

The Boice Report #31



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Under the Sea With the Nuclear Navy

It's Veterans Day, a day when I enjoy reminiscing about and recognizing the military. My brother served in the Navy during the Persian Gulf War, my father was in the Army during World War II and Korea, and I spent 27 years as a commissioned officer in the U.S. Public Health Service.



John Till, left, and John Boice about to embark on the USS Montpelier

A few months ago, I had a remarkable, once-in-a-lifetime experience made possible by Admiral Rich Meis and Naval Reactors Program personnel—I went “under the sea” in a fast-attack nuclear submarine (the Mighty Monty, SSN 765). I rode on the bridge (top of the submarine, also called the sail) in a harness, submerged (and it's true that submariners yell “dive, dive” followed by two loud excruciating blasts on a klaxon horn—“ahooga, ahooga”), shot a water slug (tested a torpedo tube), went through some “angles and dangles” (steep rises and falls like a roller coaster), and almost earned my “dolphin” certification—not really since it takes about 9 months underwater to pass the comprehensive operational examinations (not 9 hours), but I did become an honorary submariner (with certificate). I was incredibly impressed with the young submariners who were bright, committed, and enthusiastic about where they were and their service to the nation . . . we should all be so passionate about our lives! They were gracious and patient in explaining the intricacies of submarine service to me—and this was a true “proud to be an American moment” for me.

When my wife Jennifer is asked whether it was okay to ask me about the submarine voyage, she responds, “Only if you have at least an hour”! I usually start by explaining that the USS Montpelier is a Los Angeles-class submarine (as in *The Hunt for Red October*). So here's an eclectic review of my underwater experience with the U.S. Nuclear Navy.

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Nuclear Navy. The Navy has 97 operational reactors, including 73 submarines and 10 aircraft carriers. The responsible organization, Naval Reactors Program, has managed 536 nuclear reactor cores since the USS Nautilus (SSN 571) in 1955, over 60 years ago. It is remarkable that the Nuclear Navy has steamed over 249 million km on nuclear power without a single reactor accident ([Blake 2014](#)). A strong Navy is crucial to the security of our nation, and I recommend highly the informative and easy-to-read 2013 overview of our [Naval Nuclear Propulsion Program](#) (NNPP). The U.S. military should also be recognized for its worldwide efforts to promote human welfare. For example, during the Fukushima accident in 2011, the Navy sent 24 ships, including the USS Ronald Reagan (CVN 76), and U.S. military forces rapidly deployed over 24,000 service members to provide disaster relief to the Japanese communities destroyed by the earthquake and tsunami as part of [Operation Tomadachi](#).

How do you sleep on a sub? With great difficulty! There are 120 or so crewmembers and 90 bunks. The bunks are “triple bunk beds” starting at ground level. You have duty each day and “hot bunk” to sleep, i.e., when you are on duty someone will be sleeping in your shared bunk. This is not the Ritz! I tested a center bunk, smashed my head, could barely stretch, and had difficulty turning over (but hey, I'm a senior, I'm no longer lean, so I understood this difficulty).



Control Room on the SSN Montpelier, left to right, John Till (rear admiral, ret), CDR Steve Mongold (commanding officer), and John Boice (NCRP)

How do you breathe? You would eventually run out of oxygen so you make your own—by hydrolysis. But what about the hydrogen? (I've watched the Hindenburg dirigible disaster . . . not a pretty sight.) You burn it in a kiln or oven.

How do you know how deep you are? Pressure on the hull can be measured and the increase in pressure is directly related to depth! Cool stuff! The crew members are in tight quarters, continually bumping into each other and continually studying the plethora of submarine manuals to qualify for their underwater certification, the dolphin. There's one clothes washer, smaller than my home machine, which the sailors sign up to use during a voyage.

Exposures in the Nuclear Navy. About 204,000 shipyard personnel associated with the NNPP and 129,000 naval officers and enlisted personnel trained to operate a nuclear propulsion plant have been monitored for radiation exposure ([Report NT-14-2](#)). Since 1954, the average exposure per year for each person monitored has been 1.87 mSv in shipyards and 0.67 mSv in ships.

Low background radiation under the sea. Submariners might go out to sea for say 3 months, return, and then go out again, repeating this cycle for many years during their careers. While underwater, their exposure to natural background is minimal—attenuated cosmic rays, little to no radon decay products in the air, and no terrestrial exposures to radionuclides in granite!

Studies of nuclear submariners. Several studies of sailors, submariners, and shipyard workers have been [conducted](#), and to date, the low doses experienced do not provide unequivocal evidence for a measureable radiation health effect. I find the study of over 85,000 nuclear submariners of particular interest. The average lifetime badge reading was only about 5.2 mSv, with 1.4% over 50 mSv. The dosimetry was exceptional, as was the follow-up, using the resources of the U.S. Department of Veterans Affairs ([Charpentier 1993](#)). A subsequent follow-up through 1995 has been presented but not published (Friedman-Jimenez et al. Abstracts of the 36th Annual Meeting of the Society for Epidemiologic Research. *Am J Epidemiol* 157[11 Suppl]:S039, 2003). The study of nuclear submariners would make an excellent addition to the [Million Worker Study](#) in combination with groups with similar types of external gamma-ray exposure, i.e., 150,000 nuclear utility workers (many of whom started their careers with the Nuclear Navy), 130,000 industrial radiographers, and a subset of the [70,000 atomic sailors](#) who participated in nuclear weapons tests at the Bikini Atoll.

Spies and submarines. An entertaining history of our spy submarines is found in [Blind Man's Bluff](#), a *New York Times* best seller. Although not necessarily completely verifiable, it reads like a Tom Clancy spy novel and certainly gives a flavor of the challenges faced by elite attack submariners. Many covert missions during the Cold War were conducted, and I was surprised to learn about John Walker, an American spy who recruited his family and sold critical secrets to the Soviets for many decades. When I returned from the USS Montpelier trip, I read that Walker, the ringleader of his family spy ring, had just died and his [obituary](#) appeared in local and national newspapers—he had been convicted in my hometown, Rockville, Maryland, in 1985 and was serving a life sentence in North Carolina at the time of his death.

An international aside. The HMS Ambush, a nuclear sub from the United Kingdom, was in port. The recent voting in Scotland for independence was being watched with great interest. Why? The only nuclear submarine base in the United Kingdom is in Scotland, which pledged to be nuclear free if independent.

In conclusion, please know that your National Council on Radiation Protection and Measurements can be relied upon to go to any depth in our service to the nation's needs in radiation protection.