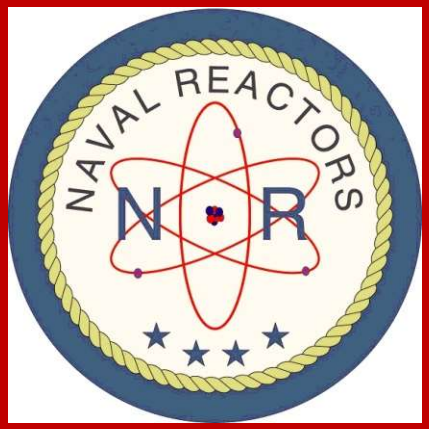


Naval Spent Nuclear Fuel

“The sea–the sea,” I cried. “Yes,” replied my uncle in a tone of pardonable pride; “The Central Sea.”

—Henry Lawson in “Journey to the Center of the Earth” by Jules Verne.

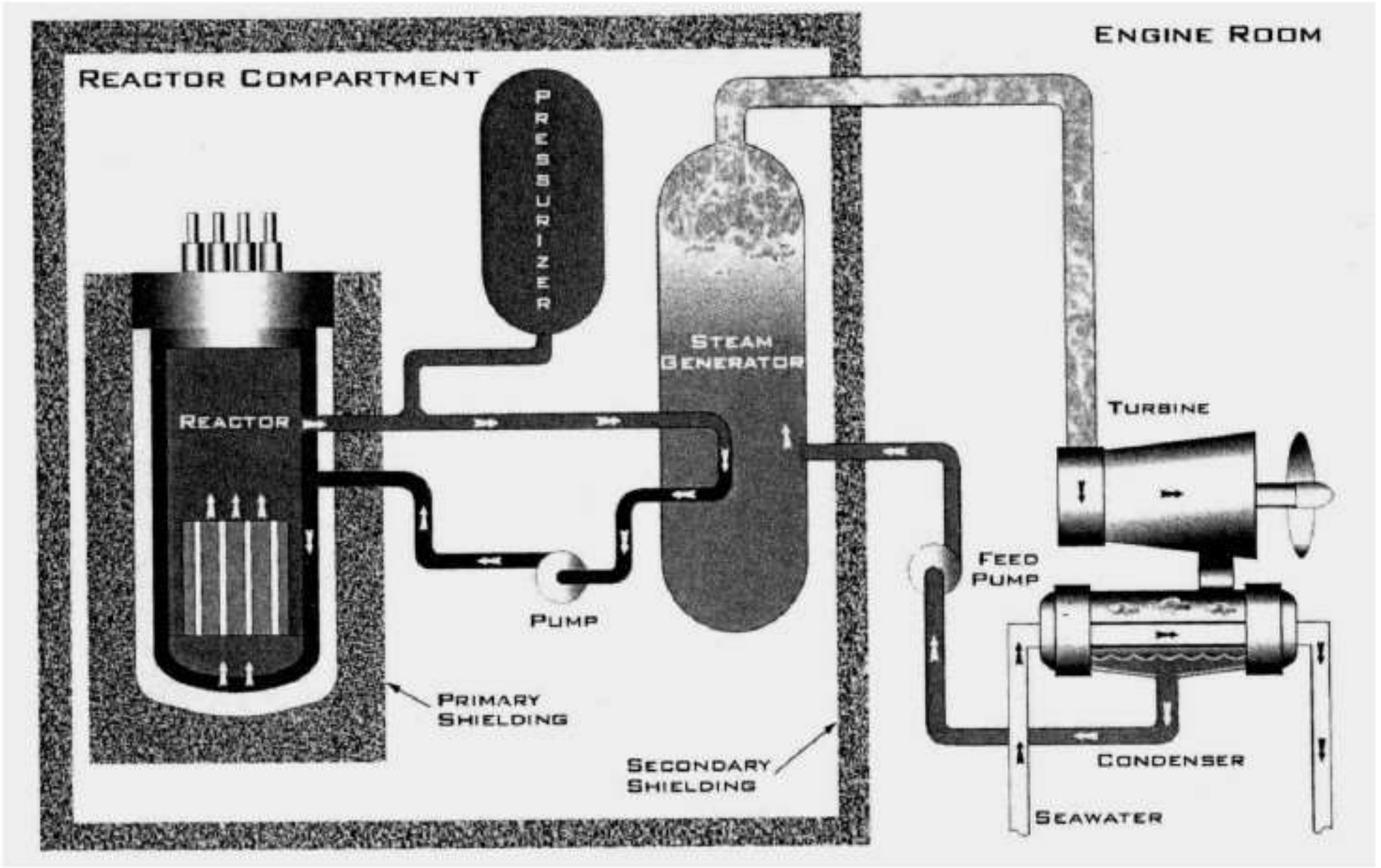
Naval reactors

U.S. Naval reactors are pressurized water reactors. Typically use highly enriched uranium (typically 90% ^{235}U).

Coupled with a steam turbine for propulsion.

83 nuclear powered vessels:

10 aircraft carriers, 72 submarines, about 130 reactors in use.



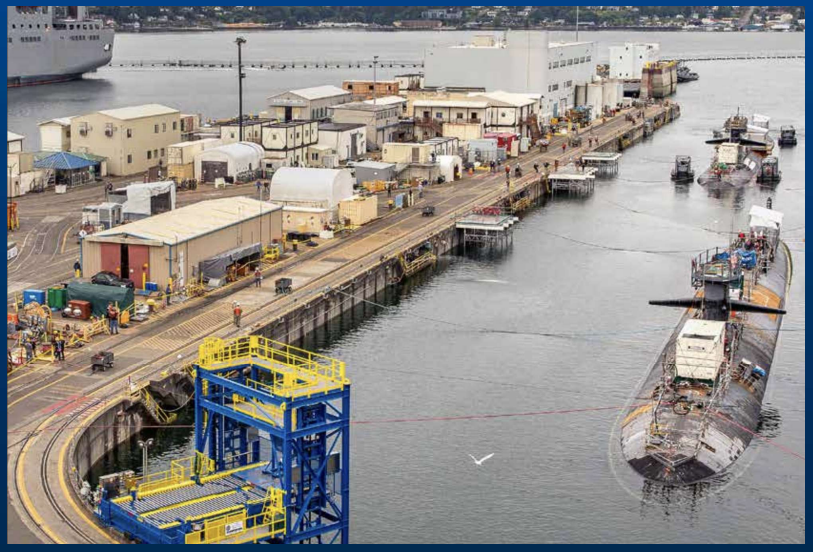
Schematic of Naval Nuclear Propulsion Plant

Inactivation and disposal

1. Inactivation: remove weapons, expendables, and classified equipment.
2. Waterborne storage (SAFSTOR).
3. Defueling. Cut open the hull.
4. Remove and dispose the reactor compartment.
5. Recycle the metals (steel, aluminum, electrical wire, brass).

Puget Sound Naval Shipyard

Submarines are decommissioned at the Puget Sound Naval Shipyard in Washington.




CANADA
WASHINGTON
IDAHO
Seattle
Bremerton
Olympia
Area to be Avoided
(ATBA) of the
Olympic National
Marine Sanctuary
Columbia River
Hanford Site
Port of Benton
Richland
Mc Nary
Bonneville
John Day
Portland
The Dalles
OREGON
N

Tow Route

Radioactive wastes

Dismantling decommissioned ships and submarines creates SNF and low-level radioactive wastes.

After the submarines are placed in dry dock, SNF is removed, and the subs are cut into three or four sections. The reactor compartment is removed, sealed and shipped to Hanford as a LLRW.

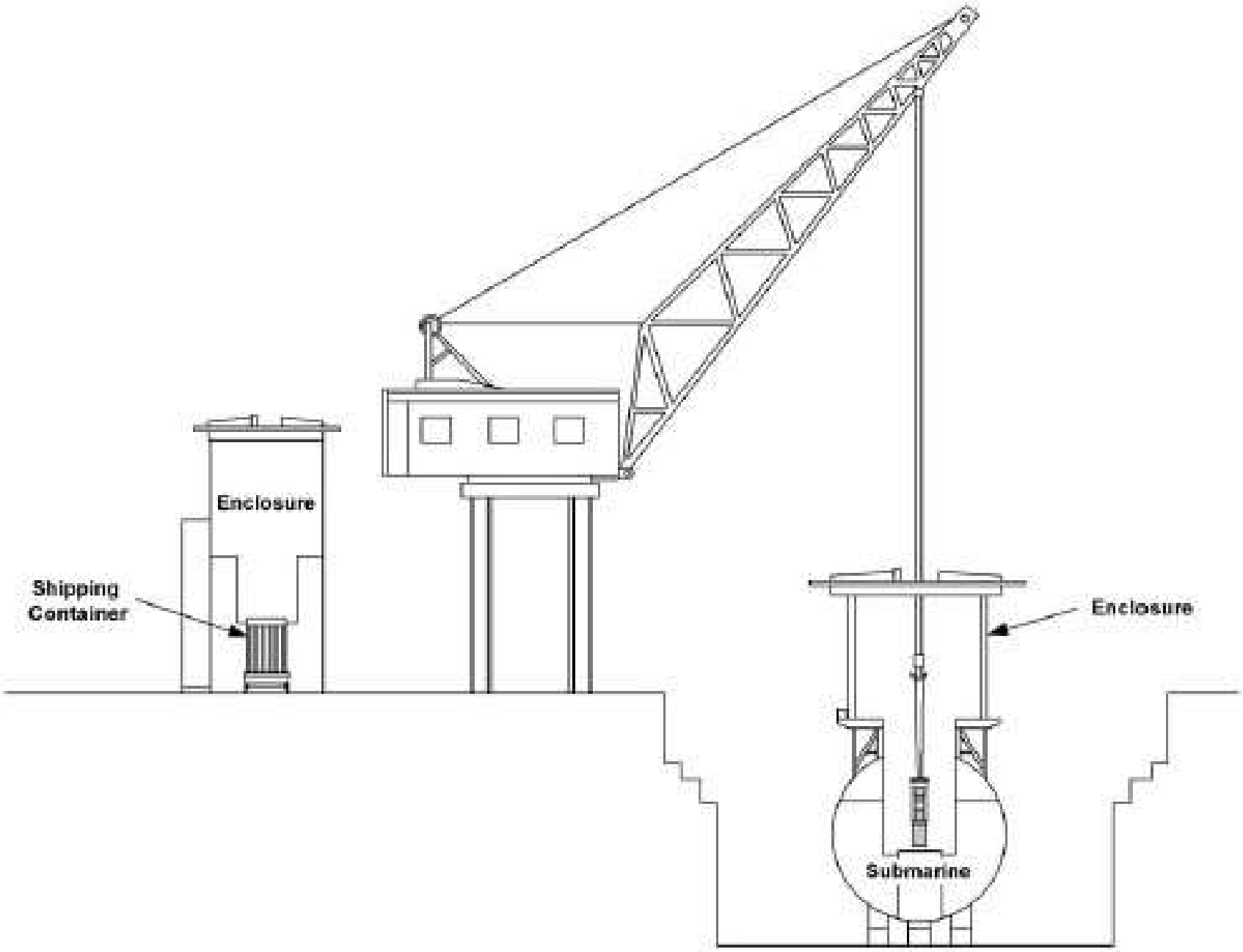
Waste types

Submarine parts that contain radioactive solids and liquids.

Asbestos in older submarines.

Lead installed as shielding.

PCBs in older submarines present in sound-dampening wool.



Submarine Defueling

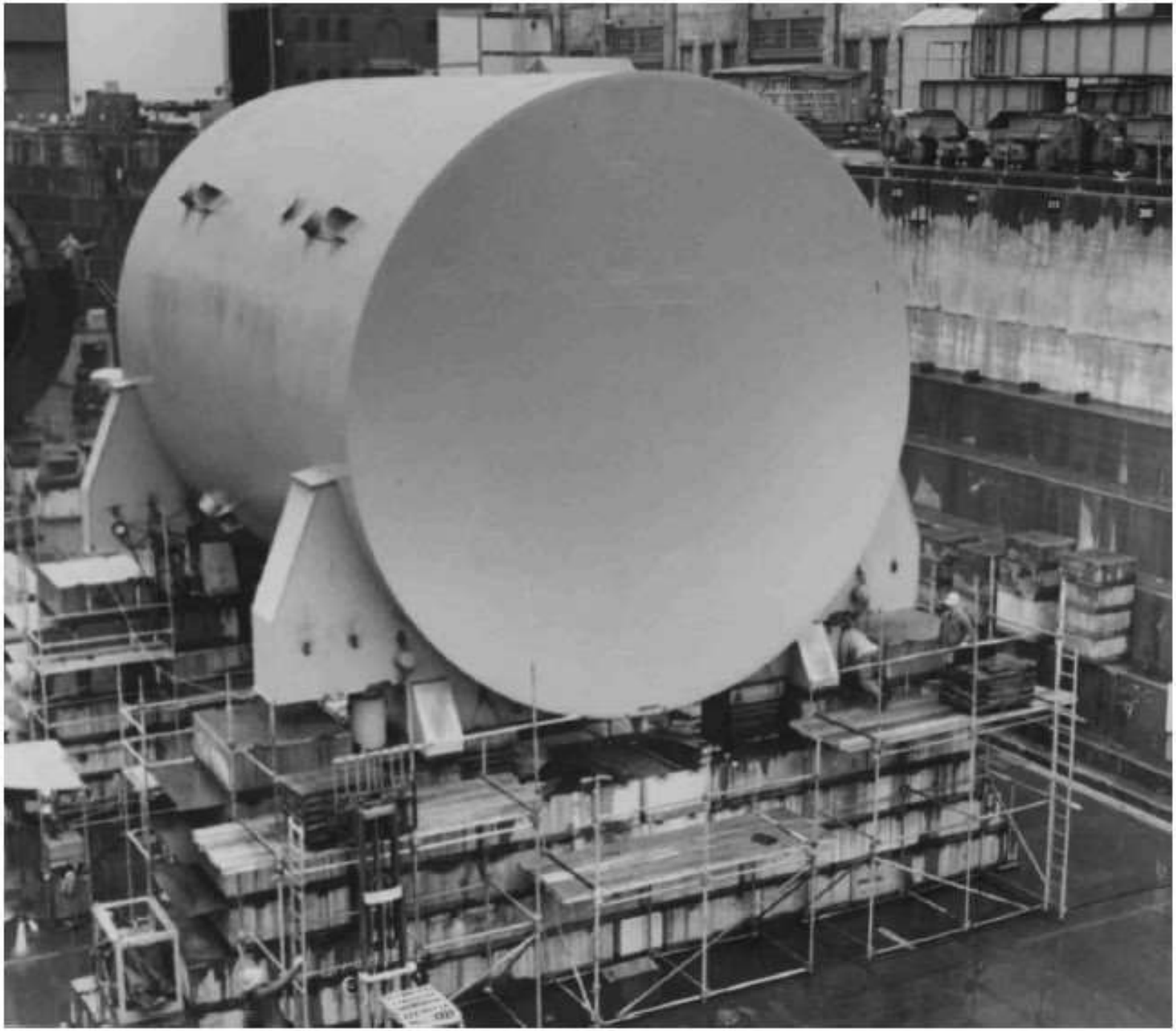
Reactor compartment (on right)

Management of the reactor component

The separated reactor compartment is encased in steel and welded to be air-tight for disposal.

The encased reactor component is intended to yield less than 30 mrem/hour at the surface. Co-60 is a major source.

It is then transported to the 218-E-12B Burial Ground in the 200 East Area.

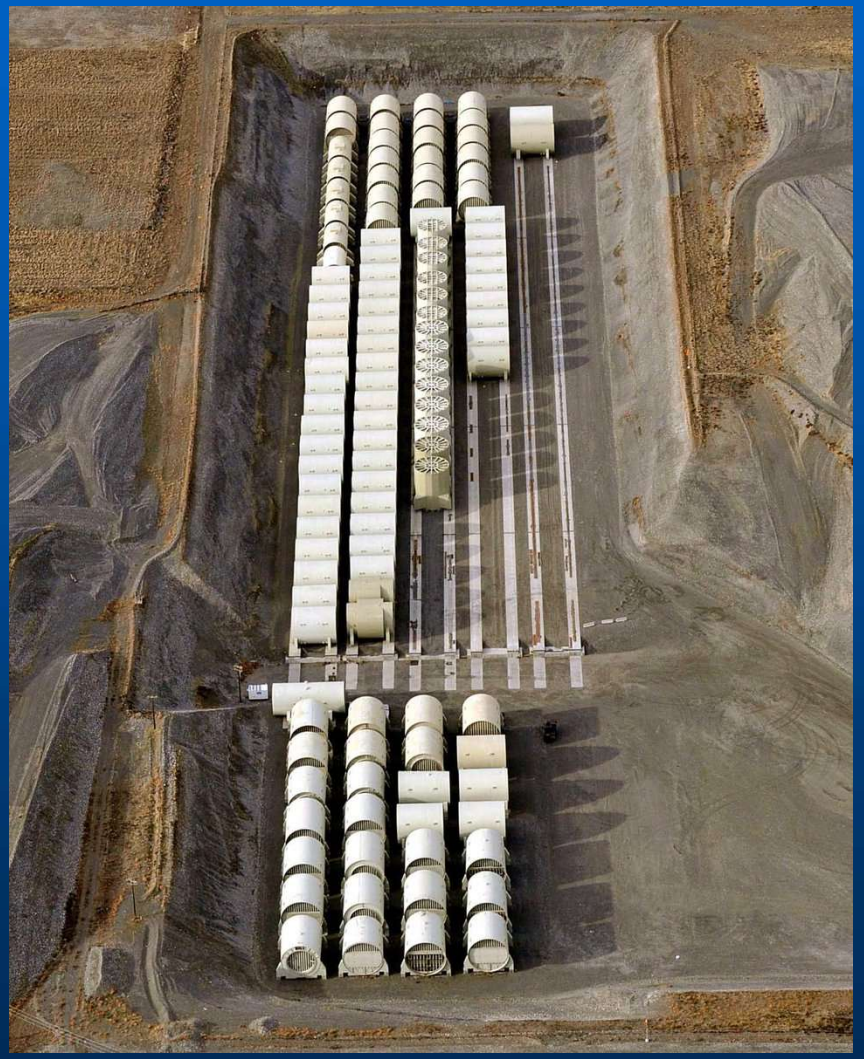


Submarine Reactor Compartment

Barge and Escort Vessel During Ocean Tow

Reactor Compartment Package enroute to the Disposal Trench

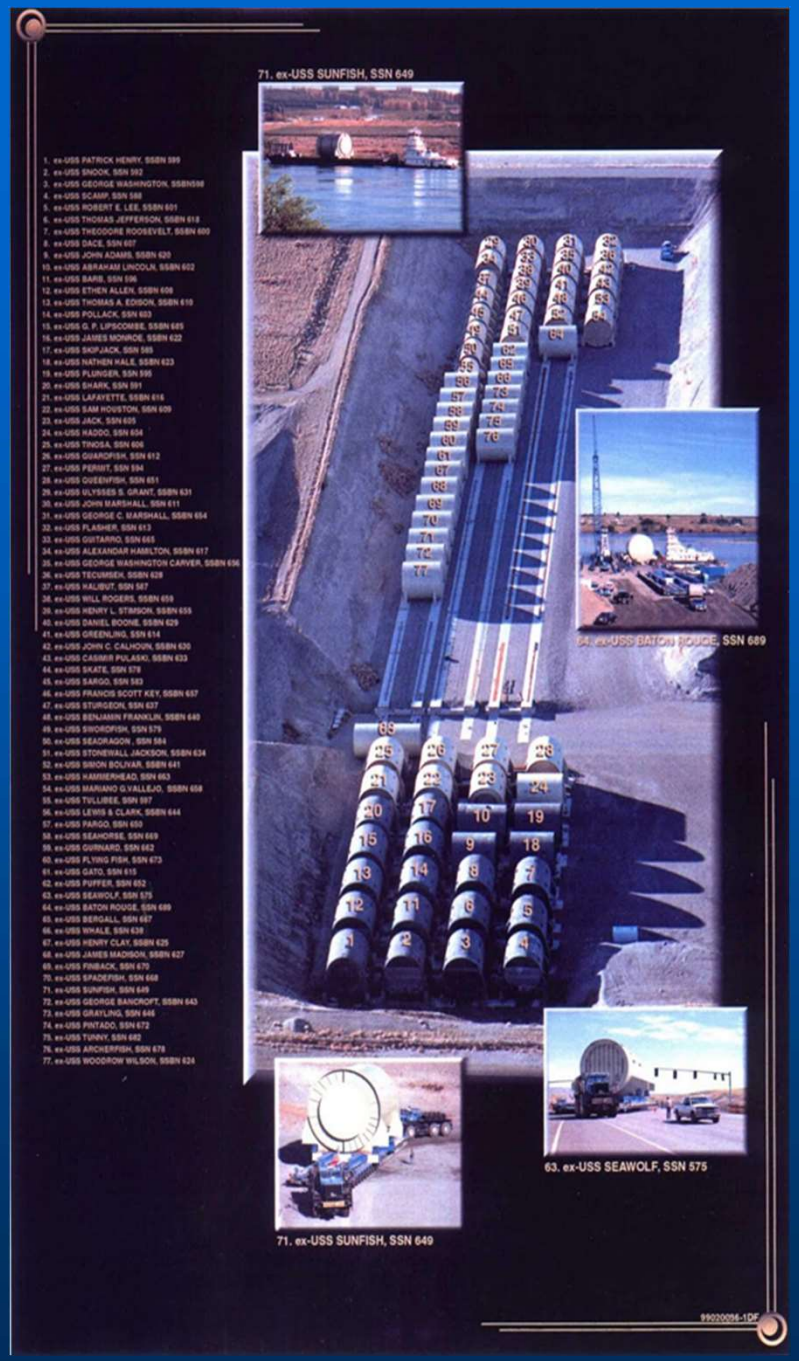
Trench 94 in the Hanford Reservation's 218-E-12B burial ground



9 cruisers (ships) have been or are currently being dismantled.

133 submarines have been dismantled.

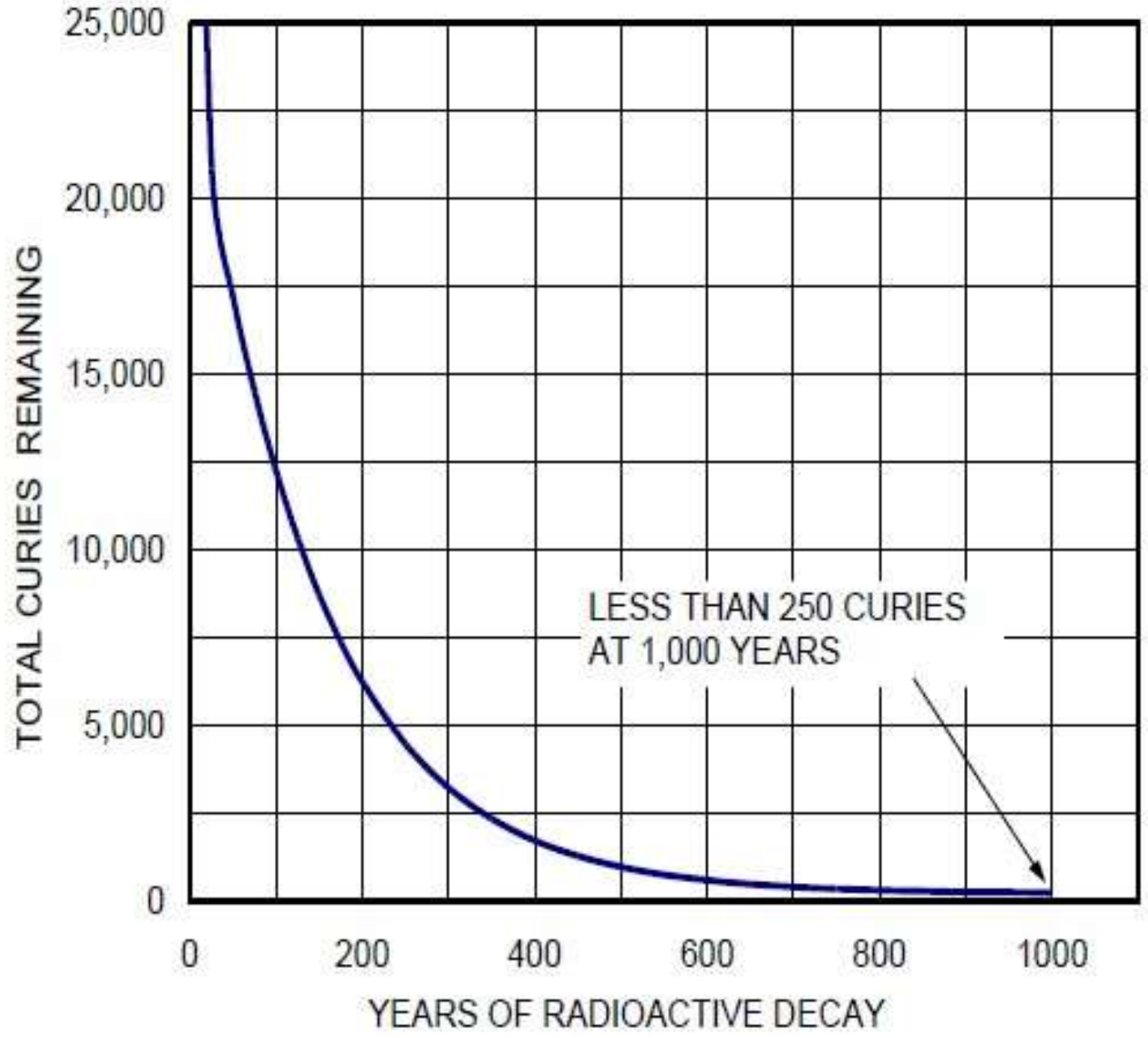
25 submarines are planned for dismantling.



Fate of the reactor compartments

The reactor compartments are buried with residual amounts of lead, PCBs, and asbestos (that which cannot be easily removed).

The U.S. Navy is confident that the reactor compartments will be resistant to corrosion for at least 600 years, and that any lead leached from the compartment will have limited mobility in the soils at Hanford.



Radioactivity in a Reactor Plant vs. Time After Final Operation
(This graph applies to submarine and cruiser class reactor plants)

Spent nuclear fuel

Projected inventory by 2035: 71 short tons.

Before 1992, Naval used nuclear fuel was reprocessed at the Idaho National Engineering and Environmental Laboratory (The Idaho Chemical Processing Plant) to recovery ^{235}U.

Spent nuclear fuel

In 1992, the Secretary of DOE issued an order to terminate all programs for the recovery of ^{235}U from SNF because the Cold War had ended, and a lack of a demand for uranium.

After 1992, Naval SNF began to accumulate Naval Reactors Facility (Idaho) at the Expended Core Facility/Dry Storage Facility.

Idaho State officials became concerned that Idaho was becoming a default permanent repository for SNF.

This concern resulted in

The 1995 Idaho Agreement and Consent Order.

The 1995 Idaho Agreement and Consent Order.

Include Naval SNF with early shipments to Yucca Mountain.

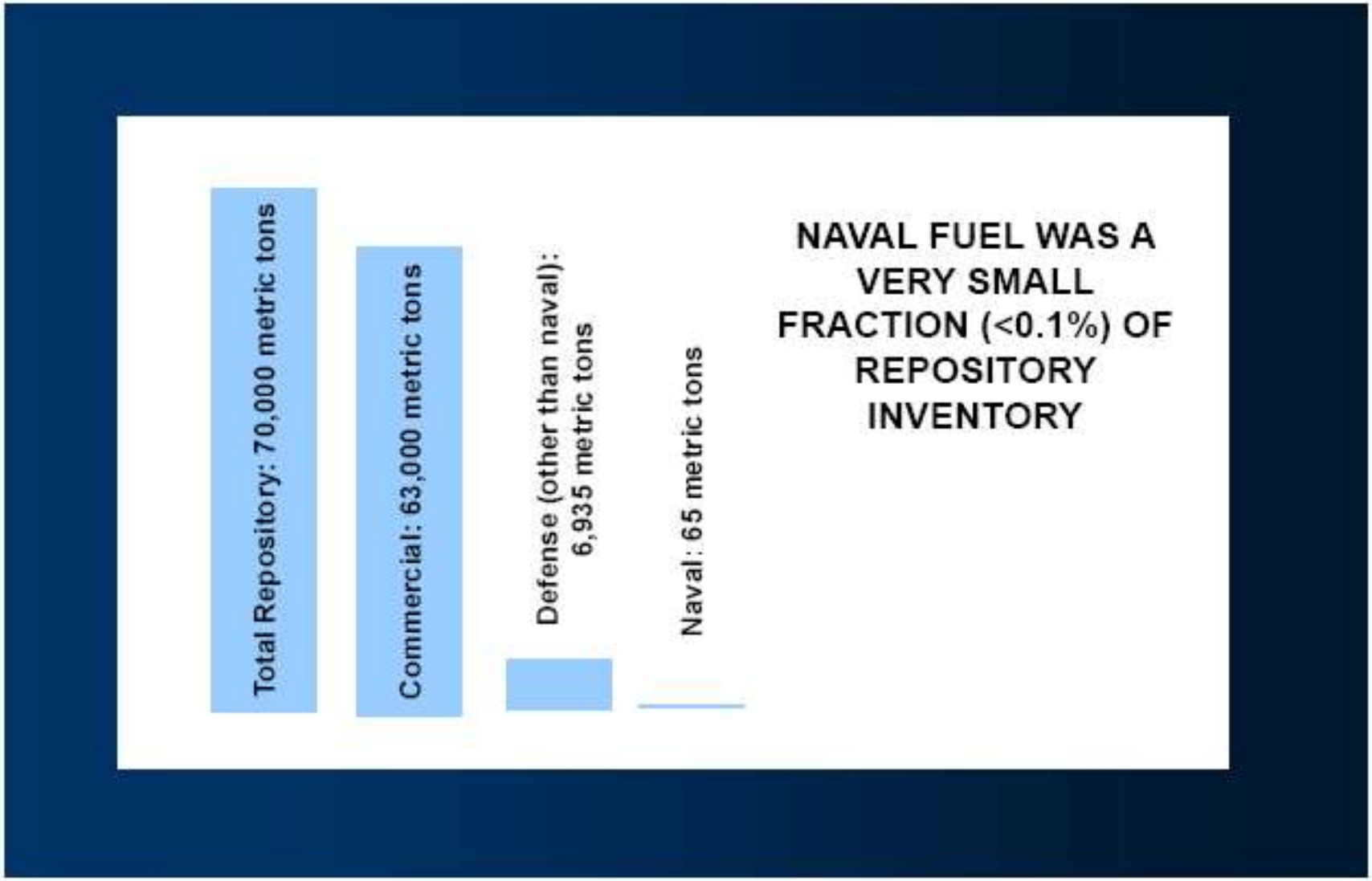
Remove all SNF from Idaho by 2035.

2008 Addendum: Continue the use of wet storage of Naval SNF beyond 2023.

Continue the management of a "limited inventory" at the Naval Reactors Facility beyond 2035.

Naval Spent Nuclear Fuel Inventory

Compact reactors, long life fuel results in a small inventory compared to other sources of spent fuel and high level waste



And in 2035?

Given that a geological repository may not be available by 2035, options are being considered for a new above-ground facility for the dry storage of Naval SNF at the Naval Reactors Facility. Re-fueling the Navy's nuclear fleet will not be threatened (for now).

Questions?