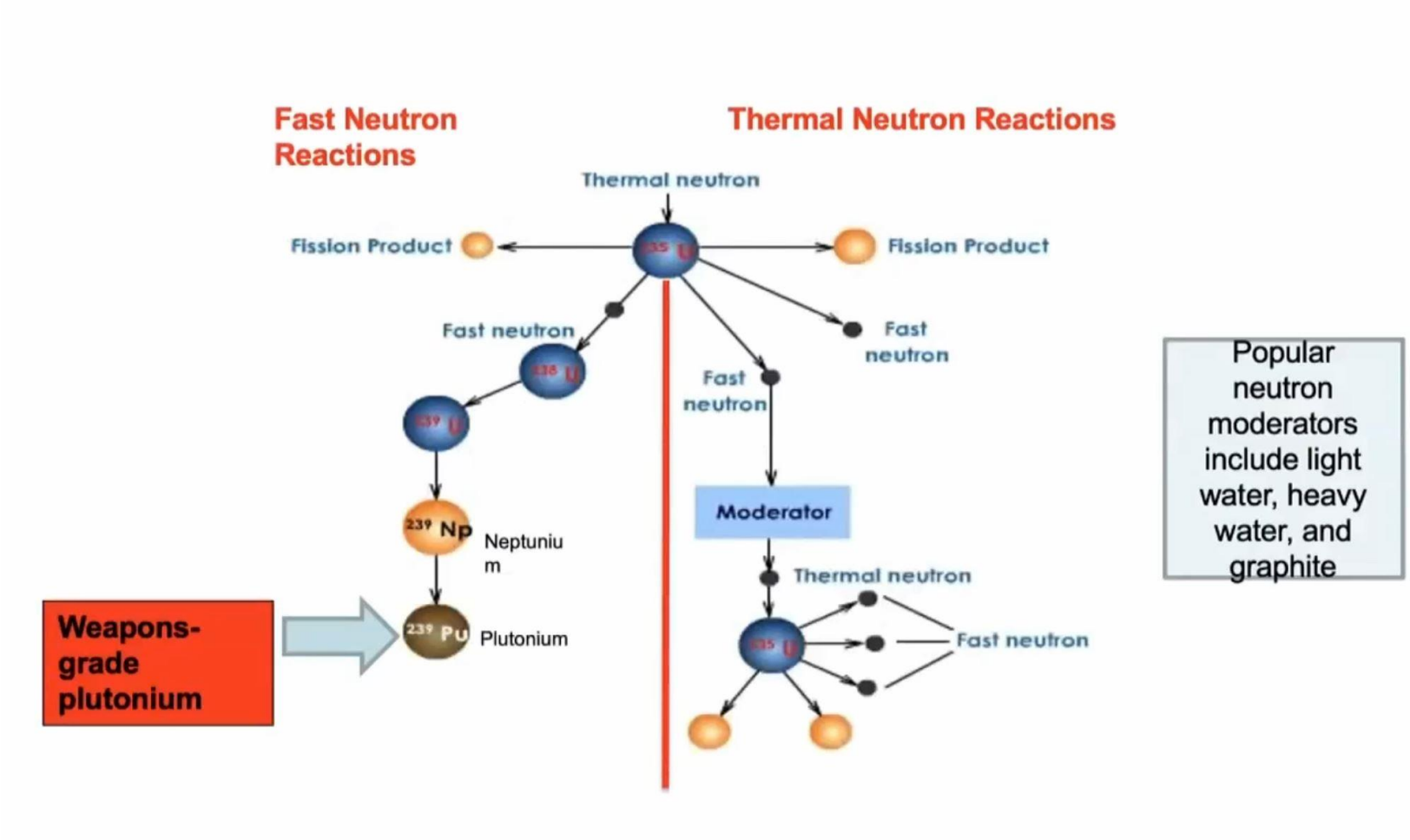
“Peaceful” Fast Reactors, Weapons Plutonium, and Power Reactor Production of Weapons Tritium

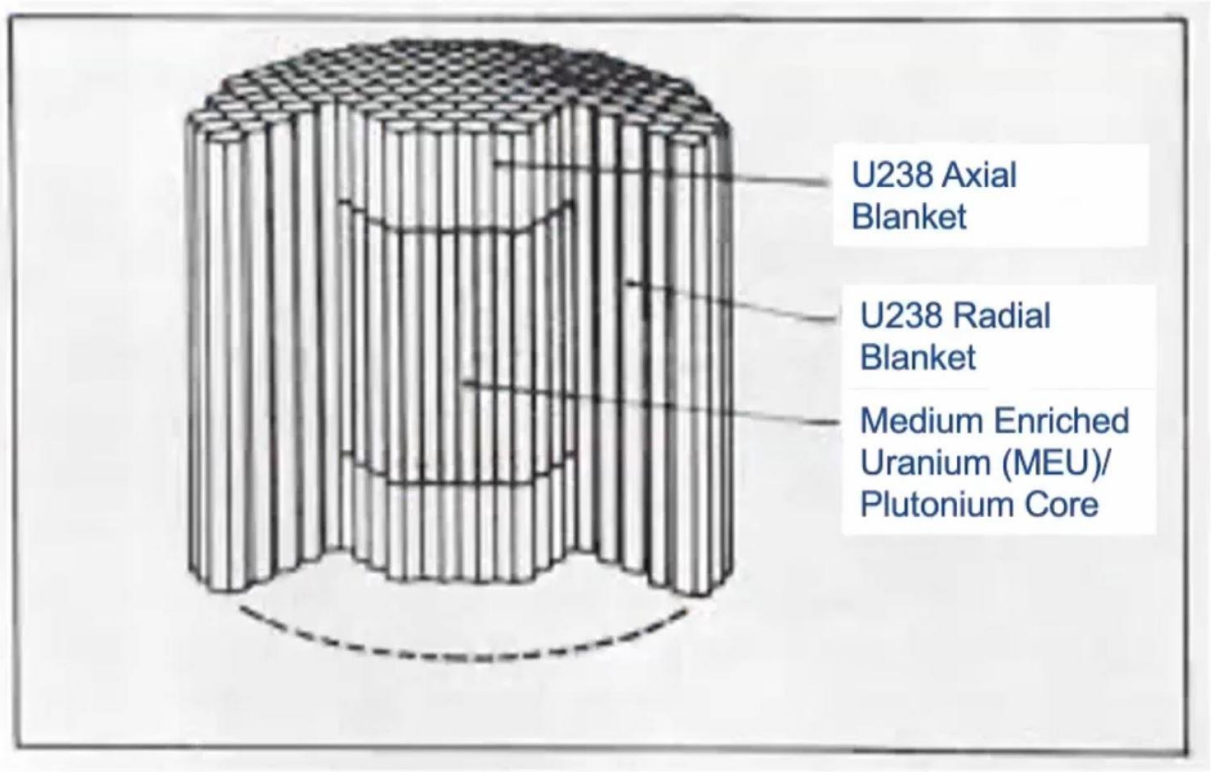
October 2, 2023

Henry Sokolski

Conventional Reactors Exploit Thermal Neutrons, Fast Reactors Exploit Fast Neutrons



Fast Reactors Use Pu or Enriched U Cores.
They Make More Weapons Plutonium than They Use.



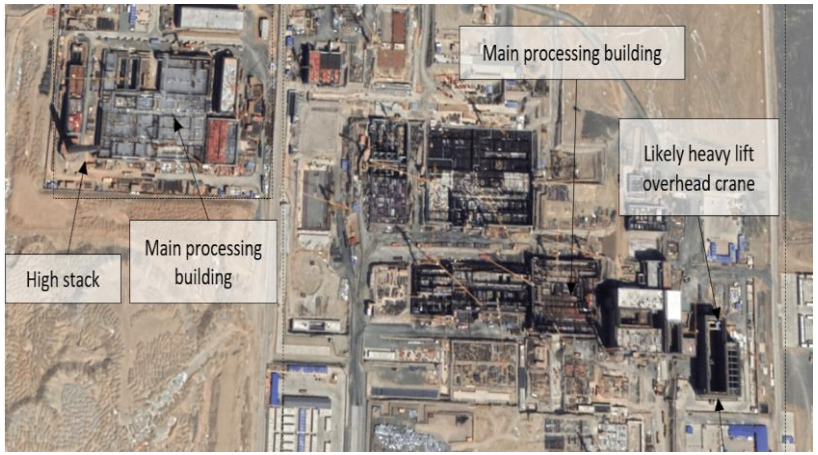
Sodium, lead, molten salt are used to transfer heat from the fast reactions. These heat transfer agents do not slow down the fast neutrons reactions.

Liquid Metal Fast Breeder Reactors also Have Been Used to Make Bomb Plutonium

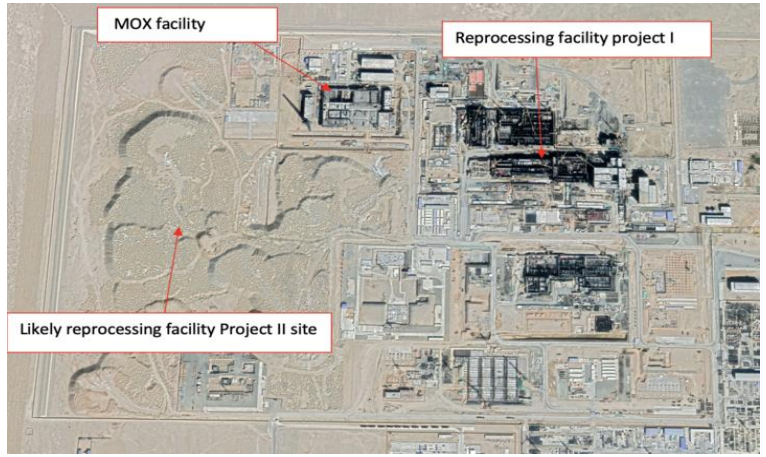
India's prototype fast breeder reactor under construction at Kalpakkam

Phénix, prototype fast breeder reactor in Marcoule, France – shut down in 2009

2019-21: PRC Revealed It's Ramping Up Its Plutonium Production Capacity Nearly 10-fold



1st PRC 200 tHM/yr plant under construction to be on line by 2025



2nd PRC 200 tHM/yr reprocessing plant to be on line before 2030

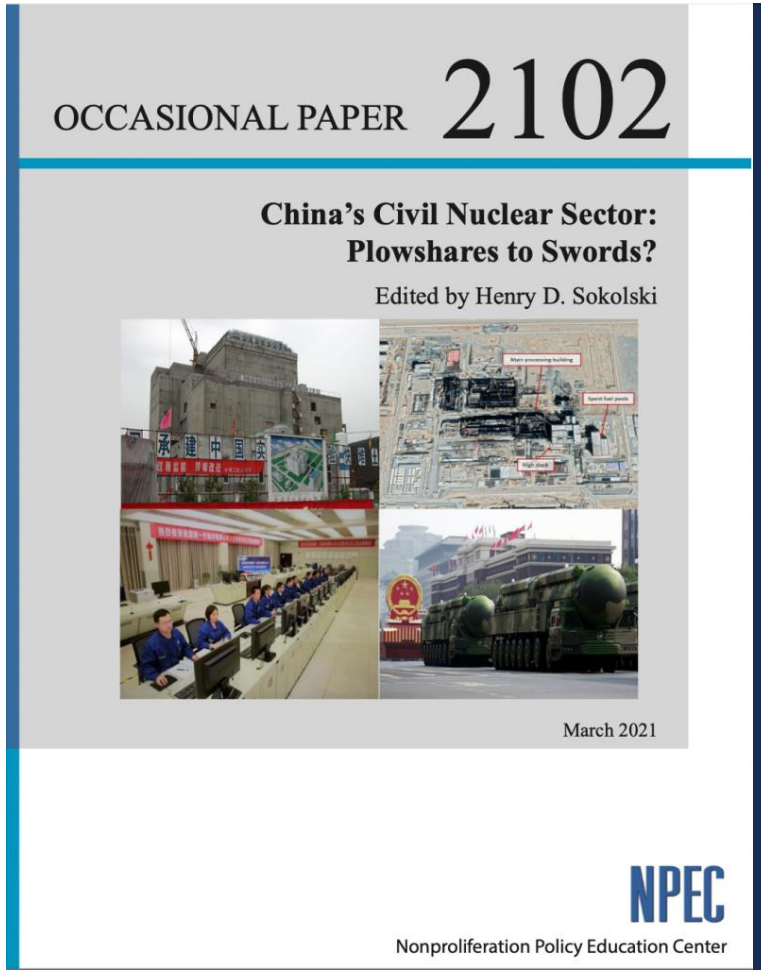
PRC 50 tHM/yr Pilot plant: ~100 bombs worth of plutonium/yr, initial operation 2010

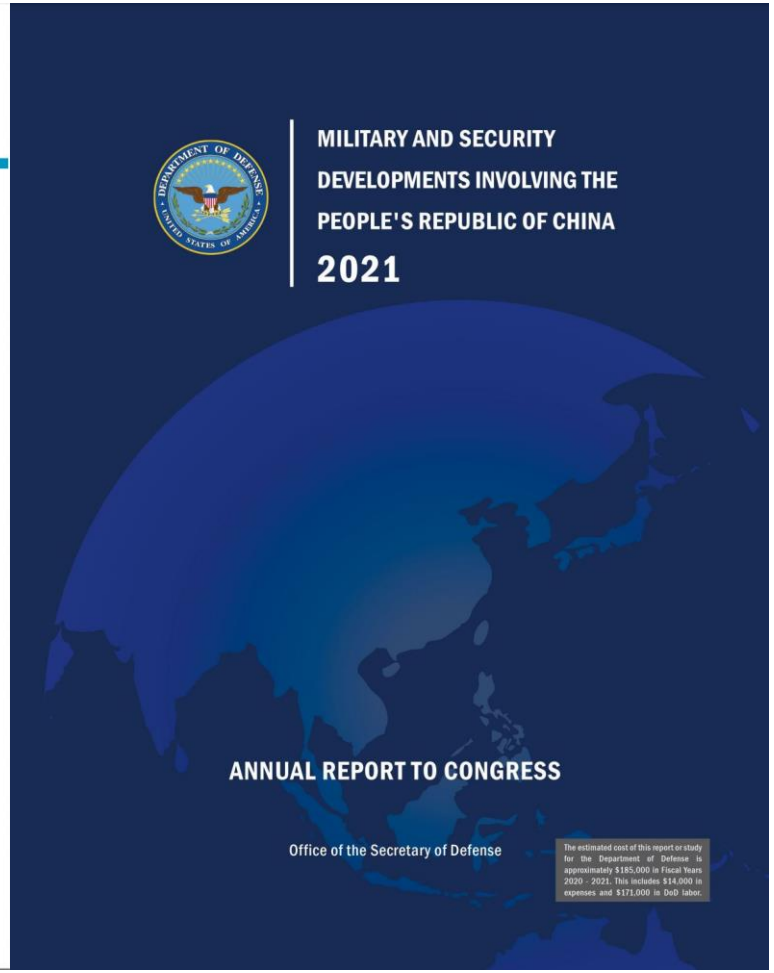
2019-21: PRC Confirmed It's Expanding Its Super-weapons-grade Plutonium-producing Fast Reactor Capacity 60-fold

China Experimental Fast Reactor, 20 Mwe, initial operation 2010

Fast Reactors under construction, first 600 Mwe reactor to begin operation in 2023, second plant to begin operation in 2026

Nov. 2021: DoD Projects PRC Will Acquire "at Least 1,000"; Nuclear Warheads by 2030. Nov. 2022, DoD Projects "1,500 by 2035." Cites NPEC Study.





"The PRC is constructing the infrastructure necessary to support this force expansion, including increasing its capacity to produce and separate plutonium by constructing fast breeder reactors and reprocessing facilities…the PRC likely intends to use some of this infrastructure to produce plutonium for its expanding nuclear weapons program. ***A Western think tank publication indicated that the PRC could field more than 1,000 nuclear warheads by the end of the decade, judging from the amount of plutonium that could be produced from reactors under construction***."

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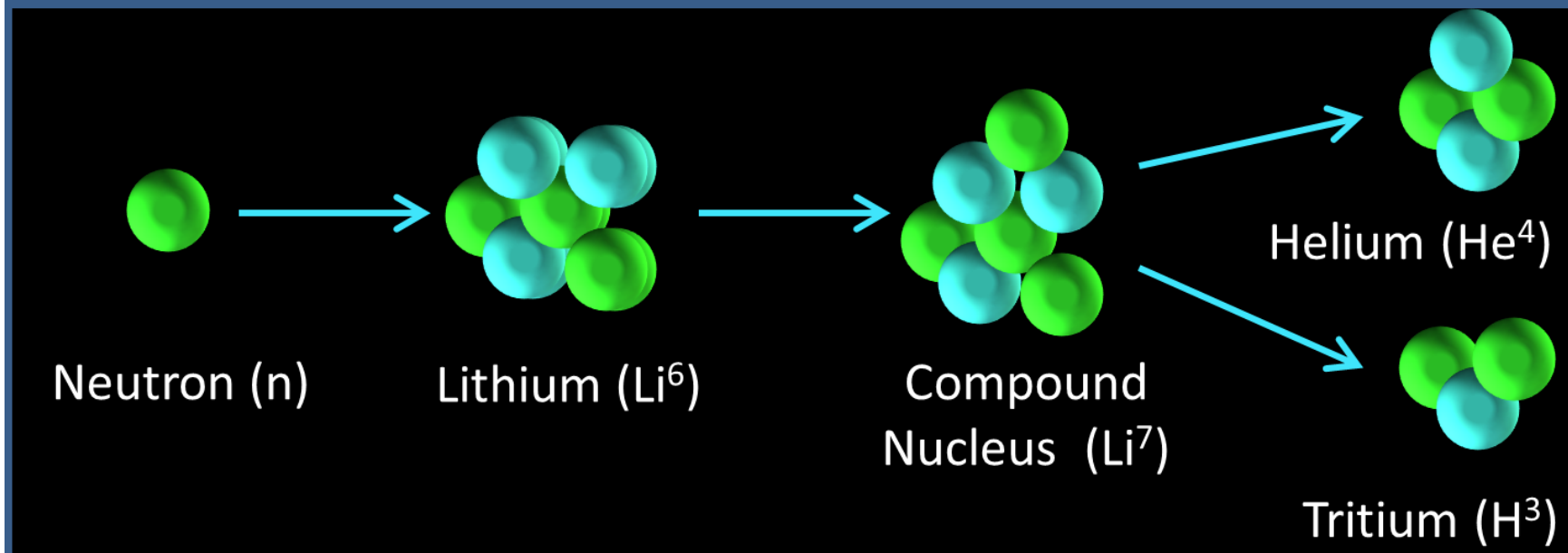
https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF

Lithium-Neutron Fission Reaction

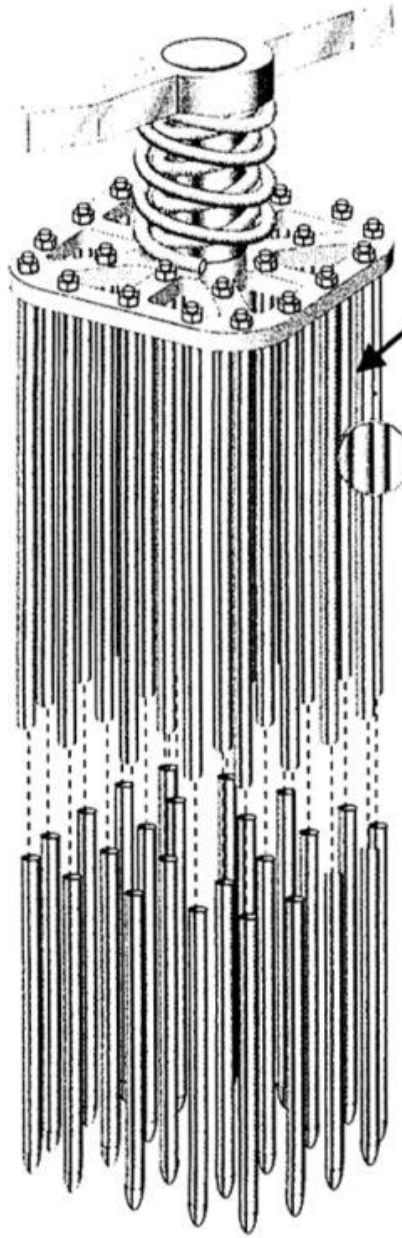


Takes place inside tritium breeding modules. Tritium must be physically collected, stored, and later injected into vacuum vessel.

In this induced fission reaction, a neutron is absorbed by a lithium-6 nucleus, turning it briefly into an excited lithium-7 nucleus, with the excitation energy provided by the kinetic energy of the neutron plus the forces that bind the neutron. The lithium-7, in turn, splits into helium-4 and tritium, releasing 4.8 MeV per reaction.

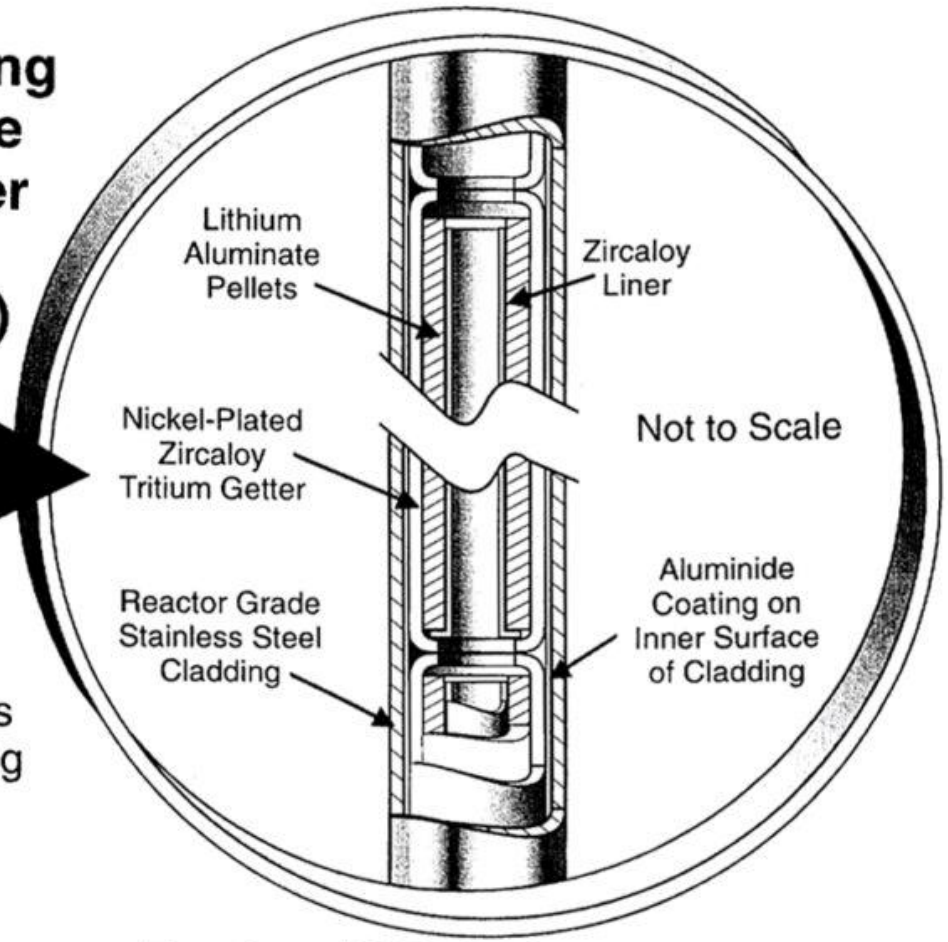
Steven B. Krivit 20211213

Tritium Producing Burnable Absorber Rod (TPBAR)



Assemblies consist of 24 rods suspended from a base plate.

Each rod is 12 feet long ~ 3/8 inch diameter



Functions of TPBAR Components

Stainless Steel Cladding - Similar to reactor fuel elements. Contains all TPBAR components

Aluminum Coating - Prevents diffusion of tritium through the stainless steel cladding into the reactor coolant. Also prevents hydrogen in the coolant from entering the TPBAR.

Zircaloy (zirconium alloy) Tritium Getter - Absorbs free tritium gas.

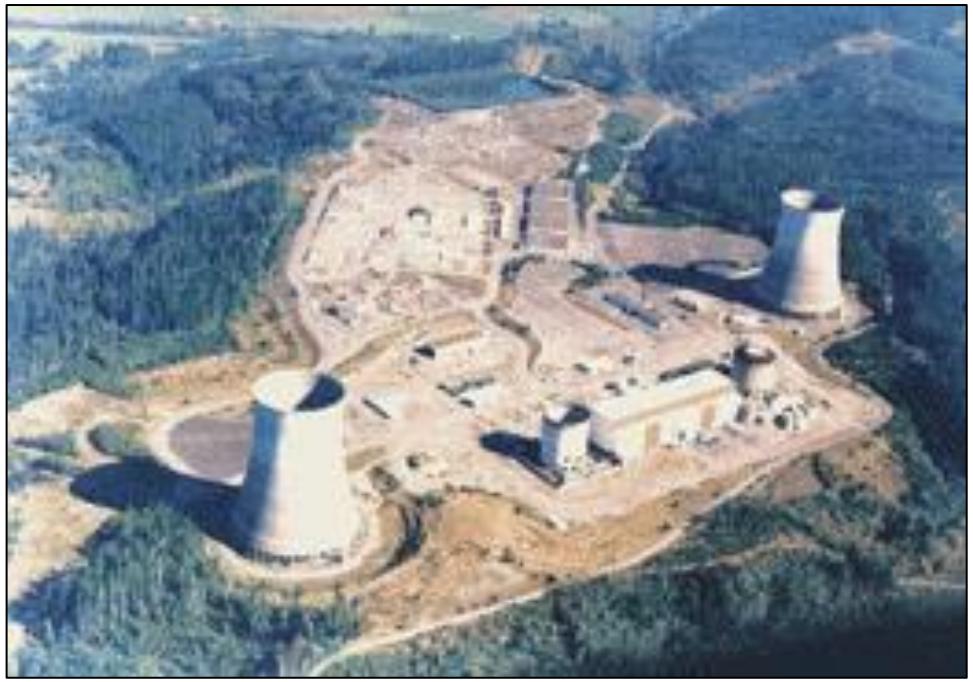
Nickel Plating - Protects the tritium getter from oxidation.

Lithium Aluminate Pellets - High-temperature ceramic material containing Lithium-6, the material that transmutes to tritium when a neutron is absorbed.

Zircaloy Liner - Removes oxygen to improve getter performance.

During and after irradiation, nearly all the tritium is held tightly in the ceramic, the tritium getter, and the zircaloy liner until it is released by the extraction process. There is little or no free tritium gas.

US Plans and Use of LWRs to Produce Tritium



1987: Reagan Administration Proposed Using WPSS LWR to Make Weapons Plutonium and Tritium

Watts Bar Nuclear Generating Station

Where Might China Be Producing Its Weapons Tritium?

Daya Bay, French-designed reactors

Tritium for Boosting Is Produced and Extracted from Heavy Water Reactors as a Matter of “Peaceful” Operation

Wosong Tritium Removal Facility, ROK has 4kgs of Tritium – enough to boost ~ 1,000 weapons

Two Candu-6 reactors (600 MWe each) at Qinshan