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Uranium Enrichment

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Uranium Isotopes

When uranium is mined, it consists of approximately 99.3% uranium-238 (U^{238}), 0.7% uranium-235 (U^{235}), and < 0.01% uranium-234 (U^{234}). These are the different uranium isotopes. Isotopes of uranium contain 92 protons in the atom's center or nucleus. (The number of protons in the nucleus is what makes the atoms "uranium.") The U^{238} atoms contain 146 neutrons, the U^{235} atoms contain 143 neutrons, and the U^{234} atoms contain only 142 neutrons. The total number of protons plus neutrons gives the atomic mass of each isotope — that is 238, 235, or 234, respectively. On an atomic level, the size and weight of these isotopes are slightly different. This implies that with the right equipment and under the right conditions, the isotopes can be separated.

Enriching Uranium

The nuclear fuel used in a nuclear reactor needs to have a higher concentration of the U^{235} isotope than that which exists in natural uranium ore. U^{235} when concentrated (or "enriched") is fissionable in light-water reactors (the most common reactor design in the USA). During fission, the nucleus of the atom splits apart producing both heat and extra neutrons. Under controlled conditions, these extra neutrons can cause additional, nearby atoms to fission and a nuclear reaction can be sustained. The heat energy released, by the controlled nuclear reaction within the nuclear reactor, can be harnessed to produce electricity. Commercially, the U^{235} isotope is enriched to 3 to 5% (from the natural state of 0.7%) and is then further processed to create nuclear fuel.

At the conversion plant, uranium oxide is converted to the chemical form of uranium hexafluoride (UF_6) to be usable in an enrichment facility. UF_6 is used for a couple reasons; 1) The element fluorine has only one naturally-occurring isotope which is a benefit during the enrichment process (e.g. while separating U^{235} from U^{238} the fluorine does not contribute to the weight difference), and 2) UF_6 exists as a gas at a suitable operating temperature.