

process that fuels our sun and the stars. Creating and maintaining a fusion reaction is more complex and expensive than performing fission. Both fission and fusion release enormous amounts of energy that can be converted into energy as heat and electrical energy, and both produce **nuclear waste**. Fission produces more waste than fusion. As new processes are developed to use energy from fission and fusion, a more vexing question arises: how to contain, store, and dispose of nuclear waste.

Containment of Nuclear Waste

Every radioactive substance has a half-life, which is the amount of time needed for half of a given material to decay. Radioactive waste from medical research, for example, usually has a half-life that is a few months or less. Some of the waste that is produced in a nuclear reactor will take hundreds of thousands of years to decay, and it needs to be contained so that living organisms can be shielded from radioactivity. There are two main types of containment: on-site storage and off-site disposal.

Storage of Nuclear Waste

The most common form of nuclear waste is spent fuel rods from nuclear power plants. These fuel rods can be contained above the ground by placing them in water pools or in dry casks. Each nuclear reactor in the United States has large pools of water where spent rods can be stored, and some of the radioactive materials will decay. When these pools are full, the rods are moved to dry casks, which are usually made of concrete and steel. Both storage pools and casks are meant for only temporary storage before the waste is moved to permanent underground storage facilities.

Disposal of Nuclear Waste

Disposal of nuclear waste is done with the intention of never retrieving the materials. Because of this, building disposal sites takes careful planning. Currently, there are 77 disposal sites around the United States. The U. S. Department of Energy is developing a new site near Las Vegas, Nevada, called Yucca Mountain, for the permanent disposal of much of this waste. Nuclear waste could be transported there by truck and train beginning in 2010. This plan is controversial—some organizations oppose the idea of the disposal site, and others have proposed alternate plans.

SECTION REVIEW

1. What is required to shield alpha particles? Why are these materials effective?
2.
 - a. What is the average exposure of people living in the United States to environmental background radiation?
 - b. How does this relate to the maximum permissible dose?

3. What device is used to measure the radiation exposure of people working with radiation?
4. Explain why nuclear radiation can be used to preserve food.

Critical Thinking

5. **INFERRING CONCLUSIONS** Explain how nuclear waste is contained, stored, and disposed of, and how each method affects the environment.