Faster Breeder Nuclear Reactor and Other Types of Nuclear Reactors

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A Fast Breeder Reactor (FBR) is a nuclear reactor that **uses fast neutrons to generate more nuclear fuels than they consume** while generating power, dramatically enhancing the efficiency of the use of resources. Nuclear fission by fast neutrons causes the increase in neutrons generated.

Features of Faster Breeder Reactors

- Besides fission of Uranium-235, there is gainful **conversion of the 99.3% Uranium-238 to Plutonium-239, which in turn is a fissionable material.**
- **No moderator** is used to slow down the neutrons, because fast neutrons transmute uranium-238 much more efficiently than slow neutrons.
- Further, because the **sodium used as coolant** absorbs fewer neutrons compared to light water, more neutrons remain within the reactor.
- Increased number of neutrons causes a higher proportion of uranium-238 converting into plutonium-239 and yields more plutonium than original nuclear fuel.
- **Natural uranium consists primarily of U-238, which does not fission readily, and U-235, which does.**
- Natural uranium is unsuitable for use in a nuclear reactor, because it is only 0.72% U-235, which is not enough to sustain a chain reaction. Commercial nuclear reactors normally use uranium fuel that has had its U-235 content enriched.
- Although the U-235 does most of the fissioning, more than 90% of the atoms in the fuel are **U-238-potential neutron capture targets and future plutonium atoms.**

Faster Breeder Reactor in India

- The prototype fast breeder reactor (PFBR) is a nuclear power reactor currently under construction at the **Madras Atomic Power Station in Kalpakkam, Tamil Nadu.**
- The PFBR in Kalpakkam will use a **mixed oxide of plutonium-239**, derived from reprocessed spent fuel from the thermal pressurised heavy water reactors **and uranium-238** as fuel to generate energy in a nuclear reaction.
- The plutonium generated will then be processed and used as nuclear fuel in a **chain of commercial FBRs that constitutes stage II of the nuclear programme.**
- The stage will also include FBRs that will **use thorium-232**, mined in India, **as a blanket. Thorium will get converted to uranium-233, which will serve as the fuel for advanced reactors in stage III.**
- Ultimately, these reactors will burn uranium-233 and convert thorium-232 to more uranium-233, creating a self-sustaining cycle of nuclear power generation.

Other Types of Nuclear Reactors

- **Boiling Water Reactor:**

. They only have one coolant loop.

. The hot nuclear fuel boils water as it goes out the top of the reactor, where the steam heads over to the turbine to spin it.

- **Pressurized Water Reactor:**

. The primary cooling water is kept at very high pressure so it does not boil.

. It goes through a heat exchanger, transferring heat to a secondary coolant loop, which then spins the turbine.

- **Canada Deuterium-Uranium Reactors:**

. They contain heavy water, where the Hydrogen in H2O has an extra neutron.

. Deuterium absorbs many fewer neutrons than Hydrogen, and CANDUs can operate using only natural uranium instead of enriched.

- **High Temperature Gas Cooled Reactor:**

. Gas such as helium or carbon dioxide is passed through the reactor rapidly to cool it.

. Due to their low power density, these reactors are seen as promising for using nuclear energy outside of electricity: in transportation, in industry, and in residential regimes.

. They are not particularly good at just producing electricity.