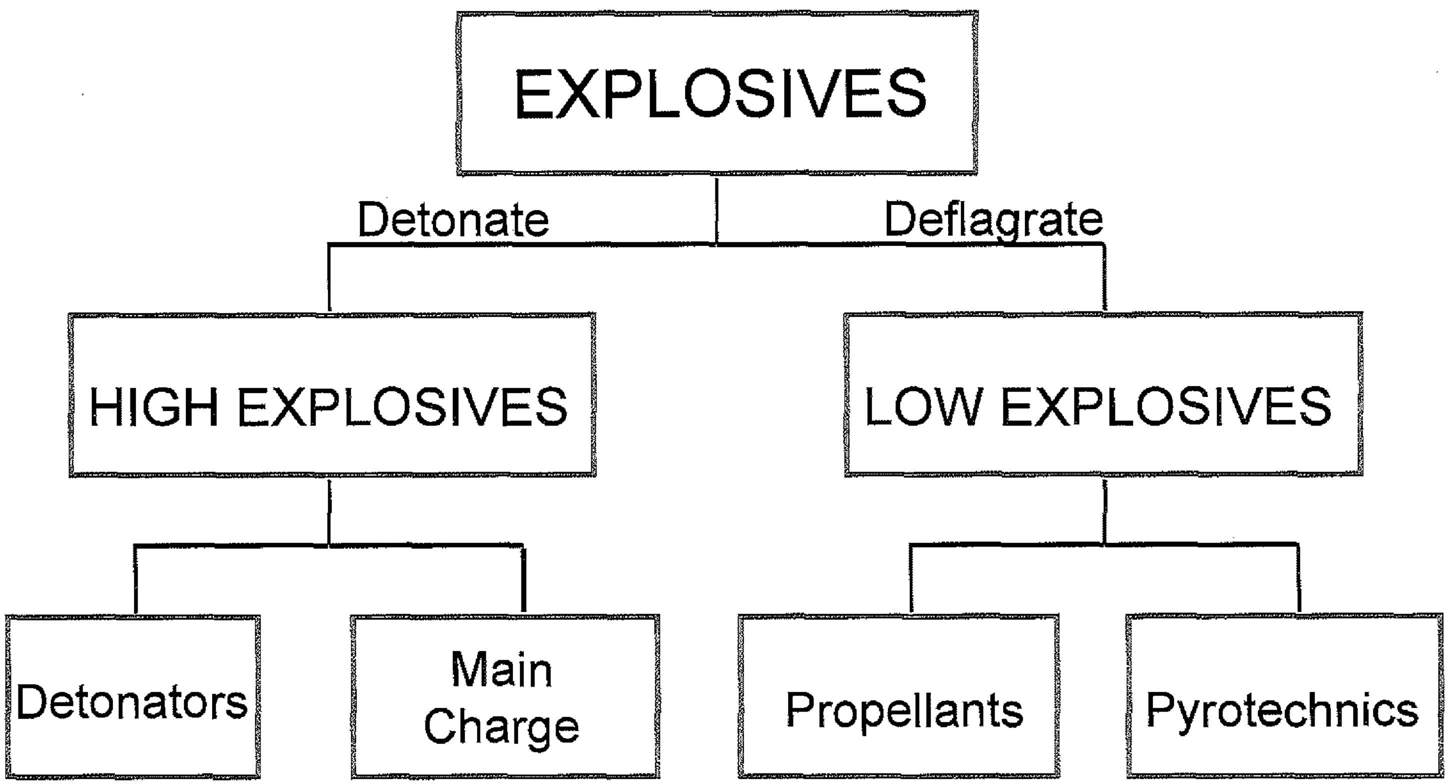
EXPLOSIVES AND IMPLOSION SYSTEMS

Types of Explosives



In The Beginning
1944

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DETONATORS AND DETONATION SYSTEMS

In The Beginning
1944

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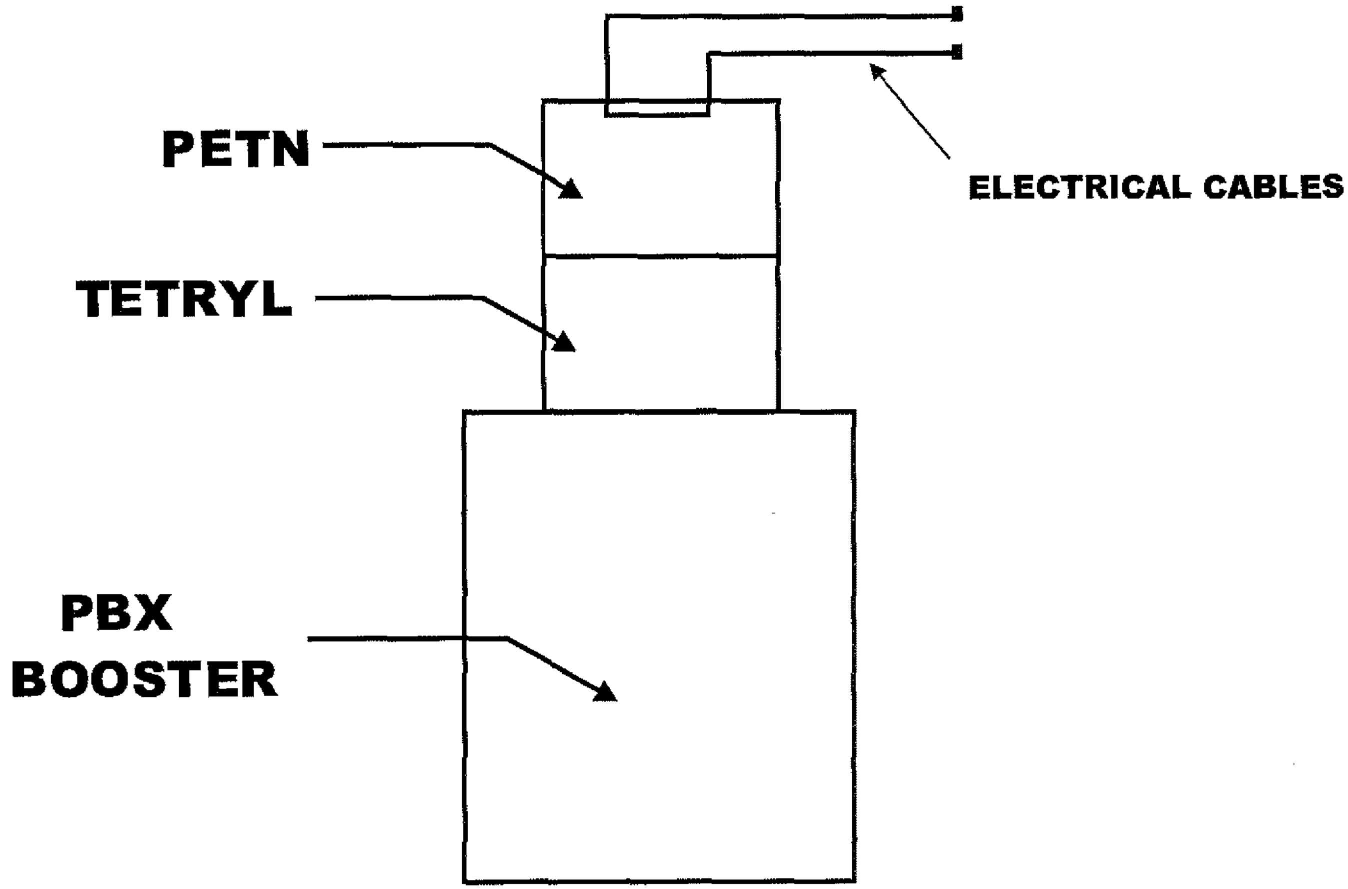
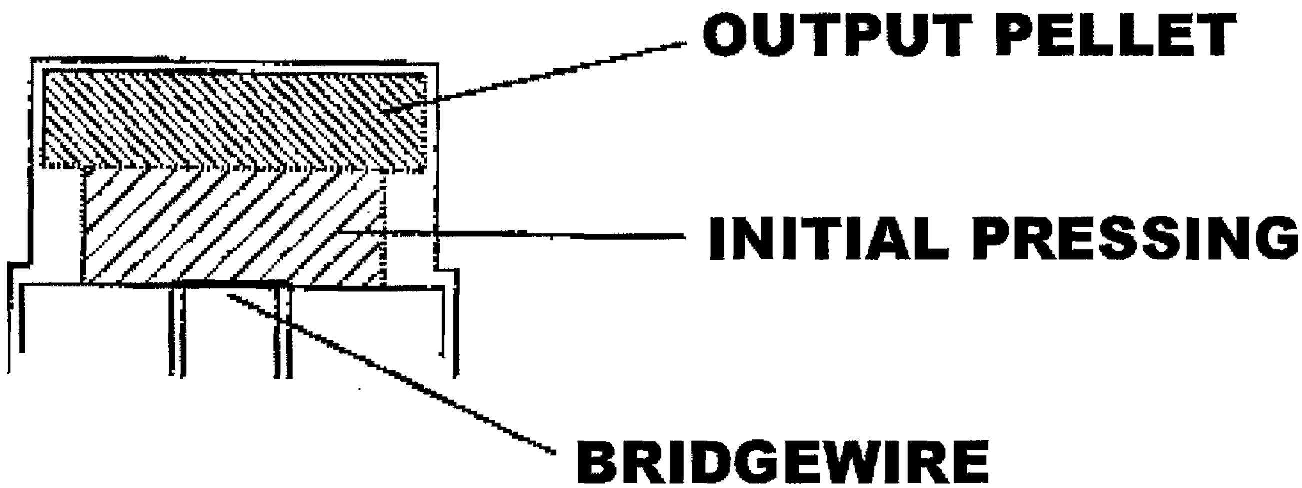
Generic Detonator



Exploding Bridgewire Detonators



Weapon Initiators

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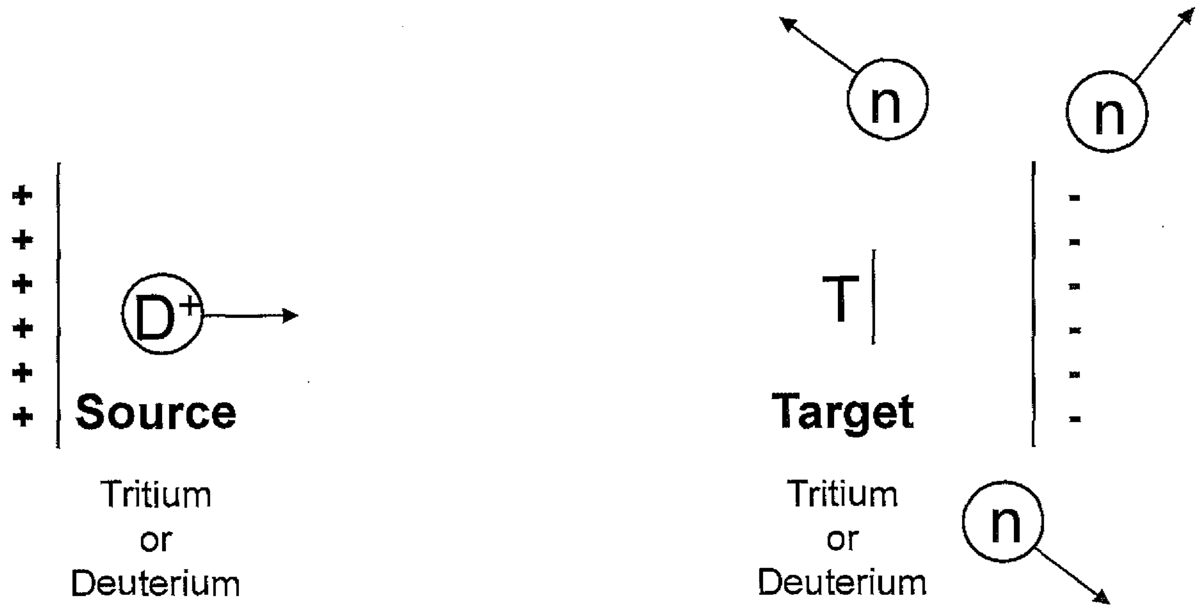
External Initiators Neutron Generators (Zippers)



- Utilizes DT fusion reaction
- Limited Lifetime Component (LLC)

Boosting and Transfer Systems

Boosting and Transfer Systems

- Why boost?

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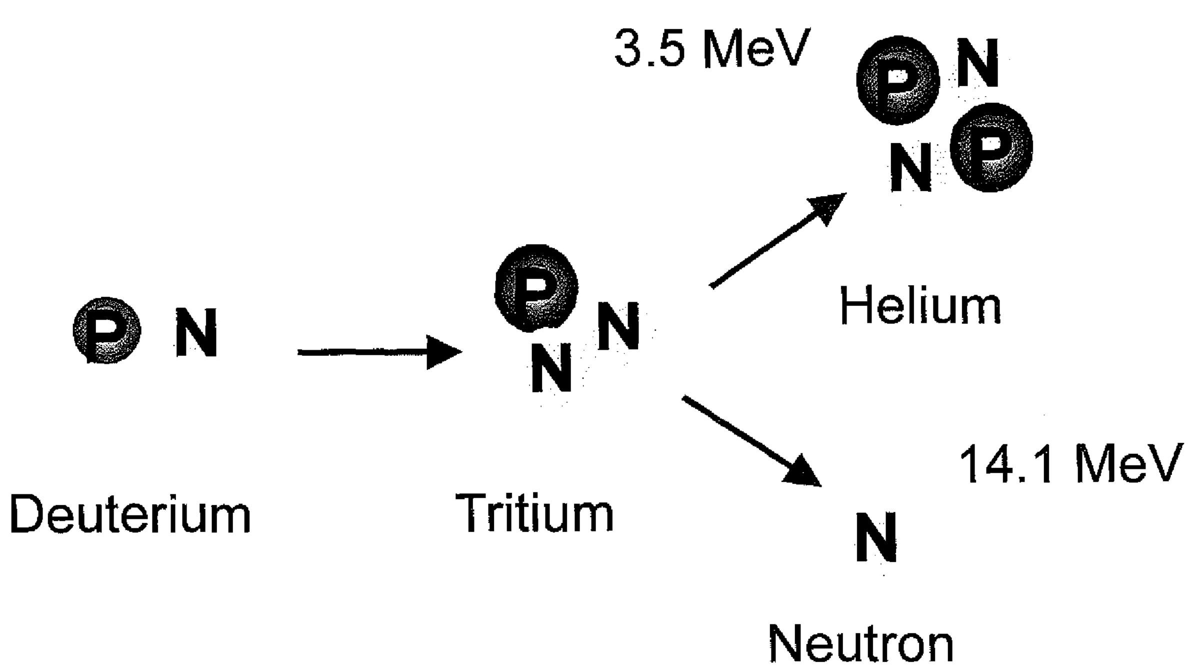
- Types of reservoirs

Boosting Reaction



Why Boost?

- More efficient burning of fuel

- Increased yield

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- Implosion and fission compresses/heats gas
- Each 14.1 MeV neutron yields 5 to 10 additional fissions

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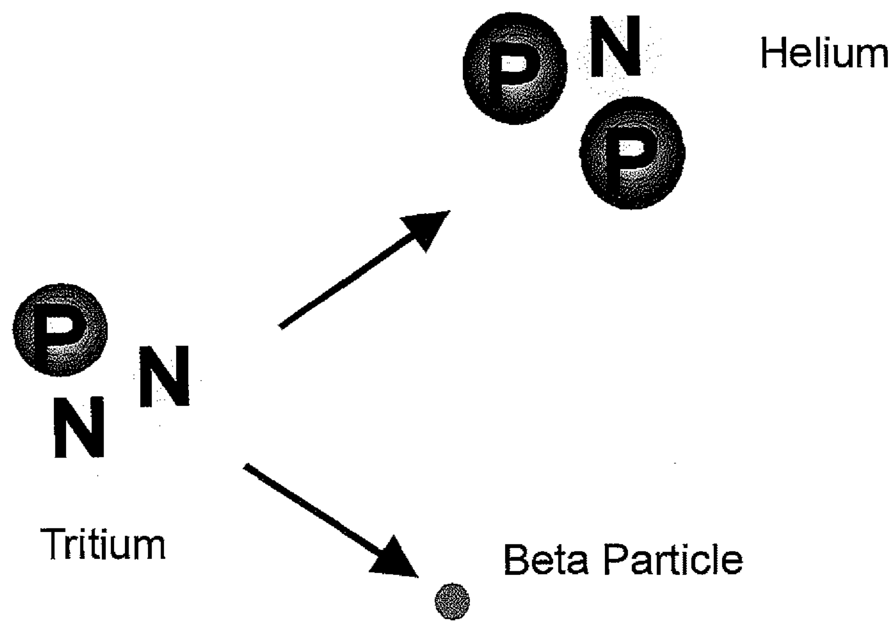
Tritium Decay



- Decreases 5.6% each year
- Less tritium available for reaction
- Reservoirs must be replaced periodically (Limited Lifetime Components (LLC))

Helium Problem

- Decreases neutrons available for fission chain reaction since it acts as a neutron absorber
- Causes 5.6% increase in pressure each year - retards implosion
- Embrittles containment material

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Types of Reservoirs

- Equilibrium
- Clean sweep
- Extended-life
- Solid storage

Equilibrium Reservoir

- Once gas pressure in pit and reservoir are equal, transfer stops

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Clean Sweep Reservoir

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Extended Life Reservoir

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Solid Storage Reservoirs

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~~SECRET/RD~~

Thermonuclear (Staged) Weapons

Why Thermonuclear Weapons?

- Yield of single-staged weapons is limited

- Missile application demanded higher yield-to-weight ratio

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Staged Weapons (Overview)

- Primary
- Radiation Transport

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- Secondary

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Radiation Case (High Z)

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Thermonuclear Fuel

- Liquid Deuterium (Mike Device-1952)
  - Cryogenic equipment required
  - Not weaponizable
- Solid Fuel (First tested 1954-Shot Bravo)
  - Lithium-deuteride fuel (^{6}Li + neutron = T + He)

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Use of Solid Thermonuclear Fuels

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- LiD is easier to handle (no cryogenic system required)

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Other Staged Weapon Development

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Clean Devices

- A device designed to reduce fission products and other sources of radiation in the residue

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Yield Variations

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Tailored Outputs (X-ray Emitters)

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- Neutron emitters

Weapon Materials

Weapon Materials

- Fission and fusion fuels (specified weapon/location/assay)
  - U-235
  - Pu-239
  - U-233
  - U-238
  - Deuterium (D)
  - Tritium (T)
  - LiD

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Summary

- Types of Fission Weapons
- Explosives and Implosion Systems
- Detonators and Detonation Systems
- Weapon Initiators
- Boosting and Transfer Systems
- Thermonuclear (Staged) Weapons
- Weapon Materials

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Example of RD Information in Documents Not Appropriately Marked

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Example of RD Information in Documents Not Appropriately Marked

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Classification Guidance

CG-W-5

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Example of RD Information in Documents Not Appropriately Marked

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Example of RD Information in Documents Not Appropriately Marked

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Classification Guidance

TCG-DS-2

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Example of FRD Information in Documents Not Appropriately Marked

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Example of FRD Information in Documents Not Appropriately Marked

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CT-A-BT (Defense Information Weapon Data Glossary):

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TCG-WT-1

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Example of Association

Subject: Readiness of Mound's Special Unload Operations

Page 1

.....The Special Unload project consists of approximately 500 units of a specific design reservoir that have been removed from active stockpile...

DOE b(3)

Page 2

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DOE b(3)

Page 3

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Example of Association

Subject: Readiness of Mound's Special Unload Operations

Page 1

.....The Special Unload project consists of approximately 500 units of a specific design reservoir that have been removed from active stockpile ..

Page 2

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Page 3

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Classification Guidance

TCG-BTS-2

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Example of Association

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Example of Association

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Classification Guidance

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Material	Use in Nuclear Weapons Research	Used in Nuclear Weapon Unspecified	Used in Nuclear Weapon Specified

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Document 3

Historical Records Restricted Data Reviewers Course

U.S. Department of Energy

Department of Energy
Office of Classification
Classification Training Institute (CTI)

(b) (6)





Module A:

Introduction





Boeing B-47E 'Stratojet'
©USAF Museum


Why Are You Here?

- To become Historical Records Restricted Data Reviewers
  - Recognize Restricted Data/Formerly Restricted Data associated terms in context
  - Tab potential Restricted Data/Formerly Restricted Data documents

What's the Big Deal?

Thermonuclear Weapons

FRD

Missile

- Restricted Data

Production Reactors

CNWDI

- Formerly Restricted Data

- Critical Nuclear Weapon Design Information

Gas Centrifuge

Plutonium Production

- Naval Nuclear Propulsion Information

Naval Reactors

NNPI

RD

Gaseous Diffusion

Strategic Deterrence

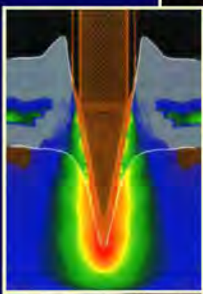
RD and FRD information represent the keys to our nation's strategic nuclear defense

- We are second to none
  - nuclear weapons
  - naval nuclear power
- Invested the Most, Have the Best…
- ***EVERYONE*** would like access to our **"RD/FRD Knowledge Base"**
- Information dating to the very early years of the program is still sensitive and valuable

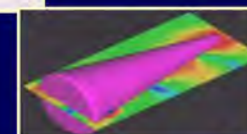
For Example,
Our Current Nuclear Forces Represent

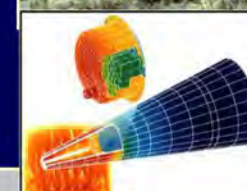


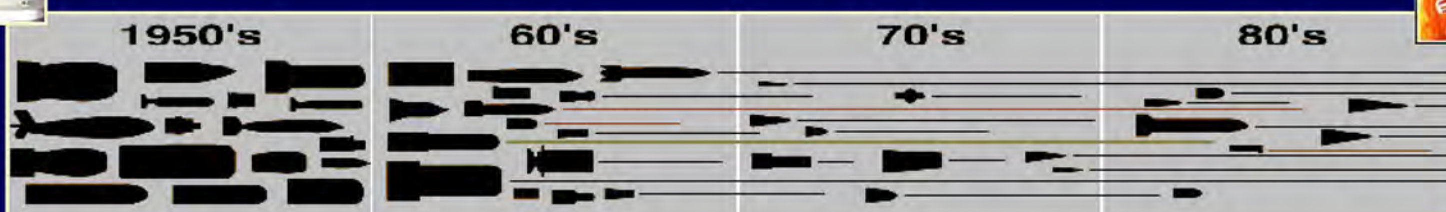



- Over 70 Years of Design and Stockpile Experience
- Tens of Thousands of Analyses & Non-Nuclear Tests
- More Than 1,000 Nuclear Tests
- 150 Nuclear Tests With Modern Weapon Types
- 14,400 Surveillance Tests
  - 70,000 Weapons of 48 Types







RD/FRD Documents in Historical Records Protect This Information

You Thought Nuclear Forces Were Passé in the 21st Century

groundzero in-depth specials

Flashback to '95: Doomsday Clock moves forward

CNN News

Special Report:
The Nuclear Crisis -
India & Pakistan

The fallout from India's nuclear tests could forever alter the global nuclear landscape–

and not for the better.

ABCNEWS.com, May 13, 1998

The longtime rivals have fought three wars since both gained independence from Britain in 1947, and last month's nuclear tests raised fears the next war could be a nuclear one.

ABC News.com, June 23, 1998

A Changing Landscape

Nuclear Weapons
<u>Development??</u>

<u>Nuclear Powers</u>

All Current Powers Face Challenges With What We Call "Stockpile Stewardship"

1940s-1950s
Older Technologies

→

Mid 1960s
Early Thermonuclear Weapons

→

1970s-80s to Today
Advanced Thermonuclear Weapons

One Key Point on Proliferation

- Our older technology may be the most attractive to "New Players"

  - Early fission weapons designs
    - simpler to design and manufacture

  - Isotope separation methods
    - gaseous diffusion = 1940s technology

East Tennessee Technology Park (formerly Oak Ridge Gaseous Diffusion Plant)

RD/FRD Protect the Most Critical Information

What We Don't Want

There Are Two Authorities For Classified Information

<u>Executive Order</u>
EO 13526

<u>Established by President</u>

National Security Information
(National Defense,
Intelligence, Foreign
Relations, etc.)

<u>Statute</u>
Atomic Energy Act

<u>A DOE Responsibility</u>

Restricted Data (RD)
Formerly Restricted Data (FRD)*
(Nuclear Related Technologies)

*Joint responsibility with DoD

ALL RD/FRD is Classified

- By the Atomic Energy Act
- NOT Under Executive Order 13526
  - NOT Exemption 2 - “Weapons of Mass Destruction”
  - NOT Exemption 9 - “Violate a Statute”

Executive Order 13526 "Classified National Security Information"

- Section 6.2(a) -- Excludes RD and FRD from ALL provisions of the EO, including this automatic declassification requirement

- Section 3.3 -- Requires all NSI records more than 25 years old which have permanent historical value to be automatically declassified whether or not the records have been reviewed

Why Are We Concerned?

DOE surveyed selected NSI files scheduled for public release under President Clinton's EO 12958 and found RD

The disclosure of this RD would damage:

- National Security
- Nonproliferation

(b) (7)(E)

FY 1999 Defense Authorization Act Conference Report

"The conferees support current efforts to reduce the volume of information retained as classified. The conferees are, however, concerned that Executive Order 12958 does not ensure adequate protection of information classified as Restricted Data…"

Congressional Record -- Sept. 22, 1998

Public Law 105-261
Section 3161

(The Kyl Amendment)

"Protection Against Inadvertent Release of
Restricted Data
and
Formerly Restricted Data"

Public Law 105-261

- "The Secretary of Energy and the Archivist of the United States shall … develop a plan … "
- "… actions to be taken … ensure … records … are reviewed on a page-by-page basis for Restricted Data … unless …determined to be highly unlikely to contain Restricted Data …"

Public Law 106-65

(The Lott Amendment)

- "The Secretary of Energy and the Archivist of the United States shall … develop a supplemental plan …"

- "…application of that plan…to all records…determined before…enactment of that Act [105-261] to be suitable for declassification."

About the Plan ...

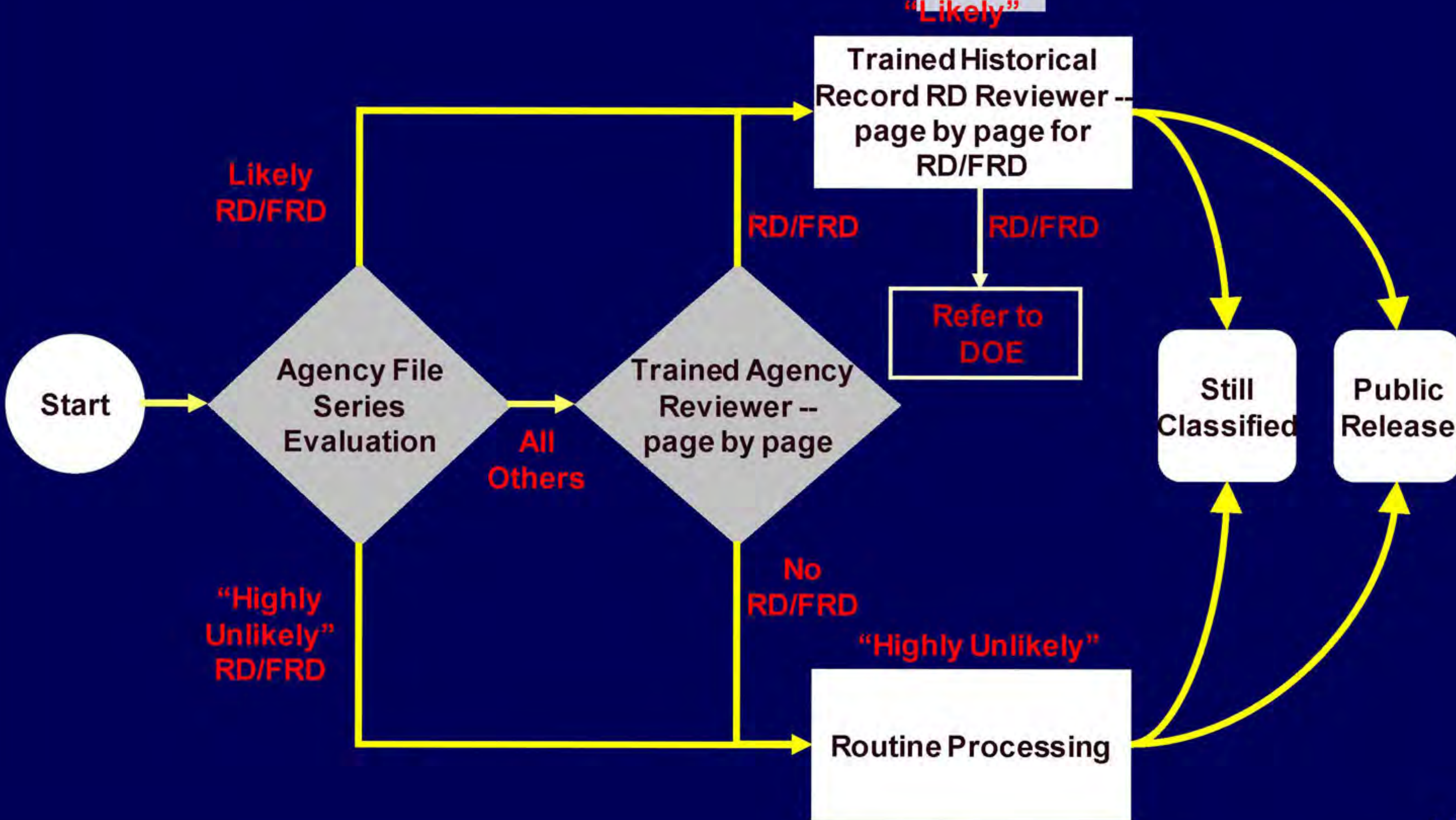
Separate the "Highly Unlikely" Records

- Agency evaluates file series through random sampling or survey, visual inspection for RD/FRD markings, or any other method
- Agency official certifies those file series determined as "highly unlikely" to contain RD/FRD
- Processes such file series under regular automatic declassification procedures

Page-by-Page Reviews for RD/FRD

- For file series likely to contain RD/FRD, agency Historical Records RD Reviewer conducts page-by-page review for RD/FRD of each record in file series
- For all other file series, agency reviewer conducts page-by-page review
  - If RD/FRD found, file series must be processed as described above
  - If no RD/FRD found, agency shall process file series routinely

Review of Records Under Public Law 105-261



Ensure Training, Supervision, and Evaluation

- DOE conducts RD/FRD recognition training
  - Recognition seminar for agency reviewers
  - Historical Records RD Reviewer course
- Agency develops an implementation plan that describes technical and administrative aspects of review, such as:
  - Quality assurance/quality control measures
  - Processing steps for document reviews
  - Expected review quotas

Procedures for Periodic DOE Review of Agency Compliance

- Quality assurance review of agency's implementation of plan
- Quality control review of declassified records to ensure RD/FRD is not being released
- If review reveals errors, DOE evaluates potential damage to national security and recommends course of action

Reports

- DOE reports to NSC and Congress
  - Results of quality control/quality assurance reviews
  - Periodically, but not less than once a year

- Agency required to notify DOE of inadvertent release of documents

Dispute Resolution

Agency submits concerns to DOE or Director of Information Security Oversight Office (ISOO)

- Joint decision required within 30 days
- Appeal rights to Secretary of Energy

Summary

- Why You are Here
- Importance of Protecting RD and FRD
- Two Classification Authorities
- RD/FRD is Governed By the Atomic Energy Act
- RD/FRD Exempt from EO 13526 Provisions
- Public Law 105-261
- Implementation Plan

Historical Records Restricted Data Reviewers Course

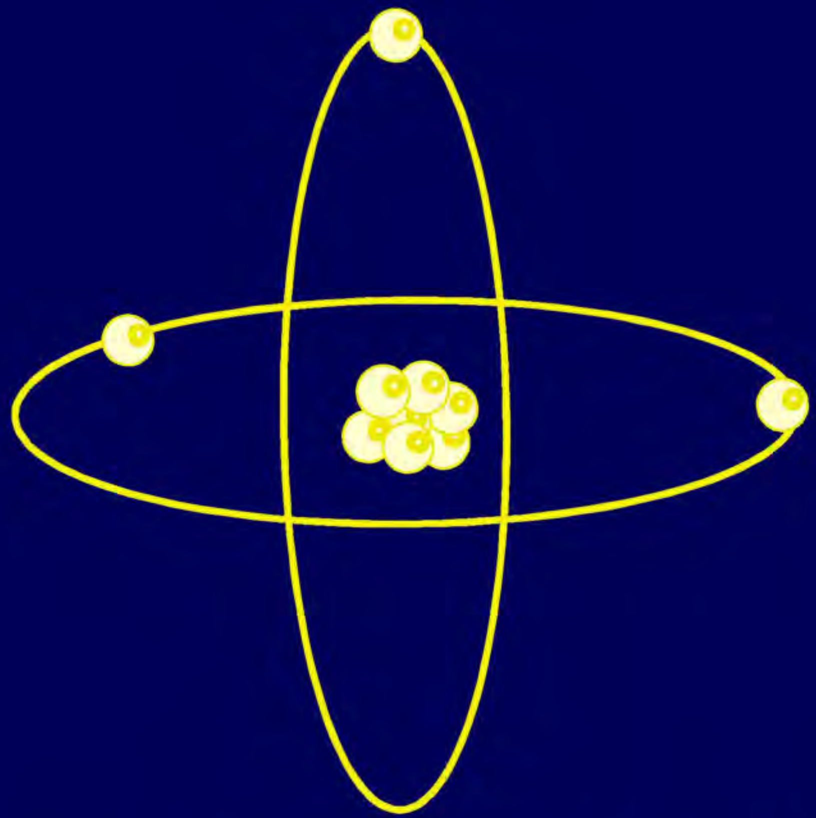
Agenda

(b) (7)(E)

Module B:

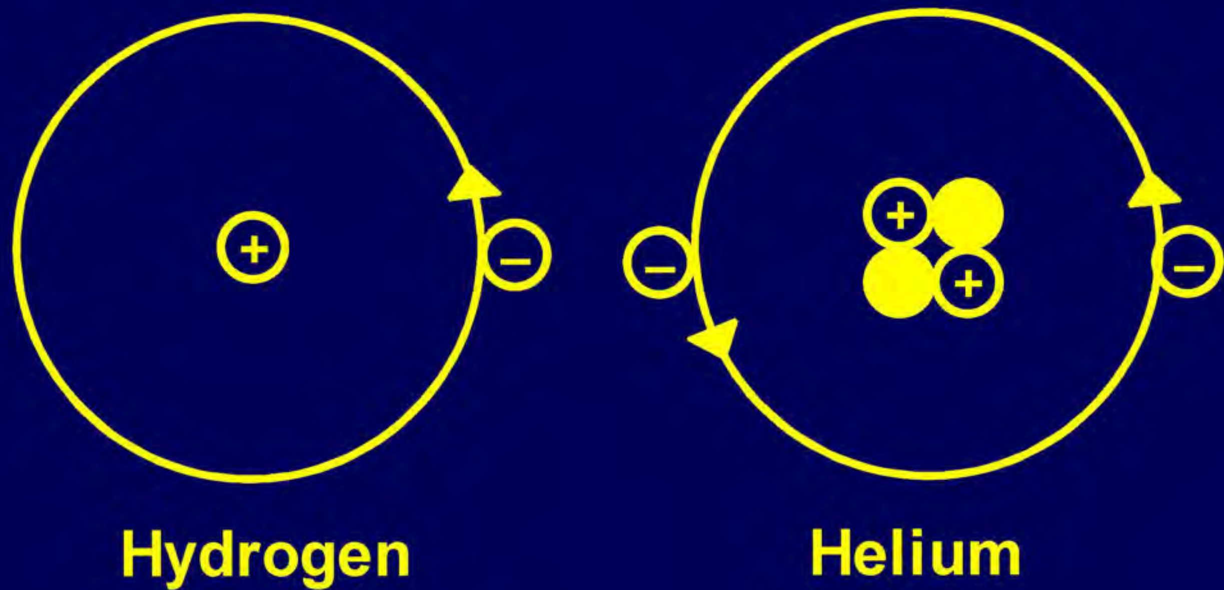
Nuclear Science and Related Terms

Atoms Are The Building Blocks Of All Matter



The nucleus contains neutrons clustered with protons

Structure of the Atom



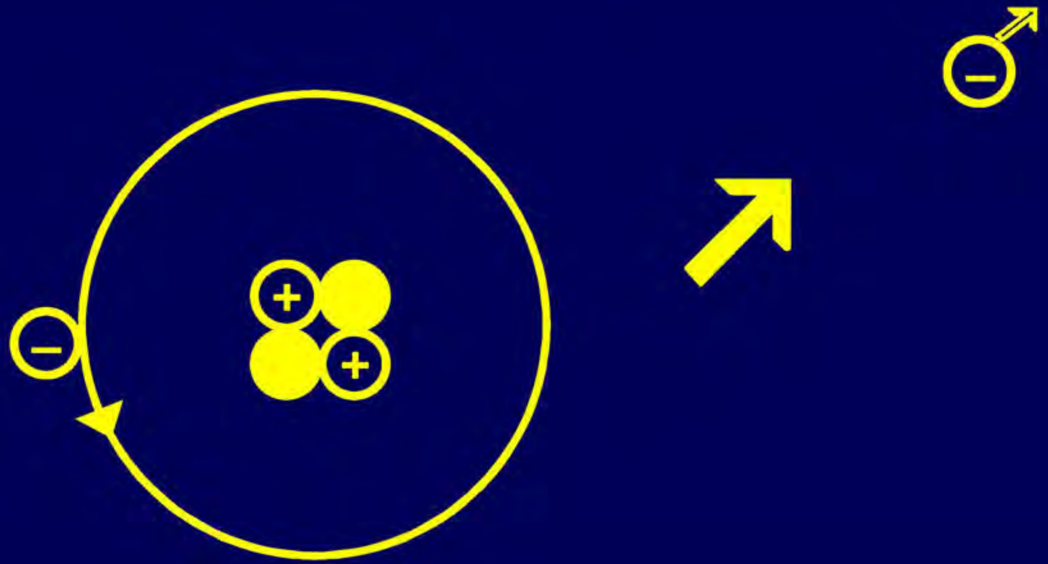
- (+) Protons - subatomic particle with charge of +e
- (●) Neutron - subatomic particle with no electric charge

} Found in small, dense central region called the nucleus

- (−) Electrons - subatomic particle with charge of -e that orbits the nucleus

Ions

- Atoms that have lost one or more of electrons
- Positively charged (+ e, + 2e,.....)
- Affected by electric and magnetic fields



Atomic Symbols

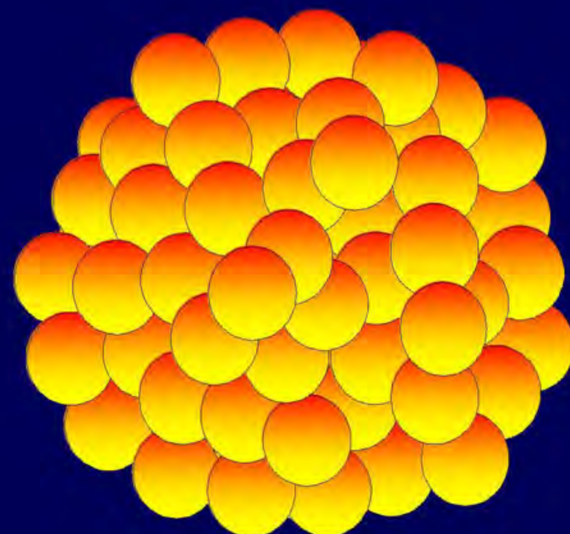
$$^{A}_{Z}\mathbf{X}$$

X - Chemical Symbol (e.g., U or Pu)

Z - Atomic Number (number of protons)

A - Atomic Mass Number (number of neutrons and protons)

Atomic Symbol (Uranium 235)



$^{235}_{92}U$

or

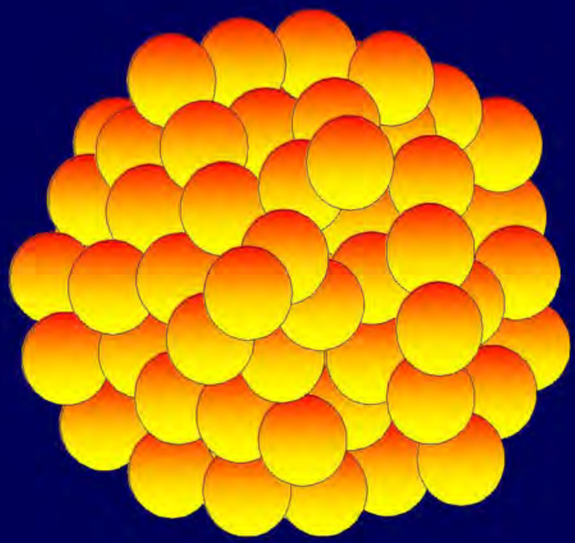
$_{92}U^{235}$

or

U-235

Chemical Symbol	=	U
Atomic Mass Number (A)	=	235
Atomic Number (Z)	=	92
Number of Neutrons (N)	=	143

Atomic Symbol (Plutonium 239)



$^{239}_{94}Pu$

or

$_{94}Pu^{239}$

or

Pu-239

Chemical Symbol	=	Pu
Atomic Mass Number (A)	=	239
Atomic Number (Z)	=	94
Number of Neutrons (N)	=	145

Periodic Table

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Cesium	56 Ba Barium	* 57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	** 89 Ac Actinium															

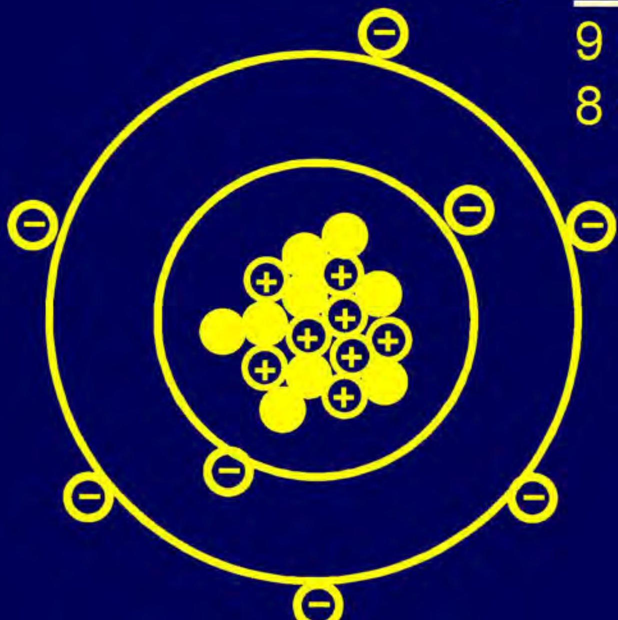
*	58 Ce Cerium	59 Pr Praseodymium	60 Nd	61 Pm Promethium	62 Sm	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium
**	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

* Lanthanide Series
** Actinide Series

Isotopes

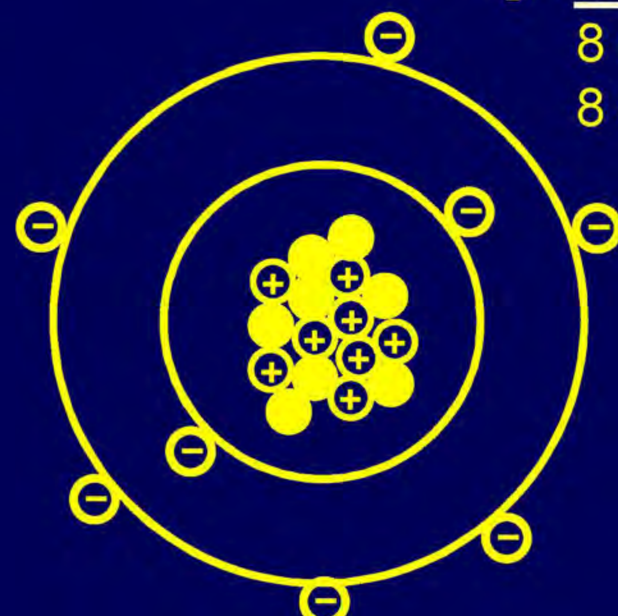
Isotopes: Nuclides having the same number of protons but different numbers of neutrons

Oxygen-17
→ **8 protons**
9 neutrons
8 electrons



$^{17}_{8}O$

Oxygen-16
→ **8 protons**
8 neutrons
8 electrons



$^{16}_{8}O$

Two Isotopes of Oxygen

Isotopes

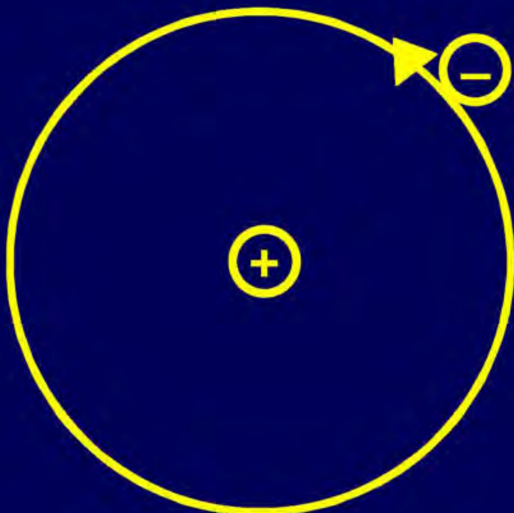
- Isotopes of the same element behave the same chemically, but have different nuclear characteristics
  - Some elements have only a single stable isotope (e.g., sodium (Na))

    $^{23}_{11}Na$

  - Some have several (e.g., lead (Pb))

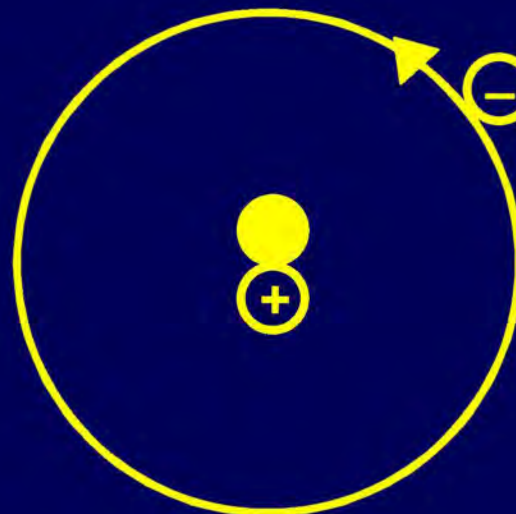
    $^{206}_{82}Pb$ $^{207}_{82}Pb$ $^{208}_{82}Pb$

Isotopes of Hydrogen



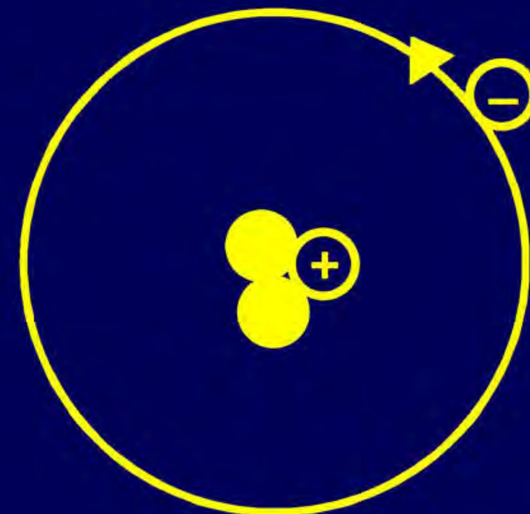
Protium
1 proton
1 electron

$^{1}_{1}\mathbf{H}$



Deuterium
1 proton
1 neutron
1 electron

$^{2}_{1}\mathbf{H}$ or $^{2}_{1}\mathbf{D}$



Tritium
1 proton
2 neutrons
1 electron

$^{3}_{1}\mathbf{H}$ or $^{3}_{1}\mathbf{T}$

Where Does Nuclear Energy Originate?

- The conversion of mass to energy:

$$E=mc^2$$

- The processes - fission and fusion

Changing Mass Into Energy

Fission

- Heavy (high Z) nucleus splits into two lighter nuclei

Fusion

- Light nuclei combine to form a slightly heavier nucleus

For both processes, the final mass is less than the original mass

$$E = mc^2$$

Fission

The splitting of a heavy nucleus into two lighter parts, releasing neutrons and a large amount of energy

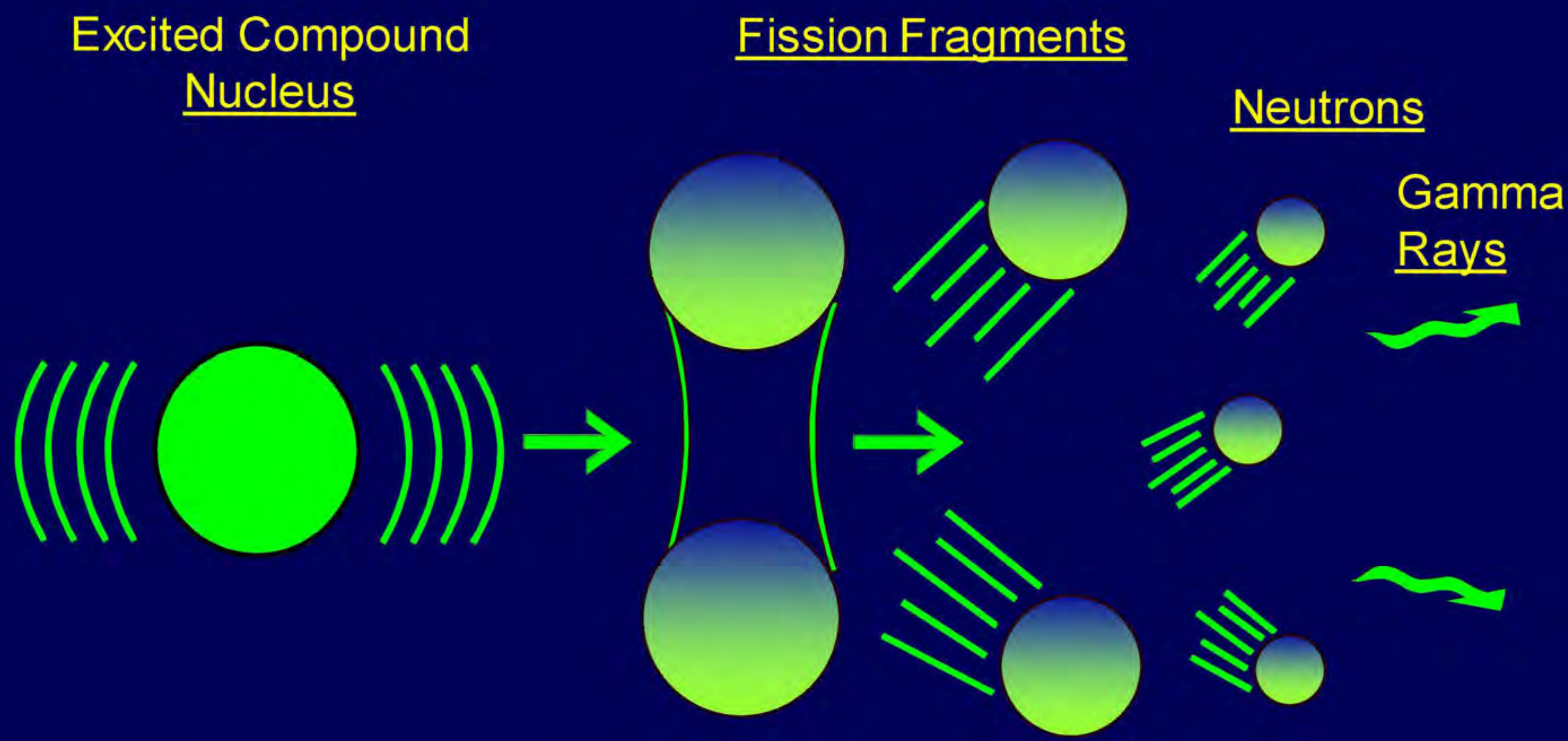
Types of Fission

- Neutron induced
- Spontaneous

Neutron Induced Fission

- A neutron will transfer its energy to the nucleus of the nuclei that absorbs it

Fission


Excited Compound Nucleus
Fission Fragments
Neutrons
Gamma Rays

Heavy Nucleus/Fission Fuel

- Not all heavy nuclei fission readily
- Some will fission by absorbing a neutron of any energy (**Fissile**)
- Some will fission only if incident neutron has a larger (threshold) amount of energy (**Fissionable**)

Fissile Nuclei
(Special Nuclear Material (SNM))

Fission is possible upon the absorption of a neutron with any amount of energy, i.e., slow or fast neutrons

$_{92}U^{233}$	$_{92}U^{235}$	$_{94}Pu^{239}$
Uranium-233	Uranium-235	Plutonium-239 *

* All plutonium isotopes are considered SNM in accordance with the Atomic Energy Act.

Fissionable Nuclei

Fission is possible only upon the absorption of a higher energy neutron (fast neutron only)

$${}_{92}U^{238}$$

Uranium-238

Fission Fragments/ Fission Products

- The new radioactive nuclides that result from the splitting of fissioning nucleus
- Over 200 isotopes from 30 different elements (zinc (Z=30) to dysprosium (Z=66))
- Analysis of fission products may divulge weapon design information, weapon yield, or nuclear material production
- Common fission products:
  - Iodine (I)
  - Cesium (Cs)
  - Krypton (Kr)
  - Strontium (Sr)
  - Xenon (Xe)

Fission Reaction Equation

General:

$$_0n^1 + {}_zX^A \longrightarrow FF_1 + FF_2 + X_0n^1 + \gamma$$

Examples:

$$_0n^1 + {}_{92}U^{235} \longrightarrow {}_{37}Rb^{97} + {}_{55}Cs^{137} + 2_0n^1 + \gamma$$

$$_0n^1 + {}_{92}U^{235} \longrightarrow {}_{38}Sr^{90} + {}_{54}Xe^{143} + 3_0n^1 + \gamma$$

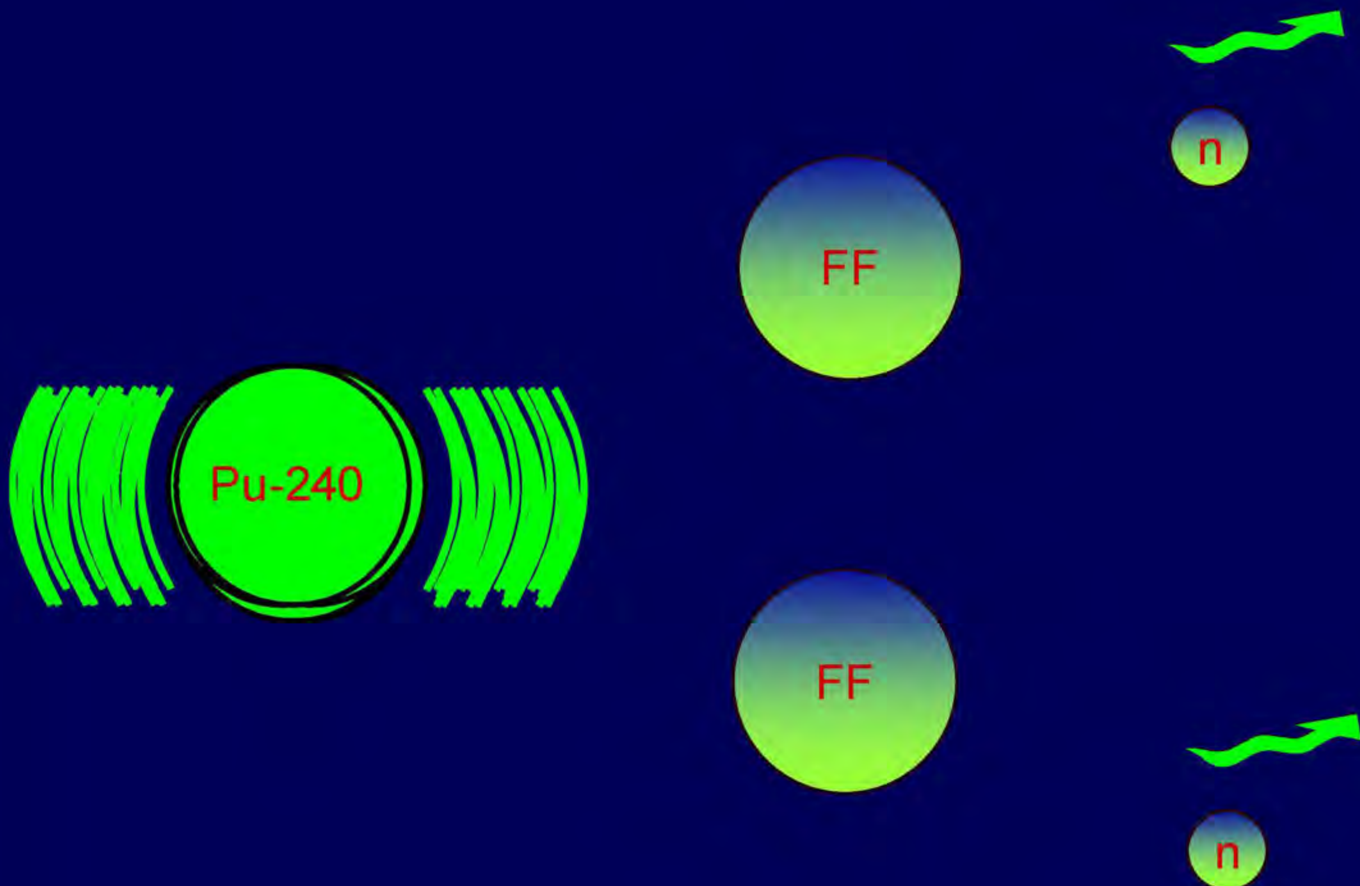
Fission Neutrons

- 2 - 4 emitted with each fission
- Energetic enough to cause additional fission in fissile fuel (U-233, U-235, Pu-239), but not fissionable fuel (U-238)

Fission of 1 Kilogram of U or Pu Yields

- 20,000,000 kilowatt hours
- Enough energy to light Washington, D.C. for a day
- 17 kilotons of energy
  (17,000 tons or 34,000,000 lbs of TNT)

Spontaneous Fission



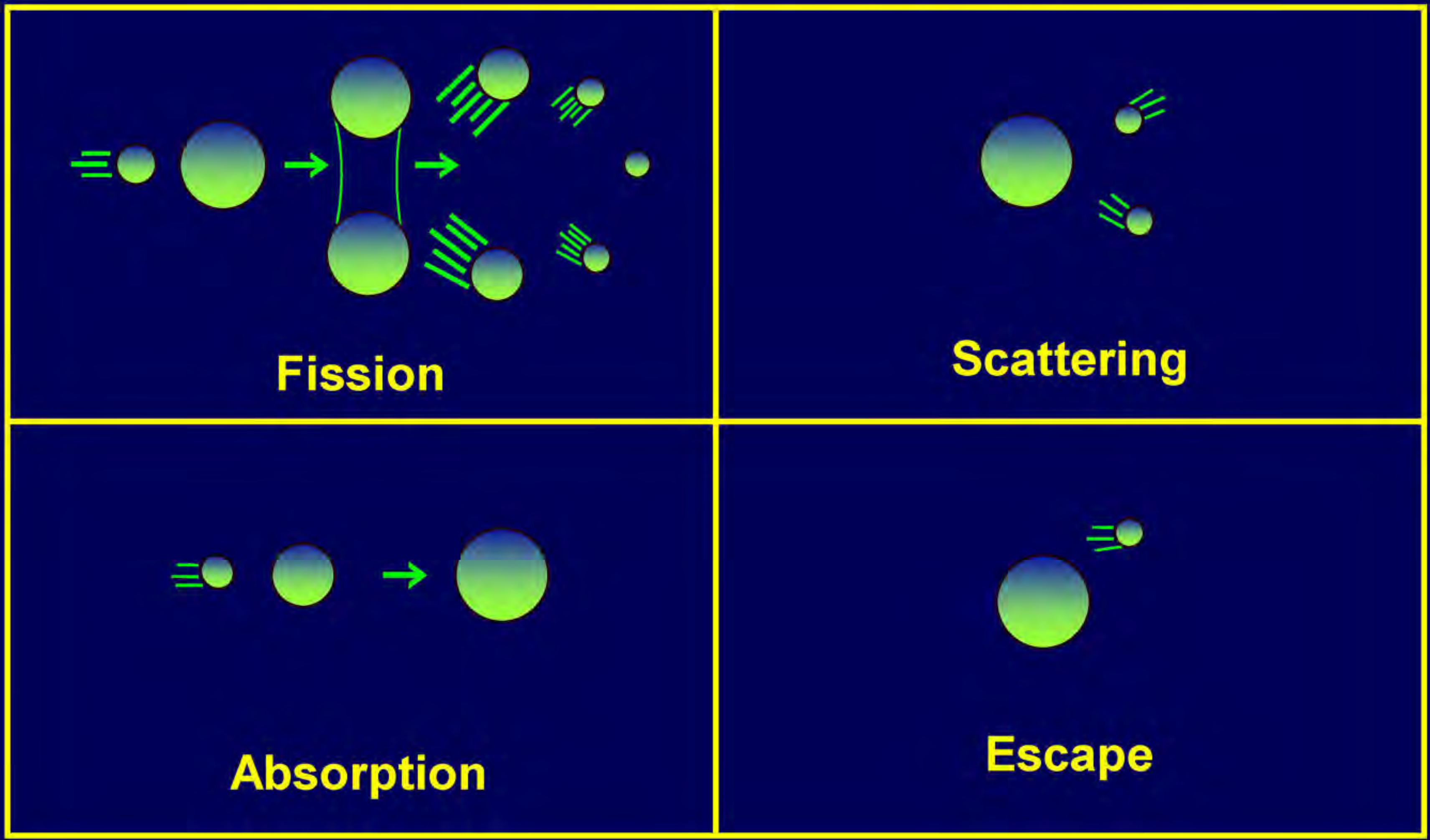
Spontaneous Fission

Nuclide Spontaneous Fission Rates

Nuclide	f/kg-min (fissions per kilogram per minute)
^{233}U	11
^{235}U	18
^{238}U	420
^{239}Pu	600
^{240}Pu*	2.8×10^{7}

* Present in all plutonium

Neutron Interactions

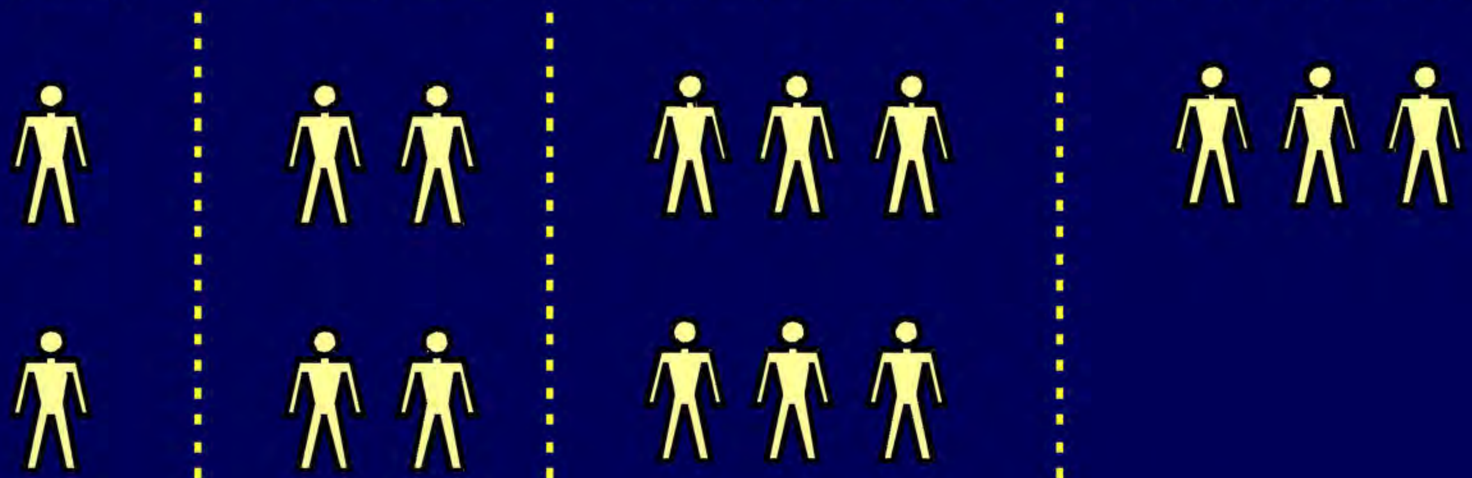


CRITICALITY

Multiplication Factor "k"

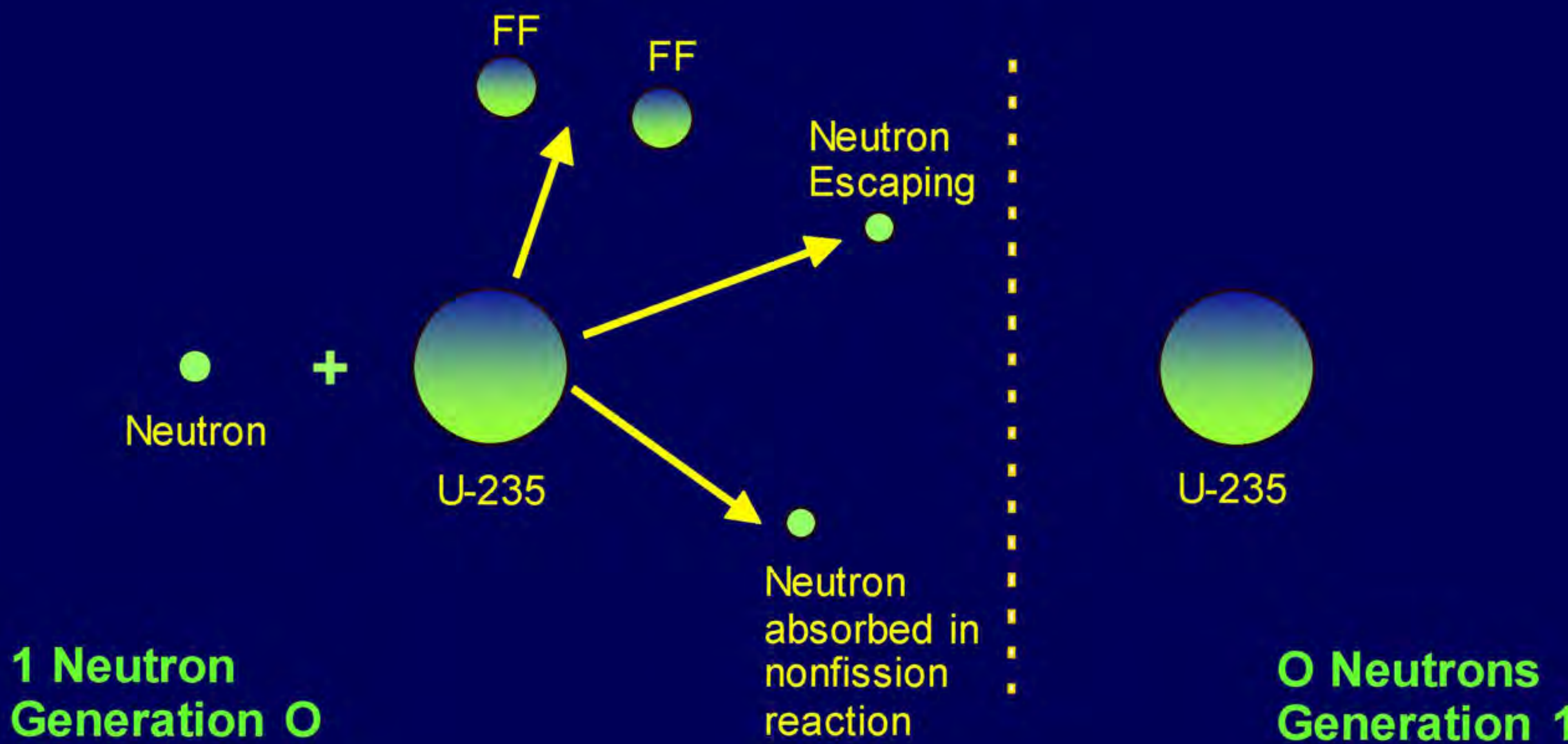
$$k = \frac{\text{number of neutrons in one generation}}{\text{number of neutrons in the previous}}$$

Parents | Children | Grand Children | Great Grand Children



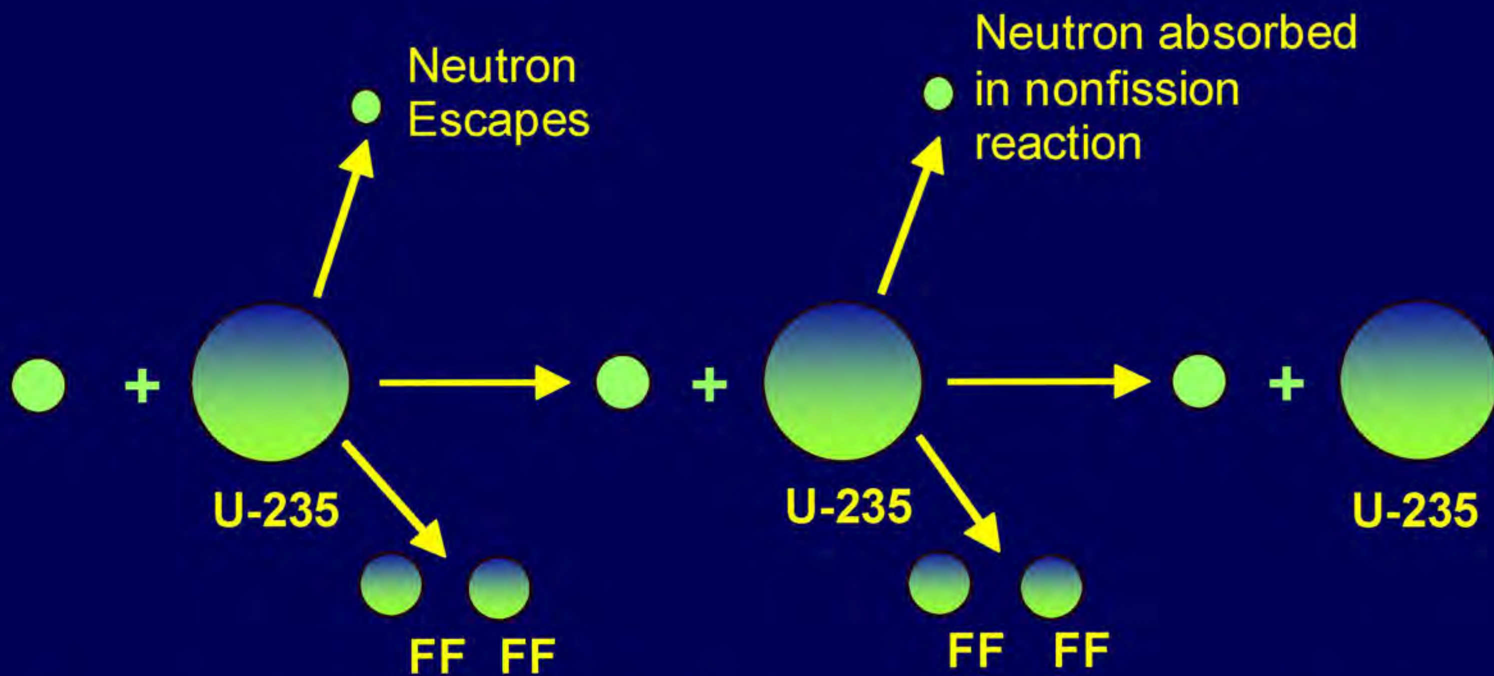
$k = \frac{4}{2} = 2$ $\quad$ $k = \frac{6}{4} = 1.5$ $\quad$ $k = \frac{3}{6} = .5$

Subcritical Nonsustaining Reaction



$$k = \frac{0}{1} = 0$$

Critical Self-sustaining Chain Reaction



1 Neutron
Generation O

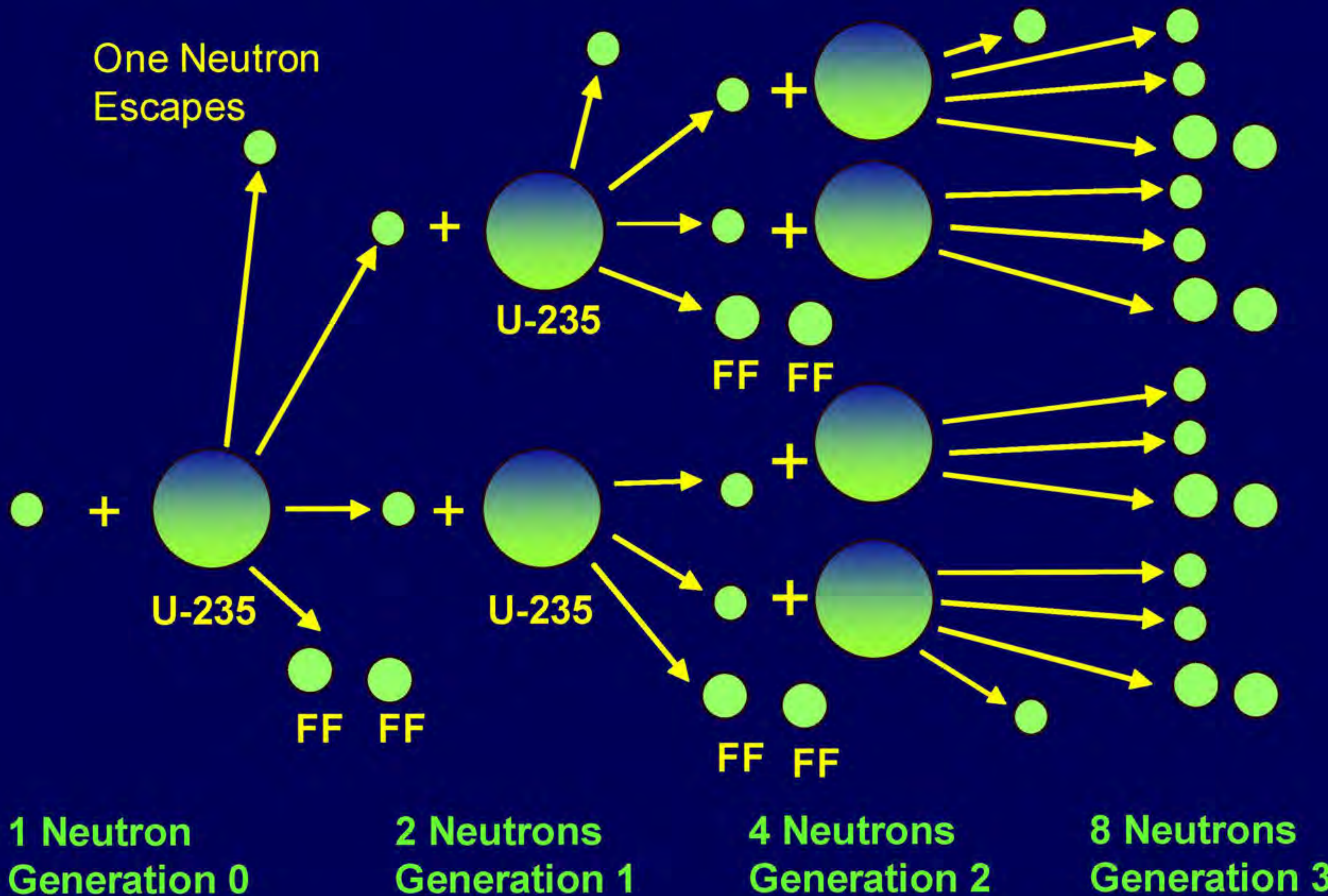
1 Neutron
Generation 1

1 Neutron
Generation 2

$$K = \frac{1}{1} = 1$$

$$K = \frac{1}{1} = 1$$

Super Critical Chain Reaction



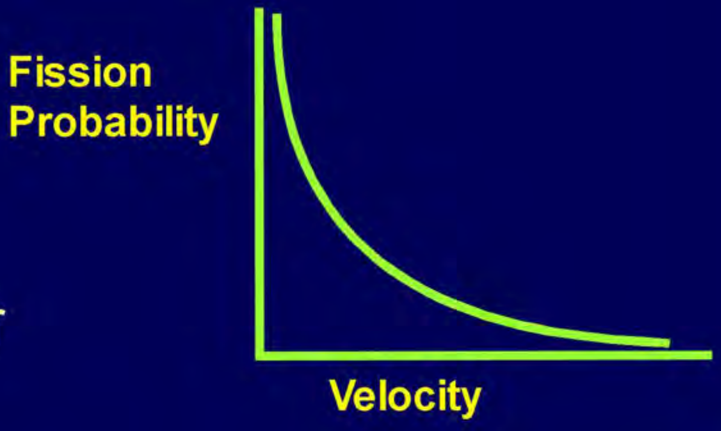
Criticality in Terms of Multiplication Factor

Multiplication Factor "k"	Criticality	Type of Reaction
Less than one (k<1)	Subcritical	Nonsustaining (Safe Nuclear Weapons)
Equal to one (k=1)	Critical	Self-sustaining (Reactors)
Greater than one (k>1)	Supercritical	Run-away (Exploding Nuclear Weapon)

Factors Affecting Criticality

- Moderator
- Shape
- Mass
- Enrichment
- Purification
- Reflection
- Density

Moderator



- Slows down neutrons by series of scattering collisions
- Fission probability in U-235 is higher for very slow neutrons
- An ideal moderator has a low atomic number and does not absorb neutrons (e.g., carbon, water (H_20), heavy water (D_20))
- Important for reactors, not weapons

Shape

- Criticality is affected by the shape of the mass
- Number of neutrons escaping from a given mass increases as the surface area to volume ratio increases
- For a given volume, a sphere has the smallest surface area to volume ratio

Sphere

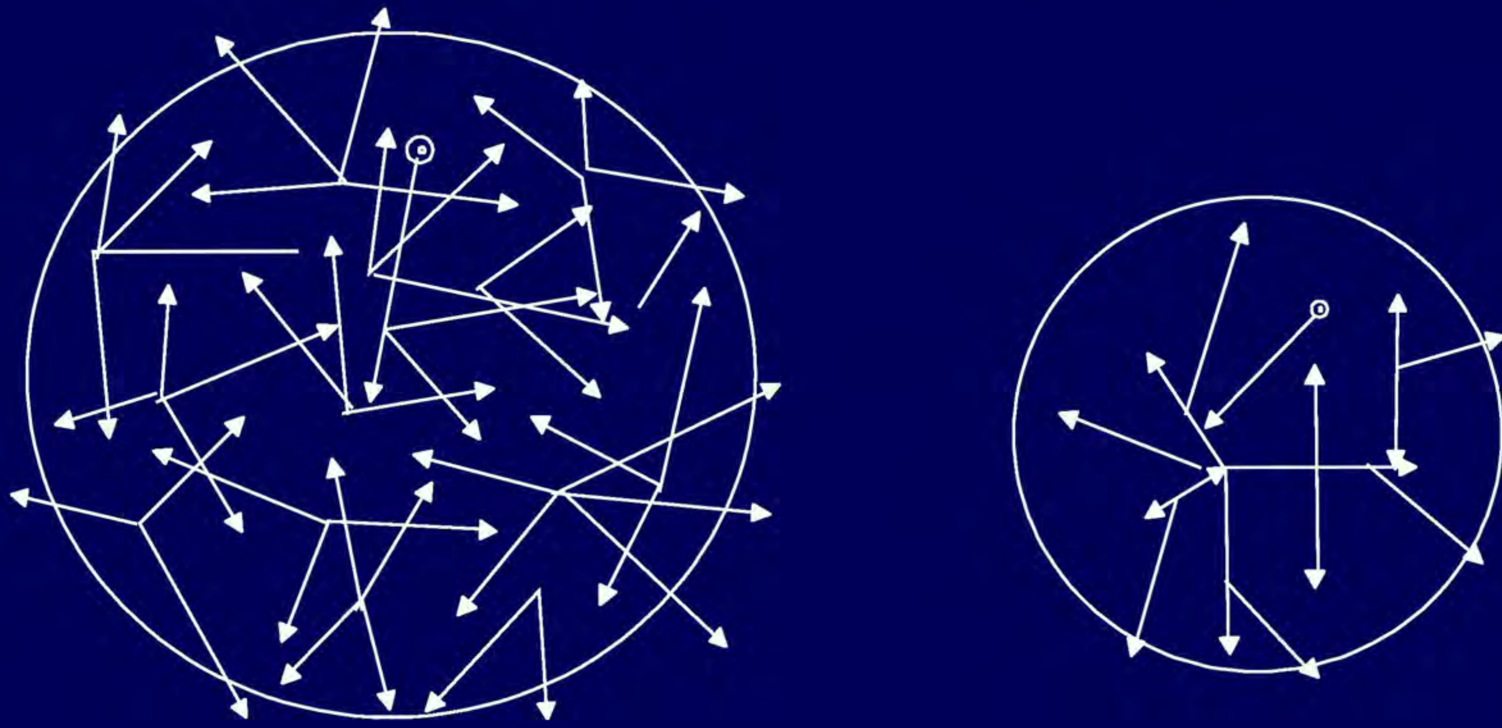
Lowest surface to volume ratio

Shape (continued)
Surface Areas for Sphere, Cylinder, Disk

Leakage as a Function of Height/Diameter (H/D) Ratios

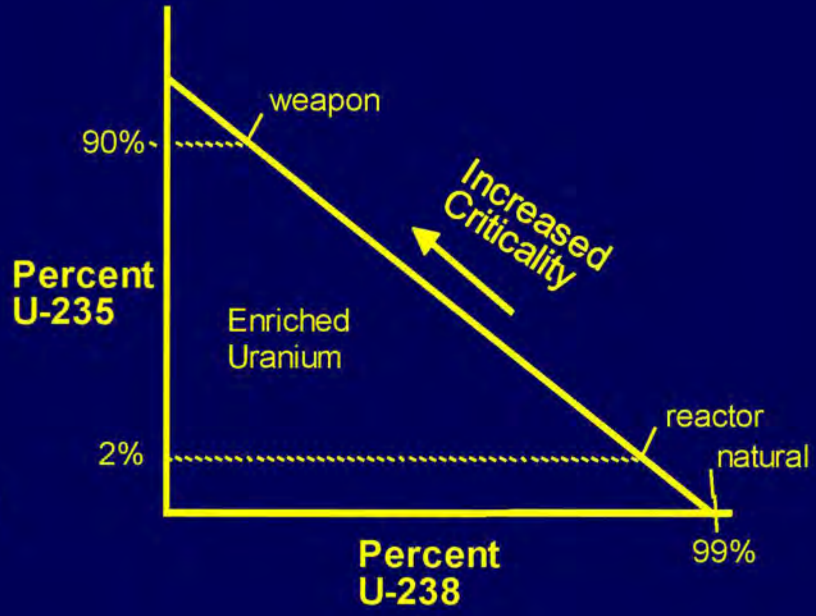
Mass

Increasing the mass of nuclear fuel material reduces the proportion of neutrons lost through escape and increases the criticality



Enrichment
(Increase Number of Fissile (U-235) Nuclei vs Nonfissile (U-238) Nuclei)

- Natural uranium is 99.3% U-238; 0.7% U-235
- U-235 nuclei are fissile; U-238 are not
- Increasing the concentration of U-235 increases the likelihood of fission and hence criticality



Critical Mass as a Function of Enrichment

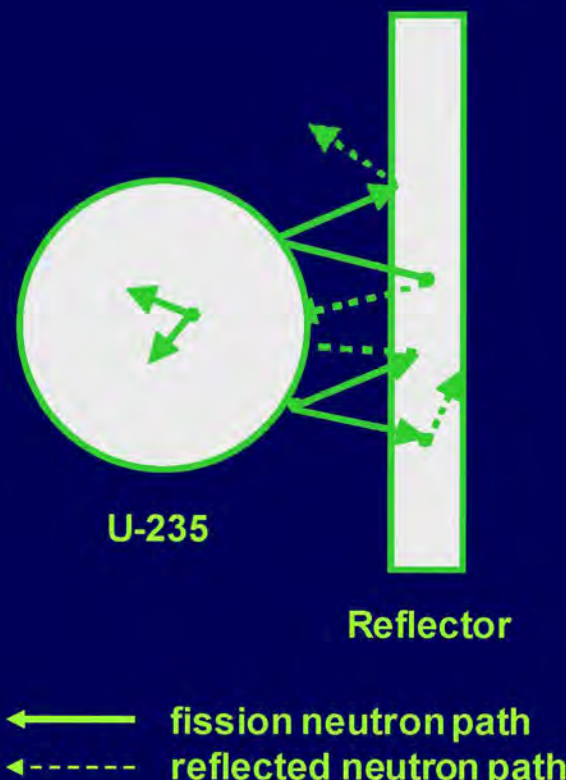
% ^{235}U	Critical Mass (Kg) (Assumes good reflector/normal density)
100	< 25
90	25
75	35
50	50
20	250
10	2500
5	Infinite

Purification

- Neutrons may be captured by impurities within the fuel
- Neutrons captured by impurities are lost from the system
- Reducing impurities will increase criticality

Reflectors

- No matter how big the nuclear fuel mass, some neutrons will always escape through the surface
- A reflector scatters the neutrons back into the nuclear fuel mass
- Reflectors increase the neutron population in the fuel and thus the criticality
- Good reflectors have low neutron absorption cross sections and high scatter cross sections. Any good moderator is also a good reflector (e.g., water, concrete, beryllium, etc.)



Spherical Critical Masses (Reflected versus Bare)

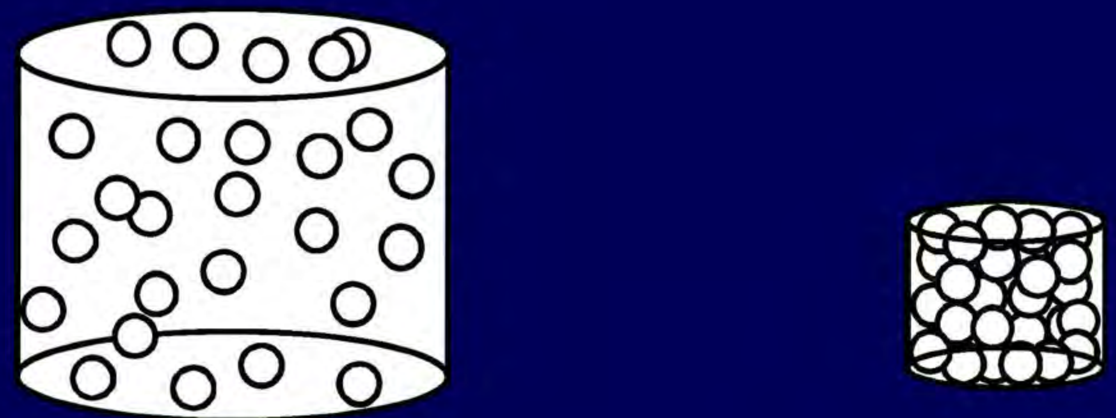
Critical Mass (kilograms)

		Bare	Reflected
Uranium	U-235*	48	16
	U-233*	16	6
Plutonium	Pu-239	11	4.5

*93.5% enriched

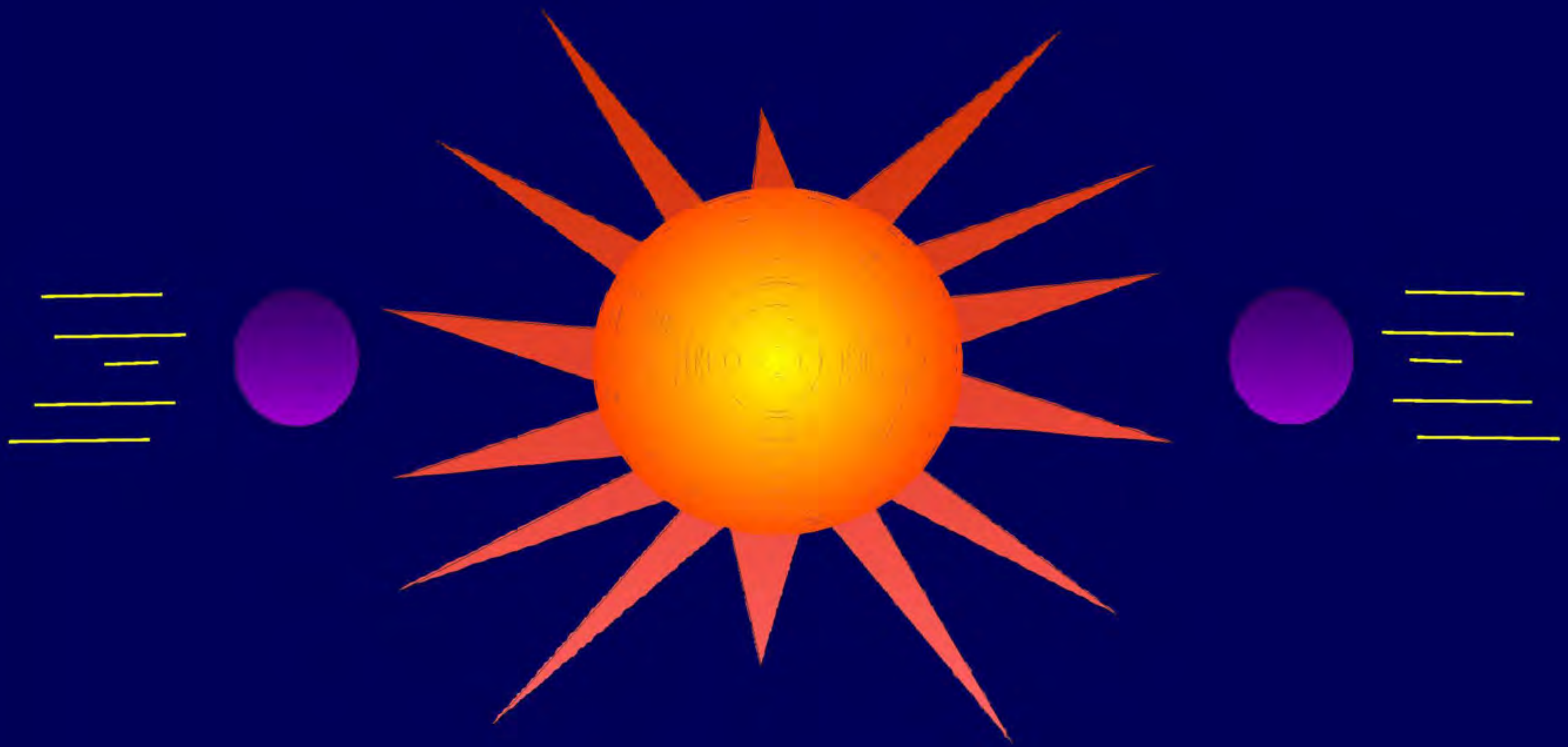
Density
(Number of Nuclei in a Given Volume)

- As the density increases, atoms are packed closer together
- Higher concentrations increase the chance of a neutron causing fission -- reduce the chance of neutron escape



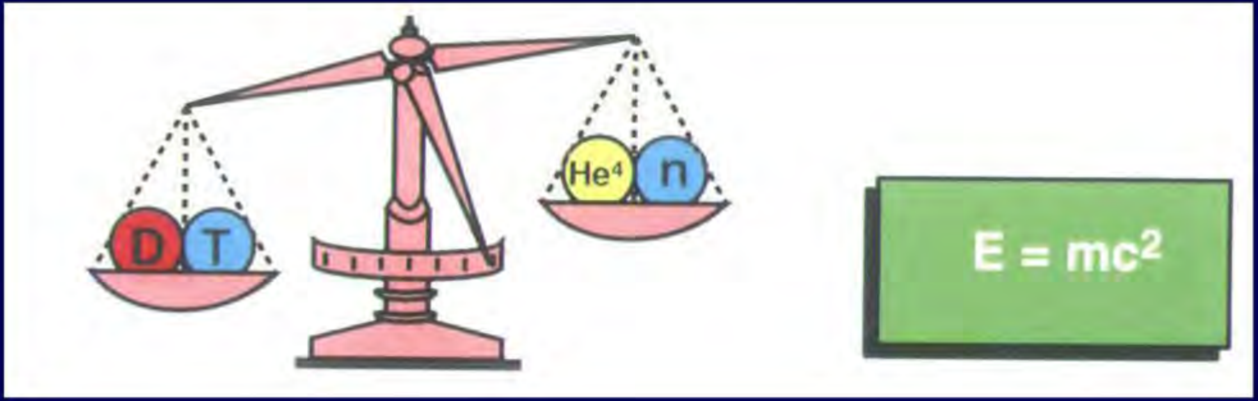
High Density vs. Low Density

Fusion



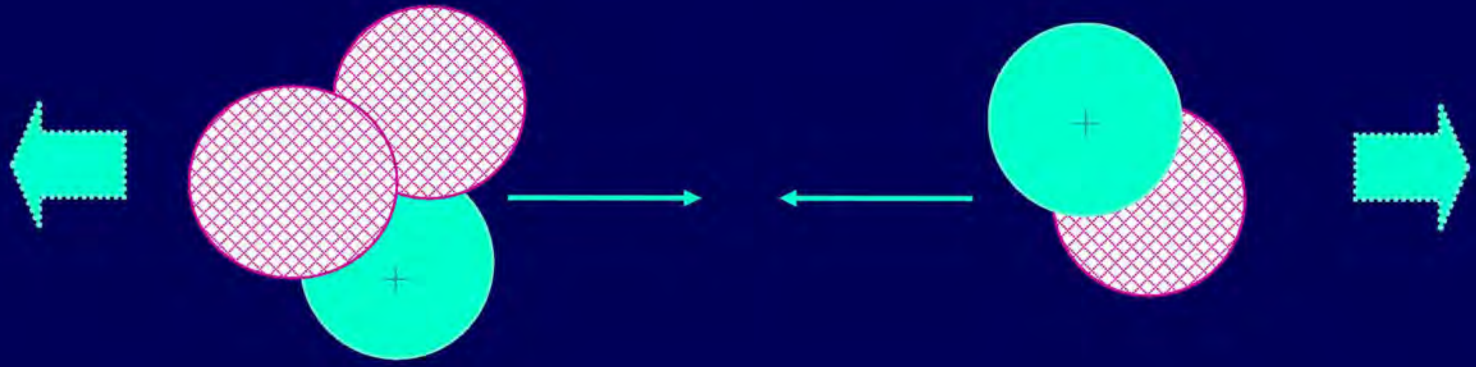
Fusion

The fusing of light nuclei into a heavier nucleus releasing energy in the process



Conditions for Fusion

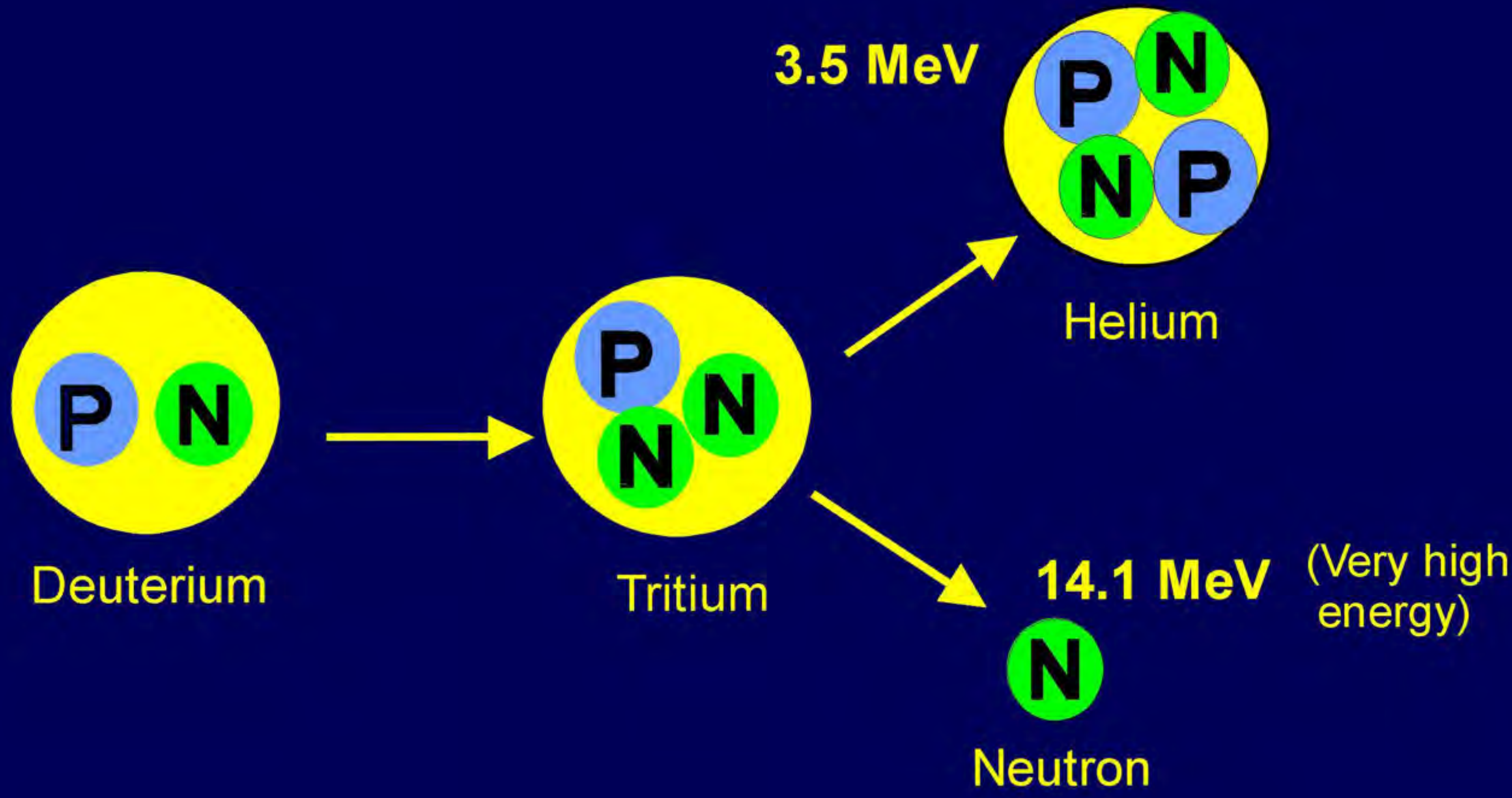
- Nuclei must overcome the repulsive force between like charges
- Extremely high temperatures and pressures required
- Fusion does not occur naturally on earth



Where Has Fusion Been Achieved?

- Stars (Sun)
- Laboratories
  - Accelerator
  - Inertial Confinement Fusion targets
  - TOKAMAK
- Nuclear Weapons

Deuterium - Tritium Reaction



Fusion Fuel

- Deuterium (H^2 or D^2) is 0.015% of natural hydrogen, separable from water as D_2O (heavy water)

- Tritium (H^3 or T^3) is produced by bombarding lithium with neutrons

$$\mathbf{n + {}_3Li^6 \longrightarrow {}_2He^4 + {}_1T^3 + 4.6\ MeV}$$

Neutron + Lithium → Helium + Tritium + Energy

Radioactivity

Radioactivity

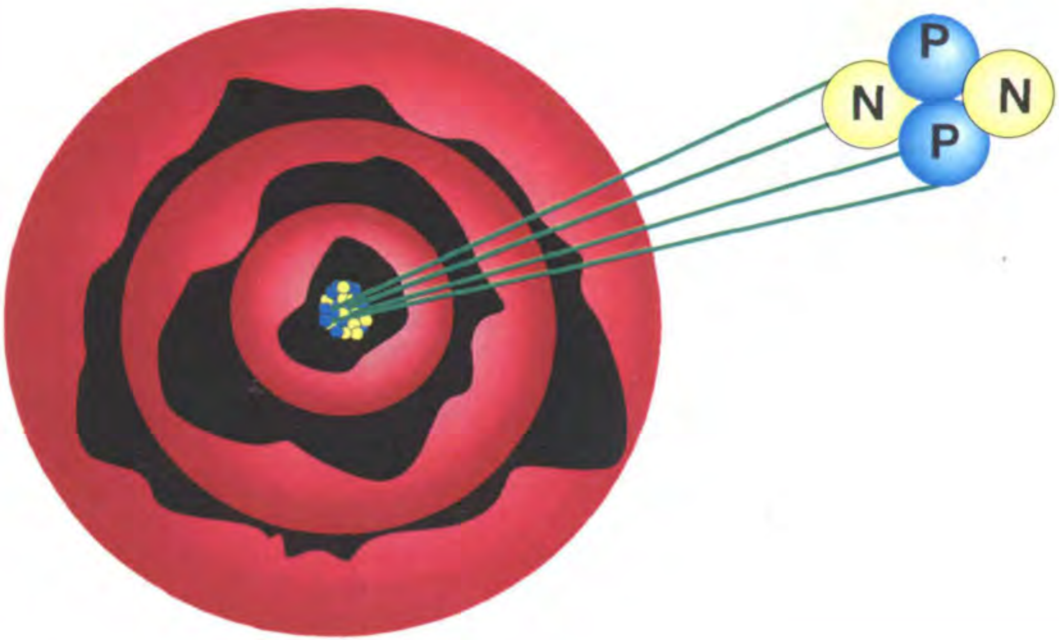
- Spontaneous disintegration of a nucleus of an unstable atom, with the emission of a particle or energy

- Sources of radioactivity
  - Natural (e.g., Uranium-238)
  - Fission Product (e.g., Strontium-90)
  - Neutron Activation (e.g., Polonium-210)

Types of Radioactive Decay

- Alpha (α) Decay
- Beta (β) Decay
- Gamma (γ) Decay

Alpha Particles (α)



Mass = 4

Charge = +2

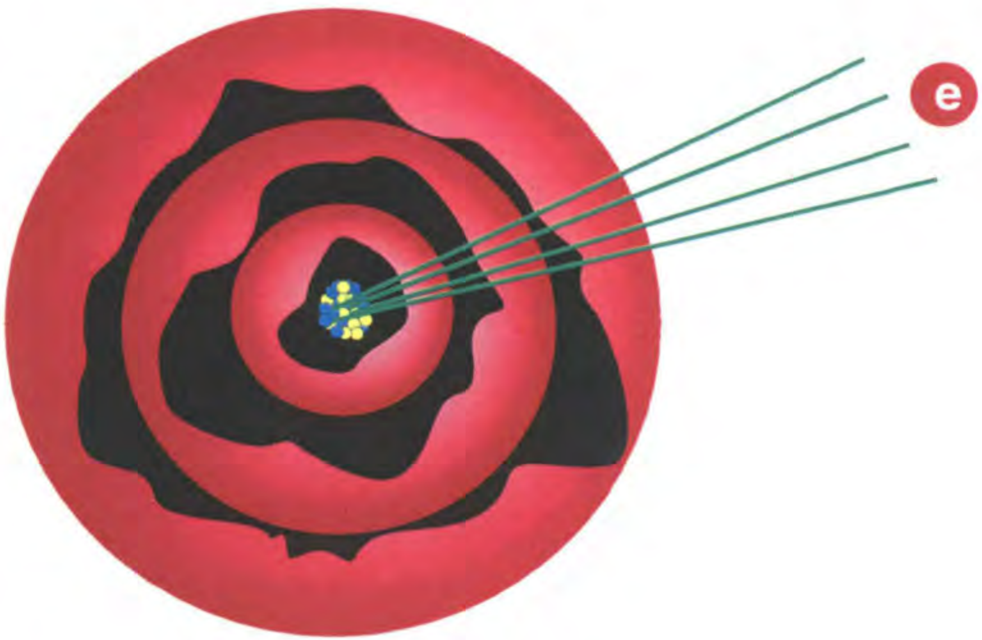
<u>Typical Penetration</u>

Inches of air

<u>Typical Stop</u>

Plastic wrap
Epidermis
Paper

Beta Particle (β)



Mass = 0.00053

Charge = -1

Typical Penetration

Feet of air
Inches of plastic
Inches of paper

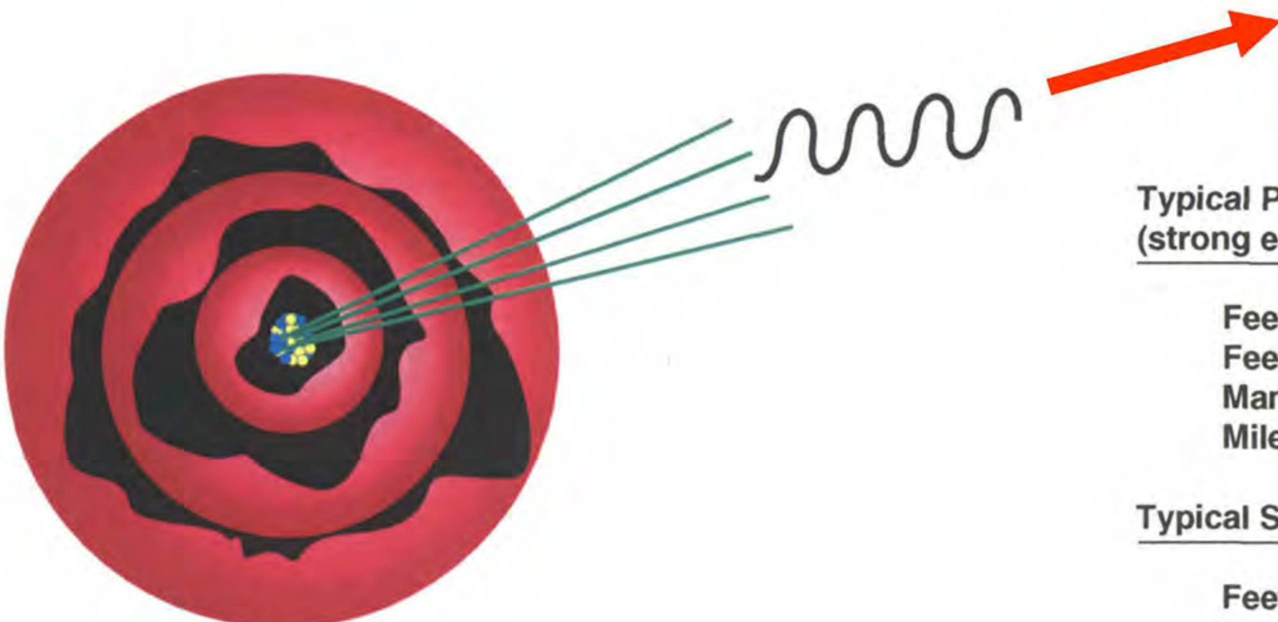
Typical Stop

Metal foil

Special Case

Positron

Gamma Ray (γ)



Mass = 0

Charge = None

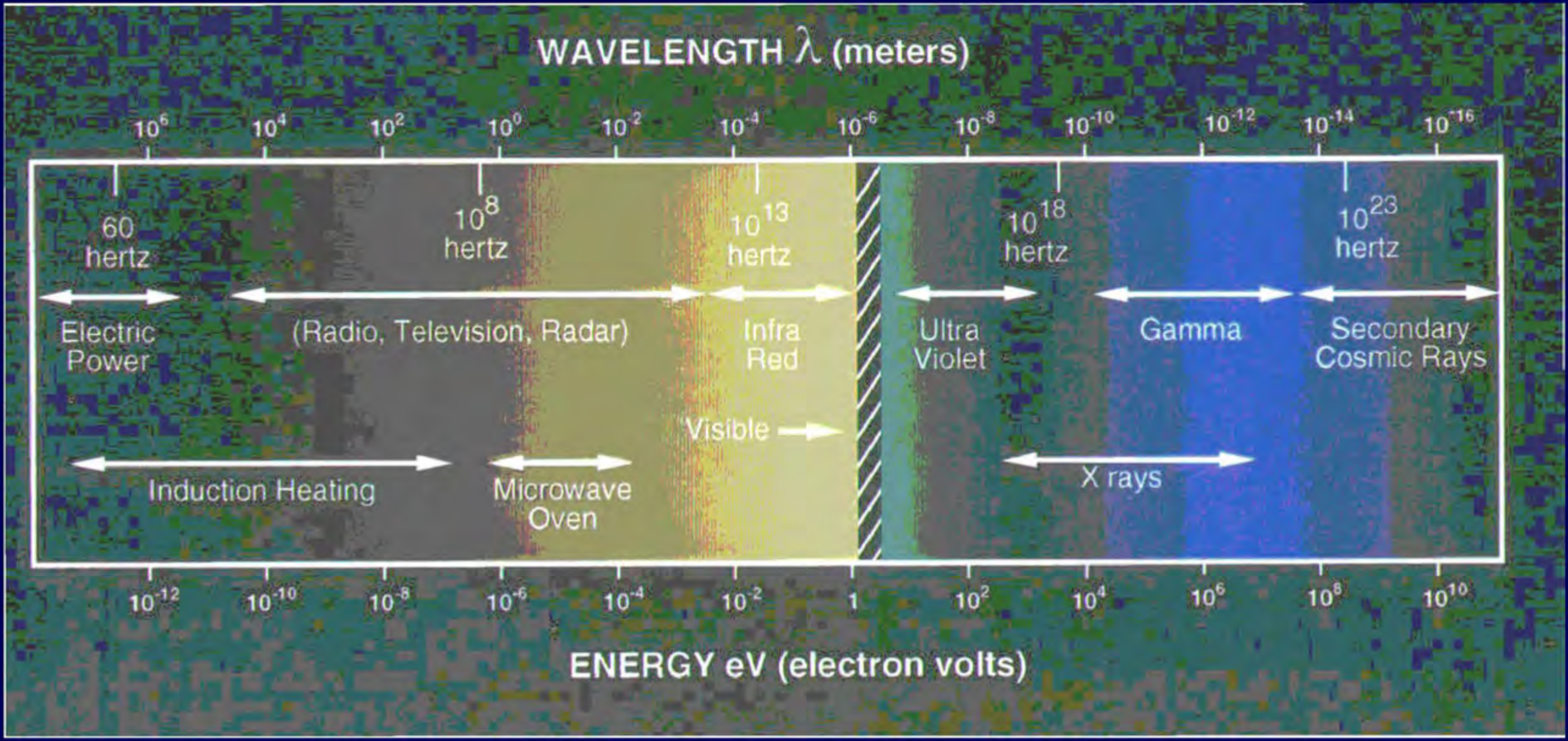
Typical Penetration
(strong energy dependence)

Feet of concrete
Feet of water
Many inches of metal
Miles of air

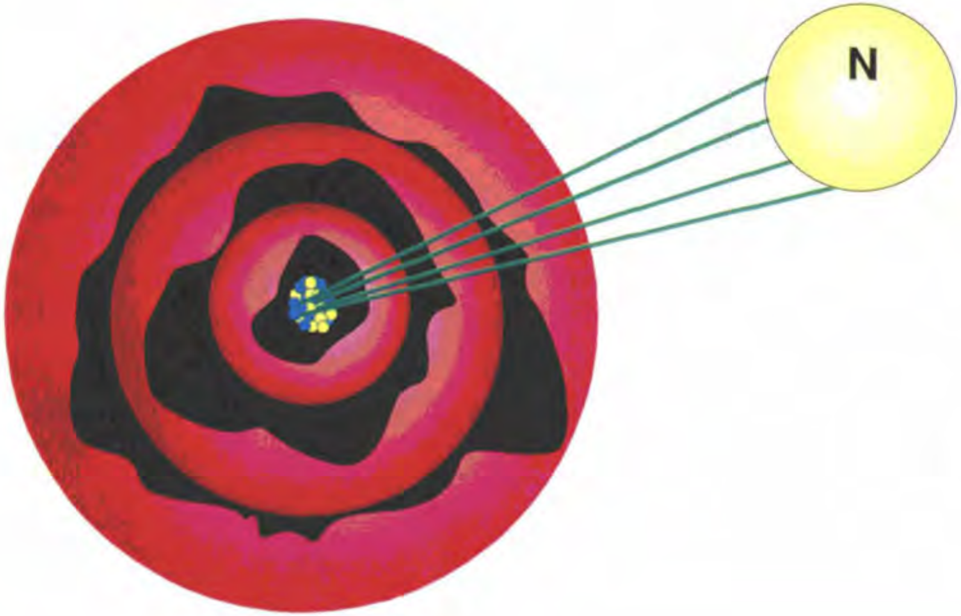
Typical Stop

Feet of water
Feet of metals

Electromagnetic Spectrum



Neutron Emission



Mass = 1

Charge = 0

<u>Typical Penetration</u>

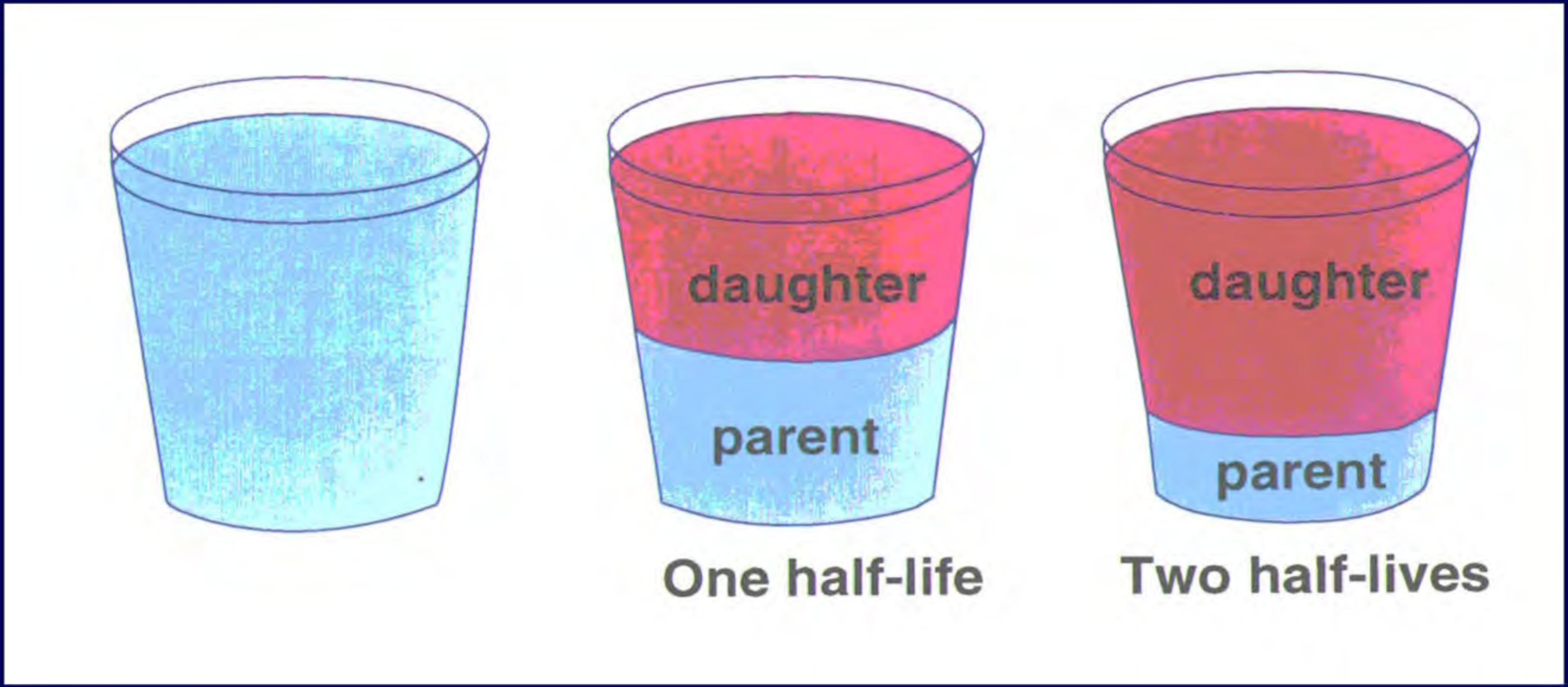
Feet of concrete
Feet of metal

<u>Typical Stop</u>

Foot of plastic
Feet of water

Half-Life

(the time that it takes for one-half of radioactive nuclide to decay)



Activity

- The number of decays per unit time of a radioactive substance
- Dependent on the ***half-life*** and ***quantity*** of radioactive material
- Measured in:
  - Decays/second
  - Curies (Ci) or Microcuries (μci)
  - Becquerel (Bq)
- **Given the activity** of a substance, **the quantity can be calculated** (e.g., 10,000 curies of tritium is approximately one gram)

Summary

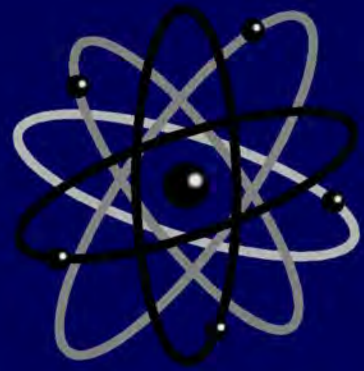
- Atomic Symbols
- Isotopes
- Fission Reaction
- Factors Affecting Fission Criticality
- Fusion Reaction
- Radioactive Decay

Nuclear Science Key Words

- Activity
- Alpha Particle
- Beta Particle
- Critical
- Criticality
- Critical Mass
- Cross Section (σ)
- Curies (Microcuries)
- Decays/second
- Deuterium
- Enrichment
- Fissile
- Fission
- Fissionable
- Fission Products (Fission Fragments)
- Gamma Ray
- Half-life
- Neutron
- Plutonium
- Radioactive Isotopes
- Reflectors
- Special Nuclear Material (SNM)
- Spontaneous Fission
- Subcritical
- Supercritical
- Tampers
- Tritium
- Uranium

Module C:

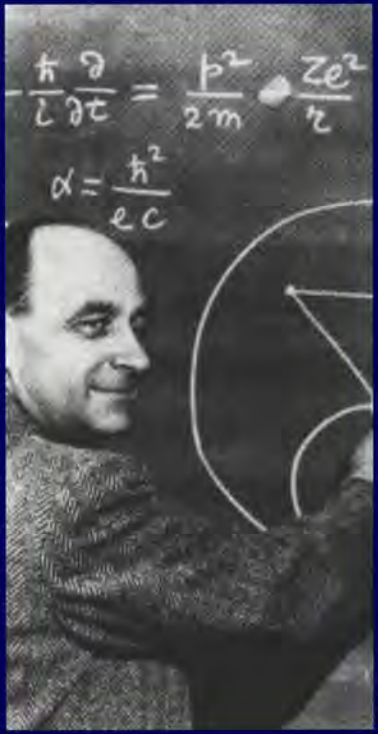
History of the U.S. Nuclear Energy Program



Manhattan Engineer District (MED)

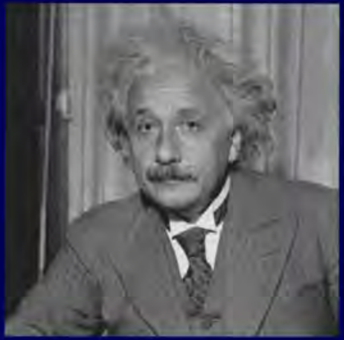
- **August 13, 1942** --
  MED established by
  Franklin D. Roosevelt

Pre-Manhattan Engineer District



- **1932** -- Neutron discovered; experimentation begins with different elements
- **1934** -- Enrico Fermi bombards elements with neutrons
- **1938** -- Otto Hahn and Fritz Strassmann identify that neutron bombardment changes uranium nuclei
- **1938** -- Lise Meitner and Otto Frisch verify results as splitting of nucleus -- “fission”
- **1939** -- Fifth Washington Conference on Theoretical Physics -- discussions of the discovery and implications of fission

The Nuclear Race Begins



- **August 2, 1939** -- Szilard persuades Einstein to write to Roosevelt explaining the implications of fission and chain reactions to produce an atomic weapon

- **October 12, 1939** -- Roosevelt appoints the Advisory Committee on Uranium

- **October 21, 1939** -- Meets for first time and recommends $6,000 to purchase uranium and graphite

Germany Joins the Nuclear Race

August 29, 1939

- Secret conference in Berlin leads to a research program, ban on uranium exports, and control of uranium sources in Reich

- Germany decides to go with heavy water, rather than graphite, as a moderator and negotiates with Norway to purchase heavy water

Japan Joins the Nuclear Race

- **April 1940** -- Imperial Japanese Army orders a full report on nuclear fission

- **April 1941** -- Imperial Army Air Force authorizes research toward development of an atomic bomb

Russia Joins the Nuclear Race

June 1940

- Igor Kurchatov reports in Physical Review on observing spontaneous fissioning in uranium. Lack of response from American scientists arouses suspicion of U.S. program

- German invasion resets priorities in Russian research, especially radar

Major Participants in the Nuclear Race

All major participants in World War II had ongoing efforts to produce nuclear weapons

United States

United Kingdom

USSR

Germany

Japan

Uranium Research Becomes Part of the Consolidation of Defense Efforts

- **June 1940** -- National Defense Research Committee (NDRC) formed
  - NDRC absorbs Advisory Committee on Uranium
  - ***Beginning of classification efforts***
- **June 1941** -- NDRC becomes part of the newly-established Office of Scientific Research and Development

Plutonium Discovered

- **February 1941** -- Glenn Seaborg at Lawrence Radiation Laboratory discovers plutonium

U.S. Effort Intensifies

- **July 2, 1941** -- The British MAUD Report concludes that a uranium bomb is feasible

- **October 1941**
  - Roosevelt and Wallace briefed
  - FDR authorizes Army to explore requirements

- **November 9, 1941** -- National Academy of Sciences report confirms the MAUD conclusions
- **December 7, 1941** -- Pearl Harbor

Manhattan Engineer District Established

- **March 1942**
  - Advisory Committee on Uranium dissolved; S-1 Committee established
  - S-1 instructed to proceed with program: obtain U^{235} and plutonium

- **May 1942**
  - S-1 recommends building two plutonium production reactors and several uranium separation plants
  - Funds allocated
- **August 1942**
  - Army establishes Manhattan Engineer District

Manhattan Engineer District

- **October 1942** -- Clinton Engineer Works (Site-X)
  One reactor for plutonium production
  Two plants for uranium enrichment

- **November 1942** -- Los Alamos Laboratory (Site-Y) started

Manhattan Project

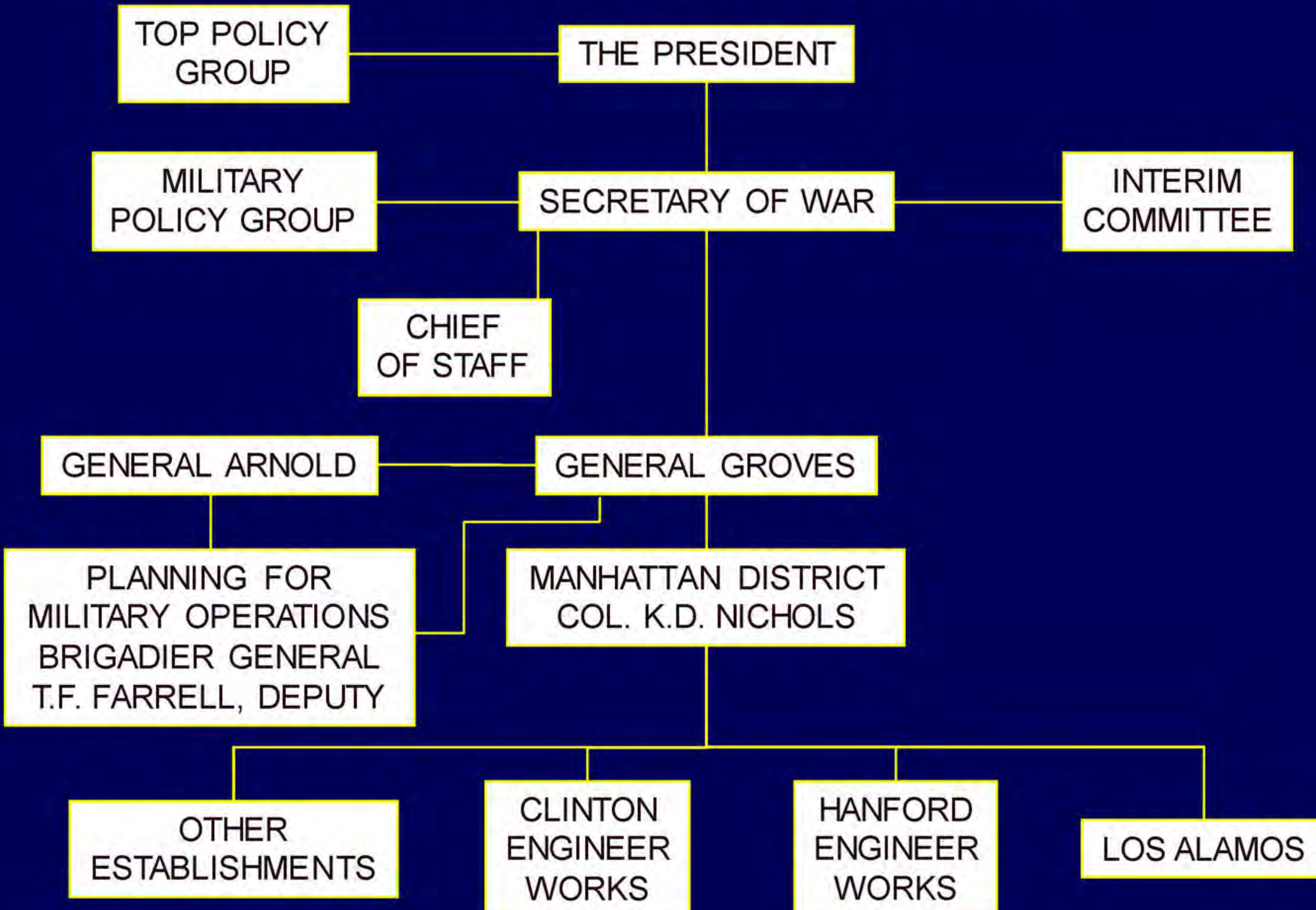
- **December 2, 1942** -- Enrico Fermi achieves first sustained nuclear chain reaction in Chicago

- **December 28, 1942** -- President approves the Manhattan Project

Manhattan Project

- **January 1943**
  - Work started on the Hanford Engineer Works (Site-W)
  - Work continues at Los Alamos (Site-Y) and Clinton Engineer Works (Site-X)

Manhattan Project



Manhattan Project

- **February 1944** -- Clinton Engineer Works ships 200 grams of enriched uranium to Los Alamos
- **May 1944** -- S-50 Uranium Enrichment Plant started at Clinton Engineer Works
- **September 1944** -- Large-scale plutonium production started at Hanford's 100-B reactor

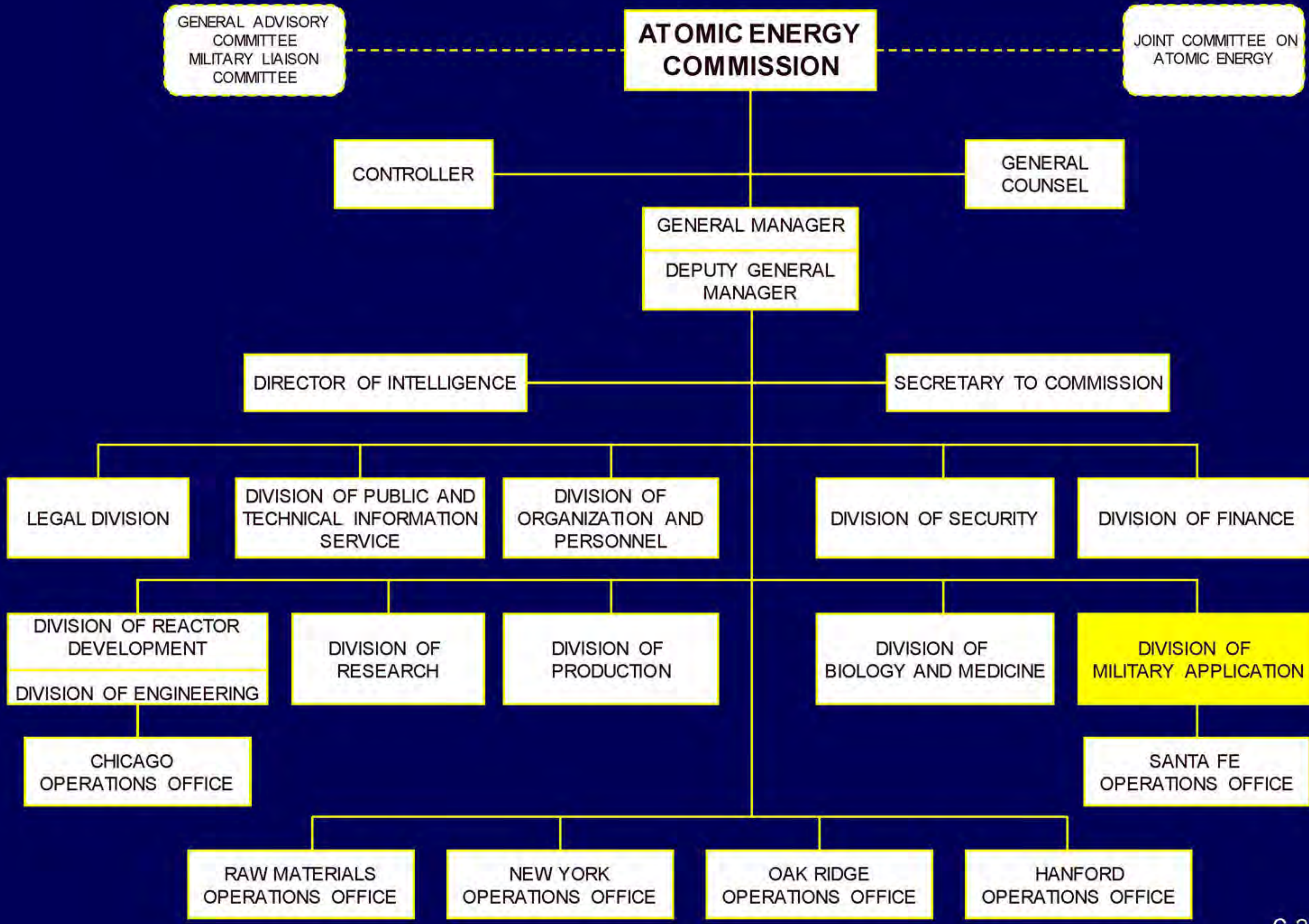
Manhattan Project

- **February 1945** -- First shipment of plutonium received at Los Alamos
- **July 16, 1945** -- Trinity Test, Alamogordo, New Mexico
- **July 29, 1945** -- Japan rejects surrender demand
- **August 6, 1945** -- Hiroshima bombed
- **August 9, 1945** -- Nagasaki bombed
- **August 14, 1945** -- Japan surrenders

Next Step

- Truman signs Atomic Energy Act of 1946
  August 1, 1946
  - Manhattan Engineer District abolished
  - Atomic Energy Commission established
  - RD comes into existence

RD


GENERAL ADVISORY COMMITTEE
MILITARY LIAISON COMMITTEE
ATOMIC ENERGY COMMISSION
JOINT COMMITTEE ON ATOMIC ENERGY
CONTROLLER
GENERAL COUNSEL
GENERAL MANAGER
DEPUTY GENERAL MANAGER
DIRECTOR OF INTELLIGENCE
SECRETARY TO COMMISSION
LEGAL DIVISION
DIVISION OF PUBLIC AND TECHNICAL INFORMATION SERVICE
DIVISION OF ORGANIZATION AND PERSONNEL
DIVISION OF SECURITY
DIVISION OF FINANCE
DIVISION OF REACTOR DEVELOPMENT
DIVISION OF ENGINEERING
DIVISION OF RESEARCH
DIVISION OF PRODUCTION
DIVISION OF BIOLOGY AND MEDICINE
DIVISION OF MILITARY APPLICATION
CHICAGO OPERATIONS OFFICE
SANTA FE OPERATIONS OFFICE
RAW MATERIALS OPERATIONS OFFICE
NEW YORK OPERATIONS OFFICE
OAK RIDGE OPERATIONS OFFICE
HANFORD OPERATIONS OFFICE

Nuclear Arms Race Escalates

- **July 1948** -- Berlin Blockade
- **August 25, 1949** -- First Soviet test
- **June 1950** -- North Korea invades South Korea
- **October 1950** -- China invades Korea
- **January 31, 1951** -- Truman directs AEC to build the H-bomb
- **November 1, 1952** -- "Mike Shot" H-bomb detonated on Eniwetok

Naval Nuclear Propulsion Program

- Formally established in 1948
- Keel laid for the first nuclear powered submarine June 1952
- USS Nautilus launched in January 1954

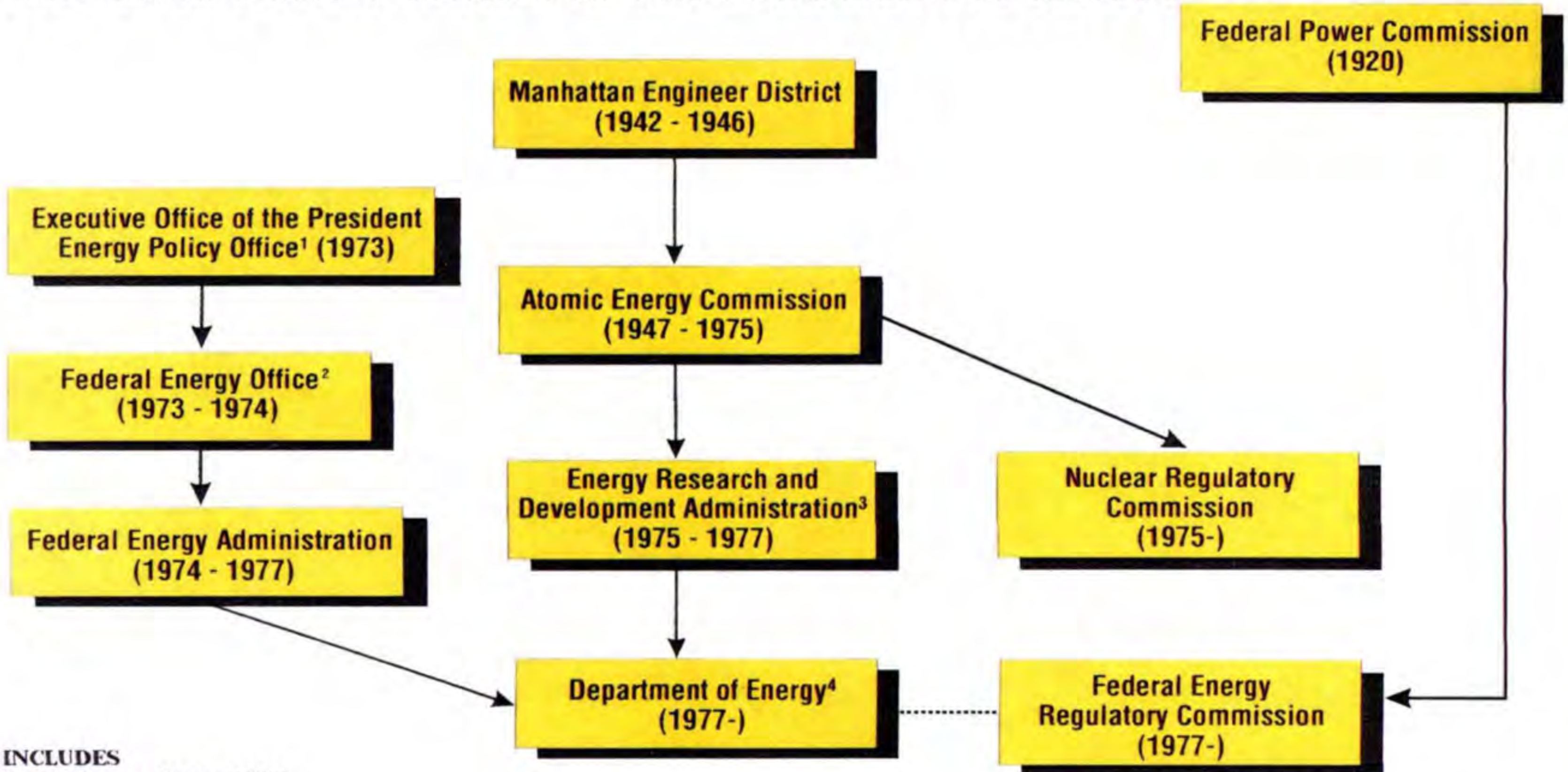
Energy Research and Development Administration (ERDA)

- October 1974 President Ford signs into law the Energy Reorganization Act of 1974
- Energy Research and Development Administration (ERDA) comes into existence
- Most AEC activities (to include nuclear weapons) transferred to ERDA
- AEC regulatory function transferred to new Nuclear Regulatory Commission (NRC)

Department of Energy (DOE)

- **August 4, 1977** – Department of Energy Organization Act signed
- **October 1, 1977** -- DOE comes into existence
  - Absorbs many other Federal functions

THE INSTITUTIONAL ORIGINS OF THE DEPARTMENT OF ENERGY



INCLUDES

1 Special Energy Office (1973)
National Energy Office (1973)

2 Treasury-Energy Office
Interior-
Oil Import Administration
Petroleum Allocation
Energy Conservation
Energy Data and Analysis
Oil and Gas
Cost of Living Council-Energy Division
Internal Revenue Service-Enforcement of Allocation and Pricing Regulations

3 Interior-
Office of Coal Research
Bureau of Mines - Energy Research Centers
Environmental Protection Agency - Research, Development and Demonstration of Innovative Automotive Systems
National Science Foundation
Solar Heating and Cooling
Geothermal Power

4 Agriculture-REA Loans
Commerce-Voluntary Industrial Conservation
Defense-Petroleum and Shale Reserves
Interstate Commerce Commission-Oil Pipeline Regulation
Securities and Exchange Commission-Electric Utility Merger
Housing and Urban Development-
Thermal Efficiency Standards
Transportation-Fuel Efficiency Standards
Interior-Power Administrations

Summary

- Manhattan Engineer District
- Manhattan Project
- Atomic Energy Act of 1946
- Atomic Energy Commission
- Restricted Data
- Energy Research and Development Administration
- Department of Energy

Historical Records Restricted Data Reviewers Course

U.S. Department of Energy

Name:

Module D

History of DOE Facilities

Manhattan Project Facilities

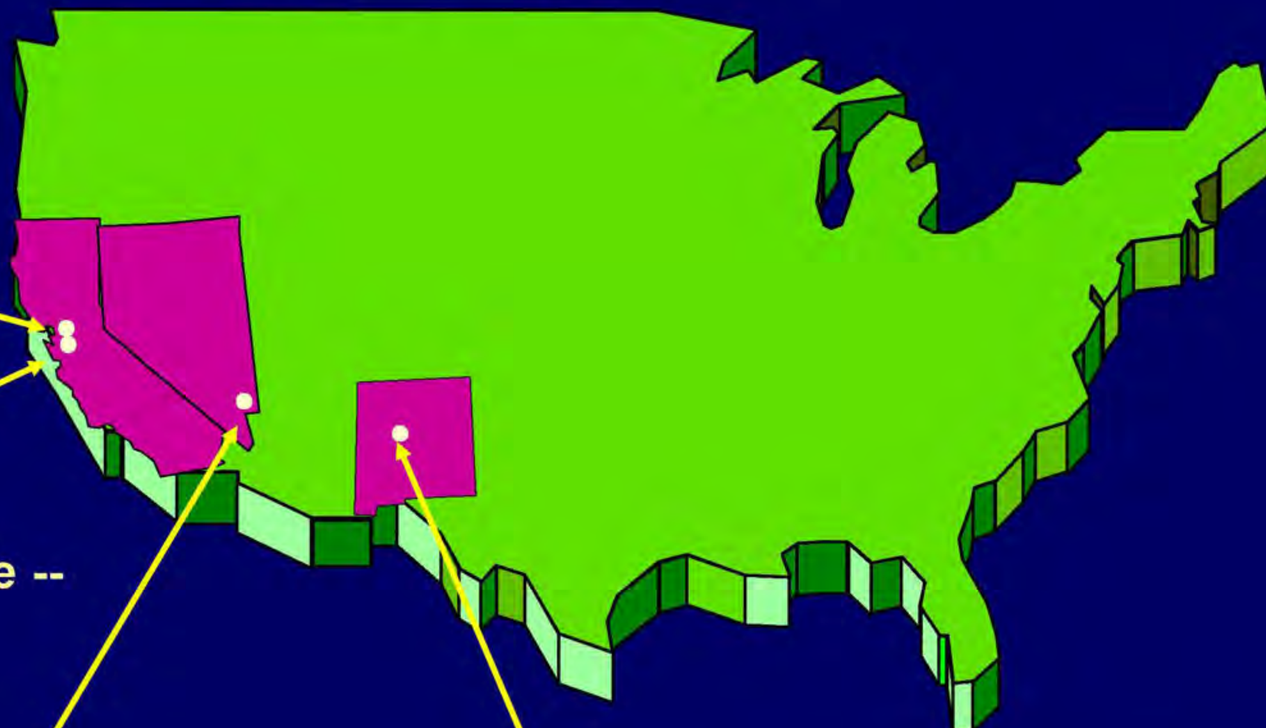
Hanford Engineer
Works -- 1943
(Site-W)

Los Alamos Laboratory --
1942 (Site-Y)

Clinton Engineer
Works -- 1942
(Site-X)

Atomic Energy Commission Facilities 1947-1950

Atomic Energy Commission Facilities 1951-1962



Albuquerque Operations Office
(Established as Santa Fe Operations Office in 1946)
Albuquerque, New Mexico

- Established in 1956
- Primary Mission: Nuclear weapons program management

Burlington Plant
Burlington, IA

- Established in 1947 by Army Ordnance Corps (known as the Iowa Army Ordnance Plant)
- Transferred to AEC in 1963
- Primary Mission
  - High explosive component fabrication
  - Nuclear weapons assembly, disasser
    and modification
- Major Contractor
  - Mason and Hanger, Silas Mason
- Closed 1975

Kansas City Plant
Kansas City, MO

- Established in 1949
- Primary Mission
  - Non-nuclear components manufacturing
- Major Contractor
  - Bendix Corporation

Kansas City Plant

Los Alamos National Laboratory
Los Alamos, NM

- Established in 1943 as Los Alamos Laboratory (Y-Site)
- Also known as Los Alamos Scientific Laboratory and Los Alamos National Scientific Laboratory Nuclear
- Primary Mission
  - Nuclear weapons design and testing
- Major Contractor
  - University of California Board of Regents

Mound Plant
(Previously known as Dayton Project -- 1943-1948)
Miamisburg, OH

- Established in 1948
- Primary Mission
  - Pyrotechnics and tritium components
- Major Contractor
  - Monsanto Research Corporation
- Ceased DOE production in 1997

Pantex Plant
(Established in 1942 as Pantex Ordnance Plant)
Amarillo, TX

- Converted by AEC in 1950
- Primary Mission
  - Nuclear weapons assembly, disassembly, modification, and retirement
  - High explosive component fabrication
- Major Contractors
  - Proctor & Gamble
  - Mason and Hanger

Pantex Plant

Pinellas Plant
Largo, FL

- Established in 1957
- Primary Mission
  - Neutron generators and specialty electronic assemblies
- Major Contractor
  - General Electric
- Ceased DOE production in 1994

Pinellas nuclear weapon functions are now done at other DOE facilities such as the Sandia Labs and the Kansas City Plant

Rocky Flats Plant
Boulder, CO

- Established in 1951
- Primary Mission
  - **Manufacture/machining of beryllium, plutonium, and uranium into weapons components**
  - **Production of tritium reservoirs**
- Major Contractors
  - **Dow Chemical**
  - **Rockwell International**
- Ceased DOE production in 1990
- Completed shutdown in 2008

Rocky Flats Site in June 2014

Rocky Flats Site in June 1995 Prior to Final Cleanup

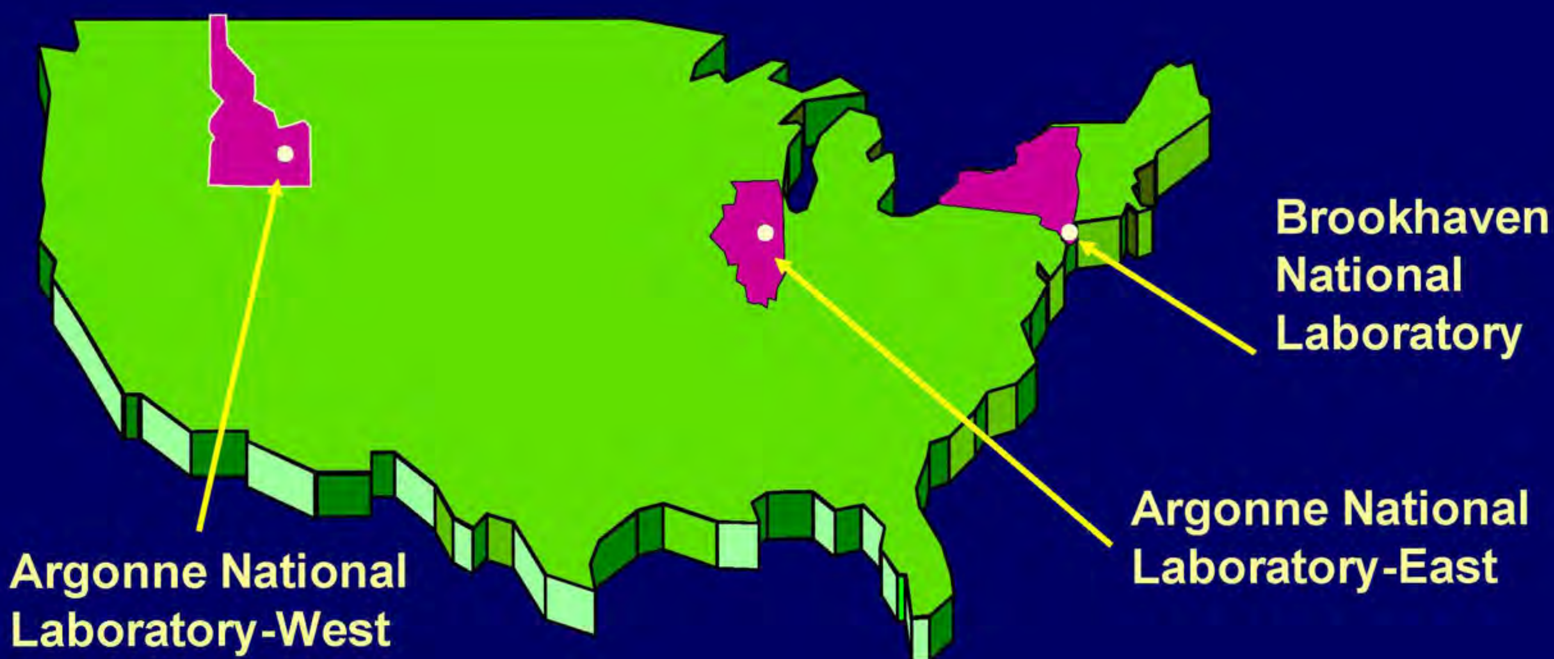
Sandia National Laboratories
Albuquerque, NM and Livermore, CA

- Established in Albuquerque in 1945
- Established in Livermore in 1956
- Primary Mission
  - Nuclear weapons design (non-nuclear components)
- Major Contractors
  - University of California Board of Regents
  - AT&T (1949-1993)

Sandia National Laboratories
New Mexico

Chicago Operations Office
Argonne, IL

- Established in 1947
- Primary Mission: Reactor research



Argonne National Laboratories
Idaho Falls, ID and Argonne, IL

Argonne West

- Established in 1946
- Primary Mission
  - Reactor research
- Major Contractor
  - University of Chicago

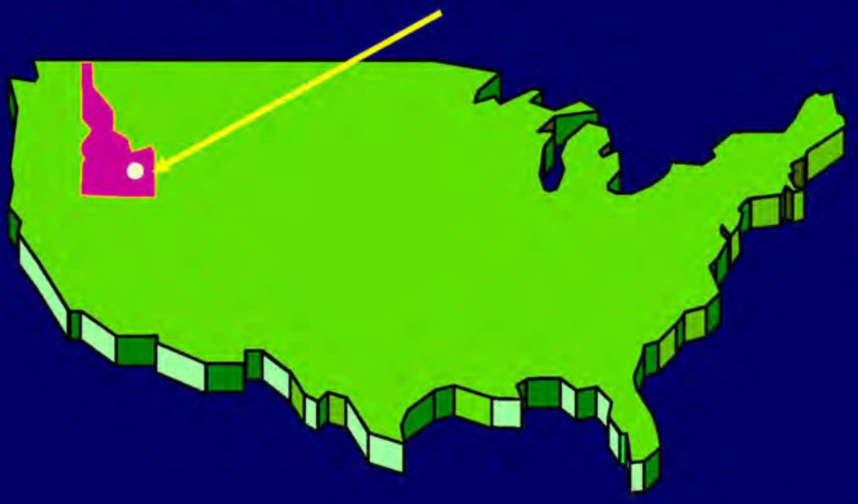
Argonne East

Brookhaven National Laboratory
Upton, NY

- Established in 1947
- Primary Mission
  - Reactor research
- Major Contractor
  - Associated Universities, Inc.

Idaho Operations Office
Idaho Falls, ID

- Established in 1949 as the National Reactor Testing Station
- Primary Mission
  - Reactor Research



Idaho National Laboratory
Idaho Falls, ID

- Established in 1974
- Primary Mission
  - Reactor research
- Major Contractors
  - Phillips Petroleum
  - American Cyanamid
  - Combustion Engineering
  - Idaho Nuclear Corp
  - Aerojet Nuclear Co
  - Allied Chemical Corp

Idaho National Laboratory
(INL)

Nevada Operations Office
Las Vegas, NV

- Established in 1962
- Primary Mission
  - Nuclear weapons testing program

Nevada Test Site

- Established in 1950 as Nevada Proving Grounds

- Managed by the Test Division of the Santa Fe Operations Office until 1962

- Primary Mission
  - Nuclear weapons testing

- Major Contractors (from 1962 to 1980)
  - Holmes and Narver, Inc.
  - Fenix & Scisson of Nevada, Inc.
  - EG&G
  - Reynolds Electrical and Engineering Co.

Oak Ridge Operations Office
(Established as Clinton Engineer Works in 1942)
Oak Ridge, TN

- Established in 1947
- Primary Mission
  - Isotope separation, nuclear materials production, weapon component production

- K-25 Gaseous Diffusion Plant
- Y-12 Plant
- X-10 Plutonium Pilot Production Plant
- S-50 Thermal Diffusion Plant

Ashtabula Extrusion Plant
Ashtabula, OH

- Established in 1952
- Primary Mission
  - Extrusion of uranium for fuel and target rods for reactors
- Major Contractors
  - Bridgeport Brass Company
  - Reactive Metals Inc.
- Ceased DOE production in 1990

Fernald Feed Materials Production Center (FMPC) Fernald, OH

- Established in 1953
- Primary Mission
  - Production of uranium compounds
  - Weapons components
- Major Contractor
  - National Lead Company of Ohio
- Ceased DOE production in 1989

Oak Ridge Gaseous Diffusion Plant (K-25)
Oak Ridge, TN

- Established in 1943
- Primary Mission
  - Production of enriched uranium
- Designed by Kellex Company
- Major Contractor
  - Union Carbide
- Other processing buildings were K-27, K-29, K-31,K-33
- Closed 1987

Paducah Gaseous Diffusion Plant
Paducah, KY

- Established in 1952
- Primary Mission
  - Production of highly enriched uranium
- Major Contractor
  - Union Carbide
- Ceased DOE production in 1992
  - Leased to US Enrichment Corporation (USEC)

Portsmouth Gaseous Diffusion Plant Piketon, OH

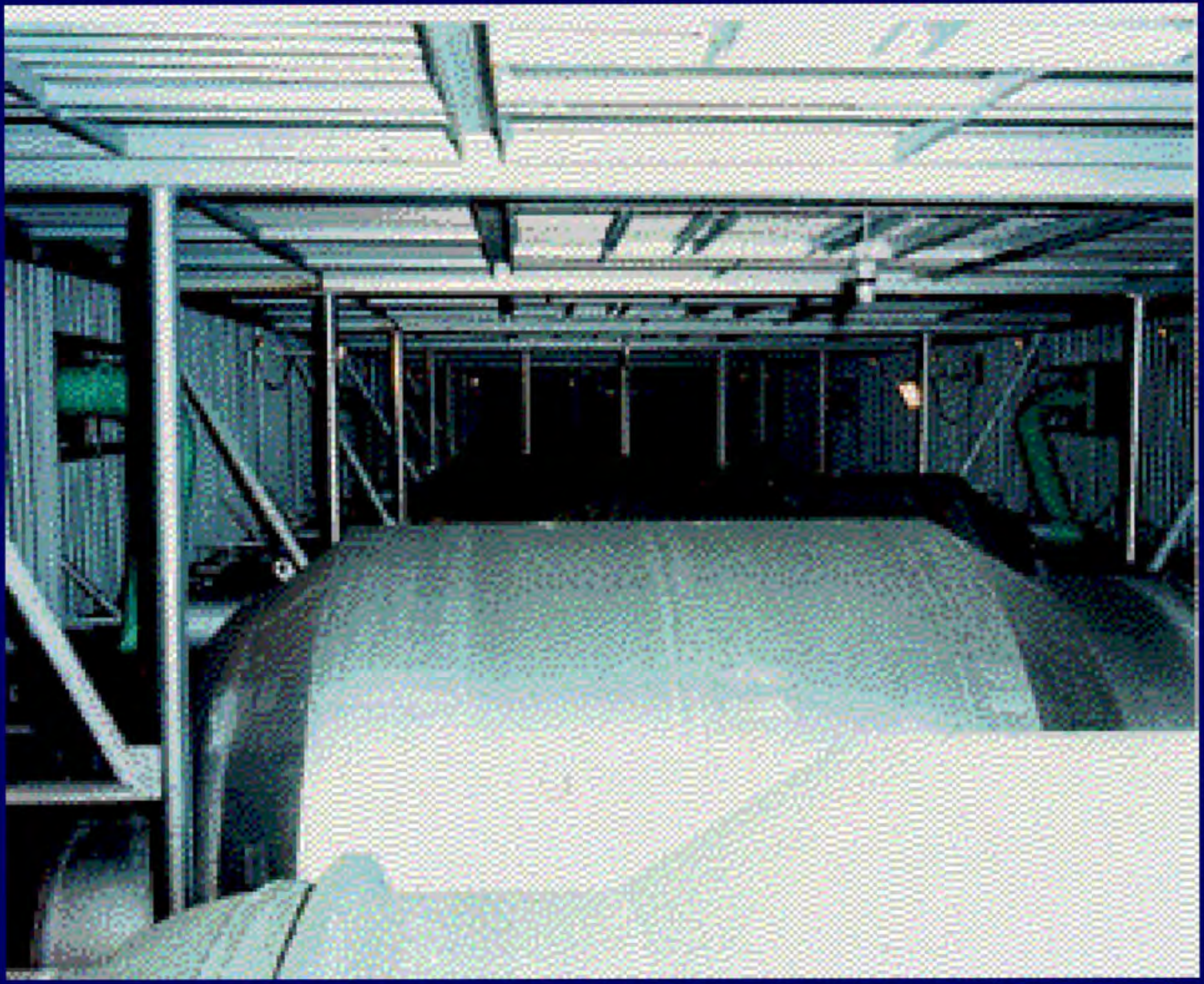
- Established in 1952
- Primary Mission
  - Production of highly and very highly enriched uranium
- Major Contractor
  - Goodyear Atomic Corporation
- Ceased DOE production in 1992
- Shutdown in 2001

Portsmouth Gaseous Diffusion Plant

Diffusion Plant Switchyard

Switchyards are capable of supplying process buildings with electrical power as high as 3000 megawatts, comparable to the level of a city the size of St. Louis, Missouri.

Gaseous Diffusion Plant Diffusers



Y-12 Plant
Oak Ridge, TN

- Established in 1943
- Primary Mission
  - Production of enriched uranium during World War II using Calutrons
  - Production of lithium and lithium compounds
  - Weapons components
- Major Contractors
  - DuPont
  - Tennessee Eastman
  - Union Carbide

S-50 Thermal Diffusion Plant
Oak Ridge, TN

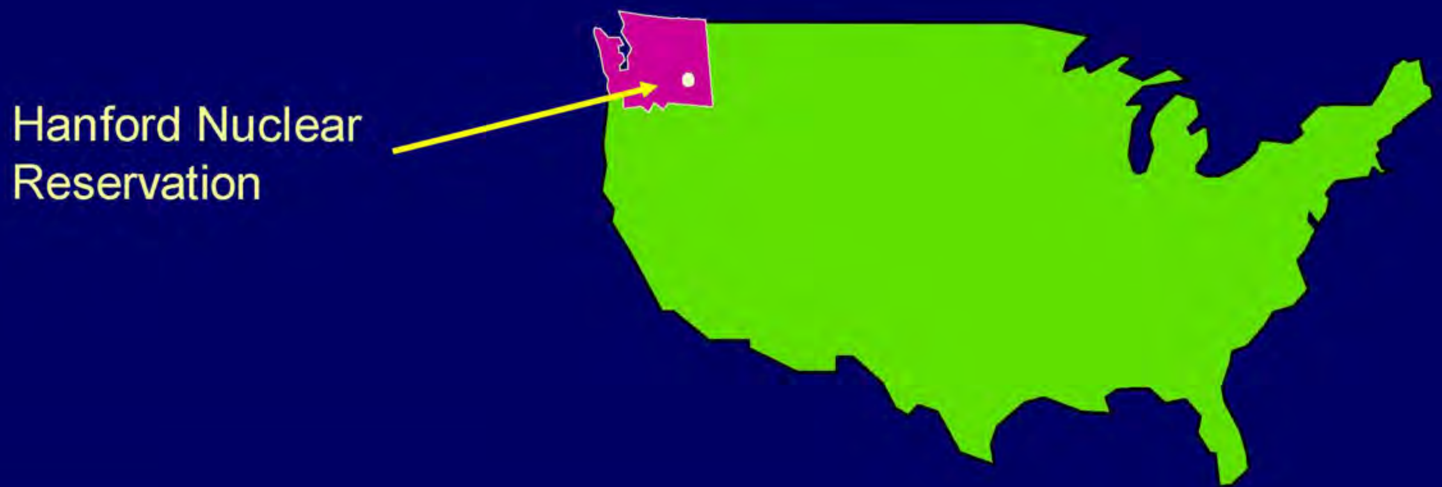
- Established in 1944
- Primary Mission
  - Production of enriched uranium during World War II
- Major Contractor
  - H.K. Ferguson Company
- Closed 1945

X-10 Plutonium Production Reactor (Clinton Pile) Oak Ridge, TN

- Became operational in 1943
- Became Oak Ridge National Laboratory in 1948
- Primary Mission
  - Pilot plant for plutonium reactors
  - Research for production of plutonium
- Ceased DOE production in 1963

Richland Operations Office
Richland, WA

- Established as Hanford Operations Office in 1947
- Became Richland Operations Office in 1962
- Primary Mission
  - Nuclear materials production



Hanford Nuclear Reservation
Richland, WA

- Established as Hanford Engineer Works (**Site-W**) in 1943
- Primary Mission
  - Nuclear materials production
    - Production reactors
      - B, D, F in 1943-1945
      - H, DR, C, KW, KE in 1948 to 1955
      - N in 1963
    - Chemical separation
      - T Plant in 1944
      - B Plant in 1945
      - S Plant in 1951
      - PUREX Plant in 1956

- Major Contractors
  - DuPont
  - GE
  - Isochem
  - United Nuclear
  - Atlantic Richfield
  - Rockwell
- Ceased DOE production in 1988

Hanford Purex Plant

San Francisco Operations Office
Oakland, CA

- Established in 1952
- Renamed Oakland Operations Office in 1994
- Primary Mission
  - Nuclear weapons design program

Lawrence Livermore National Laboratory
Livermore, CA

- Established in 1952
- Also known as
  E.O. Lawrence Radiation Laboratory and
  E.O. Lawrence Livermore Radiation Laboratory
- Primary Mission
  - Nuclear weapons design
- Major Contractor
  - University of California Board of Regents

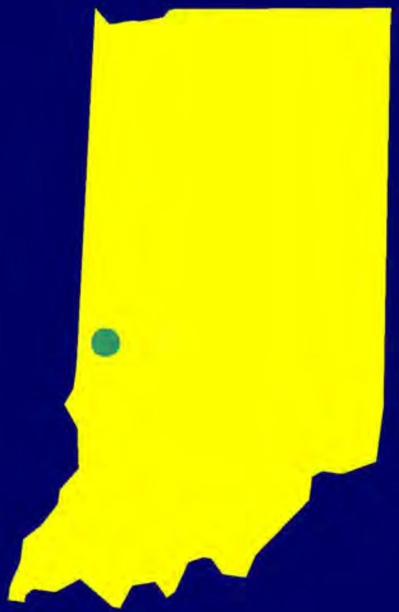
Savannah River Operations Office
Aiken, SC

- Established in 1952
- Primary Mission
  - Nuclear material production program

Savannah River Site (SRS)
Aiken, SC

- Established in 1950
- Primary Mission
  - Plutonium production
  - Tritium production
  - Deuterium production
  - Production reactors (C, K, L, P, R)
- Major Contractor
  - DuPont (1950-1989)
- All reactors shut down (R in 1964; C in 1985; L and P in 1988; K in 1996)

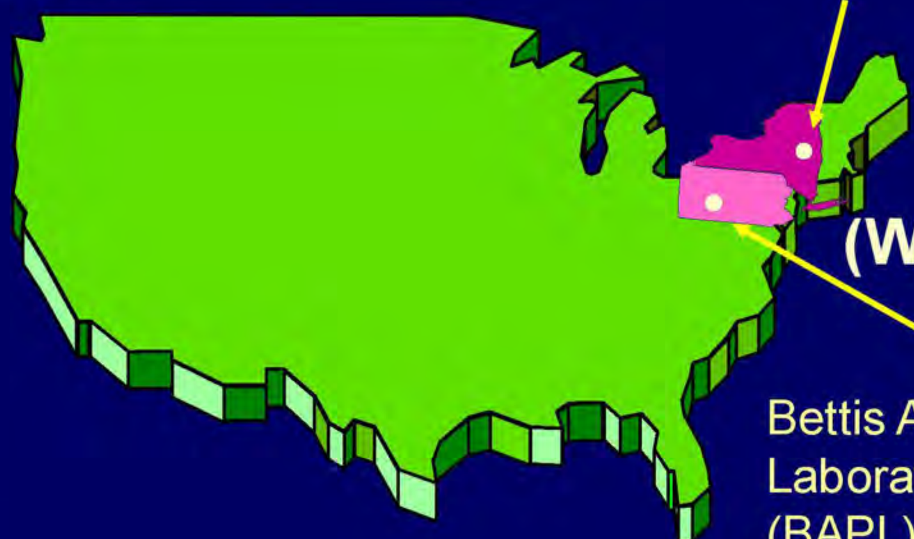
Dana Heavy Water Plant
Newport, IN



- Established in 1952
- Primary Mission
  - Production of heavy water
- Major Contractor
  - E.I. Du Pont de Nemours and Company
- Closed 1959

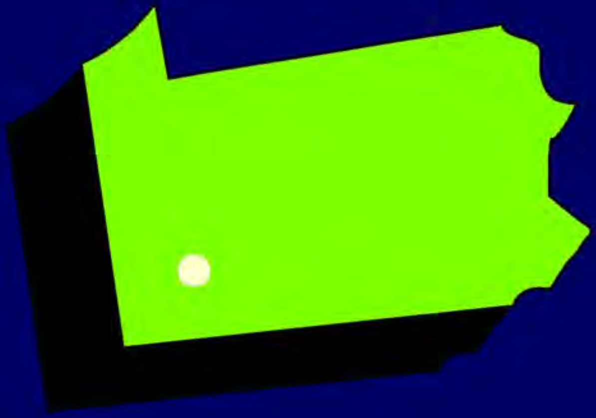
Schenectady Operations Office
Schenectady, NY

- Established in 1949
- Primary Mission
  - Reactor research
  - Naval reactors



Bettis Atomic Power Laboratory
West Mifflin, PA

- Established in 1948
- Primary Mission
  - Reactor research
  - Naval reactors
- Major Contractor
  - Westinghouse Bettis Company



Knolls Atomic Power Laboratory
West Milton, NY

- Established in 1947
- Primary Mission
  - Reactor research
  - Naval reactors
- Major Contractor
  - GE from 1947 to 1993

New York Operations Office
New York, NY

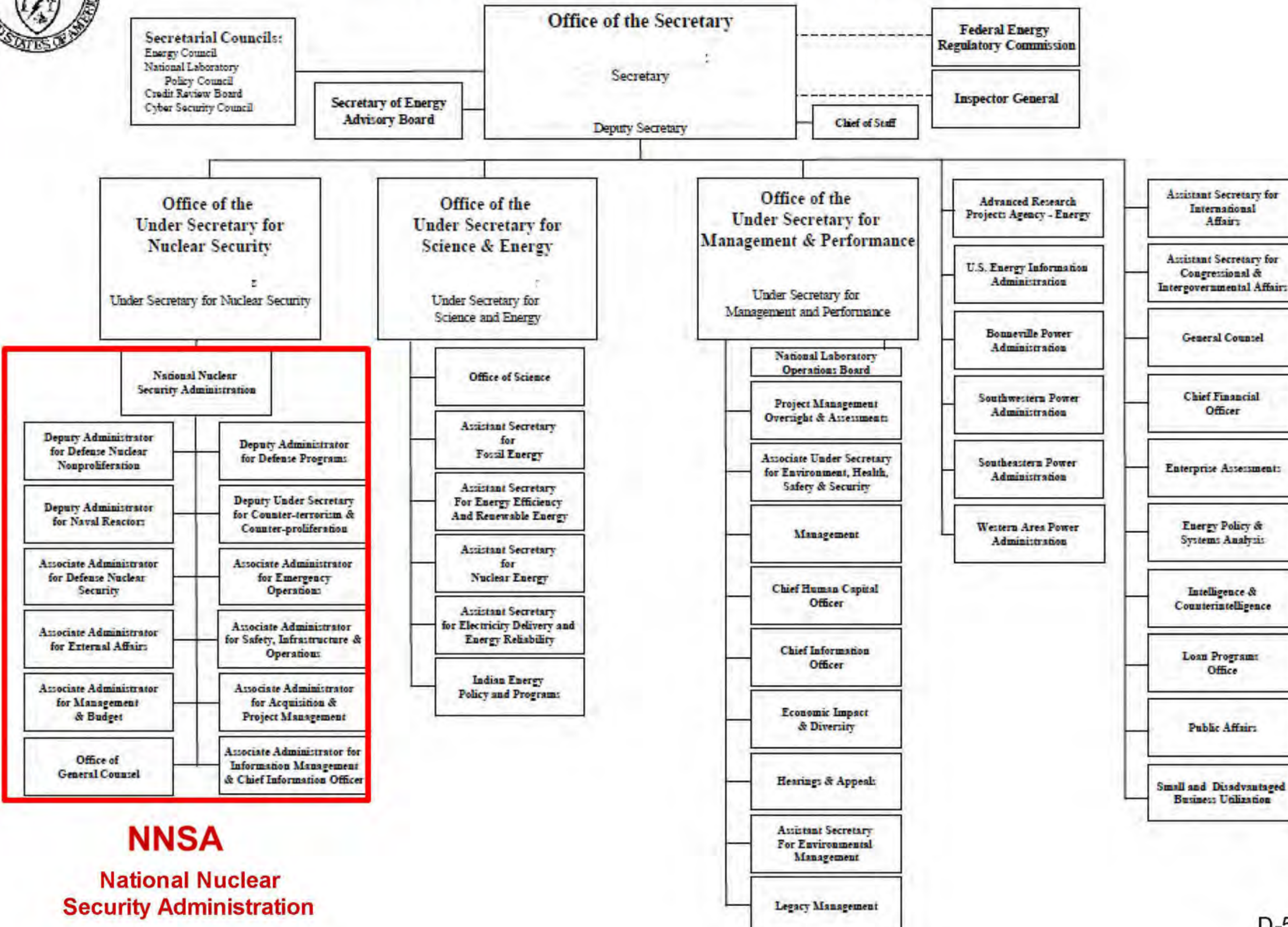
- Established in 1947
- Primary Mission
  - Raw materials import
- Closed in 1971

Grand Junction Operations Office
Grand Junction, CO

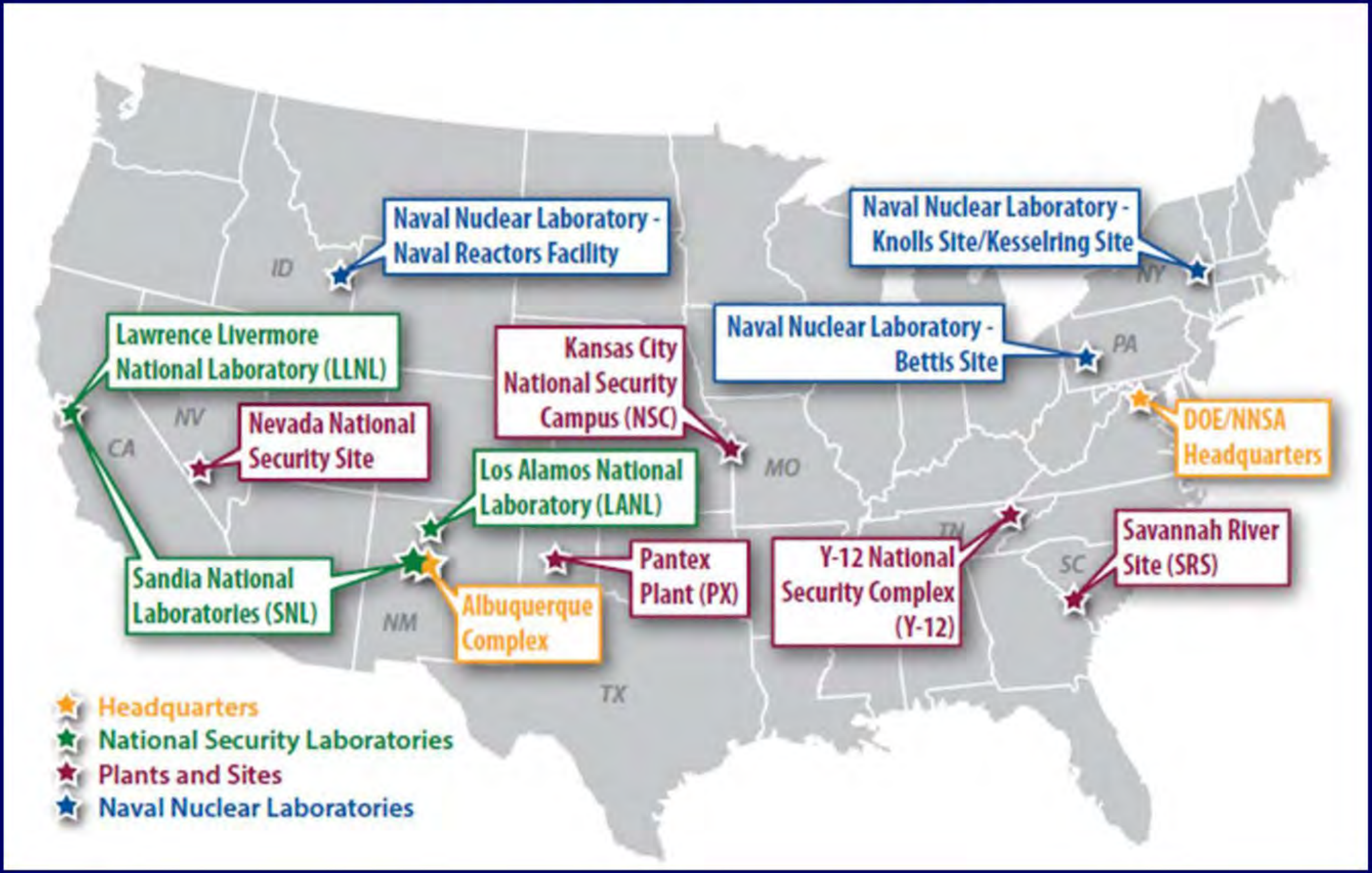
- Established in 1949
- Primary Mission
  - Uranium ore purchasing
- Ceased AEC activities in 1970

The DOE (and NNSA) Today

DEPARTMENT OF ENERGY



National Nuclear Security Administration



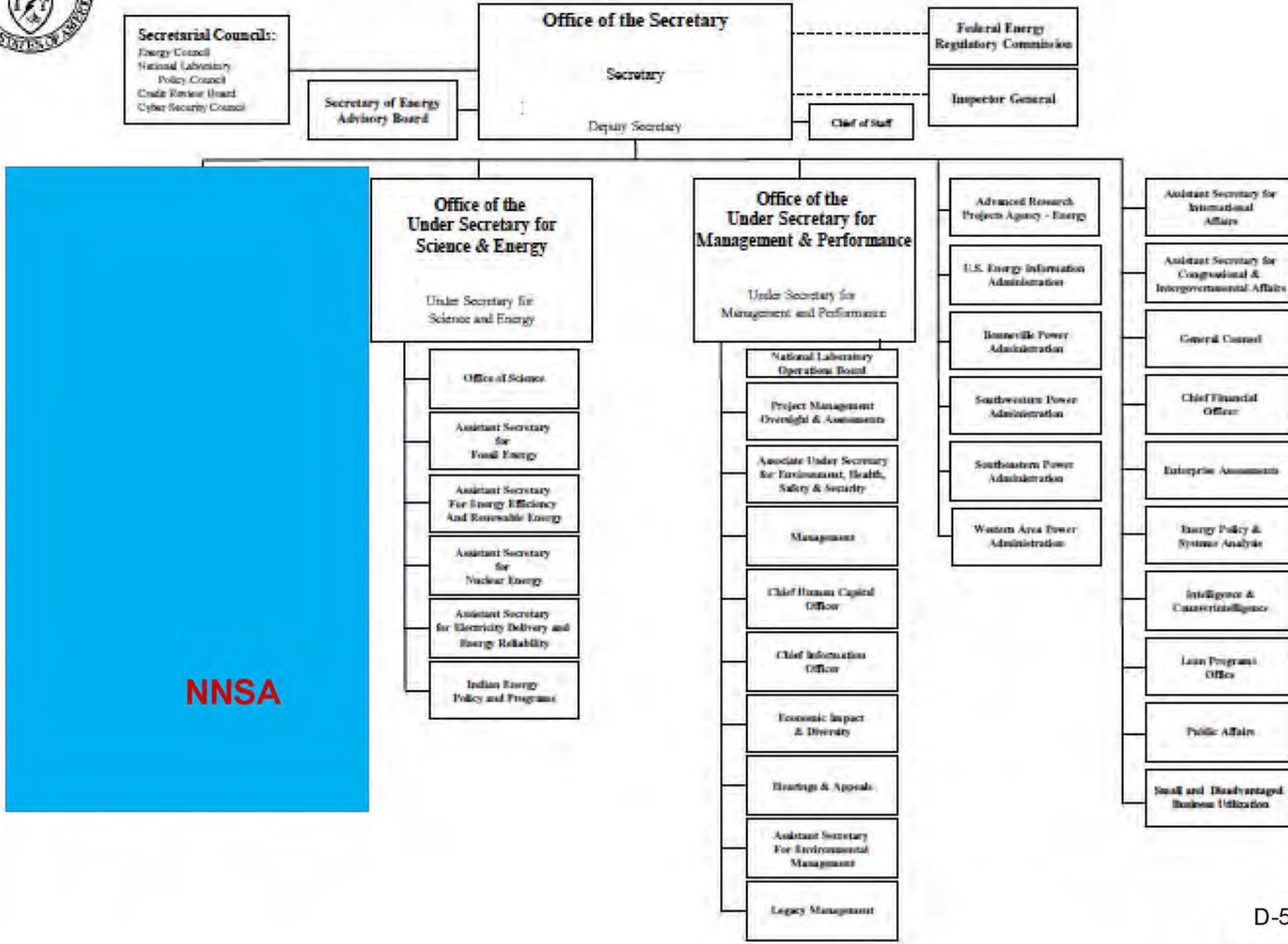
NNSA Locations

NNSA Locations	Facilities Managed	Current M&O Contractor for Facility
NNSA Headquarters Washington, DC, Germantown, MD and Albuquerque, NM	Responsible for planning, managing, and overseeing the entire nuclear security enterprise.	
Los Alamos Field Office (LAFO)	Los Alamos National Laboratory (LANL)	Los Alamos National Security, LLC
NNSA Production Office (NPO) Pantex	Pantex Plant (PX)	Consolidated Nuclear Security, LLC (Bechtel, Lockheed, ATK, SOC)
Kansas City Field Office (KCFO)	Kansas City Plant (KCP) at new National Security Campus (NSC)	Honeywell Federal Manufacturing and Technologies, LLC
Sandia Field Office (SFO)	Sandia National Laboratories (SNL)	Sandia Corporation (a subsidiary of Lockheed Martin Corporation)
Livermore Field Office (LFO)	Lawrence Livermore National Laboratory (LLNL)	Lawrence Livermore National Security, LLC
Nevada Field Office (NFO)	Nevada National Security Site (NNSS) formerly Nevada Test Site (NTS)	National Security Technologies, LLC

NNSA Locations

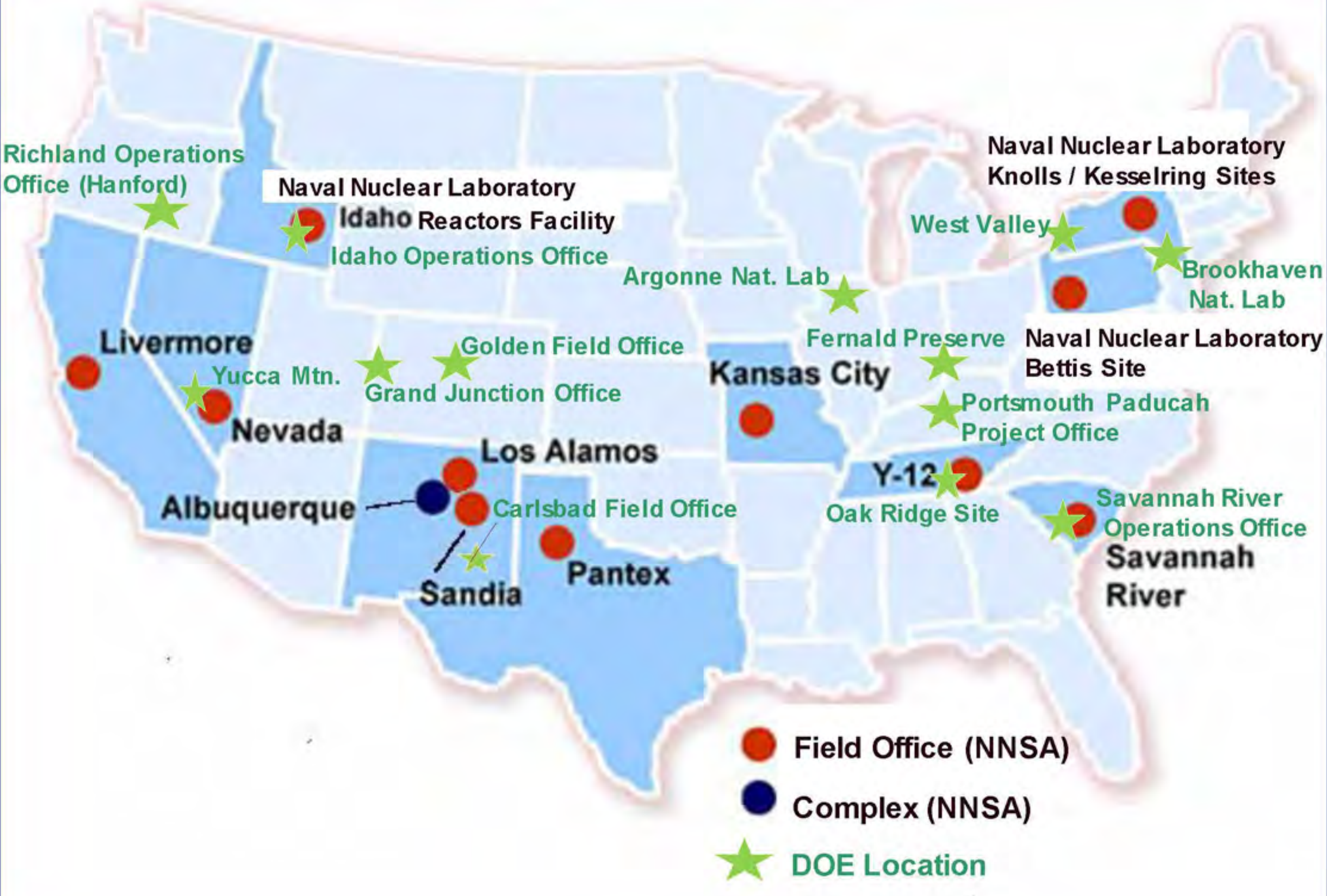
NNSA Locations	Facilities Managed	Current M&O Contractors for Facility
NNSA Production Office (NPO) Y-12 Oak Ridge, TN	Y-12 National Security Complex (Y-12) Highly Enriched Uranium Materials Facility (HEUMF)	Consolidated Nuclear Security, LLC (Bechtel National, Inc., (BNI), Lockheed Martin Services, Inc., ATR Launch Systems, Inc., SOC, LLC)
Savannah River Field Office (SRFO) (located on the Savannah River Site)	Tritium Extraction Facility (TEF) Mixed Oxide Fuel Fabrication Facility (MFFF) (facility under construction)	Savannah River Nuclear Solutions, LLC (SRNS)
Naval Reactors Laboratory Field Office (NRLFO) Schenectady	Knolls Atomic Power Laboratory (KAPL) Kesselring Site – NNPTU (Naval Nuclear Power Training Unit)	Bechtel Marine Propulsion Corporation (BMPC)
Naval Reactors Laboratory Field Office (NRLFO) Pittsburgh	Bettis Atomic Power Laboratory (BAPL) Naval Reactors Facility (NRF) (Idaho)	

DEPARTMENT OF ENERGY



★ DOE vs NNSA ●

DOE and NNSA Locations



DOE Field Locations

DOE Offices	Offices/Facilities Managed	Current M&O Contractors
Carlsbad Field Office (CBFO) (DOE Office of Environmental Management)	National TRU Program Office Waste Isolation Pilot Plant	Nuclear Waste Partnership LLC (NWP)
Argonne Site Office (ASO) (DOE Office of Science)	Argonne National Laboratory (ANL)	University of Chicago Argonne, LLC (U of Chicago Argonne, LLC)
Brookhaven Site Office (BHSO) (DOE Office of Science)	Brookhaven National Laboratory (BNL)	Brookhaven Science Associates, LLC (BSA)
Golden Field Office (GFO) (DOE Office of Energy Efficiency and Renewable Energy (EERE)	National Renewable Energy Laboratory (NREL)	Alliance for Sustainable Energy, LLC (Alliance of Midwest Research Institute (MRI) and Battelle)
Idaho Operations Office (NE-ID) (DOE Office of Nuclear Energy)	Idaho National Laboratory (INL)	Battelle Energy Alliance, LLC
Oak Ridge Office of Science - Site Office(OSO)	Oak Ridge National Laboratory (Office of Science)	University of Tennessee – Battelle, LLC
	Oak Ridge Institute for Science and Education (ORISE) (Office of Science)	Oak Ridge Associated Universities (ORAU)

DOE Field Locations

DOE Offices	Facilities Managed	Current M&O Contractors
Savannah River Operations Office (SR)	Savannah River Site (SRS) Savannah River National Laboratory (SRNL)	Savannah River Nuclear Solutions
Yucca Mountain Site (closed 2011 funding ended)	Yucca Mountain Nuclear Waste Repository (facility not completed)	USA Repository Services (USA-RS) (deactivating)
Richland Operations Office (RL)	Hanford Reservation (site)	Advanced Technology and Laboratories, Bechtel National, Inc. (BNI), CH2M HILL Plateau Remediation Company, HPM Corporation (HPMC), Mission Support Alliance, Washington Closure Hanford (WCH),
Office of River Protection (ORP)	Waste tank cleanup	Washington River Protection Solutions/Areva
Pacific Northwest Site Office (PNSO)	Pacific Northwest National Lab (PNNL)	Battelle (PNNL)

DOE Field Locations

DOE Offices	Clean-up Sites	Current M&O Contractors
Oak Ridge Environmental Management Office	East Tennessee Technology Park (EM – clean-up mission)	URS|CH2M Oak Ridge LLC (UCOR)
	Y-12 National Security Complex (NNSA Site) (EM – clean-up mission)	
Portsmouth/Paducah Project Office (PPPO) (Lexington, KY)	Paducah Gaseous Diffusion Plant (EM – clean-up mission)	Fluor Federal Services, Swift & Staley, BW Conversion Services, Pro2Serve
	Portsmouth Gaseous Diffusion Plant (EM – cleanup mission)	Wastren EnergX Mission Support, LLC (WEMS)
West Valley (NY) Demonstration DOE - EM	West Valley (NY) Project (cleanup since 1980)	Property of the New York State Energy Research and Development Authority (NYSERDA) CH2M Hill-B&W West Valley

DOE Legacy Locations

DOE Offices	DOE Legacy Sites	Current Use/Owner
Grand Junction Office (Office of Legacy Management)	Grand Junction Site Grand Junction Processing Site Grand Junction Disposal Site (former uranium processing site)	Riverview Technology Corporation (DOE-LM leases GJO) (on-going remediation and environmental monitoring by DOE-LM)
	Ashtabula Extrusion Plant, cleanup completed in 2007 (privately owned)	Industrial use (privately owned) (records managed by DOE-LM Grand Junction Office)
	Battelle Columbus Operations Columbus Site (former uranium processing) Jefferson, OH Site (former fuel fabrication)	Battelle (site remediation completed released for unrestricted use - privately owned) (records managed by DOE-LM Grand Junction Office)
Fernald Preserve Office (Office of Legacy Management)	Fernald Feed Materials Production Plant (site closed and remediation completed)	DOE – LM Fernald Preserve (nature preserve on-going environmental monitoring)
	Miamisburg (Mound) Site (site closed and remediation completed) (privately owned)	Mound Science and Energy Museum (private) Industrial uses (private) DOE-LM (on-going environmental monitoring)

Summary

- Manhattan Project Facilities
  - Clinton Engineer Works
  - Hanford Engineer Works
  - Los Alamos Laboratory

- Atomic Energy Commission Facilities
  - Operations Offices

Albuquerque	San Francisco
Chicago	Savannah River
Idaho	Schenectady
Nevada	New York
Oak Ridge	Grand Junction
Richland	

- Current Facilities and Organization: DOE and NNSA
  - www.energy.gov (website)
  - www.nnsa.energy.gov (website)

Module E:

The Classification System and Related Issues

A Historical Perspective

Executive Orders

Statutes

Executive Order History

- **EO 8381 - March 1940 (Roosevelt)**
  - Covered military equipment or installations classified by the Secretaries of War and Navy
  - *Secret, Confidential, Restricted*

- **EO 10104 - February 1950 (Truman)**
  - Formalized Top Secret
  - *Top Secret, Secret, Confidential, Restricted*

- **EO 10290 - September 1951 (Truman)**
  - Extended classification system to non-military agencies
  - *Top Secret, Secret, Confidential, Restricted*

Executive Order History (continued)

- **EO 10501 - November 1953 (Eisenhower)**
  - Abolished or limited original classification authority of many Government agencies
  - *Established current three levels - Top Secret, Secret, and Confidential*

- **EO 10964 - September 1961 (Kennedy)**
  - Established 4 groups of classified information (one (Group 4) with automatic declassification)

- **EO 11652 - March 1972 (Nixon)**
  - Established systematic and mandatory reviews
  - Established the General Declassification Schedule (GDS) for automatic declassification

Executive Order History (continued)

- **EO 12065 - June 1978 (Carter)**
  - Classification restricted to specific areas
  - Date or event

- **EO 12356 - April 1982 (Reagan)**
  - Expanded classification
  - Date or event
  - OADR

Executive Order History (continued)

- **EO 12958 -October 1995 (Clinton)**
  - Uniform System for Classifying National Security Information (NSI)
    - Classifiable categories redefined
    - Portion marking and classification guides mandated
    - Declassification instructions required
  - Automatic declassification of NSI documents after 25 years

Executive Order History (continued)

- E.O. 13292 (E.O. 12958, As Amended)
  - Signed March 25, 2003
  - Emphasis remains on declassification
  - Allows classification of new documents up to 25 years vs. 10 years in Clinton's E.O.
  - Did away with "if in doubt, do not classify" instruction for original classification

Executive Order 13526

Barack H. Obama

- Signed December 29, 2009
- National Declassification Center established
- Dec 31, 2013 deadline before public access to NDC backlog of 400+ million pages
- Reestablished If in doubt, do not classify (original classification)
- Establishes requirements for Transclassified Foreign Nuclear Information (TFNI), which can only be declassified by Secretary of Energy

Statute History

Atomic Energy Act of 1946

Restricted Data (RD)

Atomic Energy Act of 1946 (August 1, 1946)

- Abolished Manhattan Engineer District
- Established the Atomic Energy Commission (AEC)
- Guaranteed civilian control over atomic weaponry and energy production
- Gave AEC unilateral authority over the control of RD information

Atomic Energy Act of 1946

Defined RD as:

"...all data concerning the manufacture or utilization of atomic weapons, the production of fissionable material, or the use of fissionable material in the production of power, but shall not include any data which the Commission from time to time determines may be published without adversely affecting the common defense."

Issues Necessitating Changes to the Atomic Energy Act of 1946

- Expanded transfer of weapons to DoD
  - Military assumed a greater role
  - "Q" clearances too time consuming
  - Utilization data (FRD) deemed not to require same degree of protection as design/fabrication data

- Desire for exchange of RD with foreign governments
- Commercial applications of atomic energy

Atomic Energy Act of 1954

Congress Amended Act to Include:

- DoD clearances okay for access to RD
- Military utilization RD becomes FRD
- Provision for DOE/DoD declassification of FRD
- Foreign transfer proviso
- Certain reactor design information declassified for commercial use

Atomic Energy Act of 1954

Restricted Data (RD)
Formerly Restricted Data (FRD)

Atomic Energy Act of 1954, as Amended Restricted Data

The term "Restricted Data" means all data concerning the:

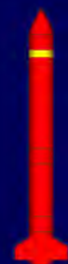
(1) Design, Manufacture, or Utilization of Atomic Weapons;

(2) The Production of Special Nuclear Material; or

(3) The Use of Special Nuclear Material in the Production of Energy

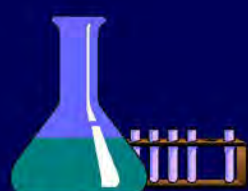
But shall not include data declassified or removed from the Restricted Data category pursuant to section 142

Major Areas of Restricted Data

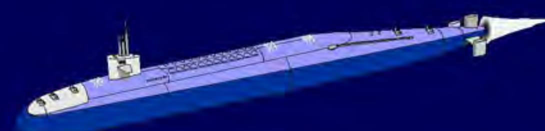


Nuclear Weapons Design

Nuclear Material Production



Isotope Separation



Naval Reactors

Transclassification

The term "Restricted Data" means all data concerning (1) Design, Manufacture, or (2) Utilization of Atomic Weapons; or (3) The Production of Special Nuclear Material; or The Use of Special Nuclear Material in the Production of Energy.

But does not include data declassified or removed (transclassified) from the Restricted Data category pursuant to section 142 of the Atomic Energy Act

Transclassification Formerly Restricted Data

CLASSIFIED information that has been removed from the Restricted Data category after DOE and DoD have jointly determined that (1) it relates primarily to the military utilization of atomic weapons and (2) can be adequately safeguarded as defense information

NOT UNCLASSIFIED

Examples of Formerly Restricted Data

Stockpile Quantities

Weapons Safety and Storage

Yields

Locations

RD/FRD

Markings

Watch for the Following Markings

RD

FRD

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954, as amended. Unauthorized disclosure is subject to Administrative and Criminal Sanctions.

Formerly Restricted Data

RES DAT

Restricted Data

FORMERLY RESTRICTED DATA
Unauthorized disclosure subject to administrative and criminal sanctions. Handle as Restricted Data in Foreign Dissemination. Section 144.b, Atomic Energy Act, 1954.

FORMERLY RESTRICTED DATA
Handle as Restricted Data in Foreign Dissemination.
Section 144b Atomic Energy Act of 1954.

Other Markings That May Indicate RD/FRD

- ATOMIC -- UK Atomic Information
- ATOMAL -- NATO marking applied to U.S. RD and FRD and UK Atomic Information
- COSMIC -- NATO
- Atomic Energy Information
- Naval Reactors/Nuclear Navy/Naval Nuclear Propulsion Information (NNPI)
- Protect as Restricted Data (PARD)
- Weapon Data/Sigma
- CNWDI -- Critical Nuclear Weapon Design Information

Critical Nuclear Weapon Design Information (CNWDI)

- CNWDI is a category of weapon data designating TSRD or SRD revealing the theory of operation or design of the components of a thermonuclear or fission bomb, warhead, demolition munition, or test device

- Access to CNWDI is on a need-to-know basis -- a special DoD briefing is required

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Nuclear Versus Atomic

Atomic - Old

Nuclear - New

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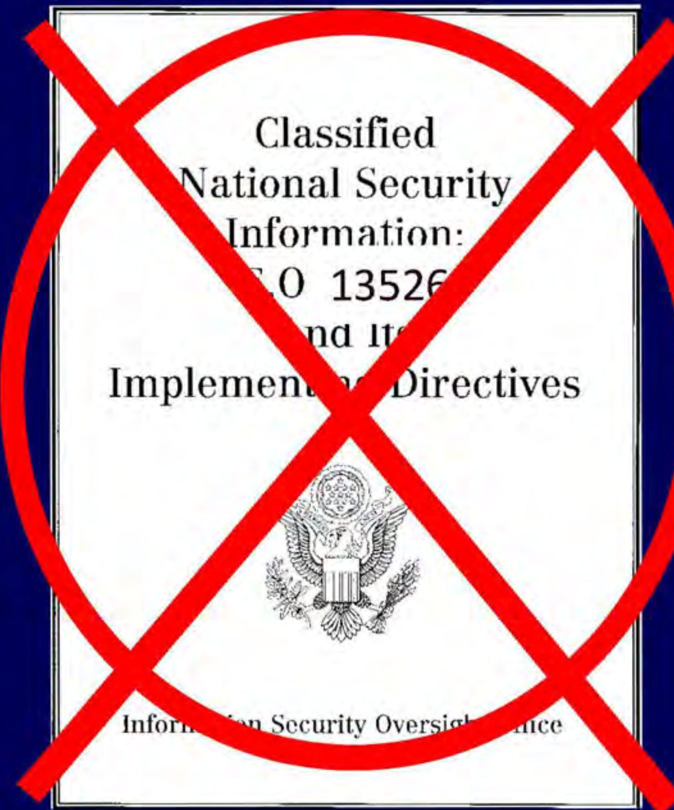
RD/FRD Abbreviations

Top Secret	Restricted Data	- TSRD
	Formerly Restricted Data	- TSFRD
Secret	Restricted Data	- SRD
	Formerly Restricted Data	- SFRD
Confidential	Restricted Data	- CRD
	Formerly Restricted Data	- CFRD

NOTE: The use of a "-" or "/" between the level and category is acceptable (e.g., S-RD, S/RD, etc.)

Declassification of Documents Containing RD/FRD

RD and FRD documents are ***NEVER*** automatically declassified -- even if NSI is present



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RD and FRD Document Declassification Authorities

- A positive action by an authorized person is required to declassify an RD or FRD document
- RD -- Only DOE may declassify RD documents
- FRD -- DoD or DOE may declassify FRD documents
  - Depends on originating agency
  - Must coordinate if joint guidance doesn't exist

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Transclassification

The term "Restricted Data" means all data concerning (1) Design, Manufacture, or (2) Utilization of Atomic Weapons; or (3) The Production of Special Nuclear Material; or The Use of Special Nuclear Material in the Production of Energy.

But does not include data declassified or removed (transclassified) from the Restricted Data category pursuant to section 142 of the Atomic Energy Act

Transclassified Foreign Nuclear Information (TFNI)

CLASSIFIED information moved from the Restricted Data category to NSI after the DOE and the DNI jointly determine that it

1) concerns the atomic energy programs of other nations, and
2) can be adequately safeguarded in a manner similar to NSI

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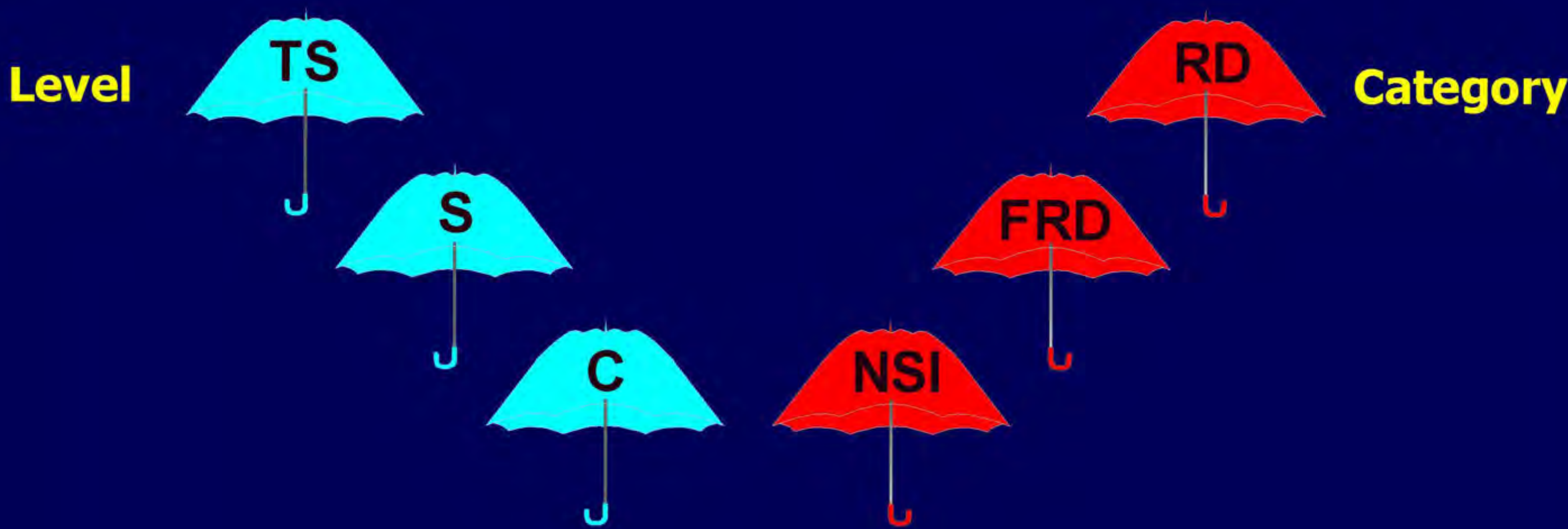
Classification Category and Level Precedence Rule



- Highest level is TS, then S, then C
- Most restrictive category is RD, then FRD, then NSI

S + C = S

CRD + SNSI = SRD

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Access Requirements for Agencies Other Than DoD

Category	*Top Secret*	*Secret*	*Confidential*
Restricted Data	Q*	Q*	L**
Formerly Restricted Data	Q*	L**	L**

Access Limited to Need-to-Know

* Eligibility for a DOE "Q" Clearance is based on a single scope background investigation (SSBI)

** Eligibility for a DOE "L" clearance is based as a minimum on a National Agency Check (NAC)

Access Requirements for DoD

- Final Top Secret or Secret clearance
- Special CNWDI briefing required

Transmitting RD/FRD to Other Government Agencies

- Sender is responsible for ensuring that
  - The receiving facility is cleared for RD or FRD
  - The recipient has appropriate clearance and access

International Exchange Limitations

There shall be no exchange of RD or FRD with any nation or regional defense organization unless specifically authorized by the President pursuant to an agreement for cooperation entered in accordance with section 123 and subsection 144.b of the Atomic Energy Act

No Comment Policy

- There are occasions when classified information appears in the public domain
  - Fact itself is classified
  - Does not make it unclassified
- Any questions raised about the accuracy, classification, or technical merit should be responded to in a “no comment” manner

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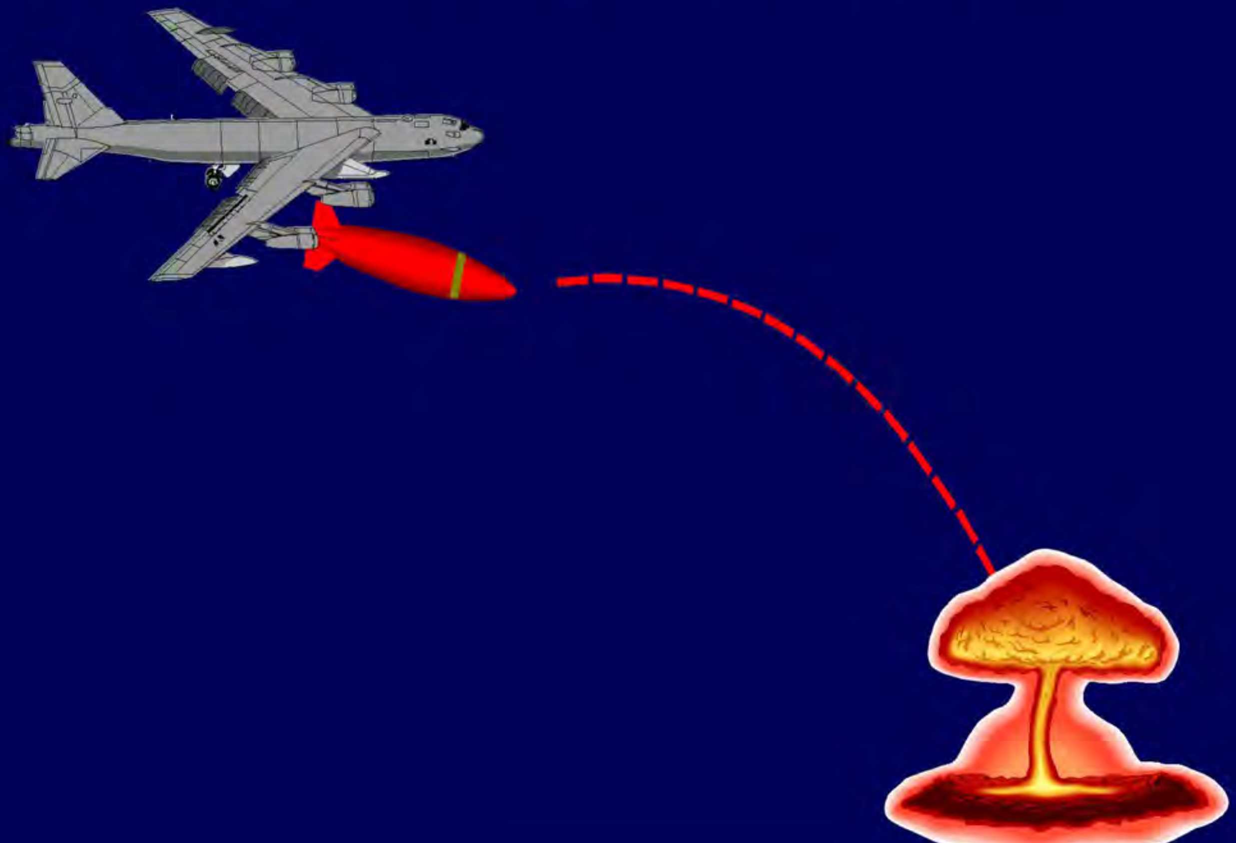
Summary

- Executive Orders
- Atomic Energy Act of 1946
  - Restricted Data
- Atomic Energy Act of 1954
  - Restricted Data
  - Formerly Restricted Data
- Markings
- Other Considerations

Module F:

Nuclear Weapons I



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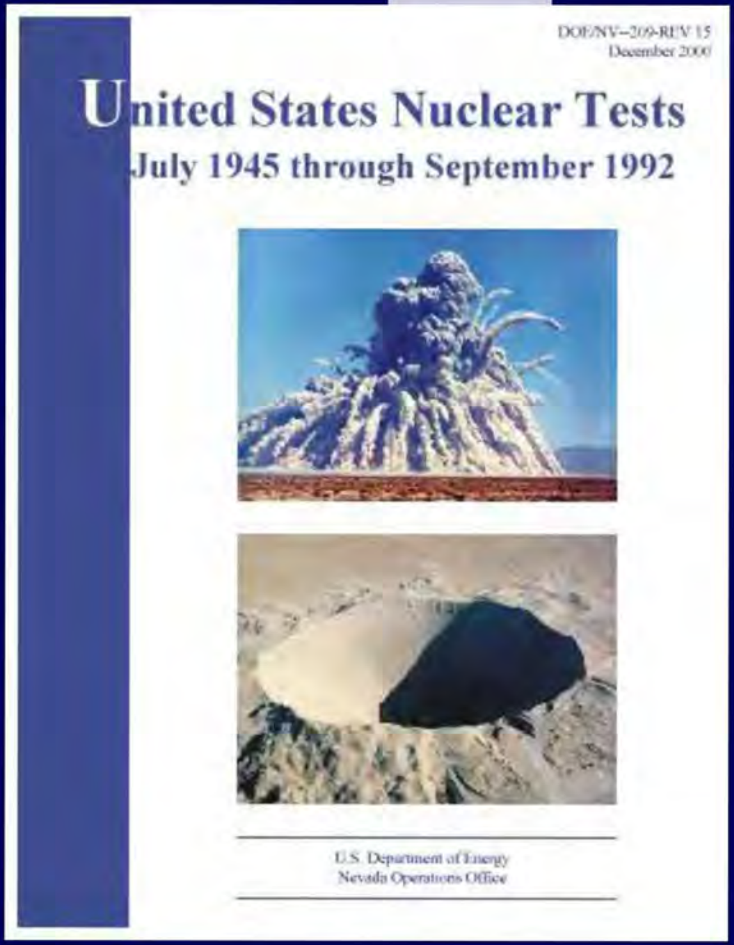


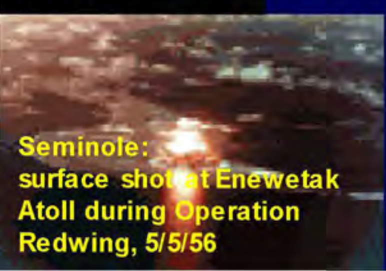
Available on the Internet at:
www.nv.doe.gov/news&pubs/publications/historyreports/default.htm

Types of Tests


John: air-to-air, Plumbbob series, 7/19/57


Romeo: barge test, fired near Bikini Atoll during Operation Castle, 3/26/54


Harry: tower shot during Operation Upshot/ Knothole, Nevada Test Site, 5/19/53


Seminole: surface shot at Enewetak Atoll during Operation Redwing, 5/5/56

- Atmospheric (1945-1962)
  - Airburst 1
  - Airdrop 52
  - Balloon 25
  - Barge 36
  - Rocket 12
  - Surface 28
  - Tower 56
- Underground (1957-1992)
  - Tunnel 67
  - Shaft 739
  - Crater 9
- Underwater 5


Stokes test: balloon drop, Nevada Test Site, 8/7/57


Charlie: dropped from B-50 bomber at Yucca Flat, Nevada Proving Ground, 10/30/51


Sedan Crater: Nevada Test Site, 7/6/62


Umbrella: underwater shot near Enewetak Atoll during Operation Hardtack, 6/8/58

Purpose

• Weapon related	891
• Weapon effects	100
• Safety experiments	88
• Joint US-UK	24
• Plowshare (peaceful uses)	35
• Vela Uniform (detection uses)	7
• Storage-transportation	4

Testing Locations (Major Sites)

- Pacific Proving Grounds (1946-1958)
  - Bikini Atoll
  - Enewetak Atoll
- Nevada Test Site (1951-1992)
  - Originally known as Nevada Proving Grounds
  - Frenchman Flat
  - Yucca Flat
  - Area # (Areas 1, 2, 3, 4, 5, 6, 9, 10, and 18)
  - Pahute Mesa
  - Ranier Mesa
  - "N" Tunnel

Testing Locations (Other U.S. Sites)

F-30

Testing Locations (Other U.S. Sites)

Location	Event	Date	Purpose
Alamogordo, NM	Trinity	07/16/45	Weapon development
Carlsbad, NM	Gnome	12/10/61	Plowshare
Fallon, NV	Shoal	10/26/63	Vela Uniform
Hattiesburg, MS	Salmon	10/22/64	Vela Uniform
Hattiesburg, MS	Sterling	12/03/66	Vela Uniform
Amchitka, AK	Long Shot	10/29/65	Vela Uniform
	Milrow	10/02/69	Weapon related
	Cannikan	11/06/72	Weapon related
Farmington, NM	Gasbuggy	12/10/67	Plowshare
Central, NV	Faultlers	01/19/68	Weapon related
Grand Valley, CO	Rulison	09/10/69	Plowshare
Rifle, CO	Rio Blanco- 1,2, and 3	05/17/73	Plowshare

Testing Locations (Other Off Shore Sites)

- Pacific
  - Johnston Island
    - Operation Hardtack (1958)
    - Operation Dominic (1962)
    - Operation Fishbowl (1962)
  - Christmas Island Area (Operation Dominic) (1962)

- Southern Atlantic (Operation Argus) (1958)

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Nuclear Test Series

TEST	DATE	LOCATION
Anvil	1975-1976	NTS
Aqueduct	1989-1990	NTS
Arbor	1973-1974	NTS
Argus	1958	South Atlantic
Bedrock	1974-1975	NTS
Bowline	1968-1969	NTS
Buster	1951	NTS
Castle	1954	Bikini/Enewetak
Charioteer	1985-1986	NTS
Cornerstone	1988-1989	NTS
Cresset	1977-1978	NTS
Crossroads	1946	Bikini
Crosstie	1967-1968	NTS/Farmington, NM/Central NV
Dominic	1962	Christmas and Johnson Islands

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Underground Test Site

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Test Chamber

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Module G:

Nuclear Weapons II

See Classified Notebook

Module H:

Safing, Arming, Fuzing, and Firing

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Safing/Safety

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Module I:

Nuclear Weapon Use Control

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Module J:

Nuclear Weapon Outputs and Effects

Nuclear Weapon Outputs and Effects

- What happens when a nuclear weapon is detonated?
- Types of weapon outputs
- Types of weapon effects

Weapon Yield

Nuclear

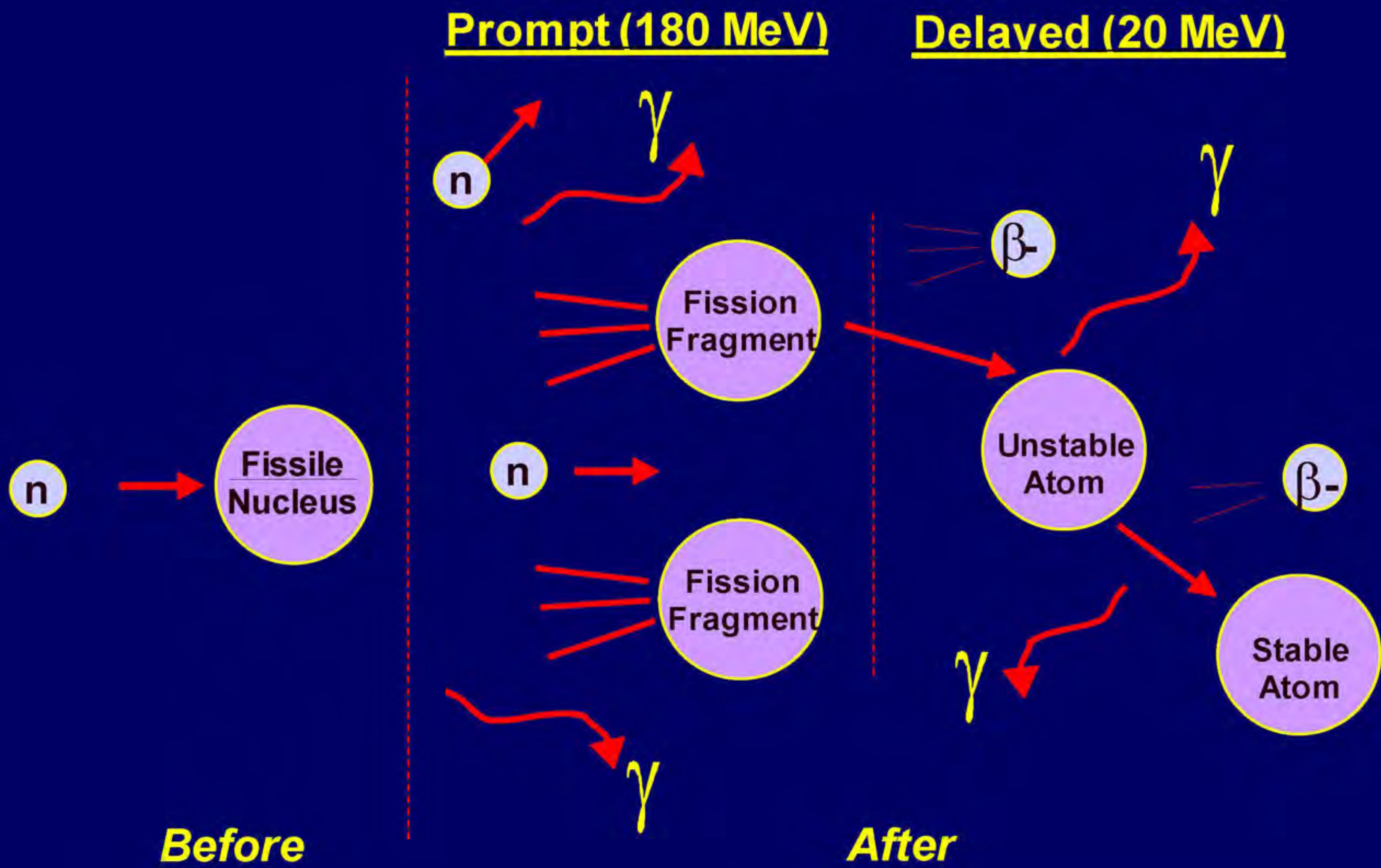
TNT

- Measure of the explosive energy produced
- Expressed as the quantity of TNT that would generate the same amount of energy (e.g., a 1 kiloton nuclear weapon produces the same amount of energy as 1,000 tons of TNT)

Conventional vs. Nuclear Explosions

- Nuclear explosions are many thousands (or millions) times more powerful
- Temperatures reached in a nuclear weapon are much, much higher than a chemical explosion (10's of millions of degrees versus 9,000° F)
- Only nuclear explosions are accompanied by initial nuclear radiation (neutrons, alphas, betas, gamma rays, and x-rays)
- Only the residue of nuclear explosions can give off significant amounts of harmful (residual) radiation well after the explosion

Where Does All This Energy and Radiation Originate?



It's All About Energy Transfer

- Fission fragments, neutrons and gamma rays interact with surrounding weapon materials transferring much of their energy
- Temperatures rise tens of millions of degrees
- Pressures reach millions of atmospheres
- The continued interactions and energy transfers generate what are known as **outputs** and **effects**

Radiative Output
vs.
Radiation Effects

- **Radiative Output** - Neutrons, gamma rays, and x-rays that cross the surface of the device

- **Radiation Effects** - Anything generated beyond the surface of the device

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Source of X-rays

- An exploded nuclear device is extremely hot (10's of millions of degrees) so it radiates heat

- Radiated energy is in the form of x-rays

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Source of Neutrons

- Fission and fusion reactions
- Approximately 1 x 10^{23} neutrons per KT yield

Sources of Gamma Radiative Output

- Fission
- Neutron inelastic scattering with weapon debris

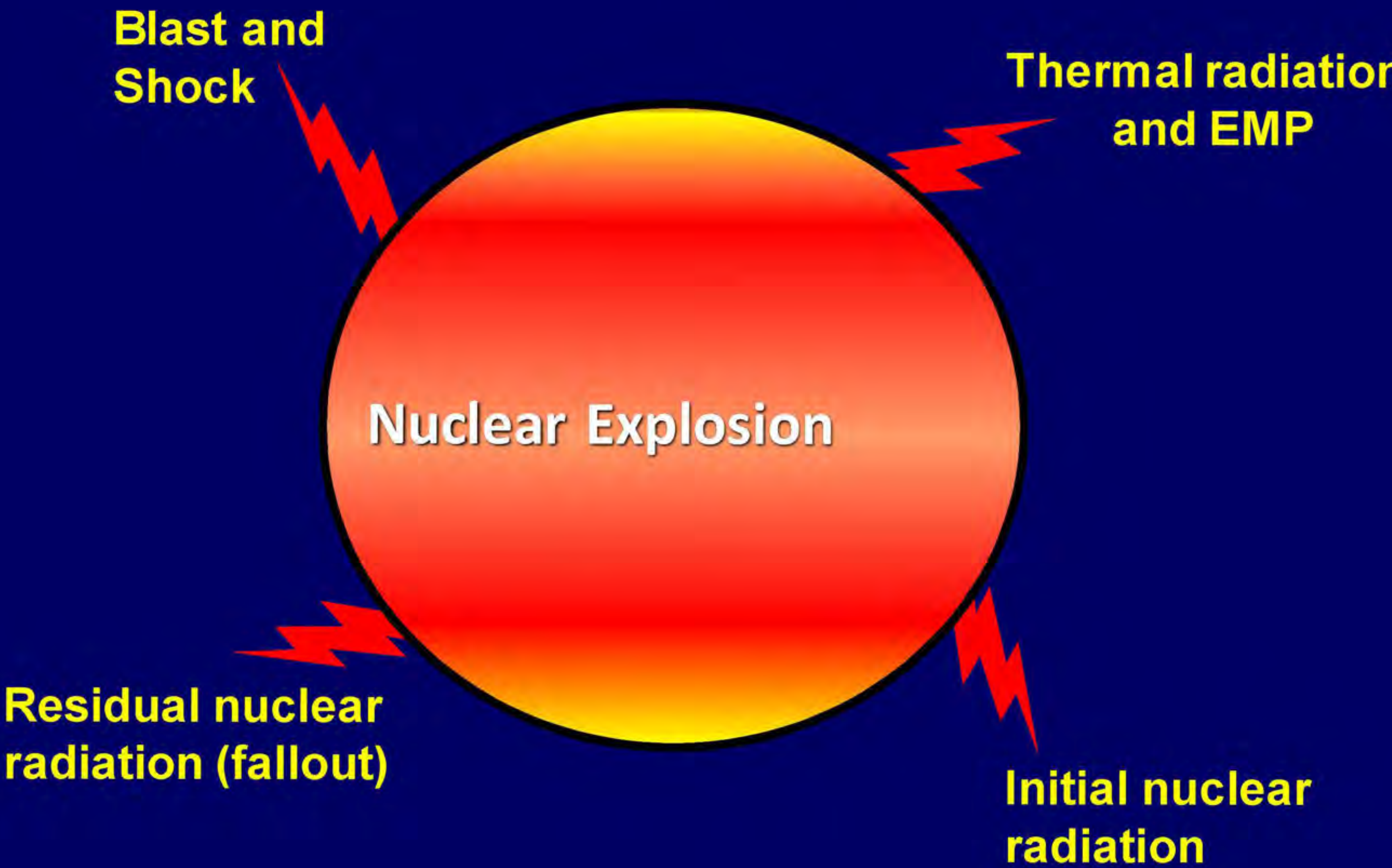
Further Conversion of Energy

- Weapon output energy is divided among x-rays, neutrons, nuclear radiation and kinetic energy of fission fragments and other weapon debris

- Continued interactions of radiation and debris with the surrounding environment further partitions energy and changes its form

- Transfer of energy generates what is known as weapon effects

Effects of a Nuclear Explosion



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X-ray Interactions Vary with Environment (Atmospheric Burst)

- X-rays absorbed in short distance, create fireball
- Energy re-radiated as thermal (ultraviolet, visible and infrared) radiation

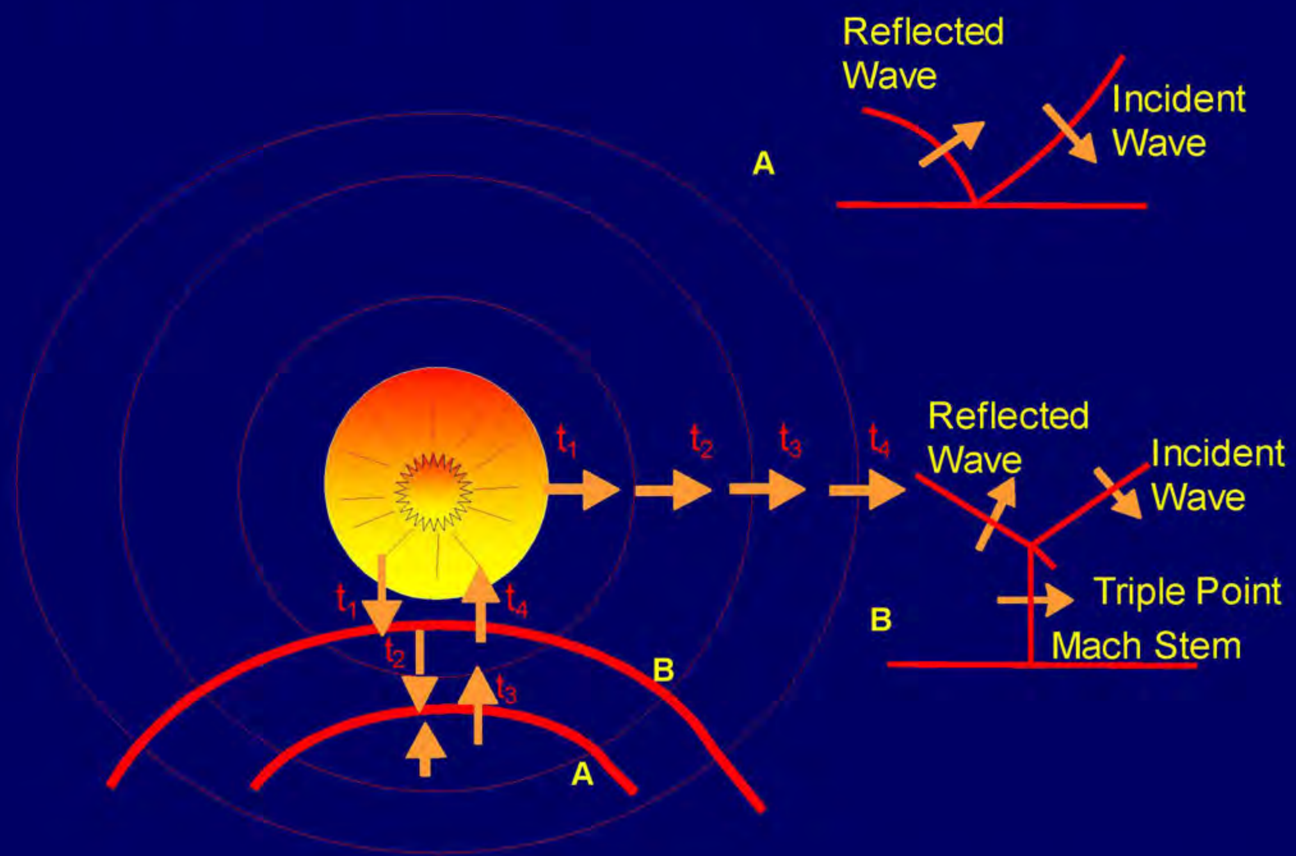
Thermal Radiation
(Atmospheric Burst)

- X-rays are converted to ultraviolet, visible, and infrared radiation
- Can propagate long distances through air
- Causes fires, burns, flash blindness

Blast and Shock

- Normally constitutes 35 to 50 percent of the explosive energy yield for an atmospheric burst
- Varies with height-of-burst (goes to zero at extremely high altitudes)
- Caused by intensely hot gases at extremely high pressure in the fireball forming a blast wave in the air
- Produces most material damage for low air or surface burst
- Consists of static and dynamic overpressure

Blast Wave for Low Air Burst



GROUND ZERO

Reflection of blast wave at the earth's surface in an air burst: t_1 to t_4 to represent successive times.

Ground Shock

- On or near surface
  - Direct coupling of explosive energy
  - Pressure of air blast wave

- Deep Underground
  - Much energy in cavity formation
  - Remainder in ground shock
  - Zone of permanent distortion
  - Seismic activity with temporary disturbance of the ground
  - Aftershocks

Nuclear Radiation

- Initial -- Emitted within one minute
  - Fission and fusion neutrons
  - Gamma radiation
- Residual -- Emitted after one minute
  - Fission product decay (alpha, beta, and gamma) (fallout)
  - Neutron induced radioactivity

Neutron Effects

- Gamma ray production
- Radiation effects on electronics, other materials
- Activation of surrounding material
- Biological effects

Gamma Effects

- Total dose, dose rate effects on electronics, optics
- Biological effects
- Electromagnetic pulse

Electromagnetic Pulse (EMP)

- A sharp pulse of electromagnetic radiation resulting from the explosion of a nuclear weapon, especially at high altitudes
- Results mainly from asymmetric interaction of gamma radiation with the surrounding medium
- Can damage electrical systems even at a considerable distance from the burst point

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Sources of Residual Radiation (Alpha, Beta, and Gamma)

- Fission product decay
- Neutron induced radioactivity (for burst close to ground only)

Residual Radiation Effects

- Biological effects
- Total dose effects on electronics, optics

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Module K:

Vulnerability and Hardening

Vulnerability

Susceptibility of a piece of equipment to damage or destruction as the result of a defensive effort (e.g., an enemy's nuclear burst)

Hardening

Intentional measures taken in the design and fabrication of a weapon, its delivery vehicle, and their components to reduce vulnerability

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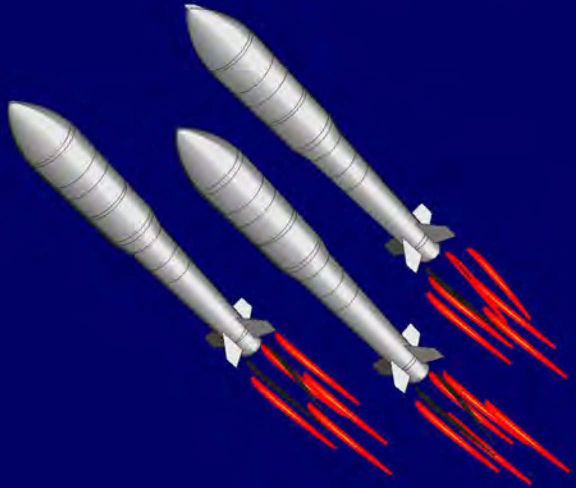
Module L:

Nuclear Weapons Production and Military Utilization

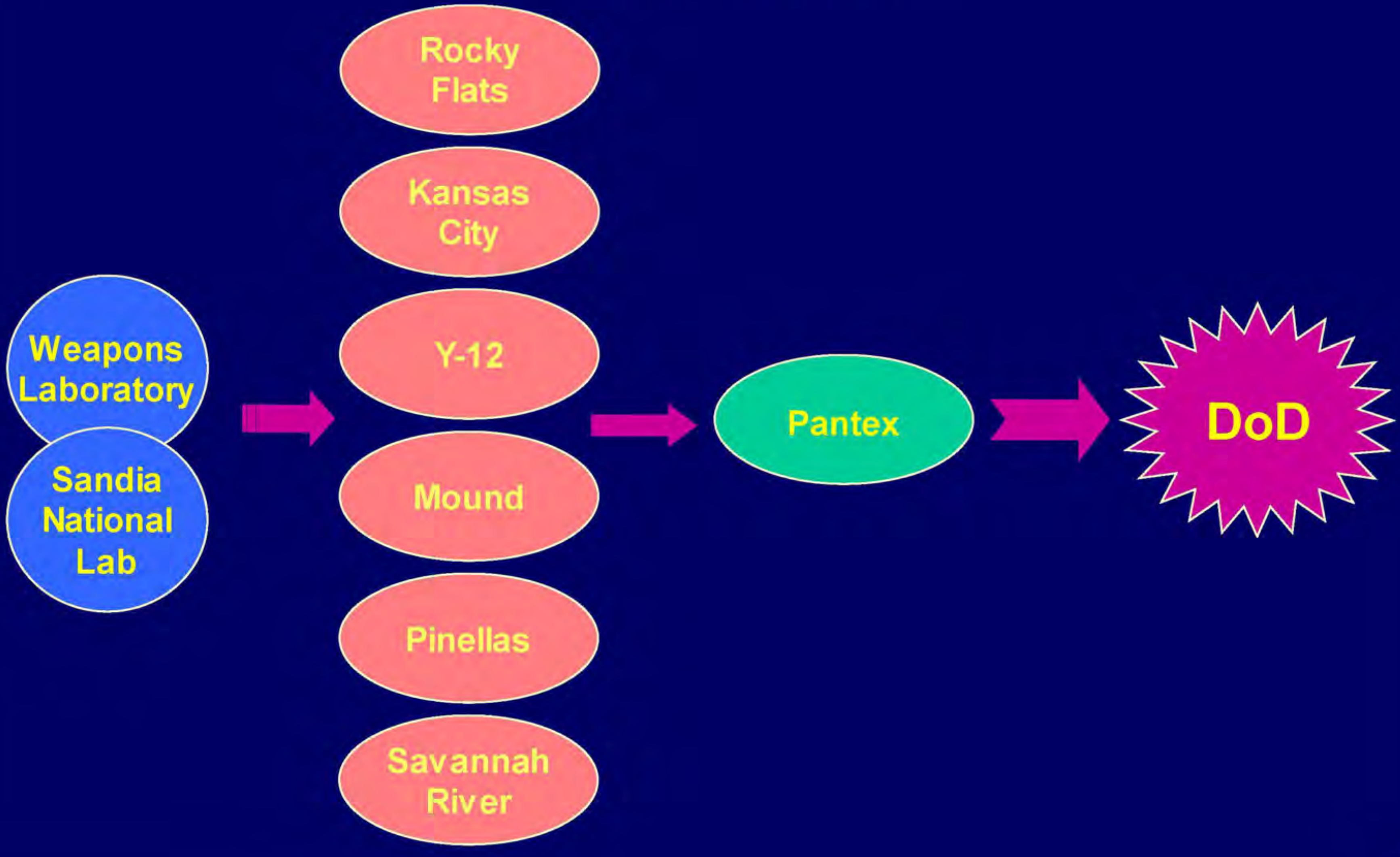


Overview

- Weapon Production and Development

- Military Utilization

DOE Weapons Production Complex



Weapon Development

Phase 1 →

Concept Definition

Phase 2 →

Feasibility

Phase 2A →

Design Definition and Cost

Phase 3 →

Development Engineering

→ Phase 4 →

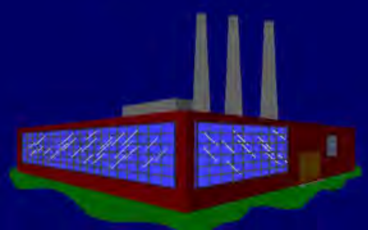
Production Engineering

Phase 5 →

First Production

Phase 6 →

Quantity Production & Stockpile



Phase 7

Retirement

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Weapons Production

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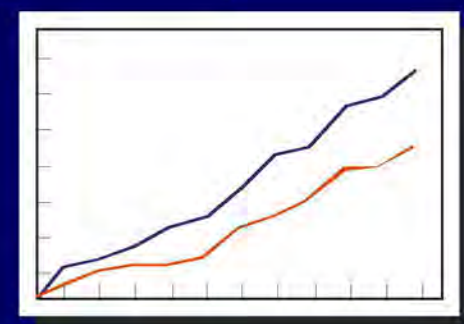

Production Facilities and Problems

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Nuclear Weapons Safety

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Weapon Reliability and Quality Assurance

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Weapon Reliability and Quality Assurance

(b) (7)(E)

Program Funding/Cost Data

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Military Utilization
(Areas of Classification Concerns)

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LOCATION

LOCATION

LOCATION

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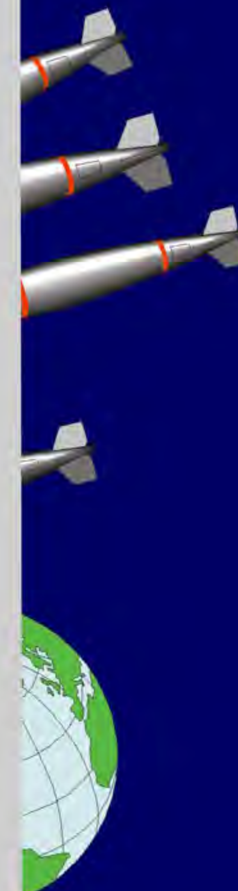

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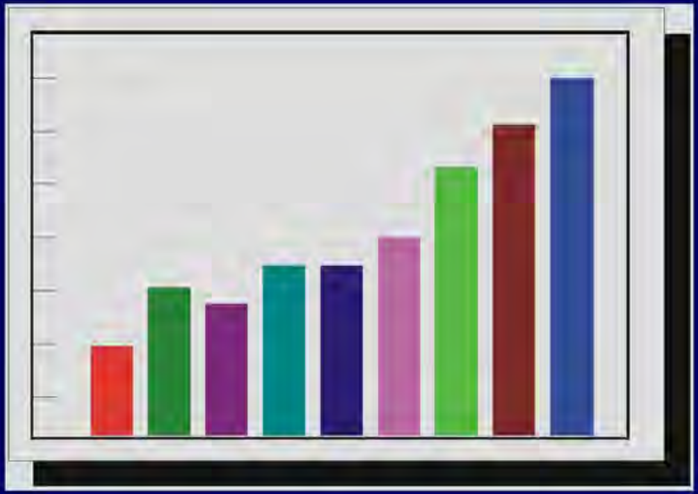

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USAF Nuclear Capable Aircraft

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USN Nuclear Capable Aircraft

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MX Reentry Vehicles

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Polaris A-1 Missile

Poseidon C-3 Missile

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Air Launched Cruise Missile (ALCM)

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Nuclear Weapons Accidents

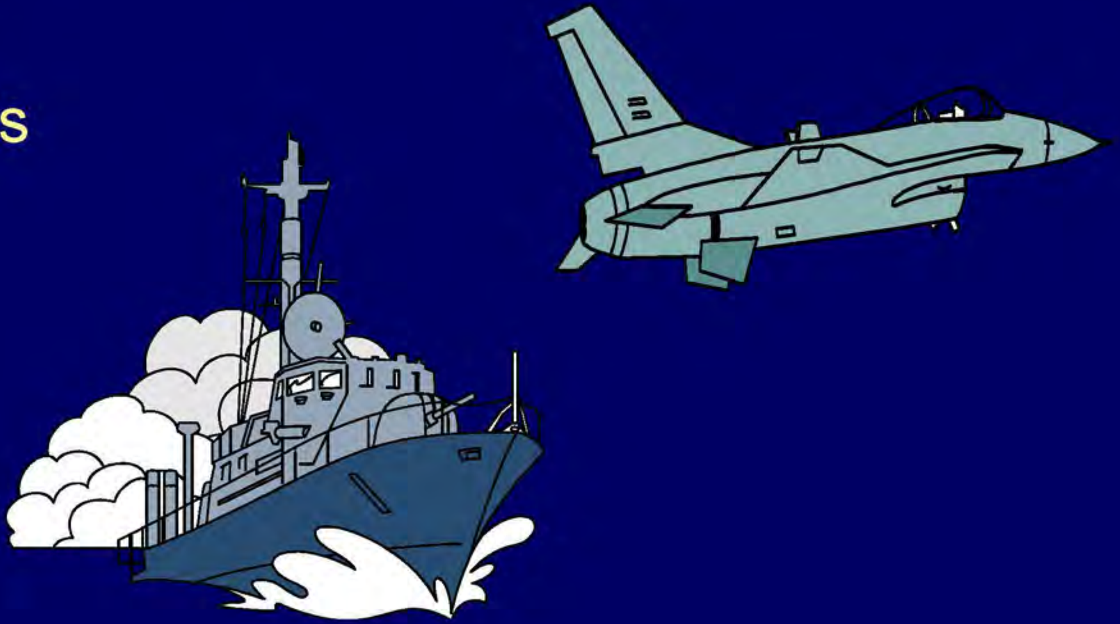
- Non-nuclear detonation or burning of a nuclear weapon or radioactive weapon component, including a fully assembled nuclear weapon, an unassembled nuclear weapon, or a radioactive component;

- Nuclear detonation; or

- Public hazard, actual or implied

Nuclear Weapons Accidents

- Accidents have occurred during normal operational deployment and logistical operations
  - Aircraft
  - Ships
  - Missiles



Nuclear Weapons Accidents

- All accidents have been caused by the failure of the delivery system, NOT failure of the weapon. There has NEVER been an accidental nuclear detonation.

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Nuclear Weapons Accidents

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Nuclear Weapons Accidents Examples of Classified Information

(b) (7)(E)

Nuclear Weapons Accidents

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Module M:

Isotope Separation

Review of Isotopes

Atoms that have the same number of protons (and electrons) but different numbers of neutrons

U^{235} vs U^{238}

Nuclear and Chemical Properties

- Nuclear Properties
  - The nuclear properties of an atom depend on the number of protons and neutrons in the nucleus

- Chemical Properties
  - Chemical properties of an atom depend on the number of electrons and their arrangement around the nucleus

Why Separate Isotopes?

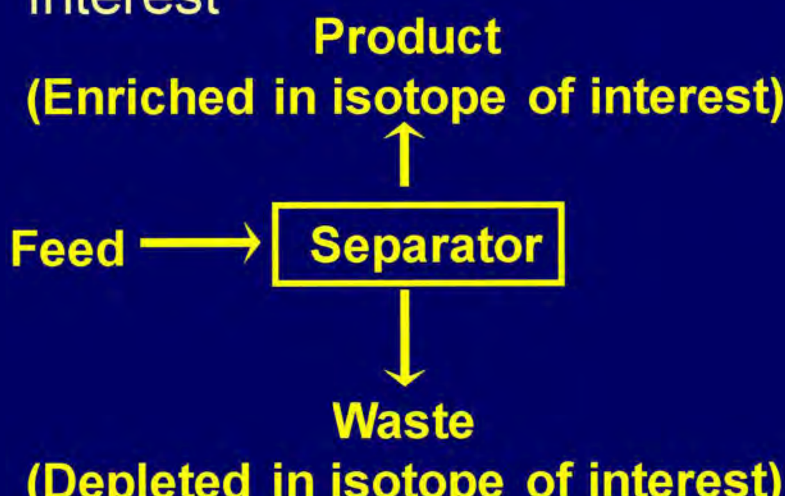
To isolate those nuclei that possess favorable nuclear properties and eliminate those that are undesirable for the intended purpose

Some Isotopes Useful for Nuclear Technologies

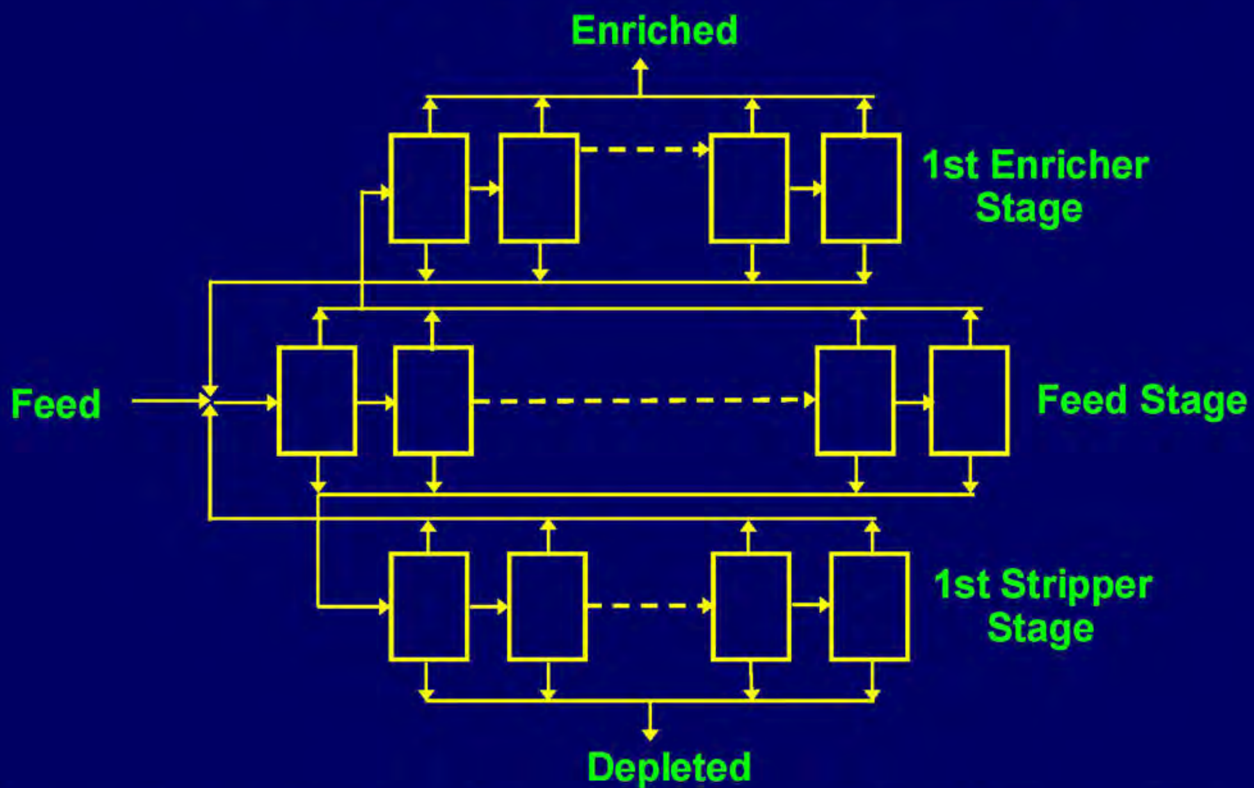
Uranium-235	weapons, reactors
Lithium-6	thermonuclear fuel
Deuterium (H-2)	thermonuclear fuel, fusion power, production reactors
Boron-10	reactors, shielding
Tritium (H-3)	weapon boosting, fusion power

Raw Materials Enrichment Terminology

- Separator — Device in which isotope separation takes place
- Feed — Natural element (e.g., uranium) processed by separator
- Product (heads) — Isotope of interest (e.g., Uranium-235) produced by separator
- Waste (tails) — Output of separator depleted in isotope of interest



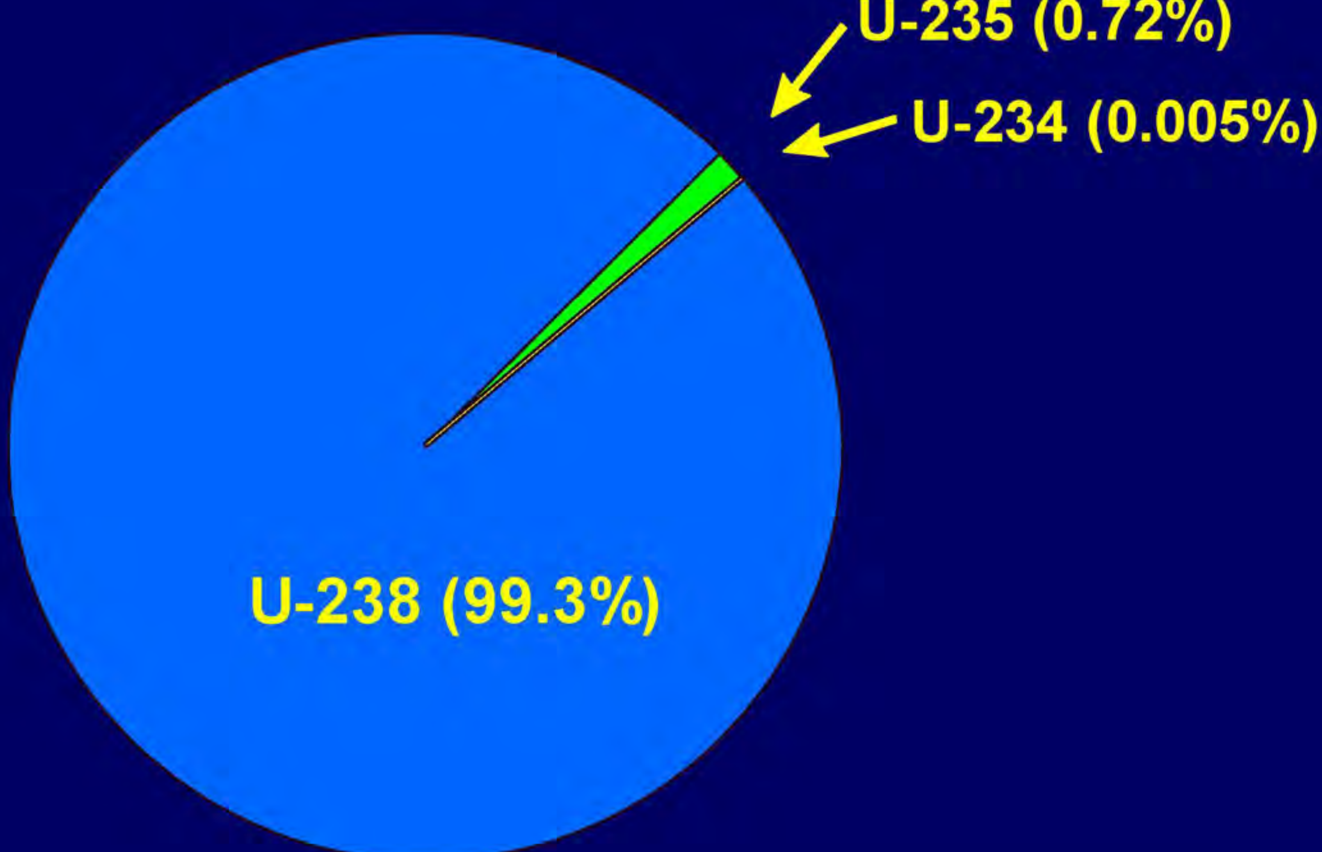
Separator Cascade



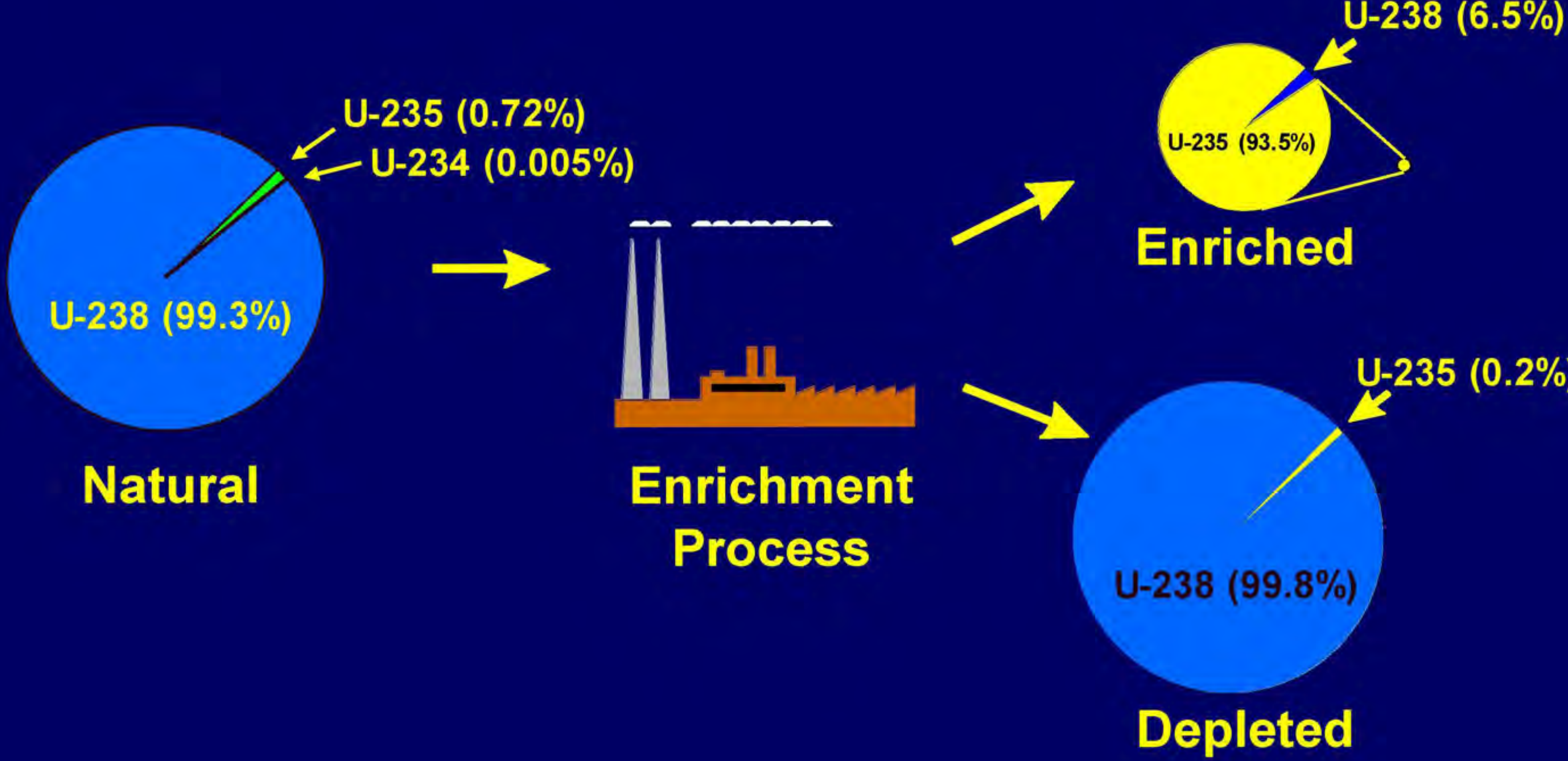
- Cascade multiplies the enrichment/depletion of a single separator
- Add enricher stages to increase cascade product assay
- Add stripper stages to decrease cascade waste assay
- Add parallel separators to increase processing rate

Uranium Enrichment

Natural Uranium



What is Uranium Enrichment?



Enriched Uranium Definitions

- Low enriched uranium (LEU) - less than 20% U-235
- Intermediate enriched uranium (IEU) - between 20 and 92% U-235
- Highly enriched uranium (HE/HEU) - over 20% U-235
- Fully enriched uranium - 92% or more
- Weapon-grade uranium - between 92 and 94%
- Very highly enriched uranium (VHE/VHEU) - 94% or more

Other Uranium Terms

- Tuballoy (Tube Alloys) - Natural or depleted U-235 content (U-235 less than or equal to 0.72%) (Tu)
- Oralloy (Oak Ridge Alloy) - Uranium enriched in the isotope U-235 (Oy)
- Assay - percentage of uranium atoms that are ^{235}U

Principal Uranium Enrichment Processes

- Electromagnetic Isotope Separation (EMIS) (Calutron)
- Gaseous Diffusion
- Gas Centrifuge
- Laser Isotope Separation
- Other methods

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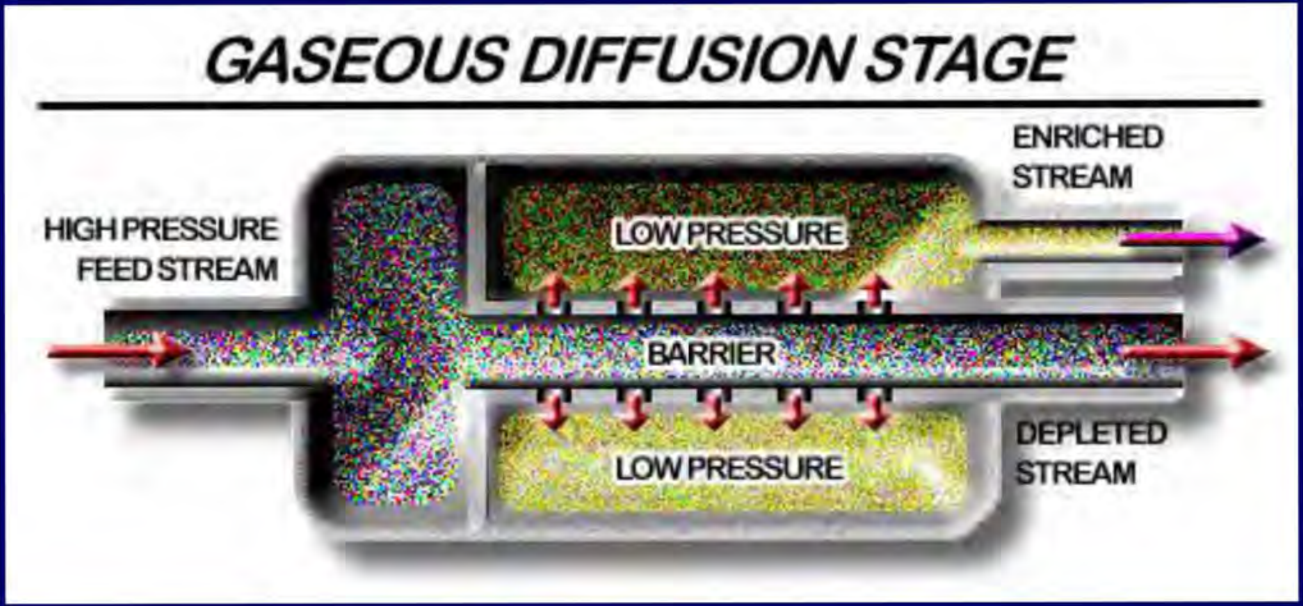
Gaseous Diffusion

Gaseous Diffusion Theory



- Uranium hexafluoride (UF_6) is passed through a barrier at high temperature
- Molecules with U-235 are lighter and will diffuse more readily

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Gaseous Diffusion Plant (K-25)

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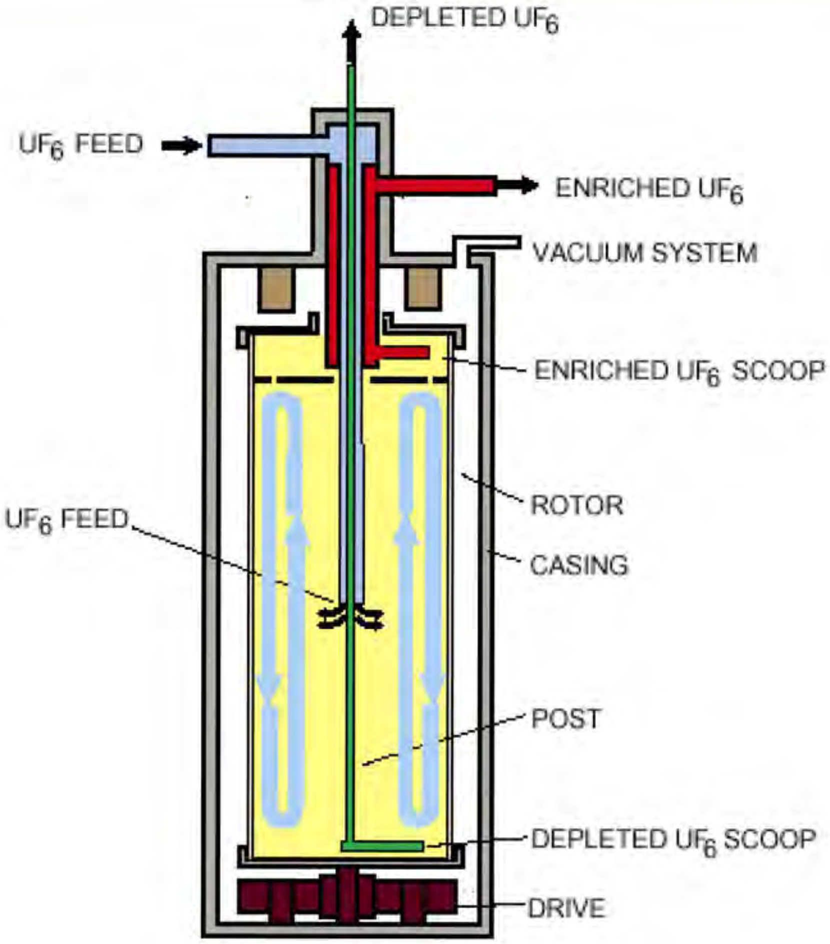
Gas Centrifuge Technology

Schematic of Gas Centrifuge

- Rotor spins at very high speeds
- UF_6 gas is concentrated next to the rotor wall
- Heavier $^{238}UF_6$ tends to be closer to the wall than lighter $^{235}UF_6$
- Separative capacity increases with rotor speed and length



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Floor and Overhead View of DOE's Pilot Plant

PLANT CAPACITY = 24,000 SWU/YEAR

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Laser Isotope Separation

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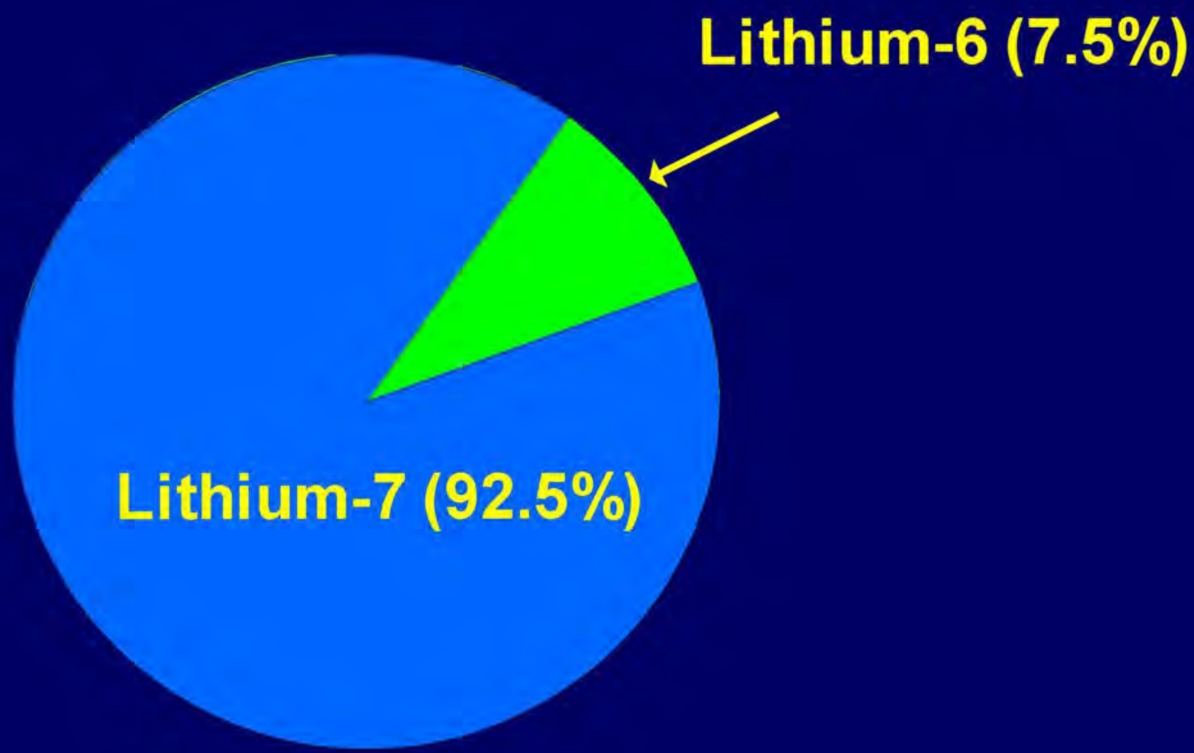
Other Methods of Uranium Enrichment

- Aerodynamic separation (e.g., Becker nozzle)
- Chemical exchange
- Thermal diffusion (S-50 Plant)

Lithium Isotope Separation

Natural Lithium



Lithium Isotope Applications

- Tritium production
  - $^{6}Li + n \longrightarrow T + He$
- Fusion weapon fuel
  - Lithium-6 deuteride (^{6}LiD)
- Control of reactor water quality
  - Lithium-7 has low neutron absorption probability
  - Requires 99% ^{7}Li
  - Lithium-7 available commercially

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Heavy Water/Deuterium Production

- Conducted at Savannah River Heavy Water Plant and the Dana Heavy Water Plant

- Quantities in stockpile and shipments to weapon programs are sensitive

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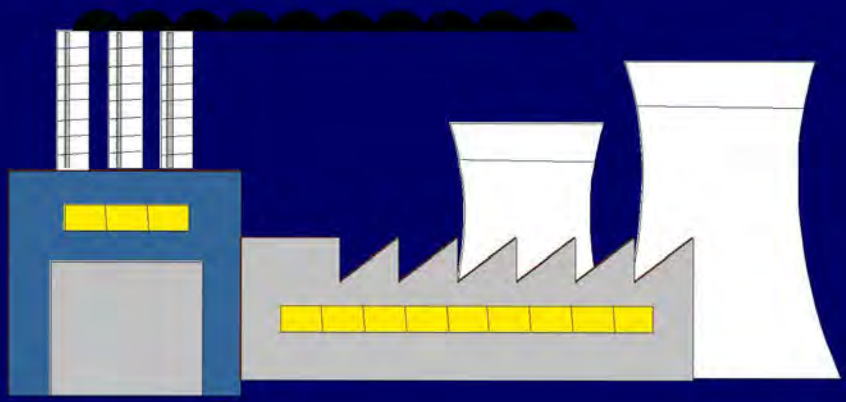
Module N:



Production Reactors and Related Technologies

Nuclear Weapon Material Production

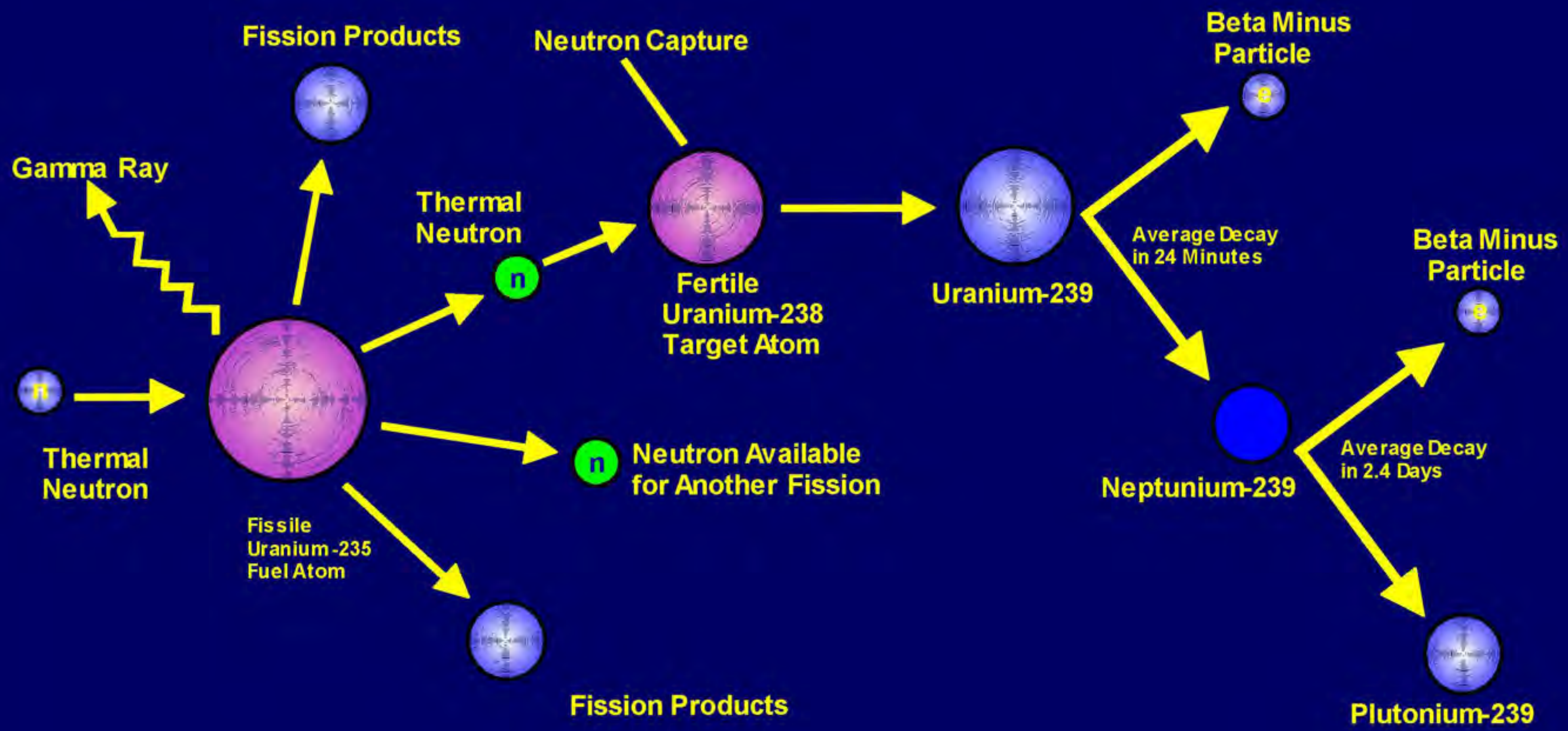
Isotope Enrichment

Uranium-235
Lithium-6
Deuterium (H-2)

Production Reactors

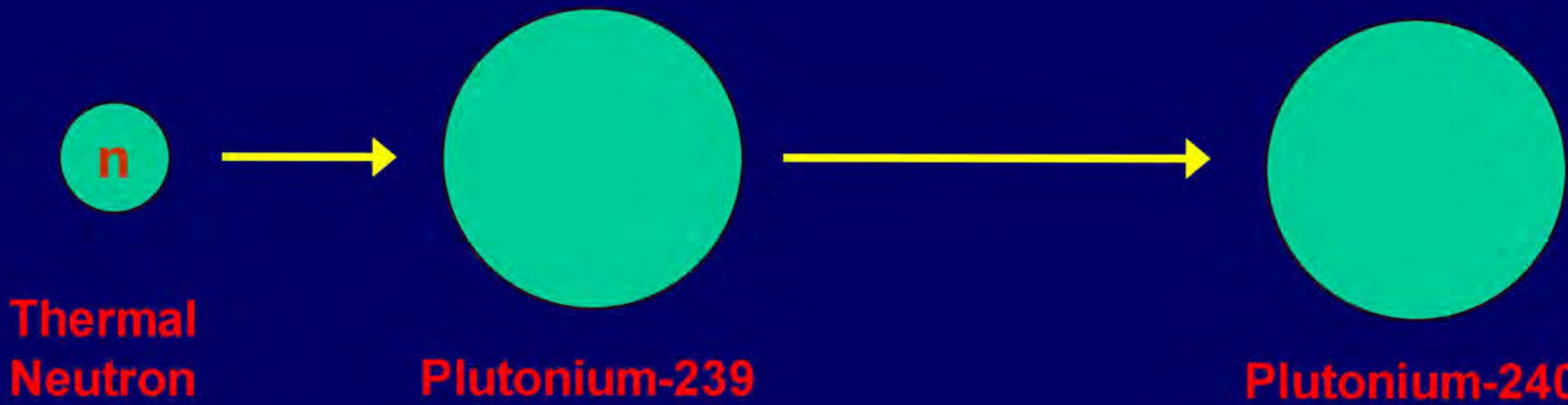
Plutonium-239
Tritium (H-3)
Others (Pu-238, U-233, Po-210)

Plutonium Production



Fission Process to Produce Plutonium-239

Plutonium-240



- Percent of Plutonium-240 increases with time
- Plutonium-240 has large spontaneous fission rate
- Plutonium-240 is highly radioactive

Plutonium Grades

- Weapon Grade: Less than 7% plutonium-240
- Fuel Grade: Between 7% and 19% plutonium-240
- Reactor Grade: Greater than 19% plutonium-240

Each grade has a nominal 0.5% of both plutonium-241 and plutonium-242

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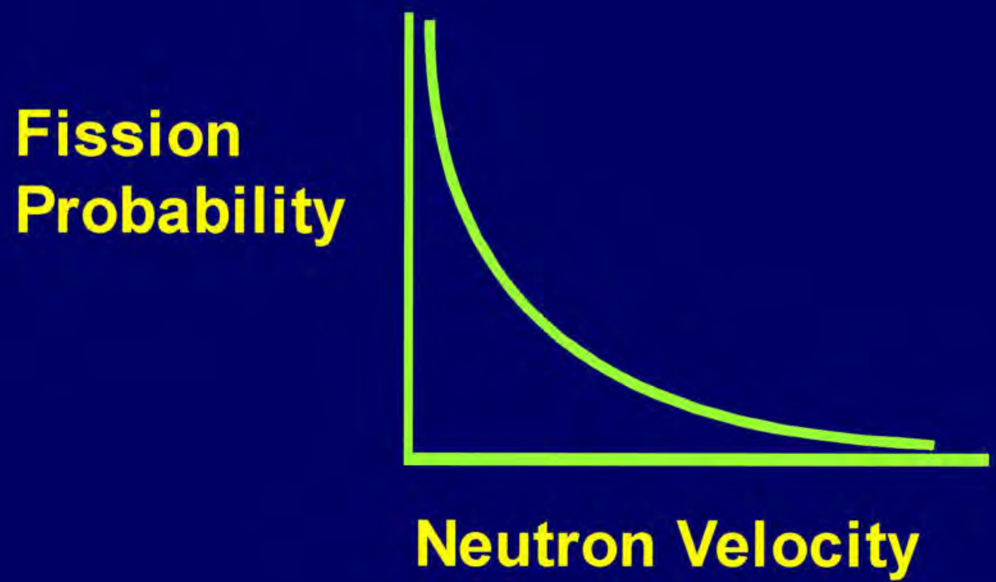
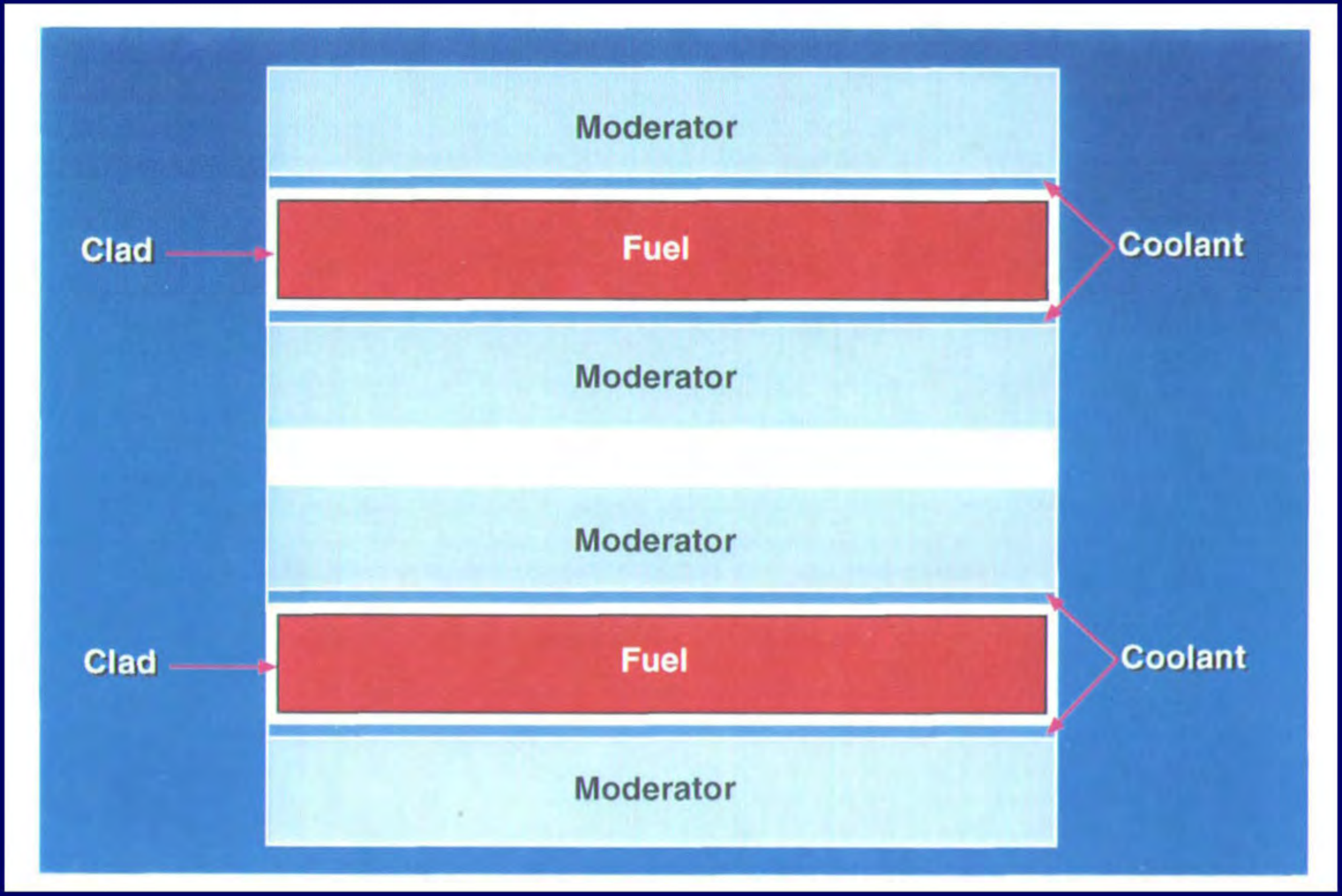
Fission Probability Dependent on Neutron Speed



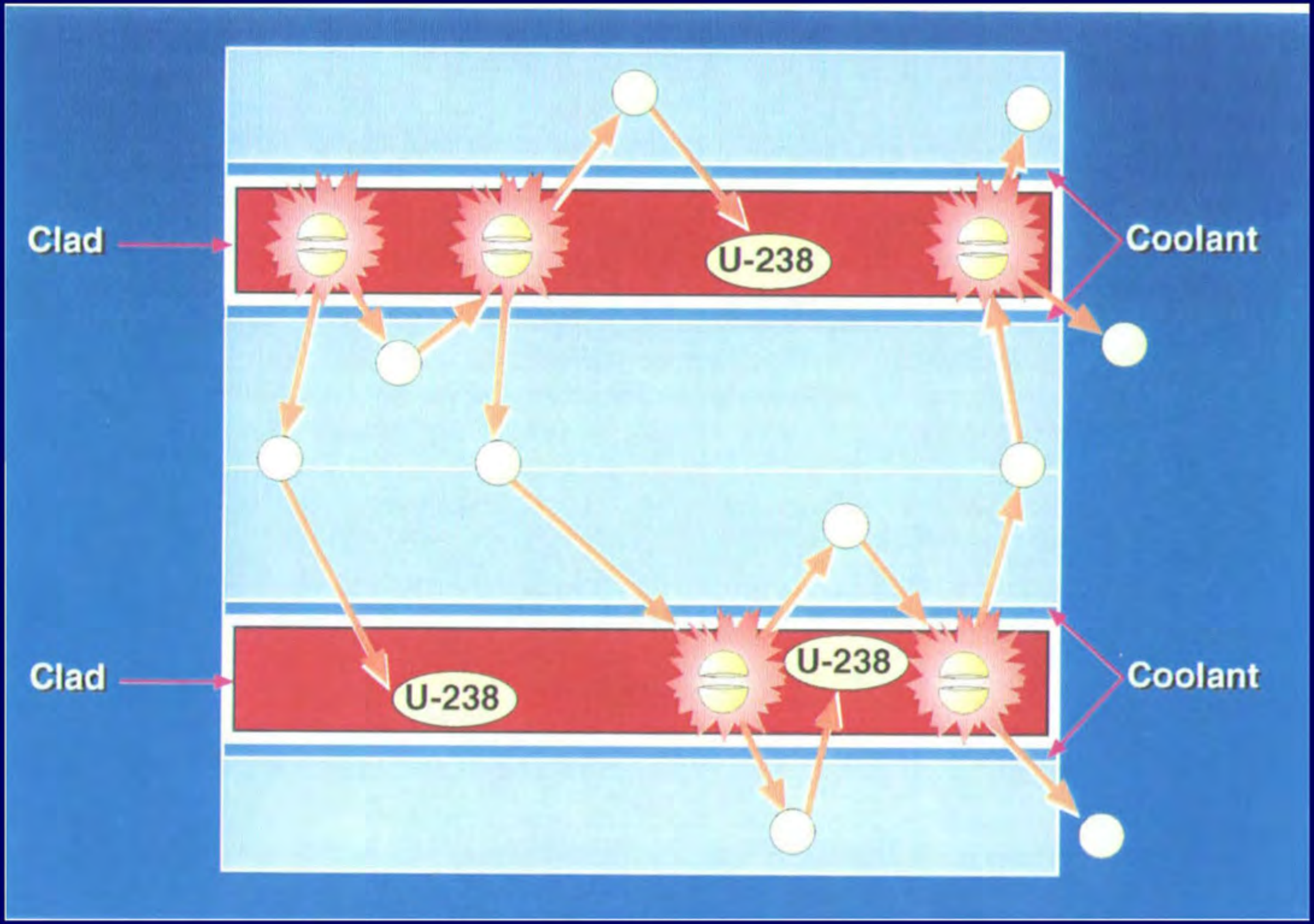
Reactor Basics - Absorption and Moderation Ratio

- Slowing down ability is not the only important aspect
- Absorption is also important
- Moderating ratio takes into account collisions to thermalize, density of material, and absorption
  - Water 58
  - Heavy water 21,000
  - Graphite 200

Reactor Components



Reactor Operating



Plutonium and Uranium Material Flow

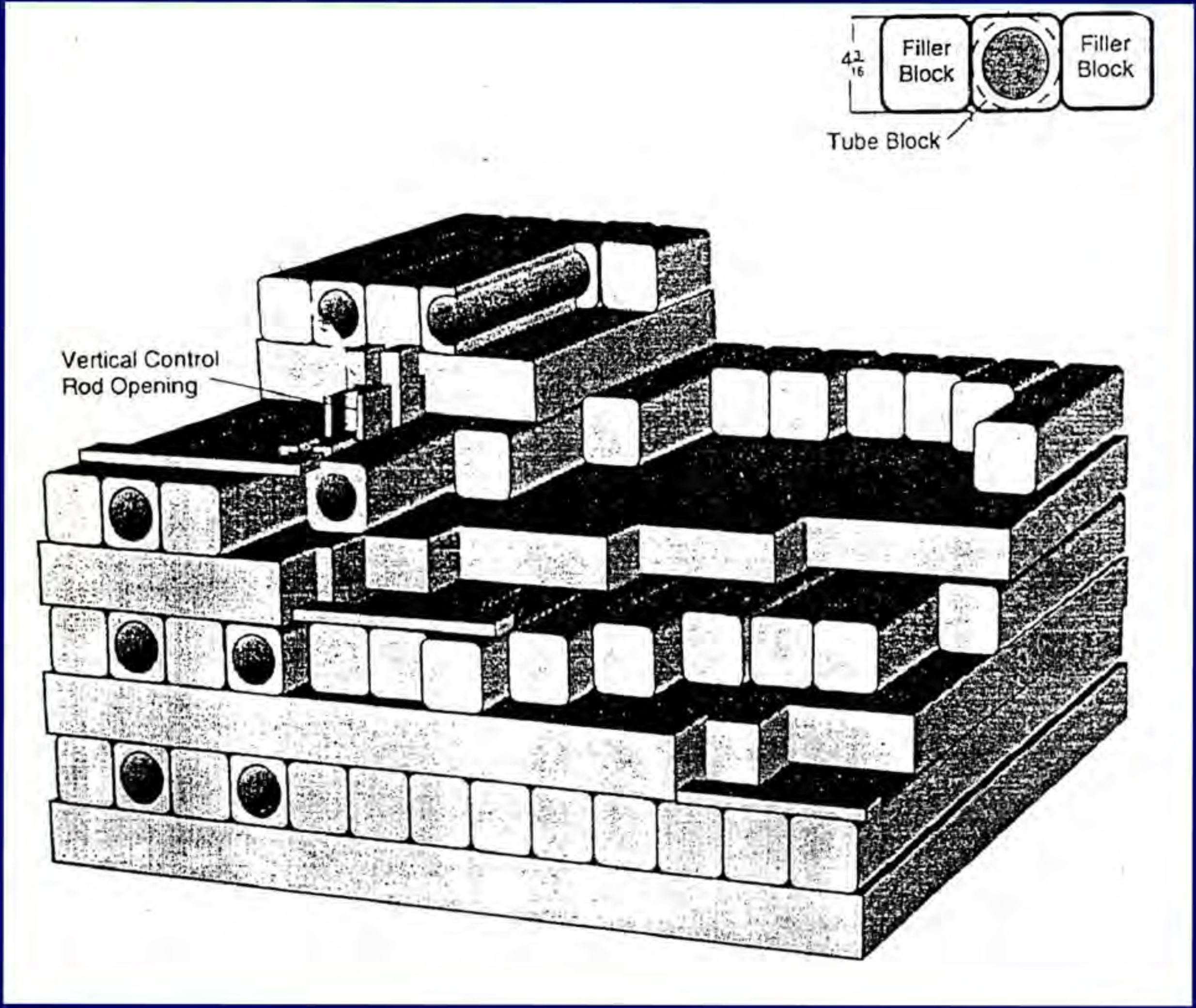
Plutonium Production Streams

- Two almost independent streams which start with enriched or depleted uranium.
  Both provide Pu metal to Rocky Flats Plant

Stream 1: Fernald → Ashtabula → Hanford

Stream 2: INEL (ICPP) → Oak Ridge (Y-12) → Savannah River (SRS)

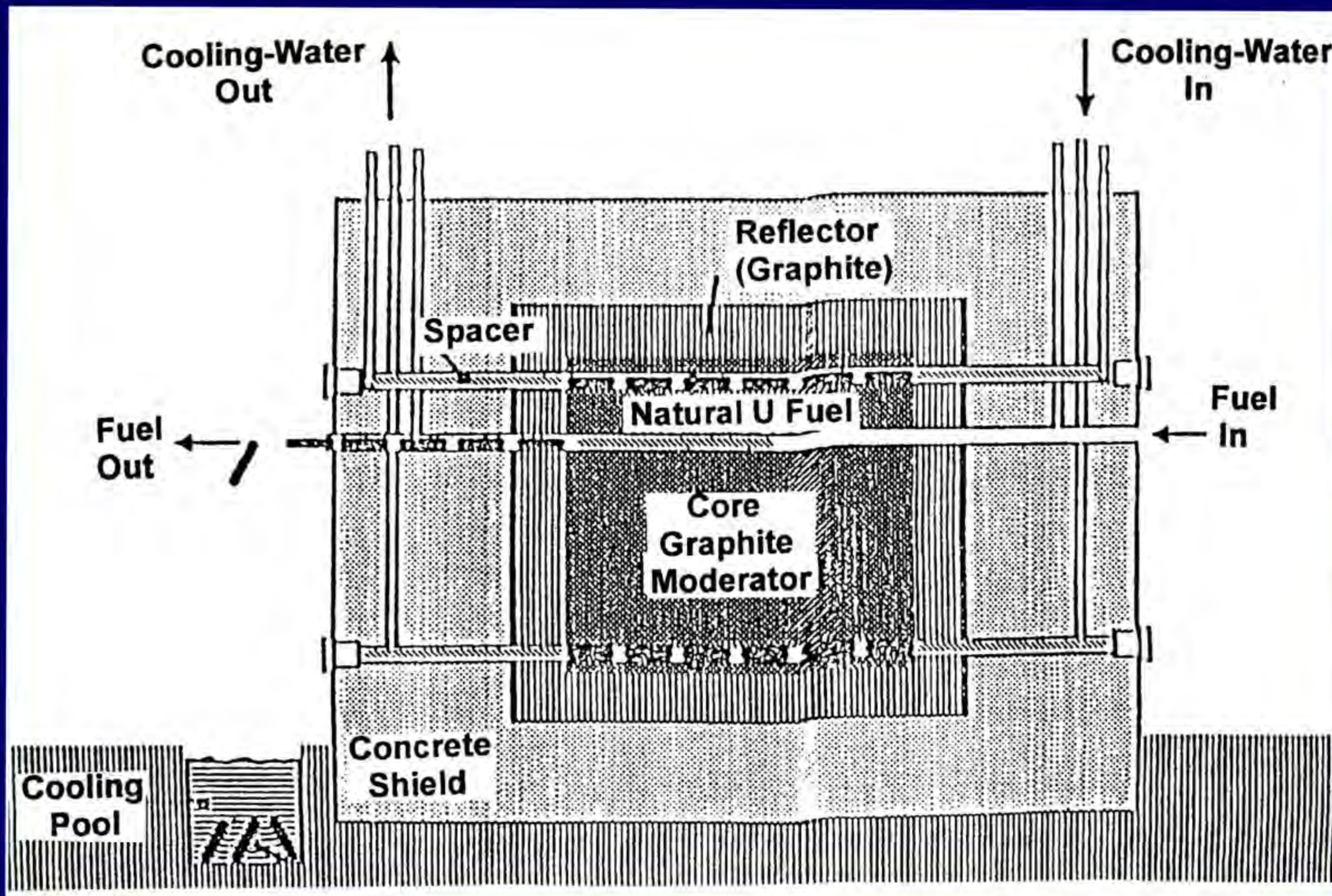
Graphite Stack (Pile)



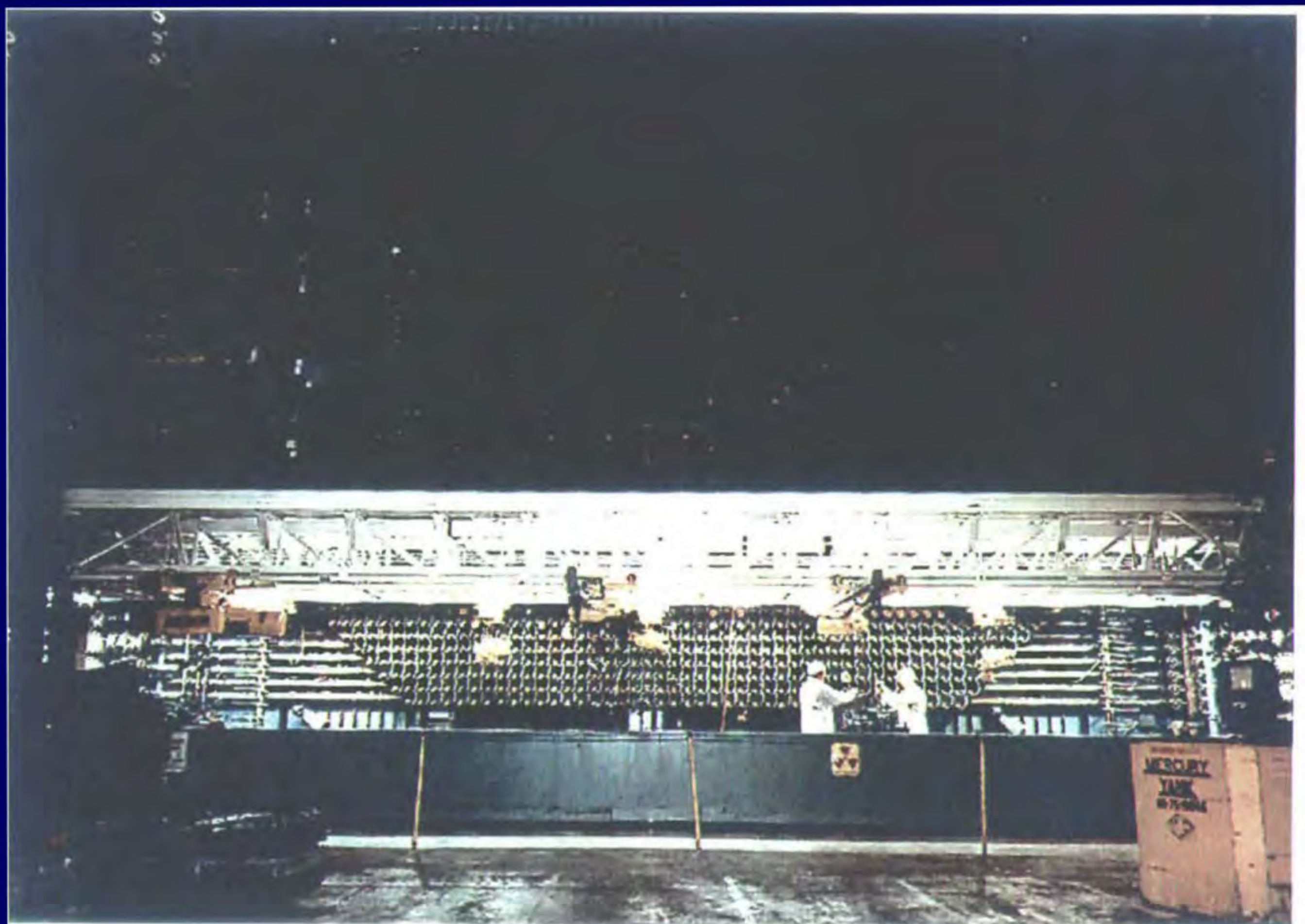
Hanford Type Reactors

- Moderator - high purity graphite
- Coolant - light water
- Fuel - natural and "sweetened" uranium
- Target elements - same as fuel elements for plutonium

Hanford-Type Production Reactor (The First Production Reactor)



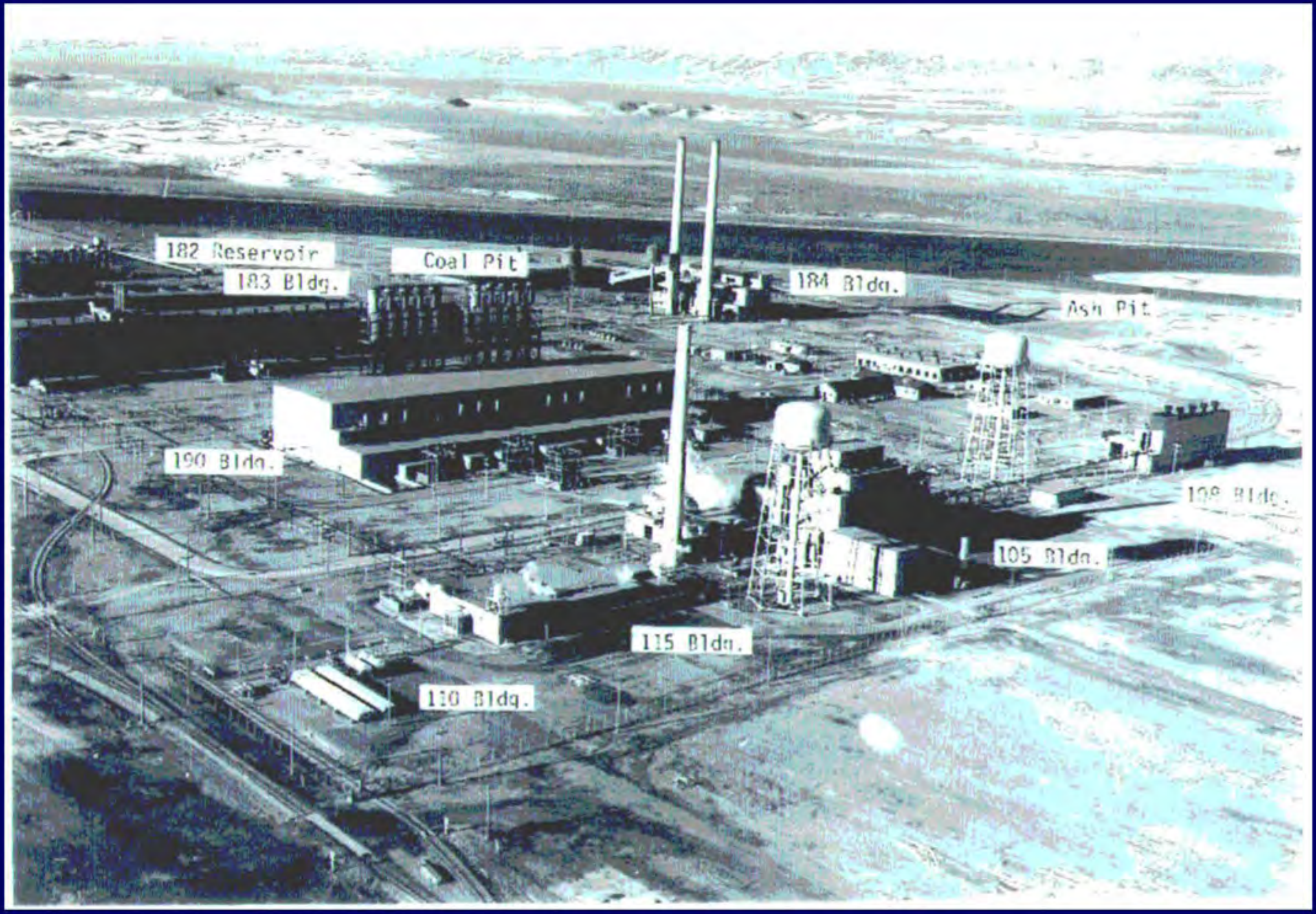
Production Reactor Front Face



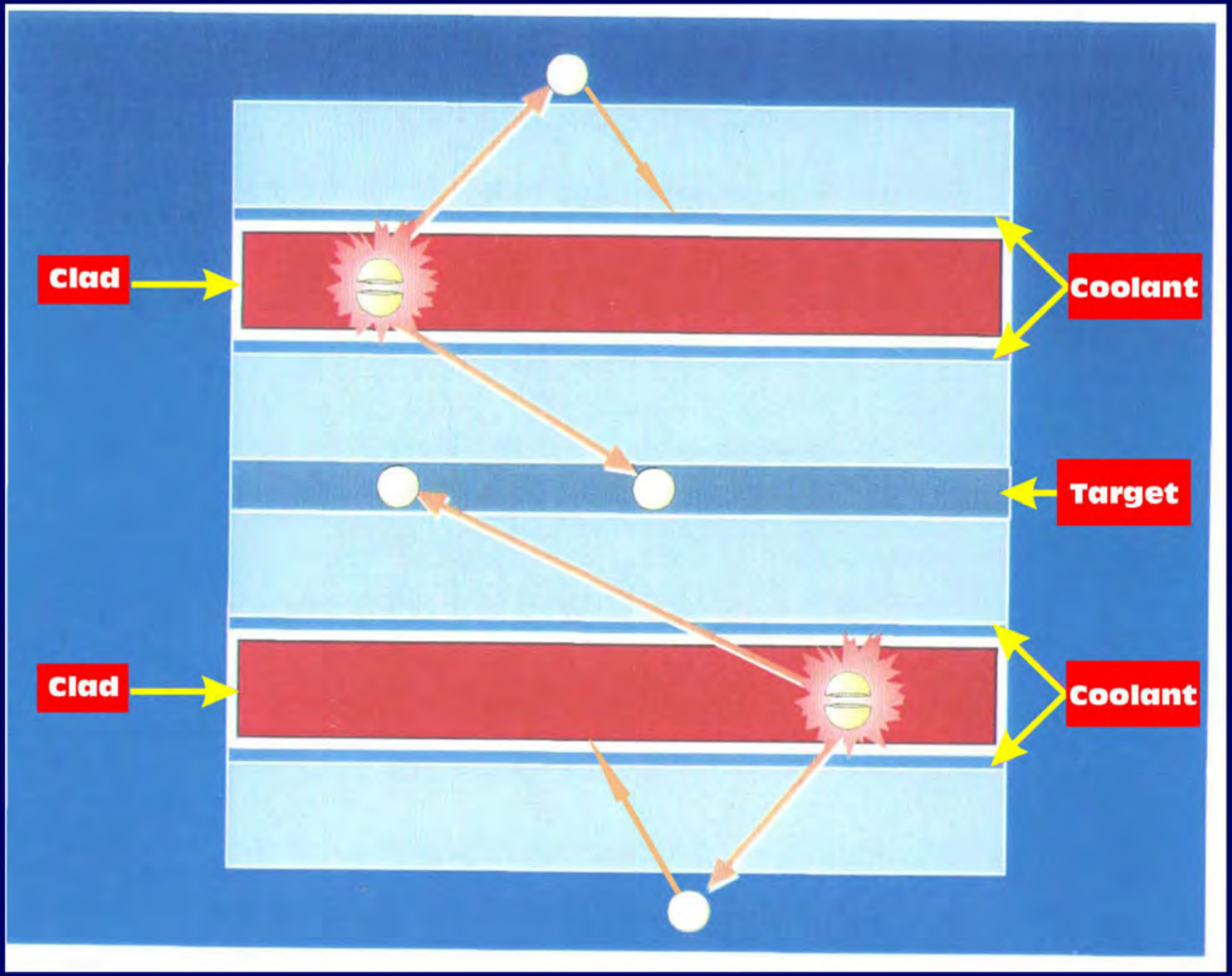
Summary of Hanford Reactors

Reactor	Start Date	Shutdown Date	Fuel	Power (Megawatts)
B	Sep 44	Feb 68	Nat U	250
D	Dec 44	Jun 67	Nat U	250
F	Feb 45	Jun 65	Nat U	250
H	Oct 49	Apr 65	Nat U	400
DR	Oct 50	Dec 64	Nat U	250
C	Nov 52	Apr 69	Nat U	650
KW	Jan 55	Feb 70	Nat U/0.95%	1850
KE	Apr 55	Dec 71	Nat U/0.95%	1850
N	Jul 64	Jan 87	0.95%/1.25%	4000

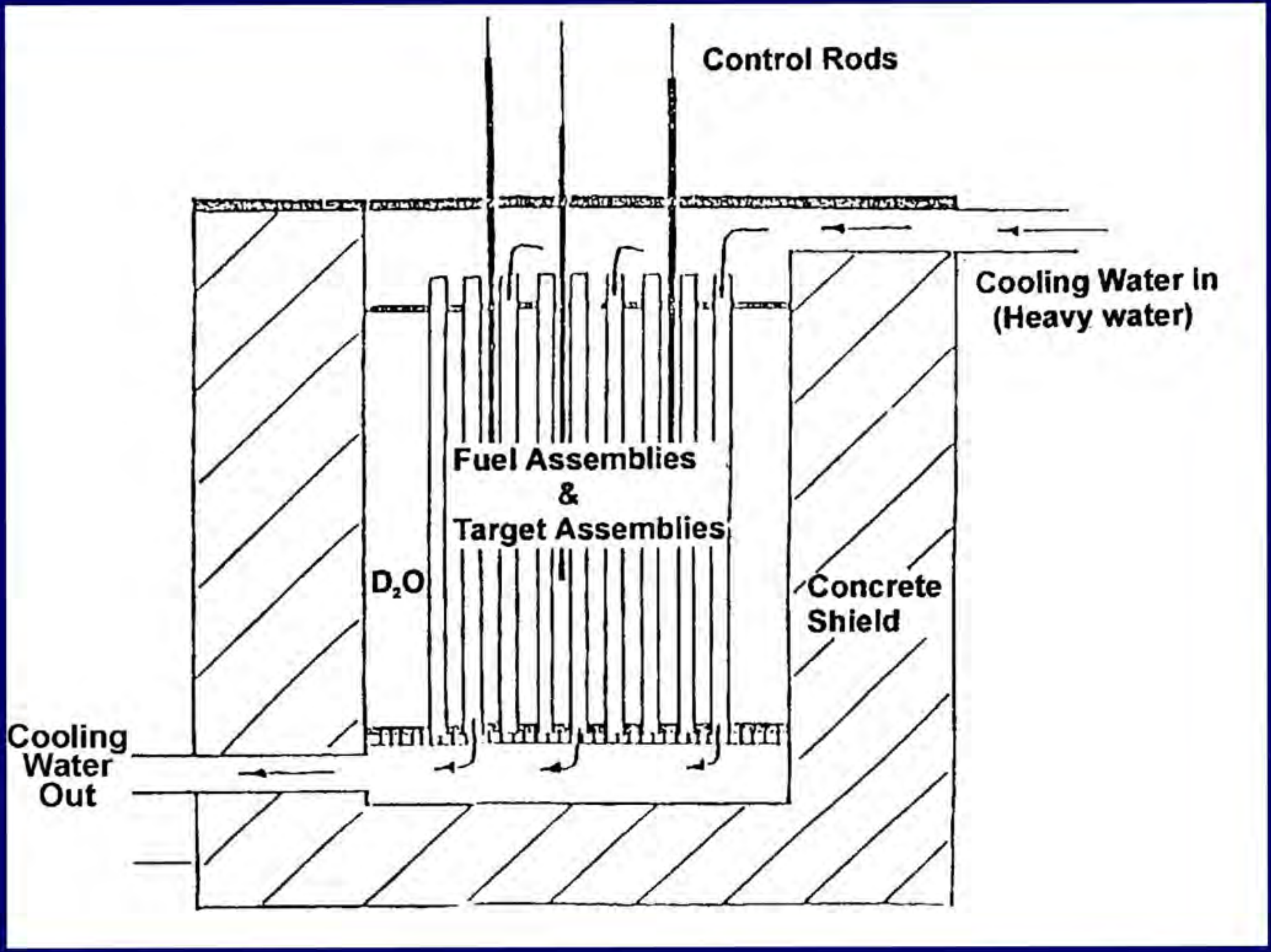
First Hanford Single Pass Production Reactor Site



Reactor Operation



Savannah River-Type Production Reactor



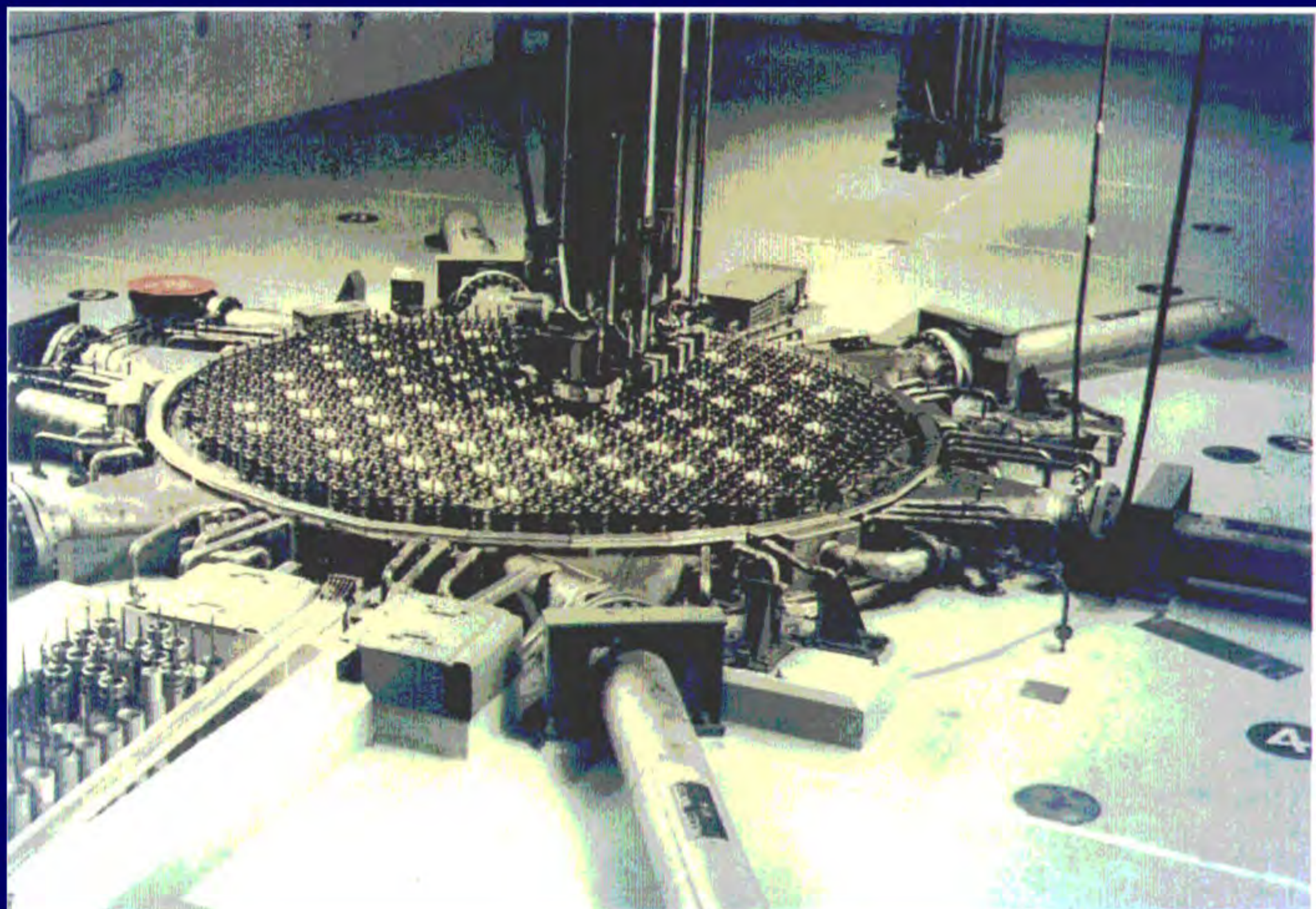
Savannah River Heavy-Water Production Reactors

- Moderator - heavy water (D_2O)
- Coolant - heavy water (D_20)
- Fuel - (0.85% to 0.95% in early 1960s; approximately 60% enrichment later)
- Target Element - depleted uranium electroplated with nickel and bonded into aluminum

Summary of Savannah River Heavy-Water Production Reactors

Reactor	Start Date	Shutdown Date
C	Mar 55	Jun 85
K	Oct 54	Jan 96
L	Jul 54	Feb 68
	Oct 85	Jun 88
P	Feb 54	Aug 88
R	Dec 53	Jun 64

Top of Savannah River Production Reactors



External View of Reactor

Chemical Processing of Irradiated Fuel and Target Elements

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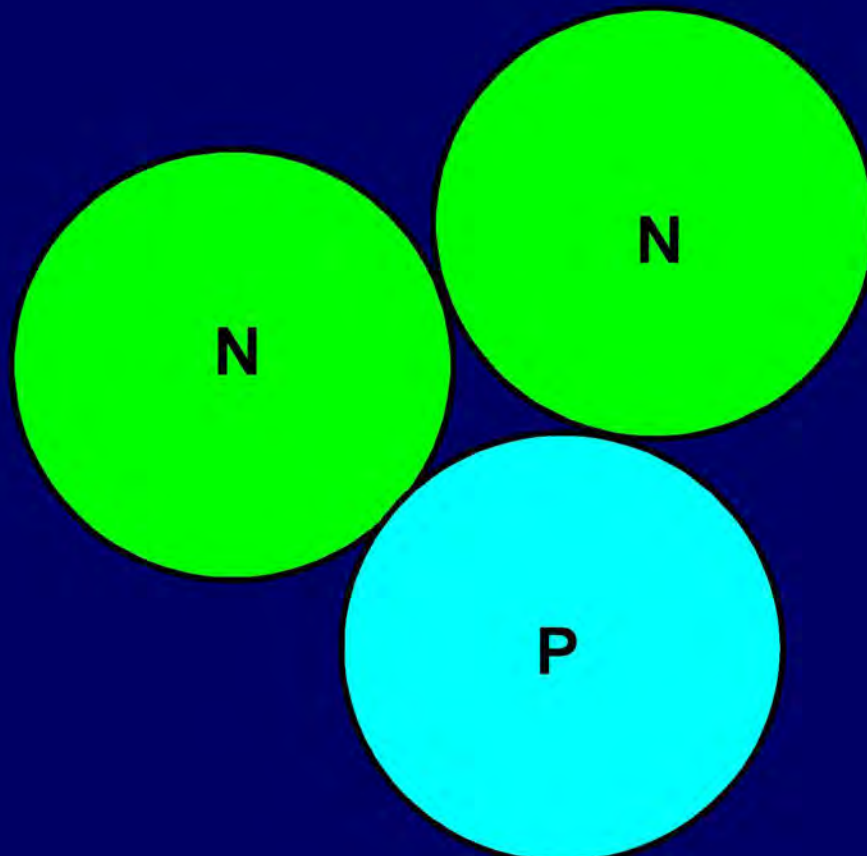
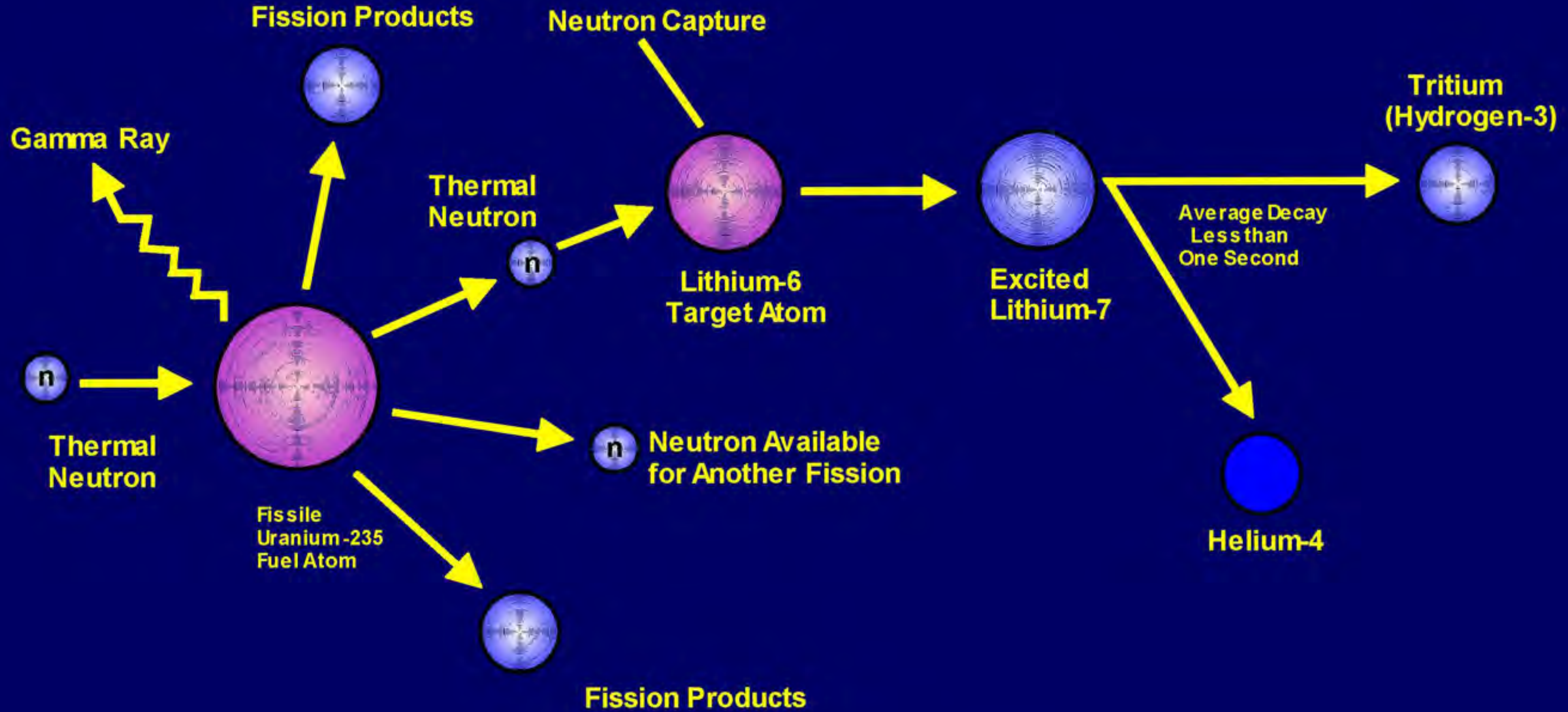
Other Chemical Processes

- Bismuth Phosphate Process (1944-1956)
- REDOX Process (1951-1967)
- THOREX Process (U-233 Production)

Tritium Production



Tritium Production



Fission Process to Produce Tritium

Reactor Operations for Tritium Production

- Uses same Hanford/Savannah River production reactors
- Lithium Targets
- Separate tritium recovery facilities

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Other Reactor Products

- Uranium-233 (Thorium targets, Thorex process)
- Plutonium-238 (Neptunium targets, solvent extraction)
- Polonium-210 (Bismuth-209 target)
- Krypton, Xenon (Fission products)

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Module O:

Naval Nuclear Propulsion Information and Other Nuclear Energy Production

Restricted Data/Formerly Restricted Data

- All data concerning:
  - Design, manufacture or utilization of atomic weapons
  - The production of Special Nuclear Materials (SNM)

or

The use of SNM in the production of energy

Naval Nuclear Propulsion Information and Other Nuclear Energy Production

- Space Reactors
- Aircraft Nuclear Propulsion
- U.S. Army Reactor Program
- Other Reactor Types
- Naval Reactors

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Refer all documents discussing nuclear power technology to DOE.

Aircraft Nuclear Propulsion Program (ANP)

Aircraft Nuclear Propulsion Program (ANP)

- Research interest from 1946 to 1961
- Objective: to develop a nuclear power plant for long range bombers
- Scope: design, construction, testing or operation of reactors
- Never fielded

Refer if discussed in a classified document.

Army Nuclear Power Program

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Refer if discussed in a classified document.

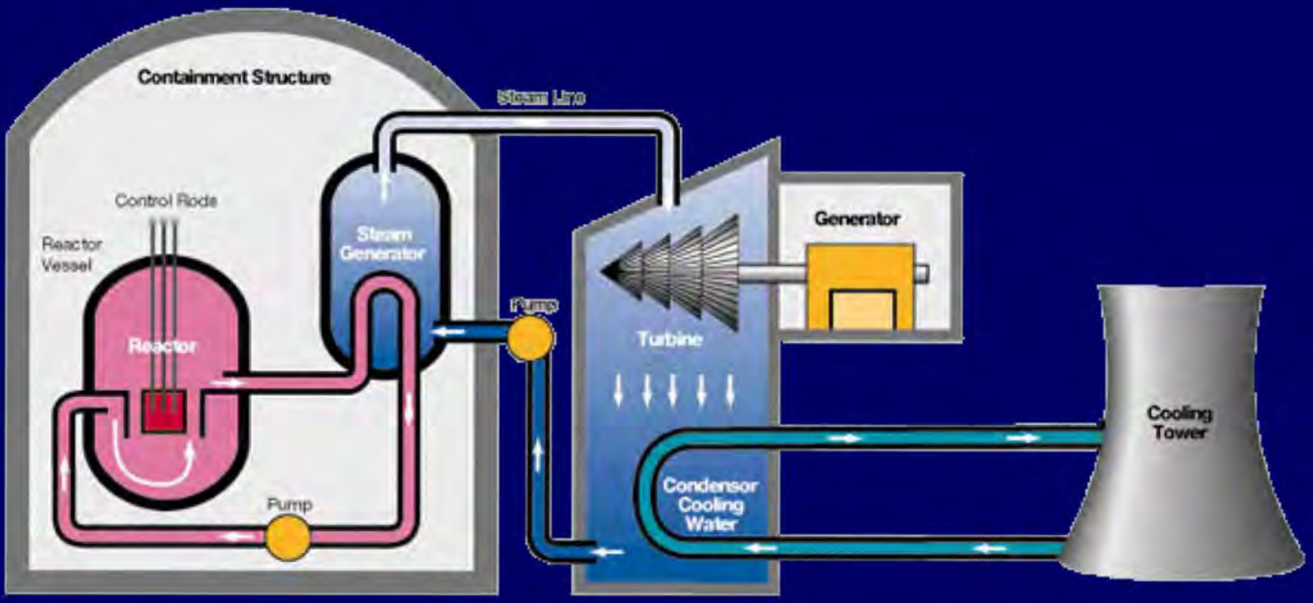
Other Reactor Types

- By Purpose
  - Power (e.g., Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR))
  - Research (e.g., High-Flux Research Reactor (HFRR))
  - Production
  - Test
  - Breeder

Refer if discussed in a classified document.

- By Moderator
  - Light-Water Reactors (LWR)
  - Heavy-Water Reactors (HWR)
  - Graphite-Moderated Light-Water-Cooled
  - Graphite-Moderated/Gas-Cooled Reactors (GCRs)
  - Liquid-Metal Reactors (LMR)
- Canadian Depleted Uranium Reactor (CANDU)

Typical Commercial Pressurized Water Reactor



Naval Nuclear Propulsion Information

What is NNPI?

- All information, classified or unclassified, concerning
  - Design
  - Arrangement
  - Development
  - Manufacture
  - Testing
  - Administration
  - Training
  - Maintenance
  - Repair

  of the propulsion plant of naval nuclear powered ships including the associated nuclear support facilities

- Information common to conventional propulsion plants when tied to or compared with naval propulsion

Who Owns NNPI?

- Naval Reactors
  - DOE NA-30 Deputy Administrator for National Nuclear Security Administration (NNSA)
  - Navy OPNAV N00N
    (Director, Naval Nuclear Propulsion Directorate)
  - Navy NAVSEA 08
    (Deputy Commander, Nuclear Propulsion Directorate, Naval Sea Systems Command (SEA-08))

<u>Note</u>:

- DOE owns Restricted Data
- Only Naval Reactors has declassification and release authority for NNPI

Recognizing NNPI

Recognize Nuclear Powered Submarines

- Non-nuclear Powered Submarines
  - SS Diesel Submarine
    - e.g., SS 576 (USS Darter) is NOT nuclear powered
  - SSG Guided Missile Submarine (e.g., Regulus)
  - AGSS Transport Submarine

- **Nuclear Powered Submarines**
  - **SSN "Attack Submarine"**
    - e.g., SSN 774 (USS Virginia) is nuclear powered
  - **SSBN "Ballistic Missile Submarine"**
    (also "Boomer", the old "FBMs")
  - **SSGN "Cruise Missile Submarine"**
    - i.e., converted Trident SSBN (e.g., SSGN 726)

Recognize Nuclear Powered Ships

- Surface Ships
  - CV Aircraft Carrier (conventional)
  - CVA Attack Aircraft Carrier (e.g., Forrestal Class) (conventional)
  - **CVAN/CVN Aircraft Carrier (nuclear) (e.g., Enterprise)**

  - DD Destroyer (conventional)
  - DDG Guided Missile Destroyer (conventional)
  - DLG Guided Missile "Frigate" (conventional)
  - **DLGN Guided Missile "Frigate", Nuclear**
  - FF Frigate (conventional)

  - CA (CL) Heavy (Light) Cruiser (conventional)
  - CG Guided Missile Cruiser (conventional)
  - **CGN Guided Missile Cruiser, Nuclear**

Recognize a Naval Reactor

- First Letter = Ship Type
  - S: Submarine
  - D: Destroyer (Frigate)
  - C: Cruiser
  - A: Aircraft Carrier
- Design Number
  - 1, 2, 3, 4, etc.
- Manufacturer
  - G: General Electric (Knolls Atomic Power Laboratory) - KAPL
  - W: Westinghouse (Bettis Atomic Power Laboratory) - BAPL
  - C: Combustion Engineering
  - B: Bechtel Marine Propulsion Corporation

Example: S1W = Submarine, 1st Design, Westinghouse

Naval Nuclear Propulsion Program

- Naval Nuclear Powered Ships
  - Submarines
  - Frigates/Cruisers
  - Aircraft Carriers
- Nuclear Support Facilities
  - Repair, overhaul, refuel, radiological control support
    - Shipyards
    - Naval Bases
    - Tenders
    - BAPL, KAPL
- Prototypes - Land Based Naval Nuclear Propulsion Plants
  - West Milton, NY (S1G, S3G, D1G, D2G, S7G, S8G)
  - Windsor Locks, CT (S1C)
  - NRTF, Idaho Falls, ID (S1W, A1W, S5G)
  - Charleston, SC Moored Training Ships
    - ex-USS Sam Rayburn
    - ex-USS Daniel Webster

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NNPI Summary

- Vital to US national security
  - Important to protect tactical characteristics and capabilities of nuclear powered naval ships
- Protect US nuclear propulsion technology

What to do if Document Contains Suspected NNPI

If contains suspected NNPI only, then tab for referral to DOE NA-30 (Naval Reactors)

If contains both suspected NNPI and weapons info, then refer to both NA-30 & DOE Office of Classification

If in doubt, refer to DOE Office of Classification

Module P:

Lessons Learned and Congressional Reports

See Classified Notebook

Department of Energy

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(NSI Exemptions)

National Security Information
Executive Order 13526

Exempt Areas

- Safeguards and Security Information
- Transportation Safeguards Systems
- Compromise of Classified Information
- Unrecovered Nuclear Weapons and Classified Components
- Nuclear Emergency Search Team
- Nuclear Proliferation
- Vulnerability and Hardening
- High Altitude Test
- Intelligence and Cryptology
- Foreign Government Information
- Naval Nuclear Propulsion
- Critical Energy Infrastructure

Safeguards and Security

- Physical security plans
- Protective personnel requirements, armaments, response times, contingency plans, etc.
- Security measures for automated information systems
- Communications Security (COMSEC)
- Operations Security (OPSEC)
- Technical Surveillance Countermeasures (TSCM)

Safeguards and Security: Potential for RD/FRD

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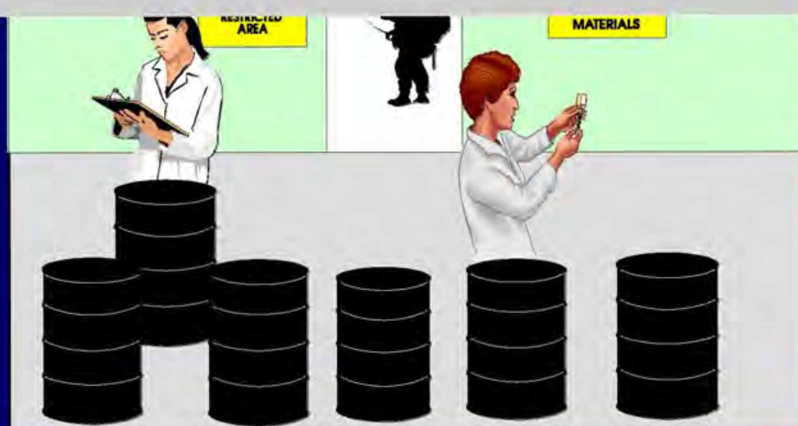

Transportation Safeguards

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Transportation Safeguards: Potential RD/FRD

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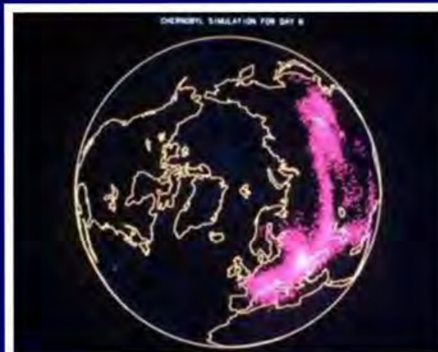
Nuclear Emergency Support Team (NEST)

- Formerly called the Nuclear Emergency Search Team
- Experts who use radiation detection equipment to:
  - Locate lost, stolen, or diverted SNM
  - Locate, identify, and provide assistance in rendering safe Improvised Nuclear Devices (IND) or Radiation Dispersal Devices (RDD)
  - Aid the FBI in the event of a crime involving the theft or alleged theft of special nuclear material, nuclear weapons, INDs, or RDDs



NEST Classification Concerns

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*   *May Be RD OR FRD*

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Foreign Government Information (FGI)

- Information that is provided in confidence by
  - foreign governments or international organizations of governments (e.g., NATO) to the U.S.
  - DOE to foreign governments or international organizations of governments
    - also includes “behind the scenes” information on policy formulation
- Most FGI is under the purview of Department of State (DOS)

DOE FGI Classification Concerns

(b) (7)(E)

Critical Energy Infrastructure

- Strategic Petroleum Reserve

- Electric Production and Transmission
  - Power Marketing Administrations (e.g., Bonneville Power Administration)
  - Office of Electricity Delivery and Energy Reliability

- Protect information that would:

(b) (7)(E) [redacted]

Summary

- DOE has exempted NSI
- Many exempted NSI areas overlap with RD/FRD
- Many exempted NSI areas overlap with other agency equities
- When in doubt refer
- Don't worry about distinguishing between RD, FRD, and NSI