Chemistry & Nuclear Power

What are the most important elements to humans? Other than the basic organic elements of Carbon, Nitrogen, Hydrogen and Oxygen, many elements play an important part of energy conversion and production. As Silicon, Boron, Phosphorus, Arsenic and Aluminum are important elements of solar electricity, Uranium, Plutonium, and play crucial roles in nuclear power.

Uranium plays a very important role in the production of energy through nuclear power. A heavy element located in the Actinide series it has 92 protons as indicated by its atomic number. Look at Uranium on the periodic table. Uranium has many different isotopes; different configurations of protons and neutrons in its nucleus. Not all of its isotopes are stable. For a indepth lesson on isotopes see the link's page.

The process of converting uranium to energy involves many decomposition reactions. In a decomposition reaction the first element breaks down and releases components of itself. If the reaction releases energy it is said to be endothermic. Reactions that need energy to occur are called exothermic reactions, because energy comes from outside. Decomposition reactions follow this general form:

Element A ---> Element B + Biproducts

For the nuclear reaction process, the Biproducts are neutrons and energy measured in the unit of Joules. Many other chemical equations occur within nuclear power. A special page reviews the basic forms of many chemical reactions and gives examples of them. All of the chemical equations of this page are listed at the linked page. For the decomposition of Uranium - 235 the reaction is summarized:

$$ {}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{92}_{36}Kr + {}^{141}_{56}Ba + 200\ MeV + 3\ {}^{1}_{0}n $$

The leftover neutrons of the reaction come from the nucleus of the Uranium. These neutrons are either absorbed by system controlling fuel rods or are used to continue the uranium decomposition reaction. A process where the products of one reaction become reactants for the next reaction is called a chain reaction. The number of these rods is changed periodically to increase or decrease power production as needed.

More nuclear control rods means that the reaction is slowed down, and less energy is produced. When more fuel rods are added, the plant produces more power.

The energy given off is 200 MeV, equivalent approximately to $20 * 10^{10}$ J. This energy will not be used directly, but indirectly to heat a liquid such as water to a gas. Thermal energy is the technical term applied to the energy given off from the nuclear decomposition reaction. This energy that is given off is similar to the energy produced in a combustion reaction. For more information about the similarities and differences between the combustion process and the nuclear power process, go to the comparison page for combustion. If you just skimmed through this page, then you need to go back through and read it. Otherwise, take this quiz to see how much you remember.