Elements of Submarine Operation

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DETECTION

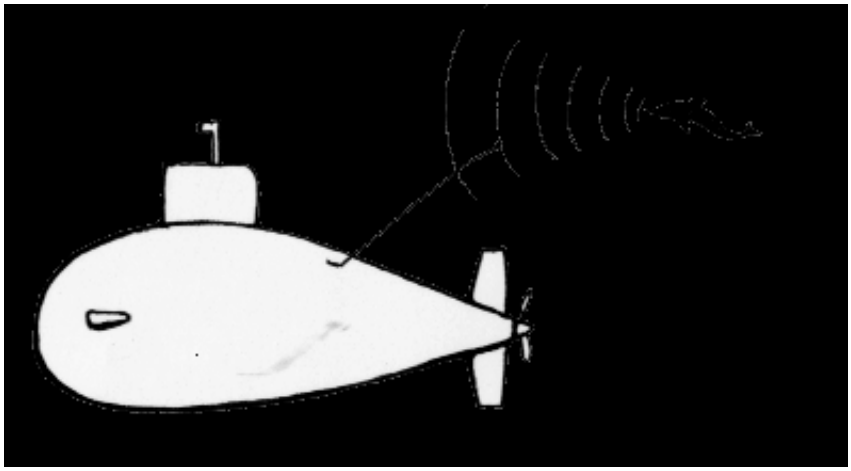
A submarine's effectiveness depends on its ability to remain submerged and undetected. From this position beneath the surface, a sub can search, track, and attack using the element of surprise. The element of surprise has always been the submarine's greatest asset and is still considered its most powerful weapon. When surfaced, however, submarines are quite vulnerable, since modern subs operate more slowly and have less armament than surface ships. By surfacing, submarines surrender their invisibility.

The earliest submersible vessels operated blindly under the sea. Until the twentieth century the only way for a sub to see was by surfacing, thus revealing herself to surrounding vessels. Since 1903, naval submarines have used periscopes at shallow depths (about 60 feet) to get a view of the surrounding sea.

The development of RADAR (Radio, Detection And Ranging) during World War II allowed surface ships to talk with submarines and warn them of impending danger. Radio communication was established with a retractable antenna from the sub that rose above the surface. In order for this to work, the submarine had to come close to the surface. Another danger was that the radio transmissions could be detected and tracked, threatening to reveal the sub's location. It wasn't until the introduction of SONAR (Sound Navigation And Ranging) that submarines were able to capitalize on their stealth.

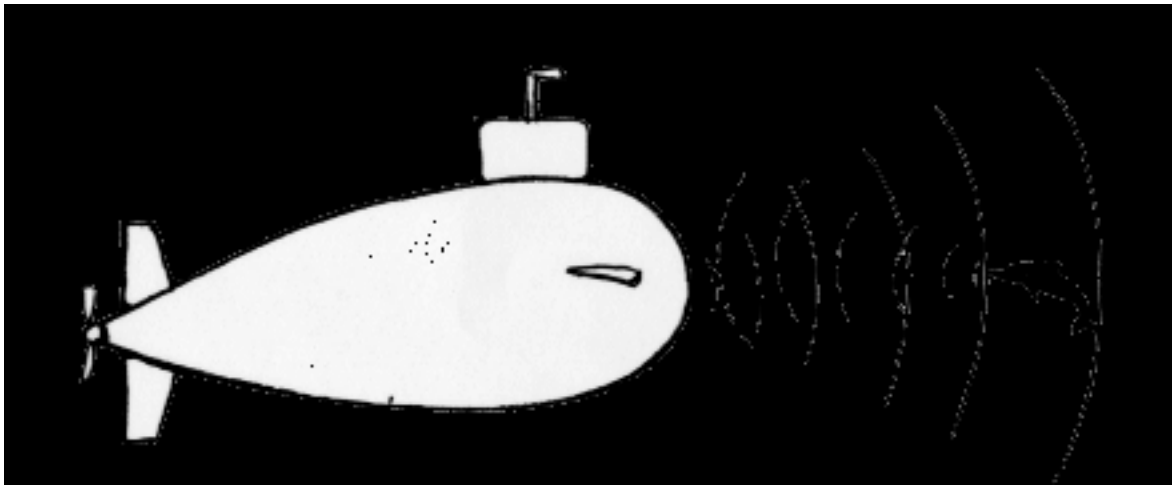
STEALTH

In order to go undetected, submarines needed something that concealed them from other boats or ships. SONAR offered submarines stealth. SONAR is a system that uses sound waves traveling through water to search for objects or geographic obstacles. There are two types of SONAR, passive and active.



PASSIVE SONAR picks up sounds using electronic listening equipment.

A target can be detected by the noise it makes from its machinery, the propeller, or the sound of the water passing around the vessel as it travels.

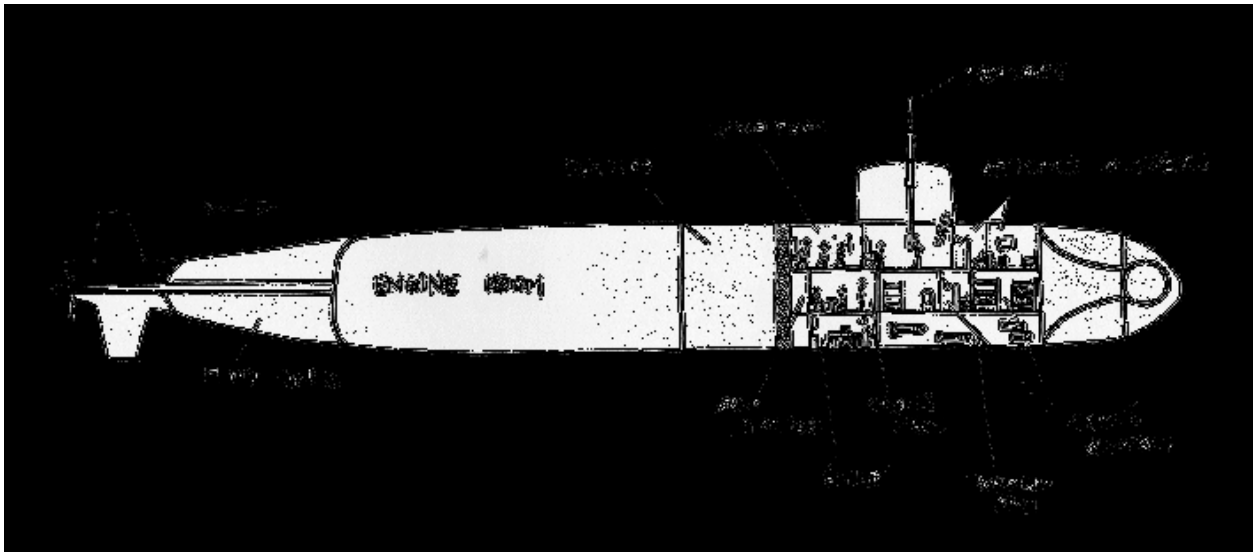


ACTIVE SONAR produces and emits a burst of sound or a 'ping'.

gasoline vapors and carbon dioxide, contaminated the limited amount of breathable air in the submarine.

Since World War II, the Navy significantly improved the environment onboard their submarines. Improvements in the air quality of subs was perhaps the most important change. The Navy learned from the mining industry how to filter out deadly carbon dioxide while the boat was submerged. Carbon Dioxide accumulated at a rate of one cubic foot per crew member per hour. With better ventilation systems, the air quality greatly improved.

Maintaining a constant source of drinkable water also was a problem. Modern submarines now carry distillation plants to make fresh water from salty seawater. Living conditions continued to improve when the Navy separated the eating, sleeping, and sanitary accommodations, and added lockers and storage facilities to cope with the lack of space on the submarine. Today, the habitability of a submarine is assured by equipment that makes fresh air and water, filtration systems that eliminate toxic vapors, and new designs that improve space management.



SPEED

While design helps improve the habitability of a submarine, it also improves its speed. Combined with stealth, speed is one of the modern submarine's greatest assets. Early submersibles were meant to cruise on the surface and submerge only for short periods. Because of anti-submarine warfare, modern subs need speed

under water to escape attack. Although the actual top speed of American naval vessels is a secret, modern submarines travel faster than 30 knots underwater.

Submarines are carefully designed to enhance their speed. They have become more fish-like in shape, or hydrodynamic. As the speed increases, the fins of these metal "fish" automatically adjust their position to help the sub control its depth so the boat may slice silently through the sea.

CONCLUSION

By the mid-20th century, nuclear power became a truly efficient propulsion system for submarines. After years of experimenting, it became clear that nuclear power held the answer to propulsion, habitability, and strategic problems that plagued earlier boats. By removing the necessity to surface for air replenishment and battery recharge, nuclear energy made submarine operations faster, healthier, and quieter.