TRAPPED on the Ocean Floor

A CO gives the order to dive, and a submarine slips beneath the waves. At 40 feet, this routine event is interrupted by a frantic cry over the intercom. "Flooding in the engineroom! Flooding..." The voice ends with a reluctant click as the system goes dead.

The diving officer immediately orders, "Blow all main ballast, shut all watertight doors." The descent stops momentarily but soon resumes at an agonizingly slow pace. At 242 feet, the submarine hits bottom with a shudder.

Investigation by the ship's officers and men reveals the main induction valve apparently was open during the dive. The flooding is so bad that no effort by the crew alone can take the submarine to the surface. Their only hope is to release a messenger buoy, settle back, and wait for someone to rescue them.

Ashore, an alarm sounds when the submarine's surfacing signal is overdue. A sister ship gets underway to search the diving area. As the sister ship sweeps through the last known position of the missing subma-

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rine, a lookout spots the messenger buoy. Communications are established with sound-powered phones, and before long, rescue efforts are in progress.

Twenty-eight hours later, survivors in the sunken submarine's forward torpedo room are rescued. In another 12 hours, the last of 29 survivors reach safety. Twenty-nine other crewmen are trapped in after compartments, which flooded first, and there is no hope for survival.

Perhaps you're saying this account of the May 23, 1939 tragedy aboard USS *Squalus* (SS 192) can't be repeated today. What if you're mistaken, though? Would you know what to do if your submarine became disabled somewhere on the ocean floor, and you were the senior surviving crew member? Thanks to scientists at the Naval Submarine Medical Research Laboratory (NSMRL), you will have some help making decisions if that crisis ever arises.

The staff at NSMRL calls it the submarine escape and rescue expert, or SEAREX. It runs on an extra rugged, waterproof, notebook computer. The software is an interactive task-management program that will help you manage the complex and unfamiliar environment of a disabled submarine.

The software presents a list of tasks, displayed as icons arranged in order of urgency and importance, using a traffic-light, color-coding system. Overdue tasks are colored red, current tasks are yellow, and pending tasks are green. The software asks you for data. Then, based on your inputs, the program recommends when to start an escape to ensure all survivors don't exceed safe limits of exposure to atmospheric contaminants. You can take tasks out of sequence or postpone them if things get too busy.

Other software routines include managing toxic gases, preparing the escape trunk, and rationing food and water. The program also gives you the data to help you weigh the risk of decompression sickness (DCS). It balances your risk of DCS while trying to escape from a submarine in shallow water against the risks of heat or cold exposure and toxic gas build-up by staying in the submarine and waiting to be rescued. The program autosaves every five minutes so you can rapidly restore your data should the computer crash.

Members of the submarine community have tested the program, and their recommendations are incorporated in the software design.

"Since modern submarines are built and operated to such high standards of safety, the probability of one sinking is extremely low," explains Douglas Wray, a senior biomedical engineer at NSMRL and head of the SEAREX effort. "Our first hope is that this work will never have to be put to use. But in the unlikely event of an actual disabled submarine, this research could mean the difference between the life or death of the crew."

NSMRL has been a major contributor to integrating leading-edge technologies into the operations of submarine crews. The SEAREX format may apply to other complex management programs, such as damage control. It also has potential as a teaching platform. For more information on research efforts at NSMRL, visit their web site at http://www.nhrc.navy.mil/nsmrl/.

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[SEAREX is not operational yet in the submarine fleet. The goal of people at NavSea is to deploy it in FY01 aboard SSN 688-class submarines. Other submarine classes are scheduled to follow at one-to-two-year intervals.—Ed.]