

Oak Ridge: The birth of the nuclear navy, part 2

(As published in The Oak Ridger's Historically Speaking column the week of August 18, 2025)

In the first part of this Historically Speaking series, the role of Oak Ridge National Laboratory's support for the U.S. Navy was featured. Now, we will look at the roles of the K-25 Gaseous Diffusion Plant and the Y-12 Plant (later known as the Y-12 National Security Complex).

The K-25 Gaseous Diffusion Plant provided the first highly enriched uranium that was provided to the U.S. Navy. During the Cold War, the K-25 Gaseous Diffusion Plant was a significant producer of highly enriched uranium for both nuclear weapons and naval reactor fuel. The highly enriched uranium produced at K-25, along with that from the Portsmouth plant, was essential for the U.S. Navy's nuclear submarines and aircraft carriers for the early years through the 1990s.

The Y-12 National Security Complex has provided the highly enriched uranium for the Navy since 2002. From 1991 to 2002, existing highly enriched uranium that was in the production stream was sufficient, but the transition to the conversion of dismantled nuclear weapons material also began during the later years of this period. For the foreseeable future, Y-12 will continue to provide for the U.S. Navy's highly enriched uranium needs.

The Y-12 National Security Complex played a significant and unique role in the USS Seawolf project, particularly concerning its propulsor (the system that propels the submarine, including the propeller itself). This was a significant opportunity for the nation to see the uniqueness of Y-12's manufacturing capabilities beyond just nuclear weapons components.

In the late 1980s, the U.S. Navy designed the Seawolf-class (SSN-21) submarines intended to be exceptionally fast and quiet. One of the main elements was an innovative propulsor design. The Navy faced a significant manufacturing challenge with the complex, precision-machined components needed for this new propulsor.

Through Oak Ridge National Laboratory connections that existed, the Y-12 Plant's precise and advanced manufacturing capabilities needed for nuclear weapons components were recommended to the Navy. Also, no other potential contractors would undertake the schedule or technical difficulties the Navy desired. Y-12 accepted the task of manufacturing a full-scale prototype propulsor. Y-12 acquired a large five-axis, computer-controlled milling machine as well as a massive lathe, and even added a 6,500 square-foot wing to the Alpha 1 machine shop.

The project began in 1989 and was delivered in three subassemblies in 1993, ahead of schedule and within budget. In recognition of this tremendous manufacturing accomplishment, the U.S. Congress designated Y-12 as a National Prototype Center. Y-12 also made the third subassembly for the second Seawolf submarine, spare parts for the propulsors, and transferred the manufacturing process to the U.S. Navy. Y-12 also contributed to the later Virginia-class submarine program.

The designation, in 1997, as one of the nation's National Prototype Centers has enabled Y-12 to assist other government agencies and become recognized as one of the nation's most capable precision machining centers. Oak Ridge, with the expertise of Oak Ridge National Laboratory, Y-12 National Security Complex, and the recent emphasis on a vital role in the nation's nuclear renaissance, which is resulting in new industry related to processing nuclear fuel for small modular reactors, as well as the small modular reactors being built here, is again leading the nation toward advancements in nuclear energy.

The collective efforts of Oak Ridge's scientific and industrial workforce profoundly shaped the trajectory of the nuclear navy. The seamless transfer of technology and expertise between Oak Ridge National Laboratory, the Y-12 National Security Complex, the K-25 Gaseous Diffusion Plant, and the Navy fueled not only the physical development of submarines and their reactors but also established a culture of rigorous precision and innovation. As submarines and aircraft carriers evolved, the partnerships that had proved so fruitful for the Seawolf's propulsor continued to bear fruit in new reactor designs, advanced manufacturing, and materials science.

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This synergy also fostered a spirit of collaboration beyond military applications, as Oak Ridge's role in nuclear energy broadened to support civilian advancements. The city's legacy is seen not only in deployed vessels but in the ongoing education and training of engineers, machinists, and scientists who continue to push the boundaries of nuclear technology.

Today, the U.S. nuclear navy consists of over 70 nuclear-powered submarines, including Ballistic Missile Submarines, such as the Ohio-class, equipped with Trident II missiles for nuclear deterrence; Attack Submarines, like the Virginia-class, which are designed for intelligence, surveillance, and anti-submarine warfare; and, 11 nuclear-powered aircraft carriers, including the Nimitz- and Ford-class carriers, provide unmatched global reach and sustained air power.

These vessels can operate for over 20 years without refueling thanks to their compact and efficient pressurized water reactors. Modern naval reactors are designed for high power output, long core life, and strict containment, embodying lessons from Oak Ridge and the legacy of Rickover's discipline.

In recognition of the importance of the birth of the nuclear navy in Oak Ridge in 1946, a prominent display that tells that story is being planned. The USS Houston submarine has been decommissioned and is scheduled for demolition. The conning tower (known as the "sail") of the USS Houston is being requested by the American Museum of Science and Energy Foundation for display in the city of Oak Ridge. The scheduled demolition of the submarine will be completed by October 2026.

We plan to have a statue of Admiral Rickover and Alvin Weinberg located with the sail. The statues are being created by Oak Ridge High School's Wildcat Manufacturing. The intention is to 3-D print them and to have them be interactive using artificial intelligence. This is part of the "Giants of Oak Ridge" statue project that the Wildcat Manufacturing team of high school students is undertaking.

The location chosen for the display is just south of the Secret City Commemorative Walk and is being included in a master plan for the redevelopment of AK Bissell Park. The plans for the USS Houston Sail and Giants of Oak Ridge statues are also being included in the current Oak Ridge Master Plan update effort.

In conclusion, the birth of the U.S. Navy's nuclear navy, one of the most significant elements of nuclear deterrence for the nation, had its origin in Oak Ridge. Because of the efforts of Admiral Rickover and Alvin Weinberg, substantial advancement of the understanding of how to effectively use nuclear power resulted in advances in the utilization of the amazing new potential of the Nuclear Age.

Both of them easily qualify as being among the "Giants of Oak Ridge." Other individuals who will be recognized in the future as "Giants of Oak Ridge" will be identified, and 3D-printed statues of them will be placed in locations yet to be determined. One example of a probable location might be the history walk being considered as part of the AK Bissell Park redevelopment planning.

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Photo of a model of the USS Houston, including statues of Admiral Hyman Rickover and Alvin Weinberg (Courtesy of Gordon Fee)



Admiral Rickover in the Nautilus, the world's first nuclear-powered submarine (Courtesy of Naval Research Laboratory/public domain)

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Alvin Weinberg (Courtesy of Weinberg Papers project)