

A Brief History of Submarine Development in the United States

Ten years after the end of the Civil War, Irish-born John Holland began designing and building submarines in the United States. Holland submitted his first submarine design to the U.S. Navy in 1875, which at the time was dismissed as impractical. Seeing this rejection as a challenge, Holland quickly went back to the drawing board to redesign and improve on the construction of these underwater boats.



Figure 1: John Holland

By 1888, the U.S. Navy recognized the potential for submarines in its fleet and held a design competition for a new underwater vessel. Holland won the competition and began building the submarine *Plunger* five years later. After experiencing difficulties with *Plunger*, Holland began work on another submarine that he named *Holland VI*.

For his sixth submarine, Holland introduced a new method of propulsion using a gasoline engine. Holland designed a small, lightweight gasoline engine that turned a propeller while the boat cruised on the surface. The engine ran a generator to charge batteries necessary to run an electric motor during underwater operations. Holland's efforts proved successful and he was able to persuade the Navy in April of 1900 to purchase this submarine. It was added to the fleet as USS *Holland* (SS-1) six months later.

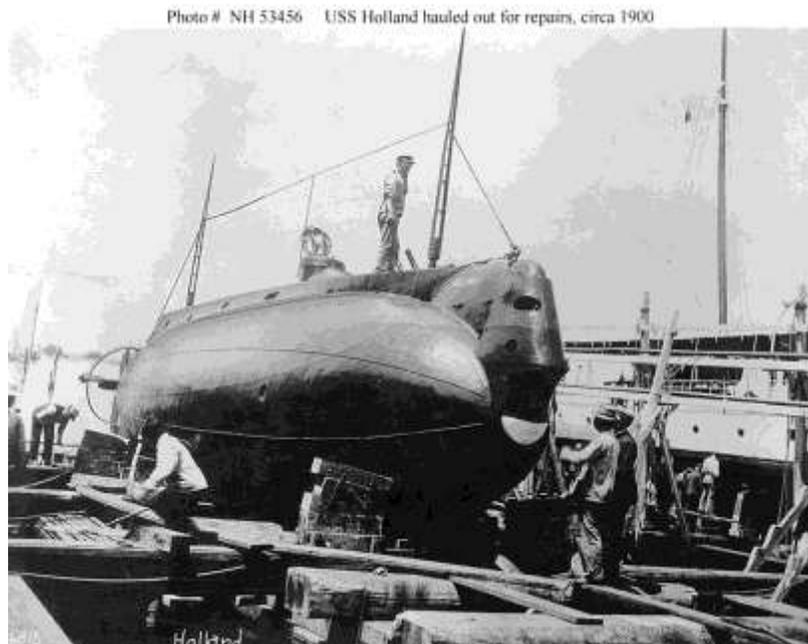


Figure 2: USS Holland

Although the gasoline engine worked well on paper, the engine had flaws. Gasoline is highly flammable so using this fuel in a confined environment, such as the submarine, endangered the crew. Another danger came from the batteries that ran the electric motor during underwater travel. They were heavy, bulky, and potentially explosive. Finding a safer means of propulsion was needed if the submarine was ever to submerge for long periods of time.

Around the same time Holland was designing gasoline submarines, German scientist Rudolf Diesel developed an excellent substitute for the gasoline engine. Diesel's engine used a fuel that was more stable than gasoline and could be stored safely. The engine also did not need an electric spark to ignite the fuel, adding another element of safety. These advantages, plus improved fuel economy, granted submarines with Diesel engines longer and safer cruises on the surface. While underwater, batteries were still necessary to provide power. After 1909, Diesel engines were adopted for use in American submarines in 1909 and were used for nearly 50 years.



Figure 3: USS O-2, a World War I submarine.



Figure 4: USS Clamagore, a World War II submarine

Despite the success of diesel-powered submarines, the quest for a single power source continued. The concept of nuclear power was discovered by German scientists in the 1930's. Upon learning of this idea, American physicist Ross Gunn visualized the potential for nuclear-powered submarines and Phillip Abelson first sketched an image of one. It was not until after World War II that the U.S. Navy began to seriously research the use of nuclear power on submarines. The most recognized proponent of nuclear-powered submarines in the U.S. Navy was Admiral Hyman G. Rickover.



Figure 5: Admiral Hyman G. Rickover

Rickover managed a research team that converted the concepts of nuclear power into working submarines. Nuclear power uses atoms, the smallest particles of an element, to produce an enormous amount of energy. That energy allows the power plants on submarines to super heat water and create steam. The steam then powers a giant turbine which turns the sub's propeller. Those small nuclear power plants on submarines could supply the necessary power to travel up to 500,000 miles and to stay underwater almost indefinitely without refueling.



Figure 6: USS Nautilus SSN 571

Rickover convinced the Navy and the Atomic Energy Commission that nuclear power was the ideal propulsion method for submarines. On January 17, 1955, the first nuclear-powered submarine, USS *Nautilus* (SSN-571) went to sea. On her first voyage, *Nautilus* traveled completely submerged in the Atlantic for more than 1,300 miles. In 1958, she traveled under the polar ice cap and reached the North Pole.

Today's fleet of American nuclear submarines spends up to six months on submerged patrol. There are currently three types of submarines operating in the US fleet: fast attack (SSN), ballistic missile (SSBN), and guided missile (SSGN). Fast attack subs are designed to search and track ships and other submarines.



Figure 7: USS Los Angeles SSN-688

Ballistic missile subs are mobile launch platforms for Trident II nuclear ballistic missiles. Each sub can carry up to 24 missiles. Four of these ballistic missile submarines were converted into guided missile submarines. Instead of carrying Trident II missiles, these submarines carry Tomahawk cruise missiles instead.



Figure 8: USS Ohio SSBN-726