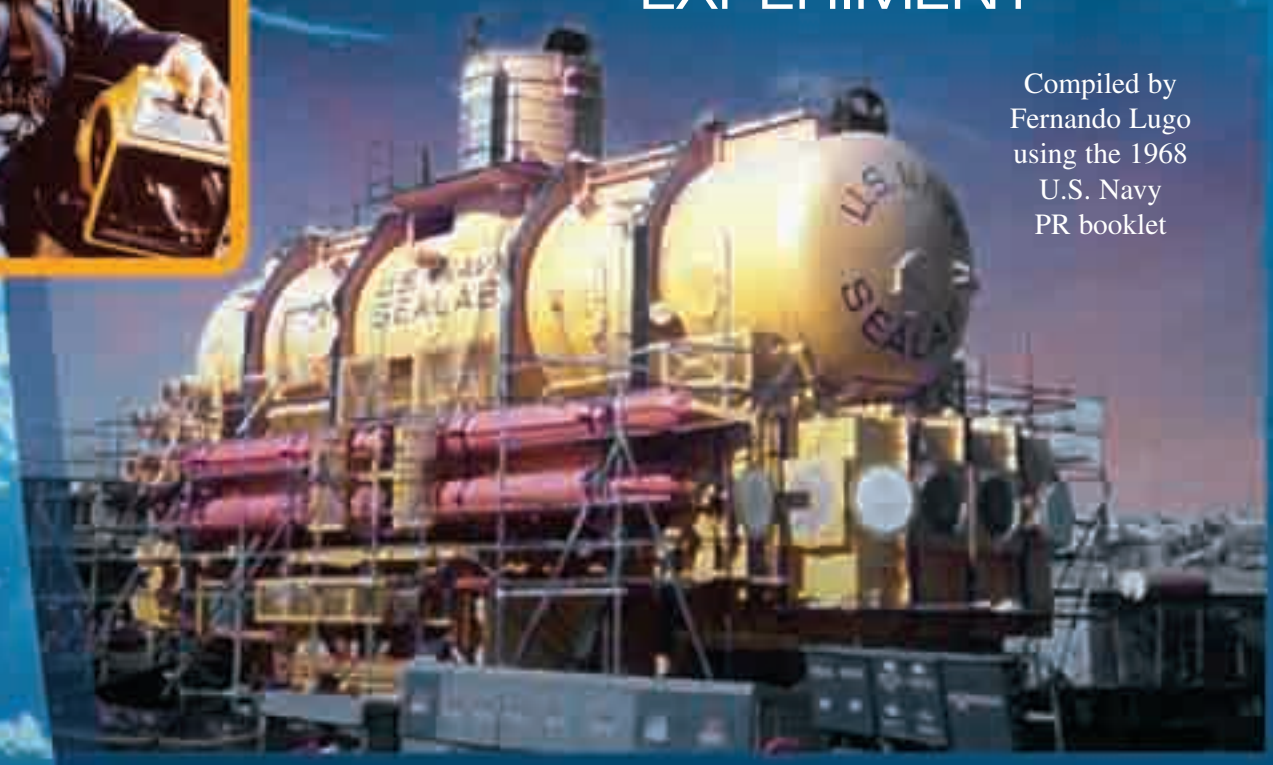
SEALAB III
EXPERIMENT

Compiled by
Fernando Lugo
using the 1968
U.S. Navy
PR booklet



Extracted from a historical technical document

The Sealab III experiment is bing conducted to evaluate techniques and equipment being developed to further Navy operational capabilities in the deep ocean environment.

Sealab III is the latest in a series of open-sea experiments conducted by the U.S. Navy employing the technique of "saturation diving" which is being used in DSSP programs.

Design and Construction

The habitat was constructed at the San Francisco Bay Naval Shipyard in 1965 specifically for use in the Sealab II experiment. The design of the habitat was dictated primarily by experience in the Sealab I experiment (in which two floats had been welded together to form the basic habitat). The design for the new Sealab habitat was constrained by the limited time available before Sealab II was scheduled to take place and a restricted budget.

In general, standard shipyard procedures were used in all phases of construction and testing. Fabrication of the large, 24-inch view ports was extremely difficult because the tolerances were very close and hard to maintain in the face of normal welding distortions.

One of the most difficult problems was fabrication of the dished heads used to cap the main cylinder of the habitat structure. Once the design specifications

were established, contact bids were let to the normal commercial suppliers of large dished cylinder heads. The Sealab II production schedule demanded delivery in 30 to 45 days. None of the major steel companies could even approach the deadline. The large size of the heads (12 feet in diameter) coupled with a rash of back orders due to an impending steel strike, made normal procurement impossible. The earliest delivery that could be expected was five to six months after the scheduled start of Sealab II.

Fortunately, the shipyard had the Navy's West Coast Shock Testing Facility and thus had a goodly amount of experience in the controlled underwater explosions. The use of energy released in an underwater explosion to form metal was a novel idea, until 1965 used only to form relatively small and simple pieces. In this process the energy of the explosion is transmitted as a pressure pulse through the water, forming the steel against a die. The forming process lasts only a few milliseconds. The use of this process to form large and complex sections like the dished heads of the Sealab II habitat had not previously been attempted.

The entire forming assembly, weighing 60 tons, was lowered 30 feet beneath the surface of San Francisco Bay using the shipyard's large gunning crane. The explosives were detonated and, in approximately .004 seconds, the first dished head for Sealab II was formed.

The results were phenomenally good with only minor straightening being required. The second head was similarly formed. The heads checked with 1/16 inch of planned diameter and within 1/4 inch of planned contour, well within acceptable parameters.

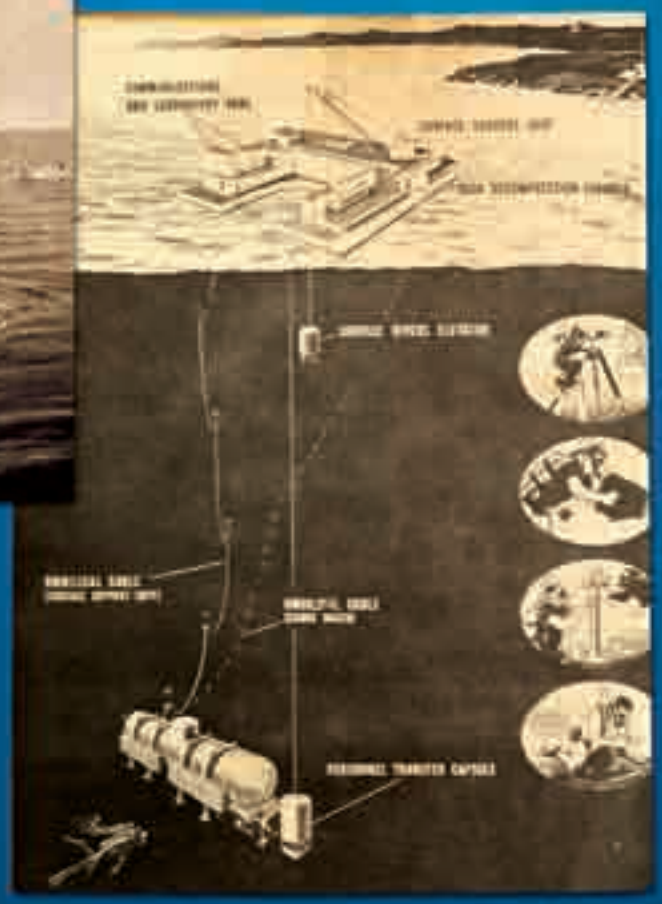
During Sealab III, five teams of eight men each, including civilian scientists and foreign Navy personnel, as well as U.S. Navy divers, will occupy a seafloor habitat for consecutive 12-day periods. While on the bottom, these "Aquanauts" will carry out experimental construction and salvage work, engage in oceanographic and marine biological research, and undergo a series of physiological and human performance tests.

By employing the technique of "saturation diving" the Aquanauts will be able to work on the ocean floor for an unlimited period, passing freely between their underwater house or "habitat" and the outside water without intermediate decompression. Rather, at the completion of the team's 12-day stay at a depth of 600 feet the aquanauts will undergo a single decompression period of approximately six days in the safety and relative comfort of the surface support ship. (The decompression in saturation diving is based on depth

Top Left: Machinist's Mate Chief Senior Master Diver, Fernando Lugo (1980 photograph), USN enlisted in the Navy in 1960. During his Aquanaut training Lugo participated in the record-setting 1,025-foot dive conducted at the Navy Experimental Diving Unit.

Above Left: Sealab III undergoing the final stages of construction.

Above: This image shows Sealab II, cabled and ready to enter the water. Although Sealab III is very different than the previous habitat, it is simular in size and structure to it's predecessor.



Above: In Direct support of Sealab III the prototype Mk2 Deep Diving System provides a means of lowering the Aquanauts to the bottom, bringing them to the surface and providing them with proper decompression after they return to the surface.

Right: A schematic showing the basic configuration of the project

Opposite: A Docked Sealab II

rather than time, thus the six-day decompression would be required whether they spend 12 days or 120 days on the ocean floor; without decompression they would fall victim to the disease known as "bends" which could be fatal.)

Prior to the beginning of the ocean-floor program the habitat will be towed to San Clemente Island and lowered to a depth of about 600 feet, just off an area known as Wilson Cove. The 57 foot-long habitat is designed somewhat along submarine principles: it uses water ballast tanks to attain positive or negative buoyancy while maintaining positive stability. During lowering operations the habitat will have approximately 9,000 pounds negative buoyancy.

As the habitat is lowered into the depths, a gas compensating system, which uses compressed helium provided from the surface support ship, automatically increases habitat pressure to a value slightly greater than ambient sea pressure. This gas if provided through an umbilical cable containing separate lines for breathing gas, power lines, communication lines, compressed air, and fresh water. This umbilical cable will be attached to the seafloor habitat for the duration of the experiment. However, the primary source of power and fresh water for the habitat will be through lines to shore facilities on San Clemente Island.

The habitat will also be connected to the surface support ship by an automatic dumbwaiter system. This system will enable transfer of food specimens, and equipment between the support ship and habitat. The system is fully automatic so that no surface support divers or Aquanauts need enter the water to handle the pressurized container.

The Aquanauts themselves will be raised and lowered in two Personnel Transfer Capsules (PTC). These can each transport four Aquanauts from the surface support ship to the vicinity of the habitat, with the Aquanauts actually swimming into the habitat. These Transfer capsules connect directly to the two Deck Decompression Chambers (DDC) in the surface support ship so the Aquanauts can remain under pressure until they begin decompression in the DDC's.

During the 60-day experiment the Aquanauts will conduct a comprehensive bottom program. Most of the activities will be conducted in the immediate vicinity of the habitat, but there will be some relatively long range forays and excursion dives to greater depths. These dives can be accomplished without intermediate decompression when the Aquanauts return to the habitat. (The Aquanauts are more restricted in the distance they can travel toward the surface; of course, sudden return to the surface without decompression means instant death.)

The Sealab III habitat was specifically designed and outfitted for use as a sea-floor laboratory (SEALAB) un the U.S. Navy's Man-in-the-sea Program.

The habitat is essentially the same used in the previous Sealab II experiment which has been extensively modified

to reflect the experience gained in earlier ocean-floor work. The main cylindrical structure is 57 1/2 feet long and 12 feet in diameter. Two rooms, each 12 feet square by 7 1/2 feet high, have been installed under the main structure.

Aquanauts enter the habitat through a hatch in the diving station, the small room attached to one end of the main habitat structure. The diving station provided space for the Aquanauts to don and doff their diving gear, to check and adjust their equipment, to change SCUBA tanks (from gas banks attached to the habitat), to control breathing gas being supplied by hose to divers in the water, and to clean and stow swimming gear. A shower stall is also provided. There is a 12-inch view port in each side of the diving station. Directly above the diving station, in the stern of the main structure, is a utility space. This utility space has another shower stall, a combination cloths washer-dryer, hot water heater, and space for additional gear stowage.

There are 11, 24-inch plexiglass viewports in the main cylinder providing observation of almost all of the surrounding water. (The number and size of the viewports was decided after a near-fatal accident in Sealab I; an unconscious Aquanaut outside the habitat was rescued only when his bottles bumped the side of the structure...he was not visible from inside the habitat.)

Atmosphere

The atmosphere of the habitat at a depth of 600 feet will consist of 92.4% helium, 6% nitrogen, and 1.6% oxygen. Relative humidity will be maintained at about 70% with a temperature of 90 degrees F. The gas composition of the atmosphere will be established before and during the lowering operation;thereafter, while the Aquanauts are on the ocean floor, the atmosphere will be maintained by gas storage bottles attached to the habitat. The habitat ventilation system was modeled after the standard submarine system with lithium hydroxide (LiOH) CO2 scrubbers and charcoal filtration.

Lowering and Ballasting Systems

The habitat complex is normally positively buoyant to facilitate handling and towing. A variable ballast system is provided for lowering and anchoring the habitat on the ocean floor.

The variable ballast system consists of three water ballast tanks plus about 2,000 pounds of portable lead pigs located inside the habitat and in trays outside of the habitat and on the “clump” suspended under the habitat. Ballast tank No. 1 is located in the small conning tower of the habitat, No. 2 in the overhead of the

habitat, and No. 3 in the "clump" under the habitat. The habitat is made some 9,000 pounds heavy for lowering by flooding the No. 1 and No. 2 ballast tanks. The habitat is then lowered to the ocean floor by crane. Once the "clump" rests on the bottom the No. 3 ballast tank is flooded, providing a suitable anchor on the ocean floor. The habitat is attached to the "clump" and the Aquanauts shifting the portable lead ballast in the habitat.

Finally, located beneath the diving station and observation room are two air-tight skirts, 18 inches in depth. The skirts provide a variable volume below each hatch to accommodate fluctuations in the water level due to tidal variations and changes in the internal pressure of the habitat.

Top: "It's up to you now" — Captain Mazzone gives the Sealab III, 1000 ft. team a final briefing.

Above: Fernando Lugo receives the United States Navy Commendation Medal for his 1025 ft dive. Lugo's outstanding performance and extraordinary dedication to duty also earned him the Legion Of Merit award .

Diver Support

While the habitat is on the seafloor the Aquanauts will regularly exit into the surrounding water to perform work tasks and conduct experiments. They will use the Mk VIII semi-closed SCUBA rig when in the water, with their breathing gas supplied from umbilical hoses from the habitat or back tanks. The habitat diving station will have facilities for maintaining and charging the back tanks. Moored outside the diving station six umbilical hose storage racks, two holding 600-foot hoses for excursion dives and four 200-foot hoses for normal, at-depth operations.

Ocean Floor Programs

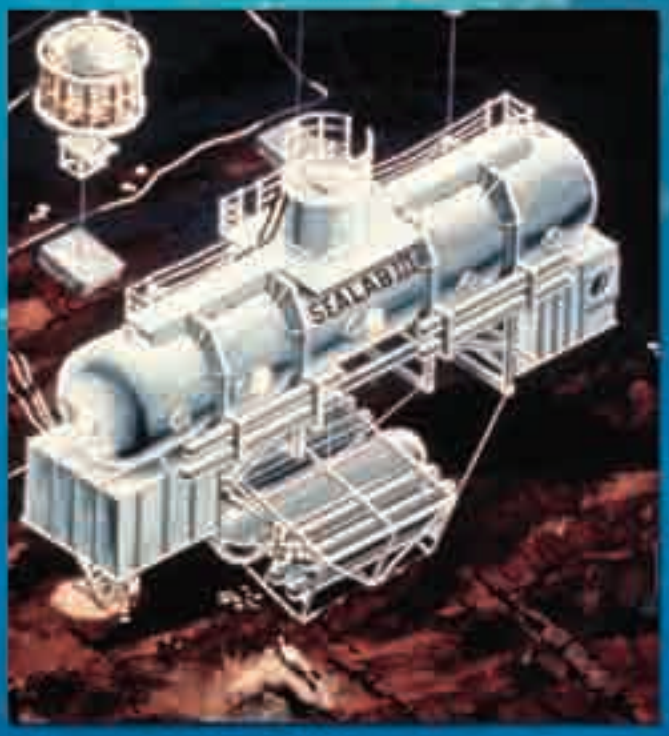
A series of comprehensive ocean floor programs are being undertaken in Sealab III to further the U.S. Navy's knowledge and capabilities in the areas of Oceanography, equipment engineering, construction, salvage, marine biology/ecology, human performance, and physiology.

Aquanaut food

The Navy is taking advantage of the latest commercial food preparation and packaging techniques for feeding the Aquanauts in the Sealab III experiment.

The meals for Aquanauts consist principally of precooked frozen entrees, canned soups and vegetables, frozen and ready-to-eat deserts, fresh and frozen bread rolls, and a variety of "goodies" for snacks.

Sealab III's menu is designed to provide each Aquanaut with attractive food and a daily diet of 4,500 calories. This is some 750 to 1,000 more than the average Navy man consumes in a day. The extra calories are not expected to add extra pounds to the Aquanauts because of their high body heat loss in the helium-oxygen environment of the habitat and the physical exertions when working in the open sea. The menu for Sealab III provides a six-day cycle of meals, thus the Aquanauts will repeat the menu once during their 12-day stay on the ocean bottom.



A Rendering which depicts Sealab III on the ocean floor.

The habitat is equipped with an infra-red oven which heats food uniformly throughout, a distinct advantage in the atmosphere which conducts heat rapidly. Frozen or refrigerated foods can be cooked quickly and with a high degree of control in the oven. The oven is large enough to provide the capability of simultaneously heating meals for an entire eight-man team of Aquanauts.

In addition to the infra-red oven, the habitat has an electric range for heating food and beverages. Other galley features include a freezer, double sink, ten cu.ft. refrigerator, and storage space for dry foods. (There is a 15-cubic-foot freeze box in the observation room.)

Dehydrated foods are not being used in Sealab III because when the containers of dehydrated foods are opened under the almost 300-pounds-per-square-inch pressure at depth the contents are often reduced to powder.

Machinist's Mate First Class, Fernando Lugo, USN enlisted in the Navy in 1960 and after brief duty in Philadelphia with the mothball fleet he attended machinist's mate school. He then served in guided missile ships before being assigned to the DSSP Technical Office in 1966. During his Aquanaut training Lugo participated in the record-setting 1,025-foot dive conducted at the Navy Experimental Diving Unit. He retired as a Master Diver, after 20 years in the United States Navy. He currently resides in Fresno, California.

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