

Reactor Designs

Who thought this stuff up?

LWR PWR BWR HWR CANDU LMFBR HTGR **MSR**



Any letters we forgot?



The Reactor

- The reactor is the heart of the nuclear powerplant.
- These designs are innovative variations on fuel and coolant
- Oddly, they aren't new—they
 were developed in the 1940s
 and 50s by the clever young
 physicists who worked out the
 first designs

Light Water Reactors

Pressurized Water Reactor



- Use light (regular) water as a moderator & coolant
- Use slightly enriched uranium ... 4% U-235

Boiling Water Reactor



- Also a LWR (regular water), but with only 2 loops
- Otherwise, pretty much the same technology

Breeder Reactors

Breeder Reactor





U-238 Blanket

- Blanket of U-238 surrounds U-235 or Pu-239 fuel to "breed" plutonium using neutrons
- Coolant is liquid metal (sodium) so neutrons stay "fast"

High Temperature Gas-Cooled Reactors

High Temperature Gas Cooled Reactor



- Uses U-235 or Pu-238 fuel in a graphite moderator
- Instead of water for coolant, it uses helium gas

Very High Temperature Gas Cooled Reactor (Advanced Pebble Bed)



- Uses U-235 dioxide or carbide fuel pebbles instead of rods
- Uses helium gas as coolant at temperature of 1000°C
- Can be designed as a breeder reactor

Heavy Water Reactors

CANDU



- <u>Canadian Deuterium reactor uses natural un-enriched</u> uranium fuel (0.7%).
- Sub-critical, so it needs heavy water Du₂O to reflect neutrons to sustain reaction

Research and Special Purpose Reactors

MIT Research Reactor MITR-II



- Actually a LWR, uses high-enriched uranium fuel
- But also sub-critical, so it uses heavy water reflector around the outside to reflect neutrons back in to sustain reaction

Molten Salt Reactor



- Uses dissolved UF4 in molten fluoride salt or sodium—the coolant and the fuel are mixed together
- Circulates the "liquid" fuel to the graphite core where it becomes critical

Naval Propulsion Reactor



Miniature PWR

• Uses high-enriched U-235 fuel

Production Reactor





Hanford B Reactor

- Graphite core, breeds Pu-239
- Weapons production for national defense

Graphite Reactor



Graphite Reactor Oak Ridge 1943-60s

- Built of blocks of graphite with U-235 fuel
- Used for research and plutonium production

Swimming Pool Reactor



High Flux Isotope Reactor HFIR Oak Ridge

- Reactor sits in a pool of water
- Used for research and medical isotope production