ESCAPE FROM THE DEEP

Lt. Phillip Kern, USN
HMI(DV) Daniel E Mane, USN
US Naval Submarine School

(Reprinted by kind permission of the Editor, FACEPLATE)

The USS NUCLEARFISH has just surfaced off the coast of New England and begun her transit of Long Island Sound, making her way toward the submarine base at Groton, Connecticut. Her patrol at an end, she now faces what has historically become the most frequent setting for a submarine accident. In the busy shipping lane, the NUCLEARFISH is accidentally rammed by a merchant ship headed for the open sea. She sinks and comes to rest in 120 feet of water.

The Submarine Rescue Ship HAWK is dispatched to assist the downed submarine. Underwater communications between the submarine and the rescue ship indicate that blowing ballast will not raise the NUCLEARFISH and that her severe starboard list will not allow the McCann Rescue chamber or the Deep Submergence Rescue Vessel to mate with her escape hatch. Deep-sea divers from the HAWK enter the water to investigate and have confirmed the report.

Although the preceding is a hypothetical situation, history has proven that it has happened, and that it may happen again. Large ships often fail to identify the small silhouette of a submarine and, thinking it is a highly manoeuvrable small craft, fail to avoid it.

The staff at the Escape Training Tank at the US Naval Submarine School in Groton, Connecticut, knows that crews will be able to safely exit from stricken submarines like the nuclearfish and be returned to port - they have trained every US Navy submarine crew in the individual Free-Breathing Buoyant Escape Method of Submarine Escape.

Escape methods have been taught at the tank since 1930. A need existed then, as it does now, for training submarine crews in methods of escape in the event that all other methods of rescue fail or are deemed impossible.

When Submarine School students arrive at the escape tank, they change into swimming trunks and go directly to a classroom where they are given instruction in the use of the Steinke Hood. This device protects the escapees head and face from the water, allowing him to breathe easier, alleviate his apprehension, and reduce the incidence of air embolism.

Upon completion of the classroom phase, the students enter the tank and demonstrate that they can safely and expeditiously make an escape from 50 feet through a lock or hatch similar to those on submarines.

The Steinke Hood provides a rate of ascent of 425 feet per minute. Because air embolism is a very real factor at this rate, the student is observed closely throughout his training in the water. The student is also instructed in the proper operation of the escape hatch, or lock. Nitrogen narcosis and air embolism are cumulative effects of exposure to pressure, and too much time spent in preparing the escape hatch can be as damaging to the escapee as improper use of the hood.

Once the student leaves the 50-foot lock (or any of the shallower locks) during his course of training, he is always within reach of an instructor ready to stop his ascent and pull him into a safety lock should he fail to exhale properly or experience trouble. If the student should be afflicted with air embolism, a diving corpsman on continuous duty during tank operation stands ready to initiate medical treatment with a recompression chamber located at the top of the tank.

The individual method of submarine escape has been used in the past and is credited with saving hundreds of lives. The other methods in use are: The McCann Rescue Chamber, a cable-controlled escape lock carried by rescue vessels; and the Deep Submergence Rescue Vessel (DSRV), a mobile escape lock carried by the most modern rescue vessels.

Improvement in escape methods were prompted by the sinking of submarines F-4 in 1915, the S-51 in 1925, and the S-4 in 1927. These disasters led to the development of the McCann Rescue Chamber mentioned above, and the Momsen Lung, which was successfully used in 200 feet of water off Key West, Florida, in 1929. This device was a vast improvement over the Siebe-Gorman apparatus developed in 1914. But, the Momsen Lung had an ascent rate of only 25 feet per minute and provided no protection for the escapee’s head, thus making all but experienced swimmers apprehensive and the potential for air embolism great.

In 1956, the “blow-and-go” method of escape was devised. The escapee was still completely exposed to the water and exhaled continuously during the ascent. The method was tested in the open sea in 302 feet of water from the submarine ARCHERFISH off Key West in 1958. It increased the rate of ascent in excess of 400 feet per minute through the water using a life jacket with 46 pounds, of positive buoyancy and relief valves for air expansion. It was a major step forward.

In 1960, Lieutenant Steinke, Officer-in-Charge of the Escape Training Tank, developed a device which protected the head and face from the water. The Steinke Hood was successfully tested in the open sea in 1961 in 309 feet of water from the USS BALLAO, again off Key West. The hood remains the primary method of individual submarine escape and has sufficient buoyancy to carry several people safely to the surface. The “blow-and-go” method is an acceptable back-up technique should something happen to the hood itself.

The escape training tank’s primary mission is to teach escape procedures. However, over the years its mission has been expanded to include scuba instruction for the Submarine Force. On a space-available basis, Marine Corps, Coast Guard and Army personnel are also given scuba training, along with selected law enforcement personnel.

The tank and staff have the capability of training 8,500 individuals in submarine escape each year. The instruction staff is made up of two diving officers, one master diver, three medical deep-sea diving technicians, and 23 qualified divers. Each must undergo an arduous qualification period after reporting for duty. It takes an average of six months for a diver to become qualified as an instructor in everything from systems and classroom instruction, to actual water station practice. The diving at the escape tank is unique in that the majority of dives made are breath-hold dives at depths of 25 to 50 feet.

The escape tank maintains two recompression chambers: a double-lock aluminium and triple-lock steel chamber. Their primary function is to perform standard pressure testing for Submarine School students, conduct oxygen tolerance tests for diving candidates and hyperbaric treatment for local diving operations and escape training. The chambers also constitute the primary treatment facility for diving casualties in the New England area. The escape training tank is supported actively by doctors from the Naval Submarine Medical Research Laboratory and maintains liaison with the National Guard, Army, Air-Sea Rescue and State law enforcement agencies in the event that evacuation or treatment of diving casualties is required. This arrangement provides patients with a specialized staff of diving medical officers, along with the complete support of the Naval Submarine Medical Center and its hyperbaric facilities.

The history of the escape tank has not been all smooth sailing. In 1969, the elevator shaft experienced a fire that required the combined efforts of the submarine base and municipal fire departments to extinguish. In 1977, the tank was given its first major overhaul, a task requiring 13 months to complete. During this period, the 135 foot tower, empty and acting like a gigantic sail, was threatened by adverse weather and extremely high gusts of wind. However, all turned out well, and as a final step of the overhaul, insulation and siding were added to the side of the tank to promote.

The escape training tank officially started training students again in July 1978, but only after a thorough instructor training period. Just six hours after receipt of formal systems certification, the staff commenced hyperbaric treatment on a civilian diving casualty. The tank has been in full operation ever since.

* * * * * * * * * *

OPERATION PANTYHOSE continued from page 41

For the actual experiment, we locked four volunteers (one female) in the inner lock of the Draeger chamber, with 3000-litre volume, supplied them with an O_2 monitor and a batch of Draeger CO_2 sniffer tubes, and left it up to the pantyhose array to do its bit. To provide for metabolic O_2 requirements, I maintained a constant flow of 2.5 litres per minute of oxygen, which perfectly kept their atmosphere at 21 percent throughout the procedure. Both CO_2 and O_2 levels were determined inside the chamber at 15 minute intervals, and recorded outside, while I maintained more or less constant visual and voice contact with our subjects.

As you might guess, Morgan Wells and I were a bit edgy at first, since the CO_2 levels in this situation could be expected to rise at a rate of 0.82% every fifteen minutes, which gives little leeway. Still, we had plenty of safeguards, so we started the show on time.

Both Morgan and I were a little stunned when the first 15 minutes reading came out at a fat 1.5 percent, and rose quickly thereafter to 2.25 percent. Still, we had some faith in the system, and stuck to our guns. Sure enough, as chamber humidity commenced to rise, the galloping slope simmered down, and after almost three hours stayed steady between 2.75 and 3.0 percent. By this time, we had already designed the Mark II pantyhose scrubber, capable of 75% efficiency, so we called the game and released our volunteers, none the worse for the experience. Tomorrow the MK II will be made up, sealed in plastic bags, and duly installed in the PTC.

Improvised, and at-the-scene experimental work is fascinating. I find it instills a sense of confidence in the aquanauts as well.