



Nuclear Submarines

The United States Navy has been using nuclear submarines since the 1950's. After the use of the first atomic weapon, scientists sought to use this technology for generating power. In 1956, the U.S. Navy completed the development of the first submarine to use nuclear propulsion. With the advent of nuclear propulsion, submarines were able to stay out at sea for extended periods of time. Unlike their diesel powered predecessors, nuclear power provided submarines with about twenty years worth of energy. Food supplies became the only constraint on the duration of a nuclear submarine's time at sea.



Nuclear submarines contain a nuclear power plant within a shielded compartment of the boat. The science and technology of nuclear propulsion is complex, but the basic concepts of it are simple. Within the nuclear reactor, atoms are split, generating heat. This heat is used to create highly pressured steam that is routed to the electricity and propulsion generator turbines, causing them to rotate and create power for both the ship's electronics and propeller. The condensed steam is then routed back through the pipes to be used again for the same process.

The nuclear reactor that powers the submarine emits radiation. In order to protect the crew, the reactor compartment is shielded by steel, water tanks and polyethylene. With this protection, the crew members and the outside world are well shielded from the reactor's harmful radiation. In fact, the crew members are actually exposed to less radiation than the general public. This is because on land there is naturally-occurring radiation, called background radiation, and water acts as a radiation shield. So when a nuclear submarine is submerged in water, the crew is actually being exposed to less radiation than what they would be exposed to on land.

The largest risk of exposure on a nuclear submarine is during maintenance. In order to assure their safety, maintenance workers are monitored for radiation exposure regularly. They work in shifts and carefully plan the work to limit their exposure time.

Due to peace treaty agreements made between the U.S. and the former Soviet Union in the 1980's, hundreds of nuclear submarines are being decommissioned. In this process, the submarine's nuclear reactor compartment is carefully removed and dismantled at Puget Sound Naval Shipyard in Bremerton, Washington. Because the various parts of the reactor compartment have become contaminated due to years of reactor operations, the materials are stored and monitored at the Department of Energy's Hanford site. The reactor fuel is removed and sent to the Naval Reactors Facility in the Idaho National Laboratory. With the help of various government organizations, this radioactive waste is stored and monitored closely.

Who is protecting you

U.S. Coast Guard

Nuclear reactor compartments are shipped on barges from the Puget Sound to the Hanford Site. The barge may be periodically inspected by the Coast Guard and the American Bureau of Shipping. During shipment, the Coast Guard or the U.S. Navy will provide an escort vessel for the barge.

U.S. Department of Defense (DoD)

The Navy's Nuclear Powered Ship and Submarine Recycling Program performs radiation surveys of each reactor compartment before it leaves for Hanford. The reactor compartments are shipped on barges modified by the Navy to increase barge strength and stability. The compartment is welded to the barge for transport.

Since 1986, the U.S. Navy has disposed of nuclear reactors shipped to the Hanford Site in Washington State. After the reactor fuel is removed, the reactor compartments are classified as low-level radioactive waste. They are placed in a large open pit about seven miles from the Columbia River, which will eventually be covered with dirt and continually monitored.

Defense Environmental Restoration Program (DERP)

DERP was established in 1984 to promote and coordinate evaluation and clean-up of contamination at DoD installations. The program includes the Installation Restoration Program (IRP), which identifies, investigates, and restores potential contamination at DoD installations and former properties such as nuclear submarine reactor storage sites. Sites that pose the greatest potential public health and environmental hazards are given highest priority.

U.S. Department of Energy (DOE)

Formerly Utilized Sites Remedial Action Program (FUSRAP)

The [FUSRAP program](#) was initiated in 1974 by the Atomic Energy Commission (AEC), the predecessor of the U.S. DOE. The purpose of this program is to identify and evaluate sites that were previously used by the AEC or its predecessor, the Manhattan Engineering District (MED). If necessary, the program decontaminates the sites to meet current standards, or controls the site to ensure the public are protected from unnecessary exposure.

U.S. Department of Transportation (DOT)

The Navy must comply with DOT regulations when shipping the reactor compartments. Radiation levels must not exceed DOT limits. These limits are in place to protect workers, the public and the environment while shipping and managing the reactor compartments and components.

U.S. Environmental Protection Agency (EPA)

Superfund

Superfund is the federal government's program to identify uncontrolled hazardous waste sites, test the conditions of the sites, formulate clean-up plans, and clean up the sites. Under the Superfund program, abandoned, accidentally spilled, or illegally dumped hazardous waste that poses a current or future threat to human health or the environment are cleaned up.

In May 1989, EPA, the State of Washington Department of Ecology and DOE entered into an Interagency Agreement and Consent Order to set up a process and legal framework for cleanup and regulatory compliance at Hanford. EPA, DOE, and the State developed an action plan addressing Superfund and Resource Conservation and Recovery Act (RCRA) issues.

Superfund maintains the National Priority List of chemically and radiologically contaminated sites in the United States. You can find a listing of the long-term remedial sites at the [National Priorities List Sites](#).

The States

Oregon's Department of Energy works with the Department of the Navy in order to ensure a safe passage of barges carrying nuclear waste. Washington State's Department of Ecology Nuclear Waste Program works to oversee all Hanford nuclear waste activities.

What you can do to protect yourself

Be Informed: Information is the best tool in keeping yourself safe. Civilians should never encounter any risk of exposure from nuclear submarines or the disposal sites that store the dismantled reactor compartments. However, as an active citizen, you should be aware of the steps that government agencies are taking to keep you safe.

Respect Safety Zones: Safety zones are often established around contaminated sites. These zones limit public access to hazardous materials that may cause adverse health effects. The people working inside of the safety zone are trained professionals who are educated in safety procedures and potential consequences.

Resources

You can explore this radiation source further through the resources at the following URL:
<http://www.epa.gov/radtown/submarine.html#resources>

We link to these resources to maintain up-to-date information.