

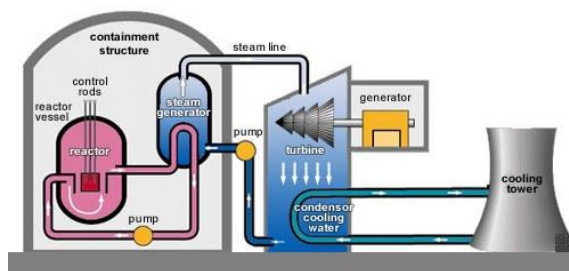
Success 24/7 Chemistry Notes: Fission and Fusion

Fission - splitting a heavy nucleus into two nuclei with smaller mass numbers.

- used for nuclear energy and atomic bombs

How a power plant works:

- production of neutrons causes a chain reaction (which must be controlled)
- 1 kg of uranium-235 is equivalent to 20,000 tons of dynamite
- Fission in a nuclear reactor is carefully controlled. Much of the energy is heat. This energy is used to produce steam and subsequently, electricity.
- A coolant is needed to prevent overheating in the core and to act as a moderator which slows down neutrons so that they can be captured by the reactor fuel.
- Control rods made of various metals are present to absorb excess neutrons to slow down the reaction. They can be raised or lowered into the reactor core.



Nuclear disasters:

Chernobyl (1986): Reactor #4 exploded after a safety test failed. Biggest reason this was a true tragedy was the fact that there was not a containment dome around the reactor and all of the radiation went directly into the atmosphere.

Fukushima Daiichi(2011): A tsunami caused by an earthquake flooded the plant and caused 3 of the 6 reactors to go into meltdown.

Fusion - combining two light nuclei to form a heavier, more stable nucleus

- Stars produce their energy this way
- Extremely high temperatures are necessary in order to initiate fusion
- This may be, in some form, a possible future energy source

Nuclear Waste: you cannot simply throw away nuclear waste. It takes at least 1,000 years to become "safe". There is a big debate right now on where to store it while it decays.

Units of radiation

- **Rad-** absorption of 0.01 J/kg body tissue
- **Rem-** n(# of rads)
 - adjusts for relative effectiveness of the radiation in causing damage to humans.
- Background radiation \approx 0.13 rem/yr
- Chest X-ray = 0.05-0.2 rem
- 0-25 rem causes no detectable damage.
- Ionizing Radiation – knocks electrons off some atoms of the bombarded substance to produce ions (α, β, γ , and X-rays)

Methods of detection

- **Geiger Counter** - gas-filled metal tube to detect radiation
 - primarily detects beta



- **Scintillation Counter** -specially coated screen to detect radiation
 - can detect all types

- **Film Badges**
 - detect beta and gamma



Luxel Dosimeter



Ring Dosimeter

Radioisotopes in Research and Medicine:

- Tracers: Iodine-131 is used to check for thyroid problems
- Radioactive barium is used to check for digestive system problems.
- Cobalt-60 and Cesium-137 are used as radiation sources for cancer treatment.