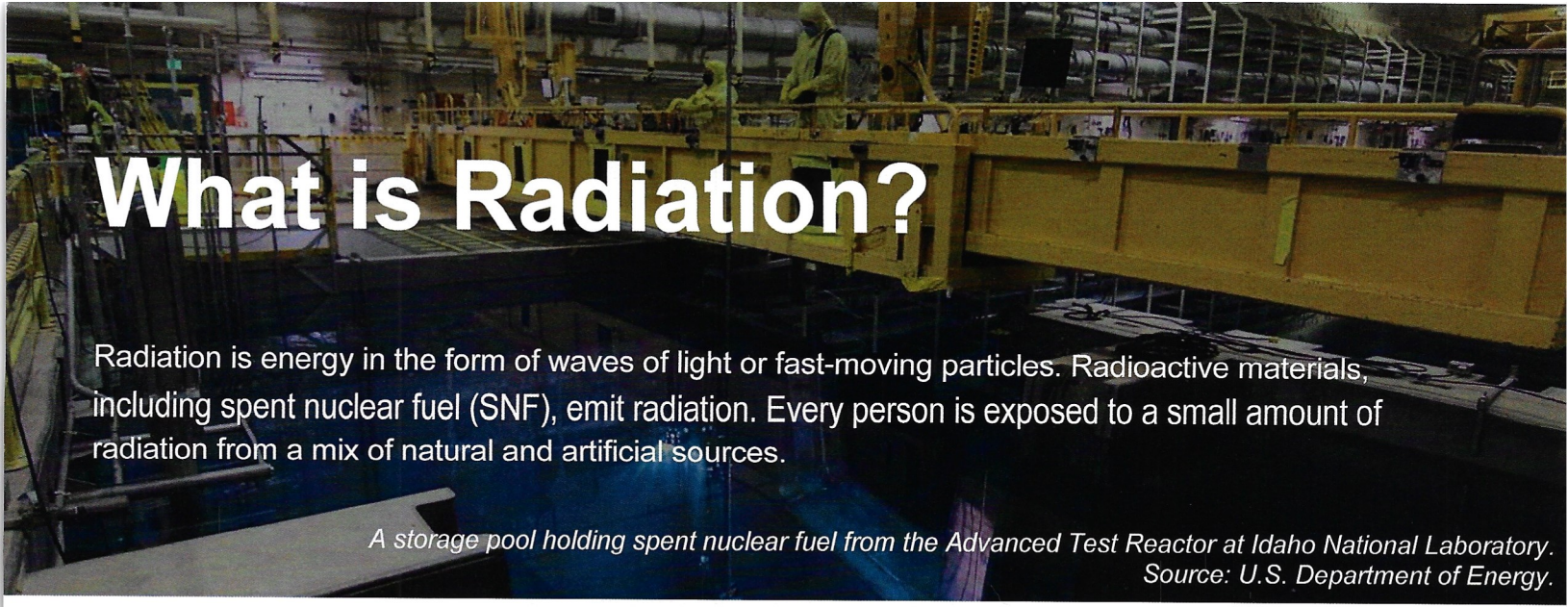

# What is Radiation?

Radiation is energy in the form of waves of light or fast-moving particles. Radioactive materials, including spent nuclear fuel (SNF), emit radiation. Every person is exposed to a small amount of radiation from a mix of natural and artificial sources.

*A storage pool holding spent nuclear fuel from the Advanced Test Reactor at Idaho National Laboratory. Source: U.S. Department of Energy.*

## Where does radiation come from?

About half of the radiation dose the average person receives in a year comes from natural sources, including naturally occurring radioactive materials in soil, plants, and our own bodies and radiation from the Sun and other objects in space. The other half comes from artificial sources, mostly X-ray imaging and other medical procedures. Nuclear power accounts for only about 1% of the artificial radiation dose a person receives. Figure 1 shows some of the common sources of radiation and how much the average person receives from them each year.

## Types of radiation

There are several different types of radiation, each with different effects and requiring different types or amounts of shielding to block. Except for neutron radiation, most types of radiation cannot make other objects radioactive.

### Alpha radiation

Alpha radiation is composed of large, heavy particles with an electric charge. It can be completely blocked by a few inches of air or by a very thin solid barrier like paper or human skin. However, alpha radiation can injure a person if they ingest or inhale radioactive material.

### Beta radiation

Beta radiation is composed of small particles with an electric charge. It can be blocked by a slightly thicker barrier like cloth or aluminum foil.

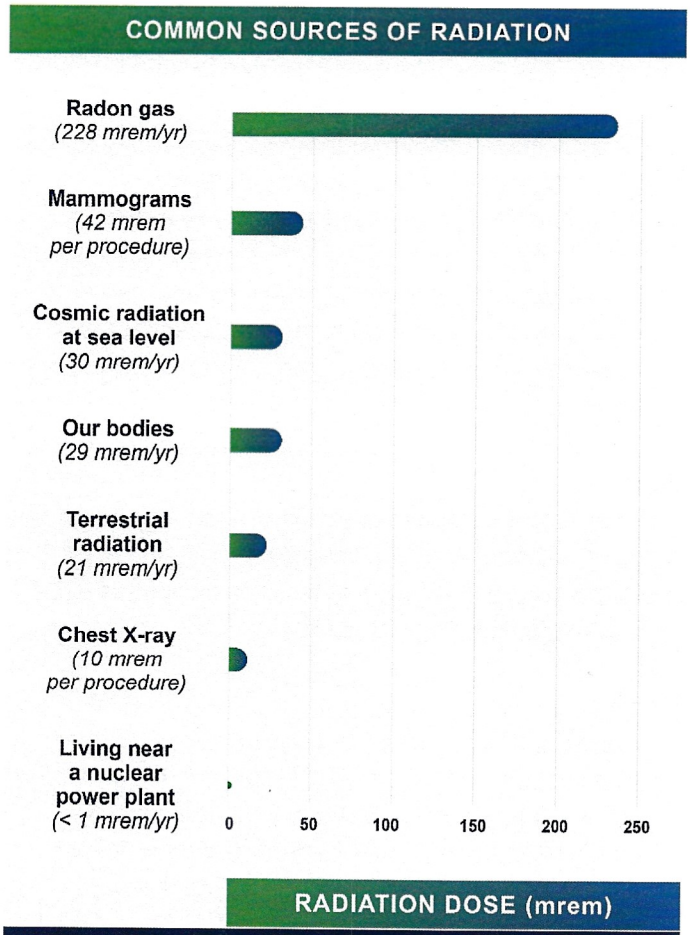


***Figure 1*** *Chart showing the yearly average dose from common sources of radiation compared to the dose from living near a nuclear power plant.*

*Data from* ***https://www.epa.gov/radiation/radiation-sources-and-doses#averagedoses***

U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy
*Spent Fuel and High-Level Waste Disposition*

**September 2025**

### X-rays and Gamma rays

X-rays and gamma rays are waves of light at much shorter wavelengths than humans can see. They can travel great distances and penetrate shielding that blocks alpha and beta radiation. X-rays can be blocked by a thin layer of heavy material like lead or steel, while gamma rays can be blocked by several inches of lead or steel shielding.

### Neutron radiation

Neutron radiation is composed of particles without an electric charge. This is the only type of radiation that can make other objects radioactive. However, it rarely occurs outside of a nuclear reactor. Neutron radiation can be blocked by a thick layer of concrete or water.

## How do we protect against radiation?

Large amounts of radiation can cause injury to the human body, which is why the U.S. Nuclear Regulatory Commission (NRC) sets strict limits on how much radiation nuclear power plants, SNF storage facilities, and other facilities that handle radioactive material can emit. Nuclear facilities use several techniques to comply with these guidelines and protect workers and the public from radiation.

### Time

The less time a person spends exposed to high levels of radiation, the less damage it can do. Workers in nuclear power plants and SNF storage facilities have strict limits on how much time they can spend in high-radiation areas.

### Distance

The intensity of radiation decreases as you get farther away from the source. The NRC requires nuclear reactors and SNF storage facilities to have boundary fences around them to keep people far away from the reactor vessel or SNF and limit the amount of radiation they receive, as shown in Figure 2.

### Shielding

Nuclear reactors and SNF containers have multiple layers of different shielding materials to block all types of radiation. Figure 3 shows SNF dry storage systems which use a concrete and steel overpack to block radiation. The NRC evaluates all new reactors and SNF storage systems developed to ensure they have adequate shielding.

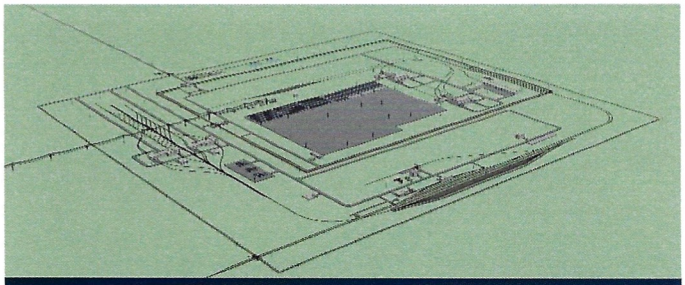

***Figure 2*** *A diagram of a proposed Federal consolidated storage facility. Spent nuclear fuel is stored in shielded canisters on the concrete pad in the center. A boundary fence far away from the storage pad reduces the radiation dose to people outside the facility.*

*Source: U.S. Department of Energy*

***Figure 3*** *Spent nuclear fuel canisters are stored inside concrete overpacks to block radiation.*

*Source: Indian Point*

### Preventing contamination

Nuclear power plants, SNF storage facilities, and other institutions that work with radiation follow strict rules to stop any radioactive material from escaping into the environment. Nuclear fuel is contained by multiple layers of sealed barriers, starting with the metal outer casing of the fuel rods which seals the radioactive material inside. When it's spent and ready for storage, the nuclear fuel is sealed inside a canister that is bolted or welded shut to provide an extra layer of containment, and that canister is placed inside an overpack to protect it from damage. Personnel who work with radioactive materials are decontaminated before leaving the facility, and gloves, protective clothing, tools, and other objects that may have come into contact with radioactive material are disposed of in sealed containers.

For more information, contact AskSNF@nuclear.energy.gov.