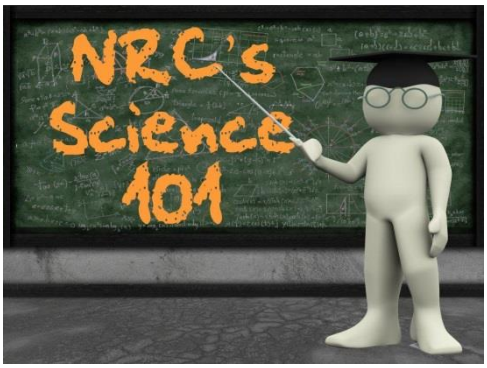
The Nuclear Regulatory Commission's Science 101: What is Nuclear Fuel?



So you know about nuclear chain reactions and how they are used to generate electricity in reactors. Now we look at the fuel that reactors use to create those chain reactions.

You may recall that nuclear fuel rods get hot because of the nuclear reaction, and that heat is key to generating electricity. But what exactly are these fuel rods?

Nuclear fuel starts with uranium ore, which is found in the ground throughout the world. For now, we'll just say that uranium ore goes through several steps to be processed and manufactured into nuclear fuel.

Each pellet is about the size of a pencil eraser. These pellets are stacked inside 12-foot long metal tubes known as fuel cladding. The tubes are sealed on each end to form a fuel rod, and between 100 and 300 fuel rods are arranged in a square pattern to form a fuel assembly. The number of fuel rods used to make a fuel assembly depends on the type of reactor the assembly will be used in and the company that makes the fuel.

While the assemblies are very long (about 12 feet), they are less than 1 foot wide. The assemblies have special hardware at the top and bottom and at intervals in between to keep the fuel rods firmly held and evenly spaced. Fuel assemblies are only slightly radioactive before they are placed into a reactor core. Typically, a reactor core will have between 150 and 250 fuel assemblies.

We talked before about the form of uranium that is important in commercial nuclear reactors. It is an "isotope," or an atom with a very specific number of neutrons, known as U-235. Part of the process of turning uranium ore into nuclear fuel is enrichment—which increases the amount of U-235 relative to the other isotopes naturally found in uranium. Under the right conditions in a reactor, neutrons will cause U-235 atoms to fission, or split. This leaves two new, different atoms and a couple of neutrons. These new neutrons will then cause other U-235 atoms to fission, forming a chain reaction.

As U-235 atoms fission, energy is released in the form of heat. That heat creates steam which turns a turbine to create electricity. After a few years, there is considerably less U-235 in the fuel. If the amount of U-235 were to drop too low, there would no longer be enough to keep a chain reaction going. So every 18-24 months about one-third of the fuel in a reactor core is removed and replaced with new, fresh fuel. The used fuel is often called "spent fuel."

Spent fuel is very hot and very radioactive. The atoms created by the fission process are unstable at first and emit particles that create heat. Therefore, spent fuel must be handled and stored carefully, and under controlled conditions.