Tomorrow's Submarine Fleet: The Non-nuclear Option

The U.S. Navy nuclear fast attack submarine fleet is the most awesome suite of weapons ever built, but gains in r nuclear propulsion technology over the last few decades raise the question of whether we should augment our nu submarine fleet with equally effective and dramatically less expensive non-nuclear submarines.

We currently float 55 fast attack submarines. Thirty are Los Angeles class and 23 are of the Improved Los Angele quieter, with improved weapons, retractable bow planes instead of sail planes, especially suited for under ice ope The remaining two are the new Seawolf class - significantly quieter, faster, with even more weapons.

The Seawolf class originally was planned for 29 subs, but with the end of the Cold War, it was truncated to three, built and one scheduled. This was done to make way for a new, more versatile, less expensive submarine, the Vir Class. The USS Virginia is expected to be launched sometime in 2004, costing about $1.6 billion, followed by the Texas, USS Hawaii, and the USS North Carolina. By comparison, the USS Seawolf cost about $2.1 billion, and th cost of Los Angeles class subs was around $1 billion.

The annual operating cost for any of these subs is approximately $21 million. The typical service life of a nuclear s about 30 years. Refueling and modernizing at the half-life point costs about $200 million. Near the end of the serv another refueling and extensive overhaul for about $410 million will extend the life another 12 years, for a total ser of 42 years. This totals to about $3.6 billion in constant dollars over the lifetime of a Seawolf class sub.

These are impressive numbers, on one hand for how long a nuclear submarine can be an effective weapon platfo on the other for how much it actually costs.

Nuclear submarines are designed to operate in "blue water," out in the open ocean. They can run fast and deep, u thermal layers and other characteristics of deep water to disguise their movements and mask their noise.

In shallow water, a nuclear submarine often is longer than the water is deep, severely restricting its maneuverabili large whale in the surf, it can fall victim to a swarm of smaller, more maneuverable subs, unable to detect and out them, unable to deploy its weapons effectively.

While the new Virginia class is designed to operate closer to shore, especially for delivery of Special Forces and o tactical in-shore options, these operations are short lived, and the sub quickly returns to deeper, safer water.

A nuclear sub uses a compact nuclear reactor to generate steam to drive a turbine to turn the propeller. Except fo adaptations, this differs little from old coal driven turbines. They are much quieter now, but they still make a lot of r Diesel submarines use reciprocating engines on the surface and while snorkeling, and battery driven electric moto submerged. The first is noisy, the latter extremely quiet.

Near the end of World War II, Germany experimented with several methods for driving a submarine independent o air. Several Air Independent Propulsion (AIP) submarine prototypes ended up with the Russians, the British, and i hands. Over the next half-century vast improvements were made with AIP systems. In the 1950s, however, under hand of Adm. Hyman Rickover, the United States turned towards nuclear power for submarine propulsion, and ne turned back.

Elsewhere, AIP progress continued on four different fronts. German Thyssen Nordseewerke (TNSW) developed a cycle diesel using liquid oxygen, diesel oil, and argon. The same diesel is used as a conventional air-breathing en surface propulsion. These systems are suitable for both retrofitting and new construction.

Howaltswerke-Deutsche Werft (HDW) in Germany has developed a hybrid fuel cell system for a diesel-electric sul
speed operations run off the conventional battery, while the fuel cell recharges the battery, and provides energy fc
speed operations. Typical submarine cost using either HDW or TNSW AIP systems is $250 million.

Hybrid diesel-electric units propel Swedish Gotland Class subs, supplemented with Kockum Stirling engines runni
liquid oxygen and diesel oil to turn a generator to produce electricity for propulsion and to charge the vessel's batt
Typical cost for a Gotland class sub is $100 million.

The French "MESMA" (Module d'Energie Sous-Marine Autonome) AIP steam-turbine system burns ethanol and li
oxygen to make steam to drive a turbo-electric generator. The design permits retrofitting into existing submarines
an extra hull section. Typical cost for a new submarine powered by MESMA is $250 million.

Each of these designs has its own advantages and disadvantages, but they all allow for about a month submergec
operating capability for 25 to 40 crew members, extended operating range, and capabilities limited only by hull str
and installed electronics and weapons suits.

In particular, the HDW and MESMA systems are extremely quiet - far quieter than any nuclear/steam plant. Comb
a state-of-the art sensing system and appropriate weapons, such a sub would be a formidable opponent for any n

AIP submarines costing between $100 and $300 million compare favorably to nuclear submarines costing from 5
times as much - $1.6 billion.

We won the Cold War, in large part, because of the important role played by both fast attack and ballistic missile n
submarines. Our large fleet of submarines, however, no longer serves its original intent. As we overhaul these beh
and build newer versions, we are changing them to serve our current needs better - hence the Virginia class with i
mission capability and lower cost.

But $1.6 billion still is a lot of money. Can we do better and still meet our needs in today's world of armed incursioi
surveillance, and special operations?

When operating in littoral waters, ice margins, straits, and other global "choke points," AIP submarines can be par
formidable. New underwater weapons will help equalize any remaining differences between AIP and nuclear subs
U.S. Navy may wish to reassess its plan to build a fleet of 18 new Virginia class subs for a total of about $29 billioi
for about half this cost, it could build a fleet of 30 AIP subs and the four already budgeted Virginia class subs.

More than twice the muscle for half the cost is a no-brainer.