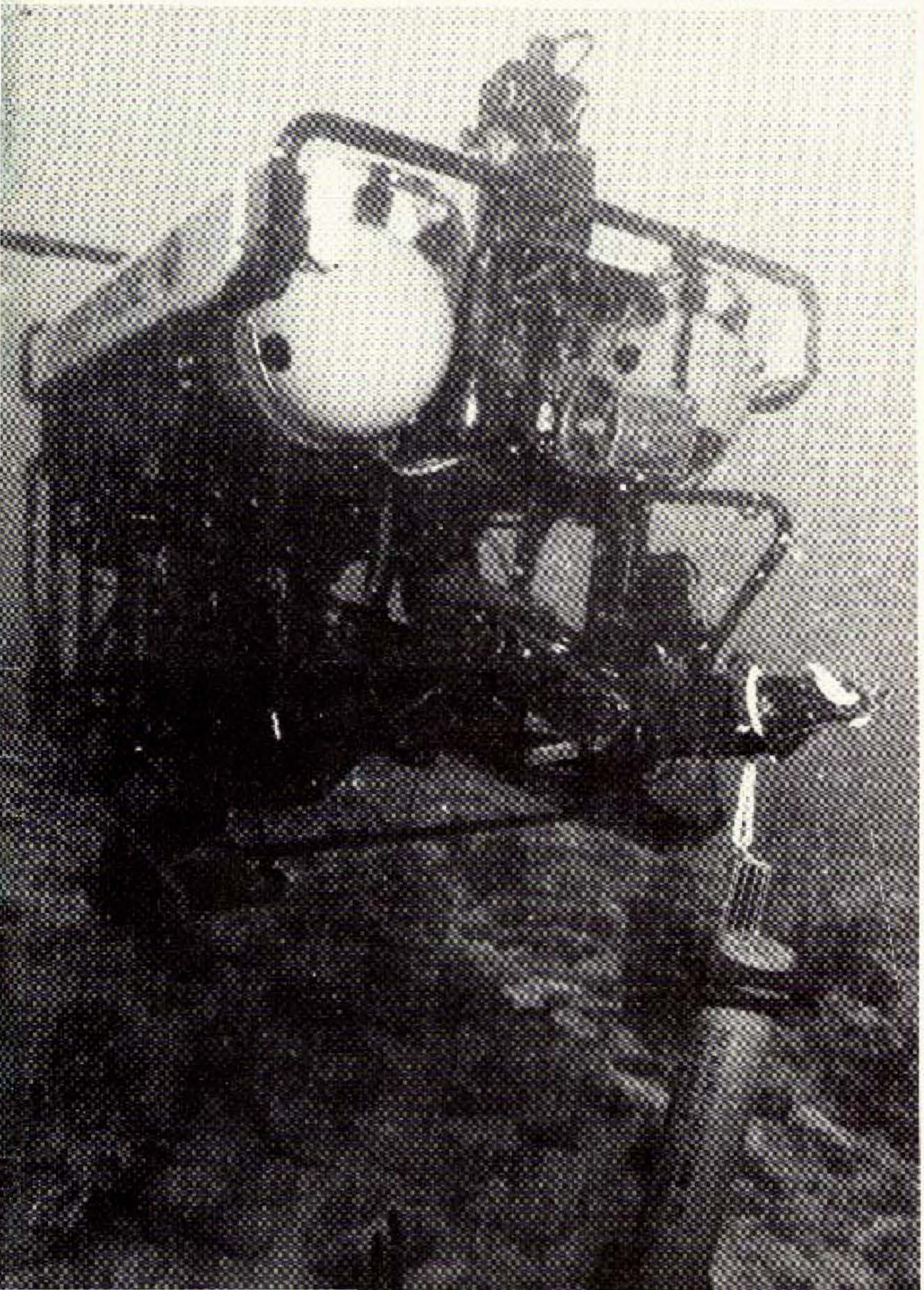
FACEPLATE

The Official Magazine for the Divers and Salvors of the United States Navy



ROV's

Fall/Winter 1985
Volume 16, No. 3

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FACEPLATE is published quarterly by the Supervisor of Diving to bring the latest and most informative news available to the Navy diving and salvage community. Articles are presented as information only, and should not be construed as regulations, orders or directives. Discussions or illustrations of commercial products do not imply endorsement by the Supervisor of Diving or the U.S. Navy.

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SOUNDINGS

Noted Navy Trainer Dies

CAPT Richard S. Jones, attached to the reserve unit of the Naval Sea Systems Command in Washington, D.C., died 30 August after a diving accident in Barbados.

CAPT Jones joined the Navy as a ship diving officer in 1964 after graduation from Gettysburg College. He served with the Navy Harbor Clearance Forces in Vietnam and in the Pacific and assisted in the evaluation of diving bell systems and equipment for aquanauts for the Navy's first operational deep-water salvage and recovery system. CAPT Jones also served as an aquanaut for the "Man in the Sea" program in which he assisted in the training of 60 aquanauts for the Navy's deep submergence program.

During his active duty as a reserve officer, CAPT Jones helped organize the first harbor clearance unit for the Naval Reserve. He later became commanding officer for the unit and most recently represented NAVSEA (OOC) Detachment 1006 in monitoring training evolutions during the salvage and transport of the USS ALBACORE.

CAPT Jones civilian career complemented his accomplishments in the Navy in marine diving and salvage technology. As sales manager for Hydroproducts in San Diego, CA, CAPT Jones was responsible for the marketing of underwater video systems. His promotion to Gulf Coast manager with Hydroproducts led to his relocation to Houston, TX. Subsequently, he became vice-president and general manager of Submar, Inc. and earned his Masters of Business Administration at the University of Houston in 1981. In 1984, CAPT Jones and his wife founded Jomar Associates, a marine consulting and marketing firm specializing in deep sea recovery and salvage equipment.

7th Annual Pacific Fleet Salvage Symposium

The 7th Annual Pacific Fleet Salvage Symposium is scheduled for 21 January through 23 January 1986 at Naval Station Pearl Harbor. This symposium is for members of the diving, salvage and EOD community (1140 community) and will be hosted by Commander, Service Squadron FIVE.

The Pacific Fleet Salvage Symposium is designed to give participants an opportunity to exchange information on diving and salvage. It also provides the diving and salvage community with pertinent and timely information on many issues of concern, such as technical improvements, training and funding.

Notices about the symposium will be sent out soon, as well as requests for topic ideas such as salvage operations.

For more information, contact LT Todd Peltzer who is organizing the symposium at 800-471-9444/9084.

EOD Memorial Ball

The 17th Annual EOD Memorial Ball will be held on September 28, 1985 at the Naval Ordnance Station in Indian Head, Maryland. Open to all members of the EOD community, the annual event includes a Memorial service as well as the ball and serves as both a reunion and fundraiser.

In 1969, the Memorial Fund committee was established by the EOD community to raise funds for an EOD memorial at Indian Head. Fund raising was planned through the Annual Memorial Ball, direct donation and sale of EOD memorabilia. The first Ball was held in September, 1969, and the Memorial was dedicated in July of the following year. Because there was a surplus that exceeded maintenance costs for the Memorial, it was determined that the surplus should start a scholarship fund for the children of those members who gave their lives in support of an EOD mission. In 1973, the criteria was expanded to include dependents of all EOD sponsors.

Since the first EOD Memorial Ball in 1971 and including this year's event, $117,100 has been raised, and 137 scholarships have been awarded. For the 1985 school year, 20 scholarships of $1,300 each were awarded.

Navy Divers at Jamboree

Navy divers participated in a diving demonstration at the Boy Scout Jamboree, held 22–29 July 1985 in the Washington, D.C. area. The divers were from the Underwater Training Division of the Naval School, Explosive Ordnance Disposal at Indian Head, MD. Scouts were allowed to go down in the tank for a few seconds with the divers. Approximately 3,000 people turned out to watch the demonstration.

USS SAFEGUARD Commissioned

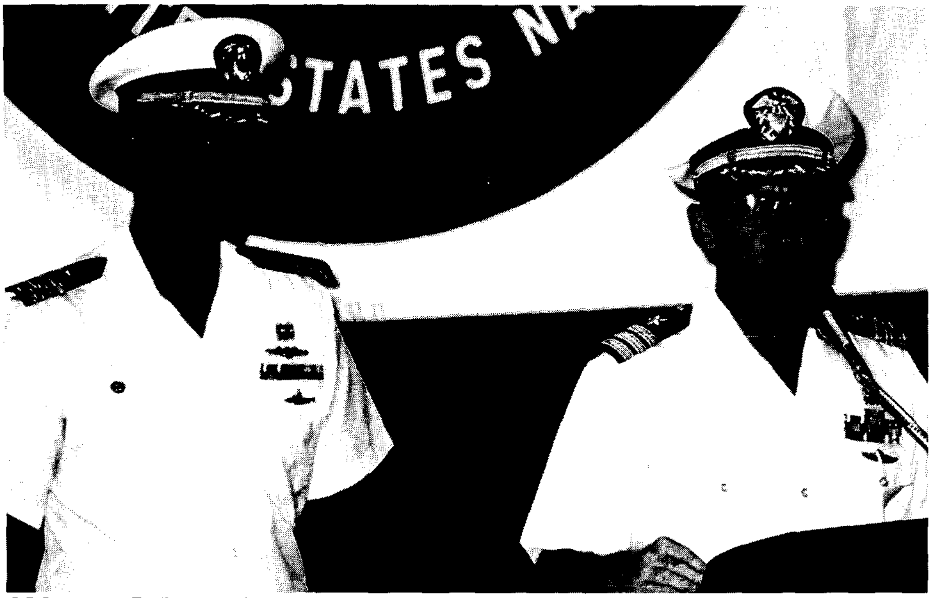
The USS SAFEGUARD (ARS 50), commanded by LCDR Kenneth D. Harvey, was recently commissioned in Sturgeon Bay, Wisconsin. As the first rescue and salvage ship designed since the ATS in 1964, the USS SAFEGUARD has two Almon Johnson towing engines and a traction winch used for synthetic towing lines. The ship is also designed to support air diving at 190 feet using MK12, MK1 or SCUBA and is fitted with a recompression chamber and two diving davits capable of handling either a dive platform or open bell. Built by Peterson Builders, the ARS-50 incorporates features for towing, debeaching, air diving and heavy lift and rescue assistance that make the USS SAFEGUARD one of the most maneuverable rescue and salvage ships in the world.

In addition to being the first ARS-50 class ship, the USS SAFEGUARD is the first Naval ship to be built and commissioned since World War II, and the first coed salvage ship. Before returning to Pearl Harbor, HI, the ship's home port, the USS SAFEGUARD will make a transit around the East Coast.

For additional information on the ARS-50 class, see *ARS-50, New Workhorse of the Fleet,* Winter 1982, Volume 13, No. 4.

The Helm Changes Hands at NEDU

CDR John D.M. Hamilton IV



CDR Frank E. Eissing (left)

A Change of Command ceremony was held at the Navy Experimental Diving Unit (NEDU) on June 29. CDR Frank E. Essing was formally relieved by CDR John D.M. Hamilton.

Commander John D.M. Hamilton IV, a graduate of Colgate University was commissioned through the OCS program in November 1965. He then served as Communications officer on the USS SAN JOAQUIN COUNTY (LST 1122), operating in the Western Pacific. In 1967, after completing the Ship Salvage and Diving Officer course at the Navy School of Diving and Salvage, he reported to the USS PRESERVER (ARS 8) as Diving Officer. CDR Hamilton then returned to Diving School for Mixed Gas HEO2 training, continuing on to further duty at Harbor Clearance Unit TWO. He received experience in combat salvage while serving as Executive Officer Navigator and Salvage Officer onboard the USS BOLSTER (ARS 38), then deployed to South Vietnam. CDR Hamilton earned a Masters Degree in Electrical Engineering (Naval Engineering Curriculum) at the Naval Postgraduate School, Monterey, California. He then reported to the Naval Ocean Systems Center (NOSC) as Officer in charge. While at NOSC Hamilton qualified as a Saturation Diver on the USN Mk II MOD 0 System. In 1977 CDR Hamilton was transferred to the Engineering Duty Officer Community and transferred to Mare Island Naval Shipyard in Vallejo, California, serving as Ship Superintendent on nuclear submarine overhauls. CDR Hamilton reported to the Navy Experimental Diving Unit assuming the duties as Senior Projects Engineer, Saturation Dive Watch Officer, as well as participating in saturation dives himself. In May 1981 he was appointed Repair Superintendent at Ship Repair Facility Subic Bay, Republic of the Phillipines.

Commander Hamilton's military awards include the Navy and Marine Corps Medal, the Combat Action Ribbon, and the Navy Commendation Medal with Combat Distinguished Device and gold star in lieu of second award. He is a qualified Surface Warfare Officer and Saturation Diving Officer and a member of the American Society of Naval Engineers.

View from the SUPERVISOR OF DIVING

By CDR Raymond Swanson, USN

As I finish my three-and-one-half year term as Supervisor of Diving, I would like to comment from my perspective on Navy Diving. At age 18, I enlisted in the Navy at the Whitehall Street Recruiting Office in New York City. Not even a high school graduate, I set my goal to become a deep-sea diver. The Navy gave me a chance to do that and more. Not only did I become trained in a highly specialized career and reach the position of Supervisor of Diving, I also completed high school and college, and obtained advanced degrees in engineering and business. I possess the added satisfaction of having served my country for twenty-seven years in a demanding yet rewarding career. This experience, I know, is similar to that of many of you.

As Supervisor of Diving, I have witnessed great strides in improving the conditions under which Navy divers operate. The Naval Medical Command, through its research of diving physiology, has furthered the understanding of the ocean's effects on divers. The field activities of the Naval Medical Research Institute and the Submarine Medical Research Laboratory, in conjunction with the Navy Experimental Diving Unit, have resulted in the development and improvement of decompression tables for the new Underwater Breathing Apparatus now being employed.

Diving equipment continues to improve. The MK 15, LAR V and the MK 16 Underwater Breathing Apparatus have expanded the abilities of the Special Warfare and Explosive Ordnance Disposal communities. The MK 12 Mixed-Gas Recirculator is now ready for delivery to the Fleet. In addition, diving tables have been developed for each of these rigs allowing divers to reach deeper depths or remain underwater for longer periods of time.

Improvements continue daily as researchers explore better equipment and methods in this field that is still in its infancy. The Roper Cart and the Standard Diving Boat are nearing completion. The MK 14 Closed-Circuit Saturation Diving System Program will soon provide the saturation diver with equipment that is much improved over the present MK 1 Mod S Mask.

Talented members of the Navy are also working to improve the knowledge and skill of divers themselves. Training procedures have been improved and safety conferences established for master divers. Having less individual impact, but still important to the diving community, are the information exchange programs we have developed with Canada and the United Kingdom. The Navy's relations with other branches of the Armed Forces and government agencies have improved, with the Navy in many cases serving as the procurement agency for diving equipment common to all services. In addition, equipment certification procedures have been made more uniform to ensure safe conditions of our divers.

During my tour, I set goals which I believed attainable and which focused on the contributions I hoped to make to the diving community, particularly in increased education, diving safety and exchange of information between diving commands. Some of these goals have been attained: the ABC-35 information exchange program with the United Kingdom and Canada will be improved, with Australia joining shortly thereafter; the new air Diving tables are being developed by the Navy Medical Research Institute; FACEPLATE was improved as an educational tool for the Navy diving community; safety conferences for master divers resulted in point papers elucidating problems perceived by our most experienced personnel and helping to direct plans to improve the performance and safety of Navy divers; standardized testing procedures have been developed within our Navy and with several foreign nations; equipment going to the Fleet is safe because of improvements in engineering; and Volume I to the U.S. Navy Diving Manual has been completely updated to bring you abreast of the current information on diving equipment, decompression procedures and treatment of decompression sickness.

Diving and salvage remains a hazardous business, and despite our many efforts we continue to lose some divers. Equipment and procedures continue to move the field ahead, but the individual still has a responsibility to vigorously learn and train. The field is truly one of man against his environment. To ensure safety and progress, we must work as specialized, highly trained teams. As my final advice, I would urge you to use both the Diving Manual and your common sense in the field to operate effectively and safely in a dangerous and often unpredictable environment.

I move to my next assignement with the confidence in a bright future for Navy Diving. My position is to be filled by CDR Richard Garrahan, who brings a wealth of experience and knowledge to the job. While I've appreciated the opportunity to participate in the growth of this field, I look forward to the contributions each of you will make, and the acceleration of the understanding of man's function in the water that the next decade holds forth. Thank you for the opportunity to serve with you. My view as the Supervisor of Diving is one of a proud and professional cadre of researchers, operators and leaders.

APRA HARBOR
OROTE PENINSULA
AGAT BAY
TUMON BAY
AGANA BAY
A G A N A
Dededo
Finegayan
Mount Barrigada
Mt Santa Rosa
Ritidian Pt
Mt Machanao
Jinapsan Beach
Falalog
Mt Alifan
Mt Lamlam
Mt Jumullong Manglo
Mt Bolanos
Mt Macajna
Mt Chachao
Mt Alutom
Pago Bay
Pago Pt
Ylig Bay
Talofofo Bay
Cocos Lagoon
SMALL ARMS SAFETY DROP ZONE
SUBMERGED SUBMARINE OPERATING AREA (SS-3)
REGULATED AREA
DANGER AREA

Clearing APRA HARBOR

By CAPT R. "Bulldog" Thurman, USN, Ret

After the big typhoon swept through Guam late in World War II, Apra Harbor was devastated. Debris was scattered on lagoons inside the harbor, and on several pontoon barges that had been used for the U.S. invasion. The pontoon sections, bolted together to make big platforms for unloading, were scattered all over the harbor; some were partly submerged and others, up on the beach, had to be parbuckled off. As a result of the typhoon, two tugboats sank at the head of the harbor.

Prior to the typhoon, the USS PITTSBURGH had been torpedoed and taken to Guam for repairs, her bow section broken off and still floating after the first 160 frames. The bow section was then placed in drydock, patched up and sealed, waiting to go back to Pearl Harbor. When the typhoon swept through Guam, the PITTSBURGH bow was ripped from her mooring, sank to the bottom of the harbor and rolled over, resting partially upside down.

The typhoon also caused the sinking of an FS ship, an inner island freighter manned by Navy personnel which carried cargo and a few passengers, and was loaded with gasoline. When the typhoon struck, the FS exploded and sank alongside the dock. Only the stack and top of the pilot house were above water.

The bottom of Apra Harbor was also cluttered with LCMs (landing craft medium), LCVPs (personnel landing craft), and various other small boats. The location of many of these sunken craft was unknown until ships or divers found them by accident.

To clear the harbor, COMSERVPAC at Pearl Harbor dispatched the USS GYPSY, commanded by LCDR Clyde Horner, and the USS MENDER, commanded by LCDR Robert "Bulldog" Thurman. Each carrying 80 man crews, they came from Kwajalein to Guam to clear the wreckage and make Apra Harbor safe for passage.

LCDR Horner of ARSD 1 and LCDR Thurman of ARSD 2 reported to the Industrial Manger's office for operations control when they arrived in Guam. The Industrial Manager, part of the harbor command, had charge of the drydocks in the harbor. LCDR Horner was tasked with clearing the PITTSBURGH bow from the drydocks section so that ships could come alongside. LCDR Thurman was given the job to clear the FS, the tugboats and the pontoon sections.

The USS MENDER crew started on the FS job. After divers examined the FS, they discovered that she was in part a refrigerator ship. The after end of the hold was lined up with refrigerators, but not the forward end. LCDR Thurman and his team determined that the after bulkhead between the engine room and cargo hold was not damaged, except for a small hole that appeared to be patchable. As the girders were not too high between the bottom deck and the platform deck and the top of the double bottoms in the engine room, it was determined that the best approach to raising the FS was to pump the engine room.

The crew of the USS MENDER began work by devising a new skylight. Using Mk 5 hard hat diving equipment, they removed the original skylight over the engine room, and lowered four six-inch submersible pumps into the engine room. Outlets above the water were provided for the electrical cable and a new plate made with four six-inch hoses welded onto it. The big 125-ton crane on the bow, with the line leading through one pipe around the bullnose and back up to the other hook, lowered the new plate. Four divers in the engine room inserted the new skylight plate, bolted it and sealed it. The electric submersible pumps were then turned on. Using four sets of beach gear on the dock, the USS MENDER crew had placed deadmen behind the dock on one side, and put gear all the way around from one side to the other to keep the FS from rolling over in both directions. As the FS was right alongside the dock, they had to take the girders from the dock and make special rollers for the 1⅝-inch cable to come over on the dock's edge.

The crew pumped the engine room, obtained some buoyancy for the bow and some flotation with the stern of the FS sticking up. They then put the crane on the bow and lifted it a few inches until there was a full load. As the draft of the crane was limited, the crew lifted several inches at a time and let her drain, then repeated the procedure. When the main deck was afloat, pumps were immediately placed inside her forward hold. LCDR Thurman and his crew floated the FS, took her out to sea, and dumped her.

By this time, LCDR Horner and the USS GYPSY crew had completed the diving inspection of the PITTSBURGH bow section. They determined that by using drills that could go into the bow, they could get considerable buoyancy back to the collision bulkheads. She was broken off by an almost straight cut across. Immediately, they decided that they would raise the PITTSBURGH bow by putting air in and bring her up floating upside down. Pontoon sections would be placed on the stern and then blown with air. One 60-section and one 20-section would be placed on each side, and two other 20-sections would be placed across the stern. These pontoon sections would be bolted all the way down at the main deck on the bottom with large chains.

Apra Harbor, Guam.

As LCDR Thurman recalls, one amusing aspect of the PITTSBURGH bow job was the 160 cases of whiskey stored in the whiskey locker. A guard from the Industrial Manager's office was stationed on deck to prevent salvaging of any of the whiskey, although some samples were taken and sent to Washington for analysis.

After finishing the FS job, LCDR Thurman was charged with collecting all the pontoon sections from the beach. These sections were brought over to the GYPSY, and holes were cut in the bottom of the sections, on a vertical position right down on the corner. Next, air fittings were put on each pontoon. With the valves and air fittings, air could be pumped into each pontoon to displace the water inside.

Each pontoon barge was prepared with valves and air fittings. Interpiping was placed between each section without too many hoses going over the side. There were two hoses to one 60-section pontoon barge.

Construction on the pontoon barges was completed in one month. LCDR Horner and his crew lowered them as they were finished. By this time, LCDR Thurman and the USS MENDER crew had raised the FS, the two tugboats, and the LCMS that were scattered all over the bottom of Apra Harbor, two of which they had discovered underneath the FS.

When the pontoon barges were in place, LCDR Horner hooked onto the stern over the grounded keel and overlaid the 150-ton lift. When everything was cleared, he decided to float the PITTSBURGH bow section. Little by little, more air was edged into the pontoons. When they were blown full with air, the USS GYPSY crew began to lift the bow. Very slowly, the stern started to come up with the after end of the bow section. Approximately 200 tons of lift were put on the bow. The PITTSBURG was left stationary for twenty-four hours after it was raised, to determine if it was stable enough to tow through the channel. After a day, the PITTSBURGH bow was lifted a little bit at a time until bubbles of air began to rise to the surface. The salvage crew lowered the PITTSBURGH bow because they did not want to lose any air for the harbor passage; they juggled the bow slowly, but left enough clearance for it to clear the 70-foot deep harbor bottom. The plan was to keep the stern end above the bottom while going through the channel, to minimize the amount of air lost, keep a slightly longer lead, and then lower her in deeper water.

Although the port director told the salvage crews that there were no tugs available to help, plans proceeded to move the PITTSBURGH bow out into the channel and see how she acted.

The USS MENDER, the towing boat for the PITTSBURGH bow section, was followed by the USS GYPSY, which provided lift. Both moved out into the channel, with the USS MENDER towing the PITTSBURGH bow by a 1¼-inch wire. Once they got into the channel, the salvage crews requested help from the port director. The Admiral, Commander of Mariana Islands, came to watch the operation at the point on the channel's entrance. Tugboats and Auxiliary Tug Fleet (ATF) boats were sent out in the channel to provide assistance, if required. LCDR Thurman continued to tow the PITTSBURGH bow, and called out fathometer readings as they got near the deep part of the channel. After they cleared the channel's shallow part, some of the air was bled out of the after end, which was lowered down with the tackle. At this point, there was too much strain on the tackle. The crew started out believing they could balance the bow by using the air inside her.

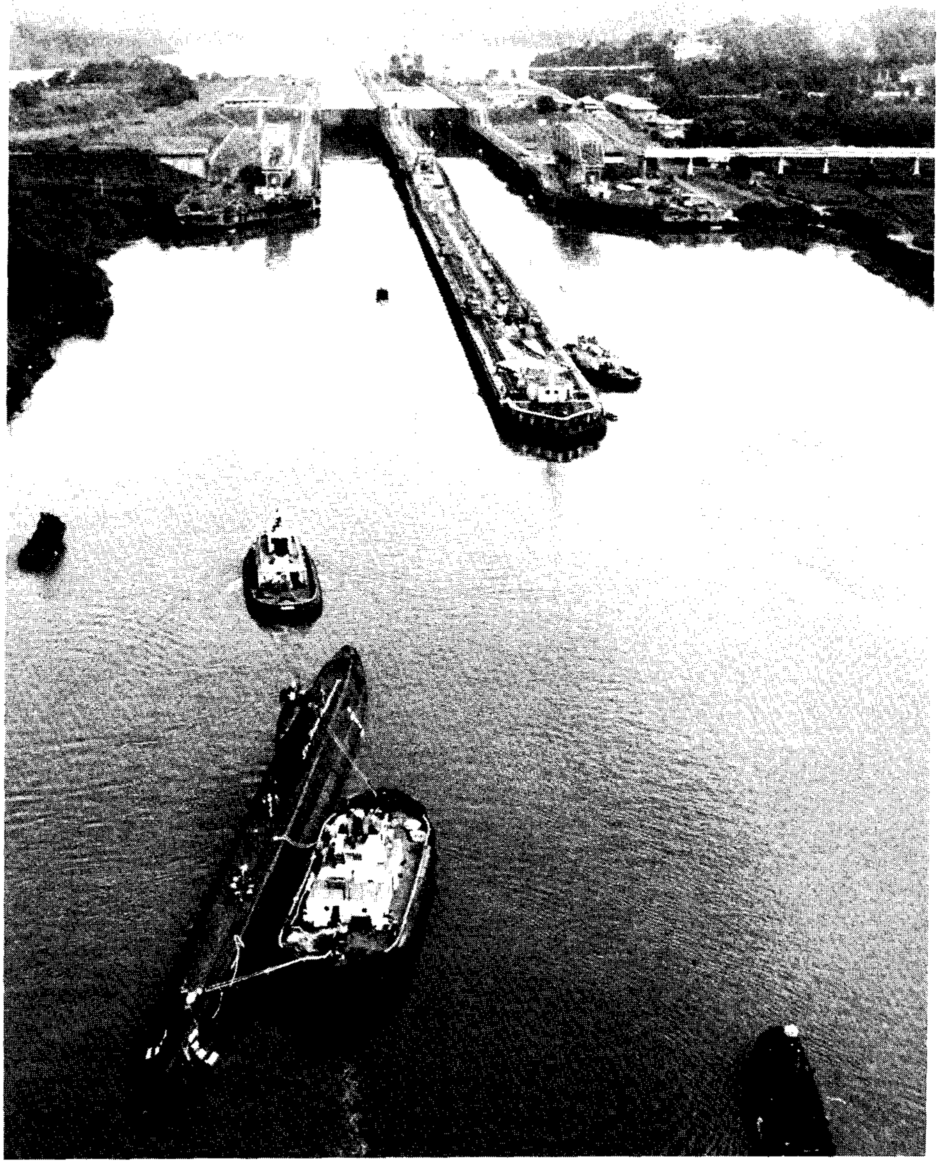
The channel through Apra Harbor had a tremendous undertow, and at the entrance, a tremendous groudswell, spinning the USS MENDER, the PITTSBURGH bow, and the USS GYPSY. They found themselves sideways half of the time, a tug on each side of the GYPSY and one on the MENDER trying to hold the stern from going crossways as the main deck of the PITTSBURGH bow was battered by the undertow. When they successfully got past the undertow, the ships came into the groundswell, just past the breast of the breakwater where the groundswell started up. LCDR Thurman turned a hard right and started to go right alongside the breakwater. The salvage crews planned to cut the PITTSBURGH bow loose if they lost control outside the channel.

The groundswell was so strong that LCDR Horner finally had to lower his blocks far enough to disconnect them and let them loose. By this time, they were past the entrance to the harbor and outside the breakwater. The USS GYPSY had special links to disconnect the bow wires and drop them, and finally, outside the entrance to the harbor, he did just that—let his big wires go. The USS MENDER continued towing full speed. Finally, one groundswell crashed and broke about four air lines leading from the GYPSY; LCDR Horner was going ahead slowly with his engine. The ships reached 1000 feet from the entrance to the harbor when everything on the GYPSY was torn off with one great big grounder. The PITTSBURGH bow started to go down. The USS MENDER kept towing until she got about 1200 feet past and around to the right of the entrance to Apra Harbor.

LCDR Thurman's fathometer was reading 2500 feet of water, indicating that the location was suitable for dropping the PITTSBURGH bow. The USS MENDER came to a stop, and her tow cable started to go straight down. LCDR Thurman immediately ordered the cable cut by men standing by on deck with a blow torch. They had barely touched the wire with the blow torch when the PITTSBURGH let go. The USS MENDER picked up speed to go full steam ahead and clear the area. No one knew for certain what was going to happen.

When the USS MENDER had traveled about 100 feet from the PITTSBURGH bow, one of the pontoons suddenly let go and came up. The pontoon appeared to shoot almost 100 feet in the air above the water, after having broken loose from the bow section.

The telegraph cable to Guam, coming in approximately 500 feet around the corner from the entrance to Apra Harbor, was the cause of great concern. But the PITTSBURGH bow, lying in 2500 feet of water, had missed the cable. Apra Harbor was clear.



Elevated starboard quarter view of the Ex-USS NAUTILUS as it is towed through Miraflores Locks.

Towing Procedures for a Nuclear Submarine

By LCDR David B. Redman, USNR-R

On 28 May 1985, USS QUAPAW (ATF-110) began her final tow. QUAPAW was selected to tow the Ex-USS NAUTILUS (SSN-571) from San Francisco to the Panama Canal for transfer to another salvage unit, the USS RECOVERY (ARS-43). NAUTILUS' final destination was Groton, Connecticut where she will become a museum.

Preparations for this journey began in November 1984 and required considerable planning and investigation. This was the longest distance any nuclear submarine had been towed and the second submarine to be towed in open ocean in recent history. The first, USS SEADRAGON, was towed in June 1984 from Hawaii to Puget Sound.

The Towing Manual has no information concerning aerodynamic and hydrodynamic resistance for submarines. Additionally, flooding charts for NAUTILUS had to be created by using an inclining experiment. An inclining experiment consists of placing a collar on the submarine and then adding weight, about a half percent of total displacement, on the collar. The weight is placed in various positions and the list angle is observed using an inclinometer. From this, the vessel's metacentric height is calculated. Using lessons learned from the SEADRAGON tow, NAVSEA provided a preliminary draft of an instruction for towing unmanned nuclear submarines. NAVSEA conducted model tests to determine the acceptable range of metacentric height, trim, stern control surface angle, primary two pad location, speed limitations and the effect of the absence or presence or propellers.

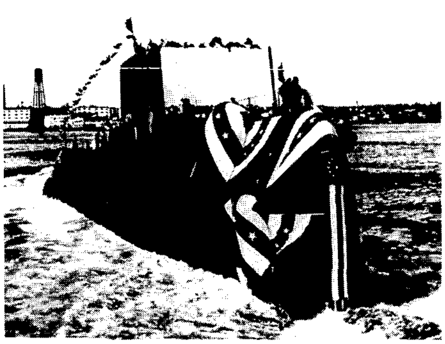
NAUTILUS is 317.4 feet long with a beam of 22.6 feet. Normal mean draft is 22 feet with 7.75 feet of freeboard. Metacentric height (GM) was to range from 0.5 feet to 1.00 feet, trim was to be 4.17 feet (maximum) by the stern with a mean draft of 19.35 feet and a list angle of less than one and one-half degrees. Actual GM was 0.8 feet, trim was 4.08 feet by the stern and was achieved by filling the aft trim tank with 5,798 gallons of water. A mean draft of 19.22 feet was achieved with a 3 degree port list.

The NAUTILUS' propellers and shafts were removed. NAVSEA determined that a 22 degree angle on the stern planes provided the most effective

Ex-USS NAUTILUS being towed to Miraflores Locks, Panama Canal.

drag for keeping the stern in the water. It was further directed that the bow planes be folded up alongside and held together by 5/8-inch wire rope. Locking of the rudders was accomplished by welding 3-inch x 3/8-inch angle iron to the rudder and rudder posts, thus preventing the rudder from swinging. To ensure that the rudder and stern planes would remain in position, collars were welded to the rams. Each collar was then welded to the hull. The towing speed limitation was set at 10 knots.

NAUTILUS required numerous modifications in order to prepare her for towing. All ballast tank flood vents and grates were closed and covered with high tensile steel plate. Ventilation flappers on watertight compartments had to be removed and blanked to ensure watertight integrity. One flapper valve in each compartment was left operational to allow the boarding team to equalize pressure in each compartment prior to entry. Visual inspections of all internal and external tanks prior to undocking certified that all such tanks were empty. All tanks and compartments received a 12 PSI pressure test for ten minutes with no drop allowed in main ballast tank pressure. A four-ounce drop in compartment pressure was acceptable. Bulkhead mounted pressure gauges required calibration to ensure proper operation, and operational tests were conducted of all salvage air fittings.



Launching of the USS NAUTILUS at the Electric Boat Company, Groton, Connecticut.

NAUTILUS received a meticulous field day prior to close up in an effort to prevent fires. Each compartment contained one CO^2 bottle and two PKP bottles. One bottle of each type was provided in the sail.

A thirty-kilowatt diesel generator with fuel supply was mounted in the sail. The generator was provided with prerigged wires connected to 2-inch electrical submersible pumps. Each compartment of the ship, with the exception of the torpedo room and reactor compartment, contained one pump. Two pumps were provided in the torpedo room with an additional spare pump in the sail. No pumps were installed in the reactor compartment. Installation of high and low level flooding alarms was accomplished without utilizing ship's wiring. Any wiring required for this or any other system was installed as needed in an effort to minimize fire risk. All such wiring had to be completed prior to the NAUTILUS' pressure tests to ensure that watertight integrity had not been impaired. Internal lighting was provided by six battle lanterns stored in the sail. Navigation and towing lights were rigged and installed in accordance with international regulations. Batteries for the navigation lights and flooding required adequate spray protection and were installed in the sail. In order to provide access to all the equipment stored in the sail, the sail door was modified so that it could be operated from the outside.

Several additions to the NAUTILUS' hull completed preparations for the tow. Existing bow life lines were rigged to allow the boarding party safe passage to the towing fairlead from the boarding point. The bow and stern messenger buoy spaces were secured for towing. The messenger buoys are located in the main deck, and are designed to be released as markers should a submarine sink while underway. Securing the buoys was accomplished by overlapping the buoy and main deck with four 2½-inch x ½-inch x 10-inch pieces of flat bar and then bolting the bars to the deck.

The primary tow point was established at 24 feet 3 inches above the keel with a secondary tow point at 18 feet 8 inches above the keel. The primary towing bridle consisted of a single shot of 2-inch chain attached to the primary tow point. Due to the narrowness of NAUTILUS' hull, the primary bridle was a straight vice Y bridle.

The secondary bridle consisted of 600 feet of 1⅝-inches wire rope leading aft from the secondary tow point. The wire rope was secured to padeyes with 20-strand manila every 20 feet between frames 36 and 89. Connected to the wire rope was 300 feet of 5-inch samson braid. The samson braid was then stored in NAUTILUS' line locker. Shackled to the 5-inch samson braid and stored in the line locker was 200 feet of 3-inch samson braid. Leading from the 3-inch braid was 200 feet of 20-strand manila. The manila was shackled to a float and streamed aft of the tow. The 3-inch samson braid was seized to a padeye so that the float would not pull all the line from the NAUTILUS' line locker.

An emergency anchor was secured to NAUTILUS' port side forward. The anchor assembly consisted of 900 feet of 1-inch wire rope, one shot of 1-inch chain and a standard Navy stockless anchor. The wire rope was lead aft from the secondary tow point and flemished down on the port side of the hull. Clips were used to secure the wire rope to the hull. A pear link was

The crew of the USS NAUTILUS (SSN-571) stand quarters for muster as she enters New York Harbor.

utilized on a metal plate welded to the hull at a sufficient angle to clear the hull should the anchor be dropped. Small stuff was used to secure the anchor to the plate. A wire rope connected to a pelican hook secured the anchor to the main deck.

Ladder rungs welded to the port and starboard side of the hull and the painting of 2-inch wide draft marks 2 feet apart, to a height of 8 feet near the bow and stern, completed the physical tow preparations. An additional white stripe was painted at the waterline on the bow of NAUTILUS. This provided a waterline mark that could be observed from the towing vessel.

When all modifications were completed, a new compartment flooding chart was compiled. Mare Island Shipyard utilized a 1981 inclining experiment report and updated it by calculating the effects of the modifications.

Due to the nature of the tow, special precautions were taken to ensure its safe delivery. A nuclear trained officer with submarine command experience was assigned as OIC of NAUTILUS. The OIC was responsible for radiological and damage control. In addition to the OIC, six submarine qualified enlisted personnel were assigned to act as the damage control party for NAUTILUS. All of these individuals rode the towing ships and were familiar with the emergency damage control gear stowed in NAUTILUS. NAVSEA directed that a Navy combatant be provided as escort ship. OIC of NAUTILUS was directed to assume duties as OTC of the escort ships, USS TUSCALOOSA (LST-1187) and USS HAYLER (DD-997), the towing ships USS QUAPAW (ATF-110) and USS RECOVERY (ARS-43), and Ex-USS NAUTILUS (SSN-571).

While in San Francisco Bay, additional escorts were provided by the Coast Guard to establish a floating safety zone around QUAPAW and NAUTILUS. Zone limits were 200 yards on all sides of QUAPAW and its tow.

Modifications on NAUTILUS had been carried out at Mare Island Naval Shipyard. On the morning of 28 May, two Navy tugs made up to NAUTILUS taking her in tow. NAUTILUS was then moved from Mare Island to an anchorage just off Treasure Island where USS QUAPAW (ATF-110) was at anchor awaiting NAUTILUS' arrival. The OTC and the six enlisted submariners were on board NAUTILUS. NAUTILUS was maneuvered close aboard QUAPAW's stern. A QUAPAW messenger line was attached to the tow chain and then brought aboard QUAPAW's deck. The NAUTILUS' tow chain was shackled to QUAPAW's bull rope. All stops holding the chain to NAUTILUS's side were cut, QUAPAW got underway, and the submarines were transferred from NAUTILUS to QUAPAW. The tugs were cast off only after QUAPAW had taken a strain on her bullrope and was actually underway with NAUTILUS in tow. The long journey began. NAUTILUS was streamed to 600 feet for the harbor transit, then to 1200 feet upon entry into international waters.

Due to the lack of information on fuel consumption while towing a submarine, worst case scenario was considered. This resulted in an estimate of burning three percent per day. It was determined that QUAPAW would arrive in Panama with 33 percent fuel onboard. As a result of this estimate, preparations had been made for astern refueling. However, QUAPAW only burned 1½ percent to 2 percent per day, arriving in Panama with 50 percent fuel onboard. The astern refueling procedure was not utilized during this transit. In Panama, the NAUTILUS was turned over to the USS RECOVERY, which successfully completed the second leg of the transit to New London, Connecticut, arriving on 6 July 1985.

As with all operations, there were quite a few individuals involved in the team effort to prepare the NAUTILUS for transit to her new home. They included:

USS QUAPAW (ATF-110)
LCDR Jim Cosper, Commanding Officer
LT Susan Cowan, Executive Officer
LT Tom Cook, Salvage Officer
CWO4 Bob James, Chief Engineer
BMC Michael Johnson, First Lieutenant

USS TUSCALOOSA (LST-187)
CAPT David Montgomery, Commanding Officer

USS RECOVERY (ARS-43)
CDR Gideon W. Almy III, Commanding Officer

USS HAYLER (DD-997)
CDR Edward F. Messina, Commanding Officer

COMSERVGRUONE
CDR Baker

NAUTILUS RIDING CREW
CDR John S. Almon, OIC
MMC(SS) Maurice L. Price
MM1(SS) Douglas R. Hueg
MM1(SS) Gary R. Baker
EM1(SS) Walter A. Litchfield
EM1(SS) Timothy J. Formolo
MM2(SS) Robert J. Becker

MARE ISLAND NAVAL SHIPYARD
Angus McLean, Project Manager
LCDR Tom Glencoe, Senior Ship Supervisor

Screw Change on the USS REASONER (FF-1063)

Workers rig new screw for the USS REASONER.

By ENS Frost, USN
Diving Officer, USS AJAX

On 24 April 1985, the USS REASONER (FF-1063) reported shaft vibrations and excessive noise levels while undergoing REFTRA. The next day, MDSU ONE DET divers inspected the screw for damage and discovered a separation of the forward pressure face at the leading edge on blade four, exposing the prairie masker air system. On 26 April, COMNAVSURFPAC assigned overall supervision of the waterborne propeller changeout to the USS AJAX (AR 6) and tasked MDSU ONE DET with the diving operations. Preparation for the screw changeout commenced, awaiting the arrival of a 12-ton screw that was being repaired in Long Beach. COMNAVSURFPAC also decided to install the new dunce cap modification for the FF 1052/1040 classes.

Diving operations commenced on 23 May 1985, one day prior to the screw's arrival, utilizing the Fly Away Diving System II (FADS II), MK 12 Surface Supported Diving System (SSDS), the new Hydro Comm set and new screw change rigging equipment. NAVSEA technical expert Clark Mallder provided the new rigging equipment which was installed easily and proved to be an invaluable time saver. The rigging consisted of four ⅝-inch wire pendants hung through the ship's four horseshoe padeyes, two flounder plates attached for and aft to the two pendants, two 12-ton hydraulic chainfalls hung on the flouder plates, a trolley bar bolted at each end onto the flounder plates and a one-ton pneumatic chainfall that rode on the trolley. This rigging placed the center of gravity directly over the shaft, eliminating the need for a balancing beam and counterweight during the removal and installation of the screws.

Diving operations proceeded smoothly during the removal of the old dunce cap, rope guards and boss nut. However, in the removal mode, the new pilgrim nut provided by NAVSEA started to bind on the shaft threads. The starting thread had sheered (gurred) and had to be repaired on the USS AJAX (AR 6). To facilitate installation, the half-threads on the pilgrim nut and boss nut were cut out (higbe'd) and the threads on the shaft thoroughly cleaned. The pilgrim nut then went on using the speed wrench method. After the placement of ten 1½-inch studs and backing plate, the first pull with the pilgrim nut broke the screw loose at 180 tons. Two more pulls were conducted to ensure ½-inch movement of the screw. A strain was taken on the aft 12-ton hydraulic chainfall to verify free movement of the screw. Once the nut and associated gear were removed, the screw was walked down the shaft using the two 12-ton hydraulic chainfalls. A pier crane lifted the screw out, and two more wire pendants were attached so the screw could be set down horizontally.

USS REASONER screw change.

A reversal of the above procedures seated the new screw on the shaft. No major problems or delays occurred until after installation of the forward section of the new dunce cap. The air seal flange outside diameter was .002 mils too large to fit into the shaft end. The USS AJAX (AR 6) scaled the flange down to specifications, enabling the divers to finish the installation of the new modified dunce cap. Air system tests were satisfactorily completed on 30 May 1985, and all rigging was removed.

In seven and one-half days, MDSU ONE DET divers compiled over 110 hours of injury-free bottom time in MK 12 to complete the screw changeout and replace the old dunce cap with the new modified one. The diver-to-diver communication feature of the new Hydro Comm set enabled divers to work rapidly and more efficiently as a team underwater. Through the combined efforts of the USS AJAX (AR 6) and the MDSU ONE DET divers, almost a half million dollars in drydocking costs were avoided and the USS REASONER proceeded on its assigned mission without any major delay.

Individuals involved with this operation included:

LCDR Herlin	LT Linn	LT Cortesi
ENS Hoff	ENS Frost	BMCS(MDV) Jennings
EMCS(DV) Gerdom	ENC(DV) Dawson	HT1(DV) VanSkiver
HT1(DV) Kelly	QM2(DV) Reehl	ASM2(DV) Horne
HT2(DV) Barker	HT2(DV) Kakuk	QM2(DV) Strynar
HT3(DV) VanDeusen	IC3(DV) Tequida	QM3(DV) Kiliszewski
HT3(DV) Boele	EWSN(DV) Miller	

Tenders check Mark 1 diver prior to dive.

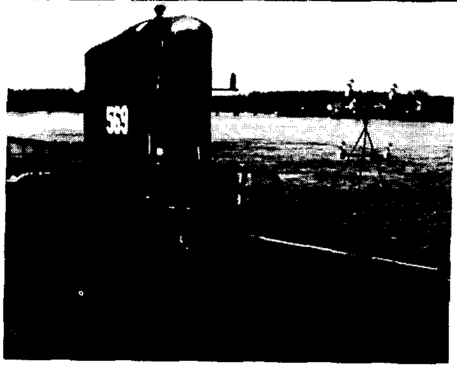
The ALBACORE Project: Teamwork in Training

By CDR Peter W. Symasko, USNR-R
Commanding Officer, MDSU-2 DET 201

On Saturday, 4 May 1985, at a ceremony attended by Undersecretary of the Navy Goodrich, the USS ALBACORE (SS 569) was hauled from the Pascataqua River for the overland transport on a special cradle to the Portsmouth New Hampshire Maritime Museum. For Reserve Divers from Mobile Diving and Salvage Unit Two (MDSU-2), Portsmouth Detachment 101, commanded formerly by CDR Breck Montague and currently by CDR Kevin Brooks, and New Bedford Detachment 201, commanded by LCDR Dave Johnson, one year of extensive diving services performed on monthly Reserve drill weekends was now complete.

Preparing the ALBACORE, a Portsmouth built diesel submarine historically important as the prototype of the teardrop hull, required approximately 200 feet of underwater electric arc welding to cover specialized hull fittings with prefabricated steel bands. Initially, a portable steel cage with rollers was fabricated for the diver to lengthen bottom time in the current; however; on station, it was determined that constantly rigging the cage was too inefficient, restricting use of the crane required to position the eight-foot long sections of steel plate. Although actual welding time was restricted to slack water, preparation and underwater rigging was accomplished by surface tendered SCUBA divers working in the strong tidal current. Underwater welding was performed utilizing the MK-1 Surface-Supplied Diving Sys-

Divers tend during underwater welding evolution.



USS ALBACORE moored alongside Naval Reserve Center quaywall on Piscataqua River.

tem (SSDS) with a portable volume tank and compressor.

Every qualified diver from both MDSU Reserve Detachments participated in the hands-on training. Reservists were riggers, fabricators, and topside welders as well as divers, tenders, supervisors, and phone talkers. This type of training is an extremely valuable preparation for mobilization because it utilizes the equipment in the Reserve diving locker for a project normally encountered only during the annual two weeks of active duty at the parent command in Little Creek, Virginia. The display of the USS ALBACORE, and knowing that the welds would be viewed by shipmates, was also a personal training incentive.

The ALBACORE was successfully prepared for transport because all hands and all commands cooperated. The project was organized by CDR Ray Hahn, the Commanding Officer of the Portsmouth Naval Reserve Center where the submarine was moored, and supported by the New Bedford Reserve Center, commanded by CDR Harry Ball. Divers from Portsmouth and New Bedford worked together, sharing dives, equipment and techniques. Diver training evolutions were periodically monitored and critiqued by NAVSEA (OCC) Detachment 1006, represented by CAPT Rick Jones. MDSU-2, Little Creek, sent MMCS (MDV) Dave Buehring, who flew north to act as a safety instructor and classroom lecturer.

For the residents of Portsmouth, the ALBACORE had come home. Since her keel was laid at the Portsmouth Naval Shipyard in 1952, the ALBACORE had served as a floating experiment in the development of the modern submarine. The ALBACORE is now out of mothballs and being prepared for proud display within sight of where she was built. For the Reservists who worked on the project, the tasks are complete and the techniques learned during the training will be proudly utilized for their next diving and salvage mission.

CDR Mike O'Connor and LCDR Dave Johnson discussing the dive.

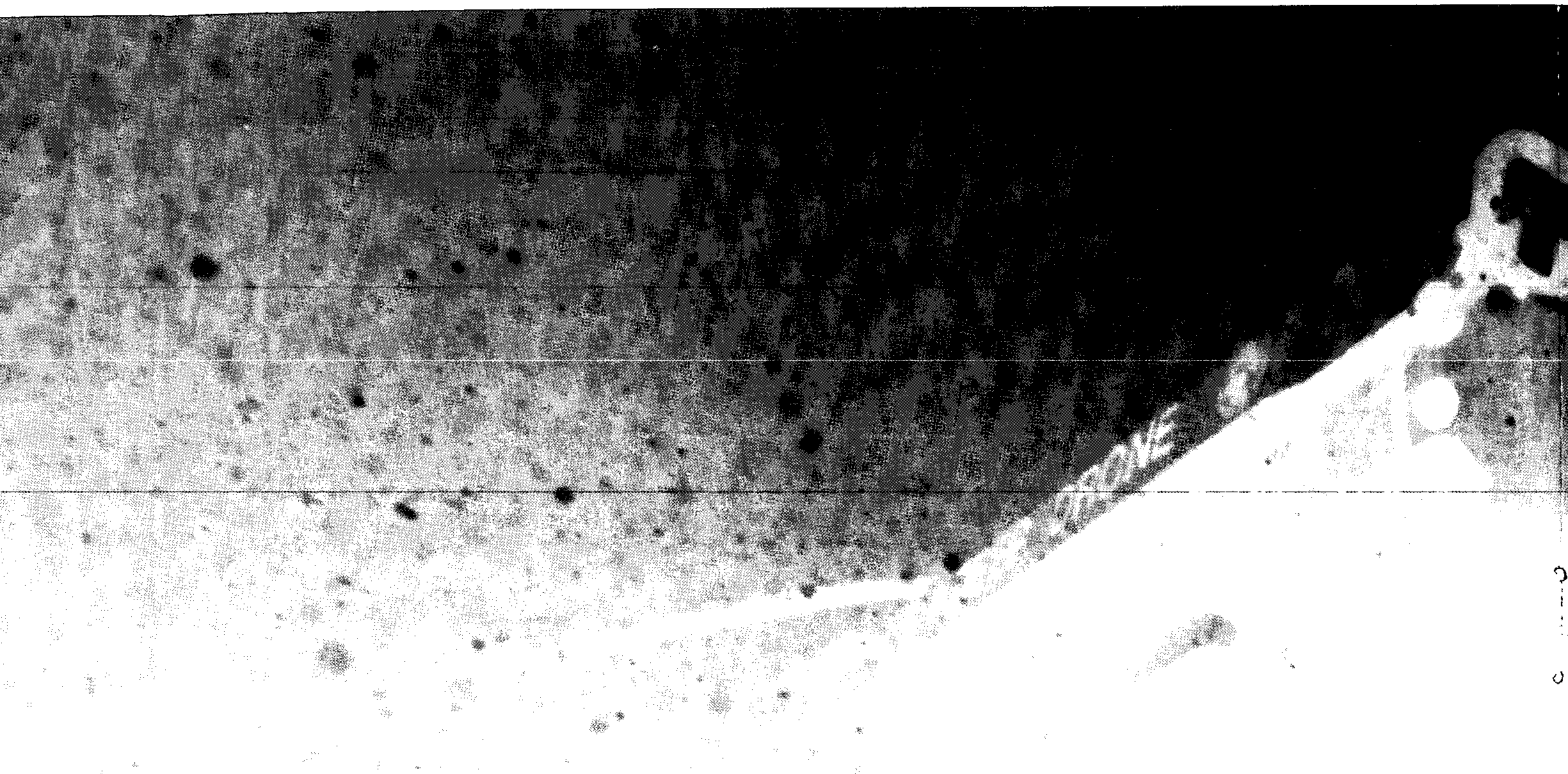
Mark 1 diver.

HTC John Bishop positions steel plate topside on bow of boat.

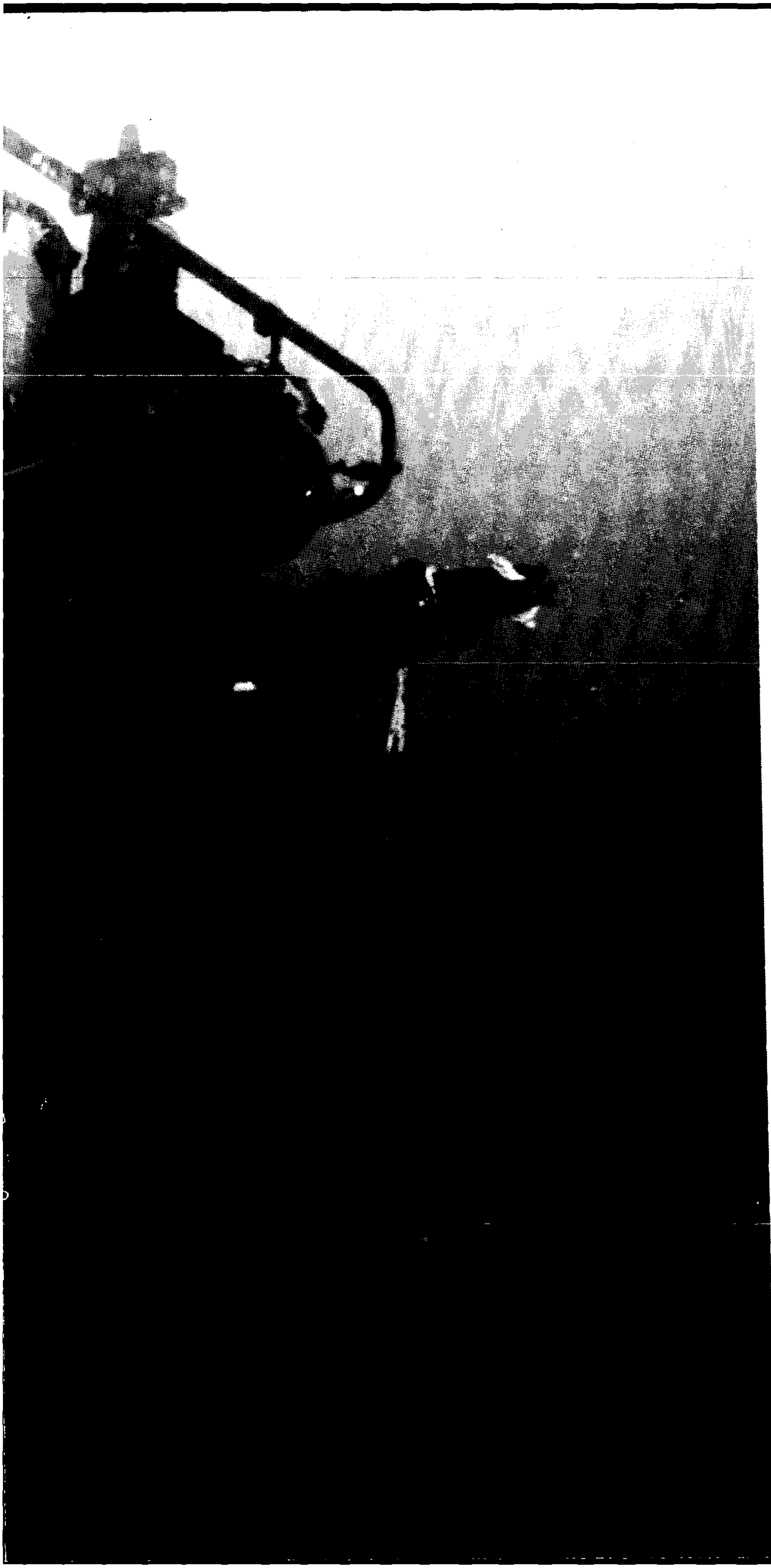
Laying out a Mark 1 umbilical.

Divers and tenders receive pre-dive instructions. Standing: TM2 Kevin Mikna, HT2 Thomas Smith, BM1 Zacek, HM3 Frank Dudas. Sitting: HT2 Bill Girard, CDR Kevin Brooks.

HM1 Robert McGough operates phones and knife blade switch.



ROV's



By **NAVSEA Staff Writer**

The world first became aware of ROVs (Remotely Operated Vehicles) and their uses when a U.S. Air Force B-52 bomber collided in midair with its refueling plane near Palomares, Spain. A 20-megaton hydrogen bomb was released and fell harmlessly into the sea in 2800 feet of water. The U.S. Navy used three different types of submersible vehicles in the recovery operation. One of these, the ALVIN, was a manned submersible. The other two were unmanned; one being a towed sonar-photographic sled which had been used to locate the submarine THRESHER which sank during sea trials and the other being the cable Controlled Underwater Recovery Vehicle (CURV) which had been developed by the U.S. Navy for the specific purpose of retrieving test torpedoes from underwater test ranges. ALVIN located the bomb and attempted to attach lift lines, but was recalled because of the danger to the onboard pilots of fouling in the bomb's parachute. CURV, being unmanned and thus immune to such problems, was subsequently able to make the recovery. Thus the era of modern remotely operated vehicles was initiated, with CURV being the forerunner of all subsequent development efforts.

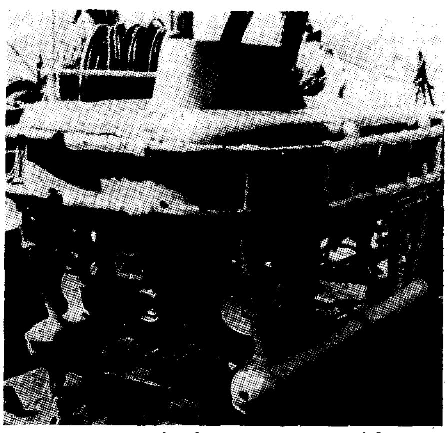
Seventeen years later in 1983, Korean Air Lines Flight 007 was shot down by the Soviets off Sakhalin Island in the Sea of Japan. The Navy sent a single ROV, DEEP DRONE, to aid in the recovery of the flight recorders on the plane. DEEP DRONE's mission was first to verify possible targets detected by other means and then, if location was successful, to recover the recorders. The operation was ultimately unsuccessful, but DEEP DRONE, a state-of-the-art ROV, showed that short-range search, inspection, and recovery capability could all be combined in a single system. Some 750 ROVs of all types, compared with fewer than 50 a decade ago, comprise the present fleet of underwater craft.

All systems typically include a control and display console, a power source, a launch and retrieval system, and the vehicle itself. Tethered systems also include an umbilical cable to carry power, control signals, and data. Untethered systems need an independent energy source aboard the vehicle and an acoustic link with the surface. Application

DEEP DRONE heads for the surface with its prize. The Drone will be met at 20 feet by surface divers who will assist with the recovery.

dictates the rest of the equipment. Work vehicles are equipped with manipulators, search vehicles with sonars of various types, mining vehicles with scoops for bottom sampling and collection, and oceanographic vehicles with extensive instrumentation. Many vehicles carry television cameras and lights, to provide for real-time inspection and control.

Underwater navigation and positioning systems vary in type, but the most common are the ultra short base line type. Utilizing a phased array on the support ship and a free running pinger on the vehicle relative positions of the ship/vehicle and a bottom mounted beacon are displayed. A second type of system, a long based line type, is also utilized to track the ship, vehicle as well as targets within the array. A long base line system involves the deployment of an array of acoustic transponders deployed around the area of interest. When these are



Scotland's ANGUS 002, designed for scientific and research purposes.

interrogated by the surface ship or vehicle, the reply times can be used to locate the ship/vehicle in the field. This information can then be linked to surface navigation systems to provide geodetic coordinates if needed.

Materials are a critical component of any ROV design. Buoyant pressure hulls of necessity, must have thick walls; and materials such as fiberglass, aluminum, titanium and carbon fiber-reinforced plastic have been used to reduce weight. Syntactic foams, which can withstand high pressure without collapsing, are also used for buoyancy, but at the cost of increasing vehicle volume and making handling more difficult.

Tethered ROVs

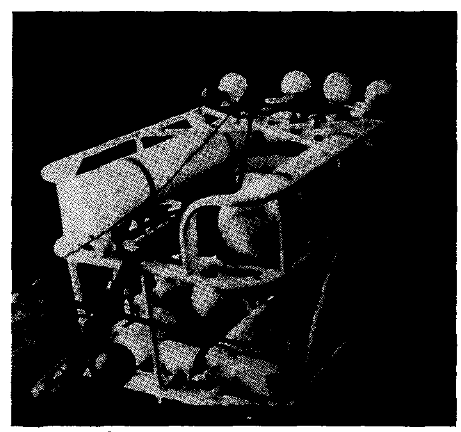
The pioneer vehicle in the tethered class, the largest group of ROVs, was Dimitri Rebikoff's 1953 POODLE, a modified version of the diver transport vehicle PEGASUS. In the 21 years following the debut of POODLE (53-74), 20 vehicles were constructed by various governments (United States, France, England, Finland, Norway, Soviet Union). Before 1974, when the oil embargo stimulated offshore oil exploration, ROVs were primarily dedicated to military and scientific research missions. For example, Rebikoff's POODLE performed much of its work in archeological exploration and the Soviet Union's MANTA 1.5, Norway's SNURRE, Finland's PHOCAS and Scotland's ANGUS 01 were used in geological and biological exploration.

The CURV program at the Naval Undersea Center, one of the best known of the Navy's tethered work systems, was organized to develop unmanned systems to recover ordnance at the Center's underwater test ranges at Long Beach and San Clemente Island, California. CURV-I proved very successful, and in 1966 it participated in the H-bomb recovery. As a result of that mission, the need for greater depth capabilities and versatility became apparent. Subsequently, the CURV-II system was developed with working limits to 2,500 feet. CURV-III, the latest of the CURV family, was built in 1970, with depth capabilities of 7,000 feet. At that time, CURV-III participated in a successful international rescue at sea when a manned submersible, PISCES III, sank off the Irish coast.

From 1958 through 1974, the U.S. Navy constructed and funded the development of eight more ROVs. Three of these were additions and replacements for the original CURV, the others were primarily testbed vehicles for the advancement of technology. One of these, the ANTHRO (anthropomorphic vehicle), was developed to investigate whether normal human perception would be preserved in the vehicle. The technology employed was referred to as "head-coupled" video presentation and involved slaving the vehicle and/or camera orientation to the operator's head attitude. SCAT (Submersible Cable-Activated Teleoperator), a U.S. Navy-built continuation of ANTHRO, served as a demonstration to evaluate head-coupled television and three dimensional television display.

In the foreign sector, the Soviet Union's Institute of Oceanology developed the MANTA vehicle in 1971. The operational theory behind MANTA was that it is practically impossible for man to successfully operate a moving system without proper sensory feedback to his central nervous system. A group of tenso-sensors was mounted on MANTA and a special servo-controlled, hydraulically-driven operator's chair was constructed. The chair repeated all the roll and pitch movements of the underwater vehicle and allowed the operator to feel MANTA's maneuvering. Further developments were made by incorporating the feedback provided by the manipulator system. Other foreign government funded vehicles of the early 1970's included the English SUB-2 and CONSUB-01, the Scottish ANGUS 001, the Norwegian SNURRE, and the French Navy's ERIC.

The SUB-2 was the prototype used to conduct feasibility trials off Portland in late 1972. CONSUB 01 was built to conduct bottom investigations in offshore U.K. waters and was also used to conduct commercial tasks in the North Sea. The original ANGUS 001 was used to generate a background of operational

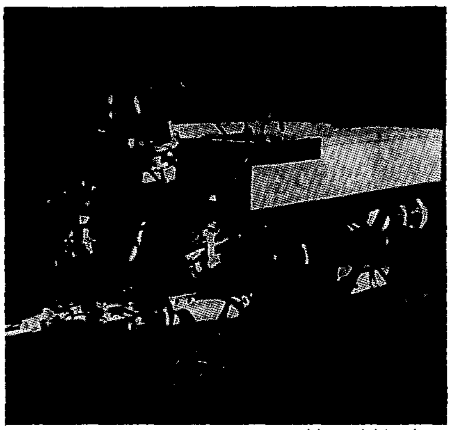


Britain's CONSUB-01 was built in the early 1970s to conduct bottom investigations in offshore waters and commercial tasks in the North Sea.

expertise and design feedback to the subsequent ANGUS 002 and 003. The SNURRE, developed in 1972, was designed to conduct basic research and industrial tasks in the North Sea.

In 1975, Hydro Products introduced the RCV-225. This was followed in 1976 by the TROV (Tethered Remotely Operated Vehicle) which was built by International Submarine Engineering (ISE) in Canada. In 1977 Ametek/Straza offered the SCORPIO. All three are compact inspection vehicles equipped with lights and TV cameras. They are well-suited to operating in and around offshore drilling structures, and many are still in service. They are equipped with horizontal and vertical thrusters which allow them to maneuver in any direction. Their tethers carry video signals as well as control commands and power. A variation introduced with the RCV, and used with the TROV system, was the subsea tether management system — a cage — which acts as a garage for the vehicle and stores a short (500') of umbilical cable. The cable is lowered by a heavy armored cable to the correct depth, and the RCV flies away from it at the end of its lighter neutrally buoyant tether. The combination serves to decouple can also travel almost in a horizontal plane which *helps* avoid entanglement in the structural members of the tower. Both types of vehicles (caged and uncaged) typically can operate at depths up to 3000 feet.

Some towed vehicles have no propulsion of their own except possibly for small attitude correction motors. These can operate at very great depths. They rely on the surface ship for their forward motion and are usually designed for photographic and side scan sonar reconnaissance or as bottom samplers which can scoop specimens from the sea floor. They



CURV III, developed by the Naval Undersea Center, has depth capabilities of 7,000 to 10,000 feet.

find both commercial and scientific uses. Commercial towed vehicles such as the DSS-125, GUSTAV, MANKA 01, and SEO are designed primarily for the collection of manganese modules. The MANKA 01 has the added capability of conducting element analysis of the modules *in situ*, which allows rapid assessment of the economic value of a module field. Scientific vehicles such as TELEPROBE, DEEP TOW, RUFAS I and II, ANGUS, DIGITOW have all been developed and supported directly or indirectly with U.S. government funding. TELEPROBE, ANGUS and DEEP TOW are photographic systems capable of 20,000 ft. operation. EG&G's Model 260 and 960 sonars, Klein's Smart Fish and the IST SEA Marc systems are other examples of towed search systems that combine modern technology in signal processing to produce high resolution records of the sea floor.

While TELEPROBE and ANGUS are search platforms equipped with cameras and magnetic sensors, DEEP TOW can conduct geological and geophysical investigations as well and has special-purpose instrumentation in addition to its photographic sensors. DEEP TOW gathers data for basic research in erosion and sediment transport, sand waves, large scale depressions, and the dynamics of the sea floor. It can also collect chemical samples from brine pits and hydrothermal springs, and biological samples of plankton and other benthic organisms. It is also used to measure the optical properties of sea water at great depths.

The U.S. Navy's ORION and STSS towed search systems combine photographic, video and long-range sonar into one package allowing location, identification and documentation in one operation. The systems have great depth capability and, in the case of ORION, are easily transported to a remote site.

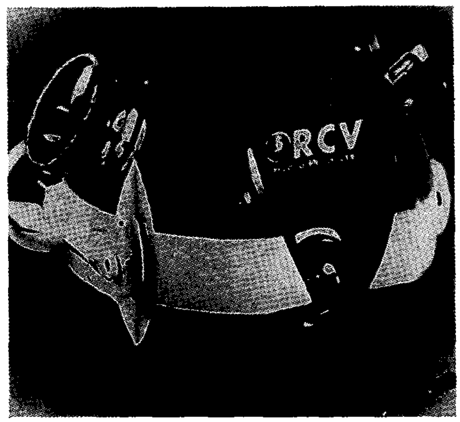
DIGITOW can perform many of the same tasks assigned to DEEP TOW. Developed by the Jet Propulsion Laboratory, it serves as a platform for the development of advanced computer-based instrumentation for underwater use and provides testing for such systems in an operational environment.

RUFAS I and II are used for fisheries assessment from the Bering Sea to the Gulf of Mexico. RUFAS II has greater depth capability than RUFAS I and can work in mid-water as well as near the deep ocean floor. Neither vehicle is capable of sampling but rely instead on photographic and TV records interpreted on the surface.

Work vehicles constitute a major class of tethered ROVs. Growing from a small number of primarily "military" ROVs in the late 1960's, today's total numbers in the several hundred and are primarily (number wise) in the private sector. Some, already described, are designed to crawl along the bottom and perform such tasks as dredging for surface minerals or trenching for pipe or cable burial. Others can manipulate underwater objects and still others can engage in salvage and recovery operations. The U.S. Navy DEEP DRONE vehicle, which can operate to 6500 feet, is a good example of the current state-of-the-art in ROV technology. Although DEEP DRONE primarily utilizes power technology, it has power to be a particularly effective search and salvage tool. A detailed account of its operations is given in a later section.

Untethered ROVs

Untethered or free-swimming systems incorporate some of the most advanced technologies in the ROV field, but the number of such systems is limited. Only a few are acknowledged to exist worldwide and most are experimental prototypes. Operational systems include ARCs in Canada and EPAULARD in France. Two earlier systems, SPURV and UARS, developed at the University of Washington, are now only partially active. Untethered vehicles are attractive because they can travel 3-5 times faster than their tethered counterparts, but their endurance is limited. Their energy sources must be both weight and volume efficient and be able to operate unattended. On the other hand, the tremendous improvement in computer technology in recent years has made it possible to build vehicles which can be



Built in 1975, Hydroproducts' RCV-225 was the first commercially-developed ROV since Rebikoff's 1953 POODLE.

programmed to do complex tasks and even make decisions without surface intervention. Acoustic telemetry has also improved to the point that operations at depths of many thousands of feet are now possible.

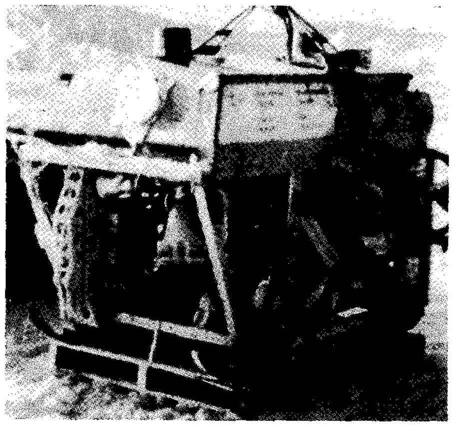
The Naval Ocean Systems Center (NOSC) is developing an untethered search system which can operate either in a preprogrammed or telemetric mode. It should increase search rates by a factor of 5-10 over what is available now. Both the Scripps and Woods Hole Institutions of Oceanography are developing untethered ROVs of extended endurance (24 hours or more).

Future of ROVs

Designers of unmanned submersibles are forced to make a basic tradeoff. The presence of an umbilical cable allows the vehicles to have virtually unlimited endurance and unrestricted communication with the surface, but cable drag limits speed severely. A free-swimming vehicle without a tether can move much faster than one with a tether, but is limited in endurance and communication ability.

The cable drag problem is being addressed by ongoing research in the use of optical fibers for communication. Use of a fiber link allows the diameter of the cable, and hence its drag, to be reduced substantially. In addition, the fiber has a broader bandwidth and lower attenuation than the coaxial cables presently in use. For video transmission, this is an important advantage.

If speed is an overriding consideration and a free-swimmer must be used, its energy source must be as efficient as possible. Power sources in use include lead-acid, nickel-cadmium, and silver-zinc batteries. More experimental battery systems include lithium-seawater, lithium-thionyl chloride, or lithium-molybdenum oxide. Fuel cells of the hydrogen-oxygen type have also been considered, as have external heat engines and internal combustion engines. These dynamic sources raise the problem of exhaust product disposal. Compact nuclear reactor sources have also been explored.



TROV vehicle, constructed by International Submarine Engineering Ltd., British Columbia.

DEEP DRONE recovers test ordnance off St. Croix in 3,000+ feet of water.

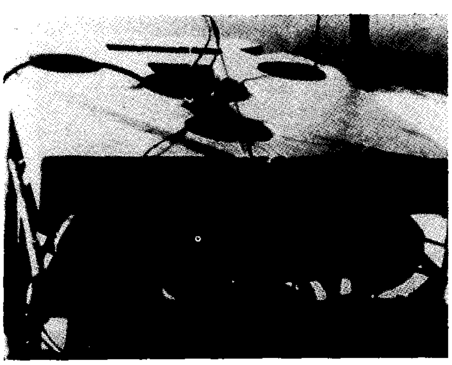
In the absence of an umbilical, data transfer and command and control became more complex. Acoustical telemetry is currently the only alternative to hard-wire communication and has been under development for many years. It has been used in some form for all untethered vehicles and reached its highest development in the EPAULARD system and the planned search system at NOSC.

Finally, on-board computer systems for both tethered and untethered vehicles have been developing very rapidly. They are beginning to take the burden of routine control operations away from the surface operator in order to allow him to exercise only supervisory control. They are also beginning to use "smart" algorithms in pattern recognition and adaptive control which essentially give the vehicle decision-making powers — a form of artificial intelligence.

For the forseeable future, both tethered and untethered ROVs will be developed according to their specialized needs. As technology improves, however, untethered vehicles will probably increase in numbers because of their speed advantages.

U.S. NAVY DEEP DRONE

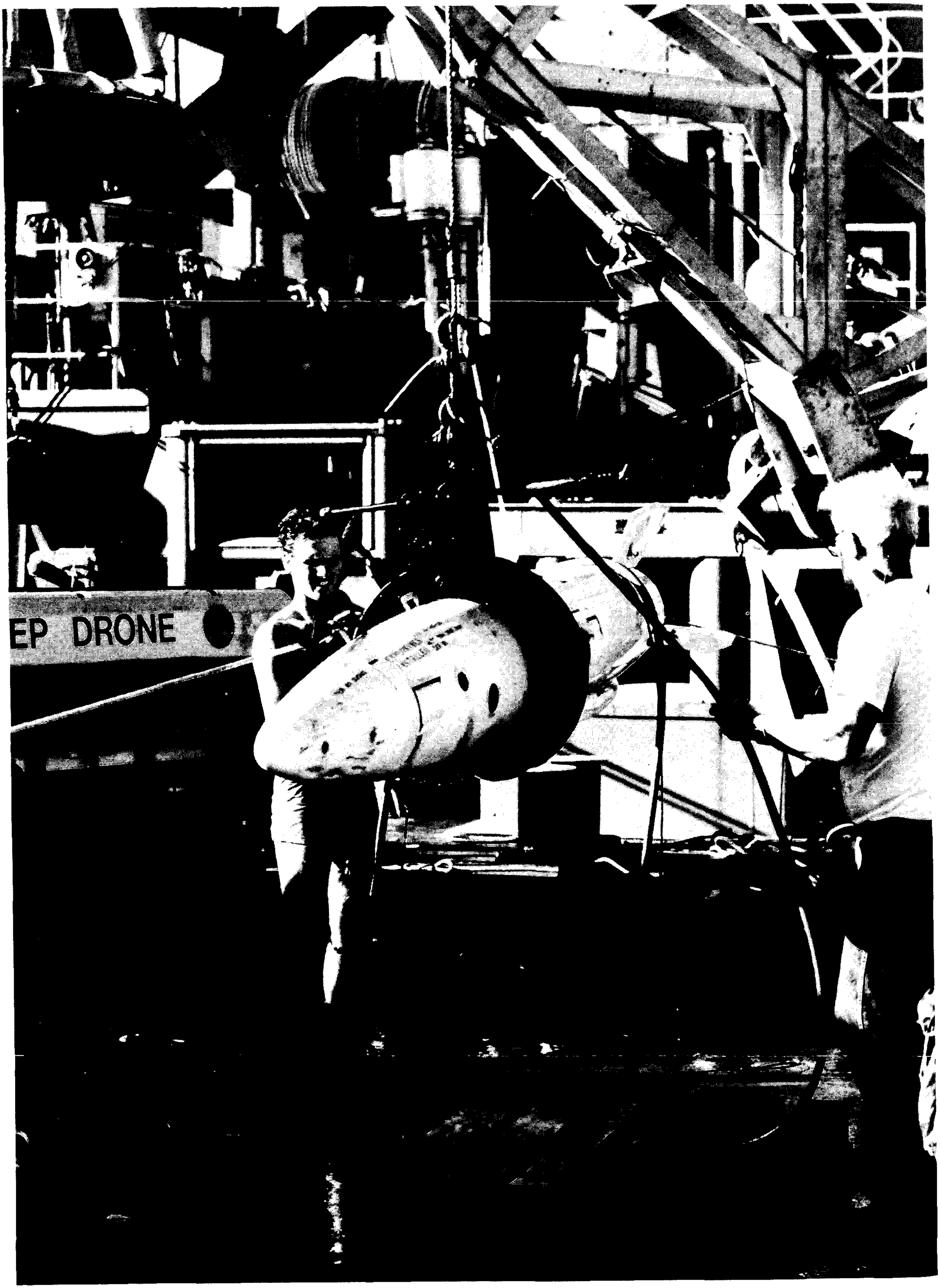
DEEP DRONE, built for the Navy Supervisor of Salvage in 1974 by Ametek/Straza and put in operation in 1976, has evolved into a state-of-the-art tethered ROV with an operating depth of 6,500 feet. The lastest in a series of upgrades was accomplished by Eastport International in 1982. DEEP DRONE's equipment consists of two hydraulic manipulators, a complete optics package, 3 five horsepower thrusters, a navigation system and a CTFM sonar with a range of 2,500 feet and the capability of detecting pingers and CTFM transponders. Most important, the system can be mobilized within four hours.

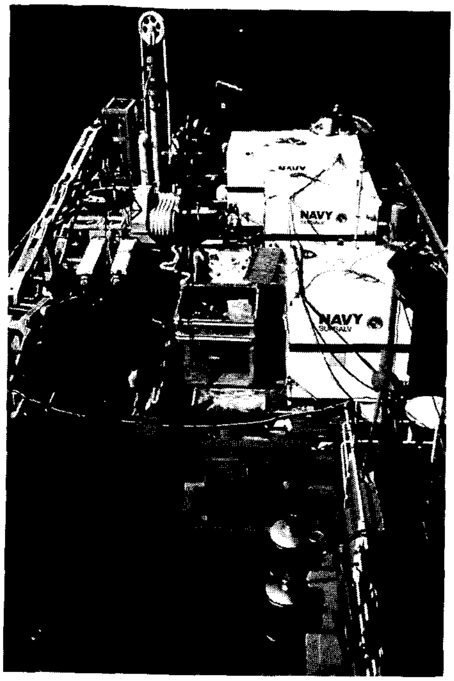


Norway's SNURRE was developed in 1972 for basic research and industrial tasks in the North Sea.

System History

In October 1975, the DEEP DRONE was delivered and after a six month test and modification effort, the system was placed into service. Equipped with a CTFM search sonar, television cameras, and the necessary subsystems required for command and control, the DEEP


EP DRONE



DEEP DRONE, ORION and the Fly-Away Deep Ocean Salvage System layed out on the fantail of the USNS MOHAWK.

DRONE provided the Navy with a rapid response, 2,000-foot, salvage and recovery system. The initial DEEP DRONE system had no manipulator or hydraulic system with which to operate complex tools.

Between 1976 and 1978, the Supervisor of Salvage was tasked to assist in seven projects that required the services of DEEP DRONE. Of those, three were simple inspections in water depths ranging between 200 to 600 feet. The remaining four projects required a work capability that at times pushed the limits of the vehicle. As the DEEP DRONE was not at that time equipped with a manipulator, a great deal of ingenuity was required on the part of the system's operators.

In 1979 a complete system overhaul was initiated to repair extensive damage that had occurred during several operations in extreme sea condition. In addition to replacing damaged components, several modifications were made that enabled DEEP DRONE to better meet the requirements of the Fleet and SUPSALV. The most significant modification was an increase in maximum depth capability to 4,000 feet. Other modifications included the addition of a seven function manipulator, lateral thruster, and a cable handling system. Because most of the electronics in the system had become outdated, they were replaced by state-of-the-art components. These modifications significantly improved DEEP DRONE's work capability. In July 1980, with the overhaul nearing completion, pressure testing and pierside trials were conducted at Naval Ship Research Development Center in Annapolis, Maryland.

In August, extensive system sea trials were scheduled to fully assess the system's readiness. Prior to commencement, however, a Navy helicopter crashed off St. Croix, U.S.V.I. The water depth of the crash site was 3,000 feet and at the time, DEEP DRONE was the only Navy unmanned vehicle available with that capability. Although it was a risky endeavor, the priority to investigate the accident dictated that the helicopter salvage take the place of sea trials.

A USAF C-130 Hercules was used to transport the system from Andrews AFB to Puerto Rico where it was loaded aboard USNS POWHATAN (T-ATF 166) the first of the Navy's new ocean-going tugs. During the next 38 days, 34 dives were completed with only one aborted. Performance of the DEEP DRONE was excellent and down time was minimal. Because the helicopter struck the water at a high rate of speed, debris was scattered over an area approximately 1,000 feet in diameter. Direct lifts were made by the vehicle for objects weighing 300 pounds or less. For heavier objects, the DEEP DRONE attached a lift line. Upon completion of the St. Croix operation, the DEEP DRONE had logged 190 hours of bottom time, and had recovered most of the aircraft. Subsequent to this helicopter recovery, DEEP DRONE was utilized for these other major aircraft salvage operations over the next two years.

In December 1981, while on a salvage mission off Norfolk, Virginia, the DEEP DRONE umbilical became entangled in the support ship's cycloidal thruster during heavy weather. The DEEP DRONE vehicle was pulled directly into the thruster, one buoyancy bottle was holed, and the vehicle sank.

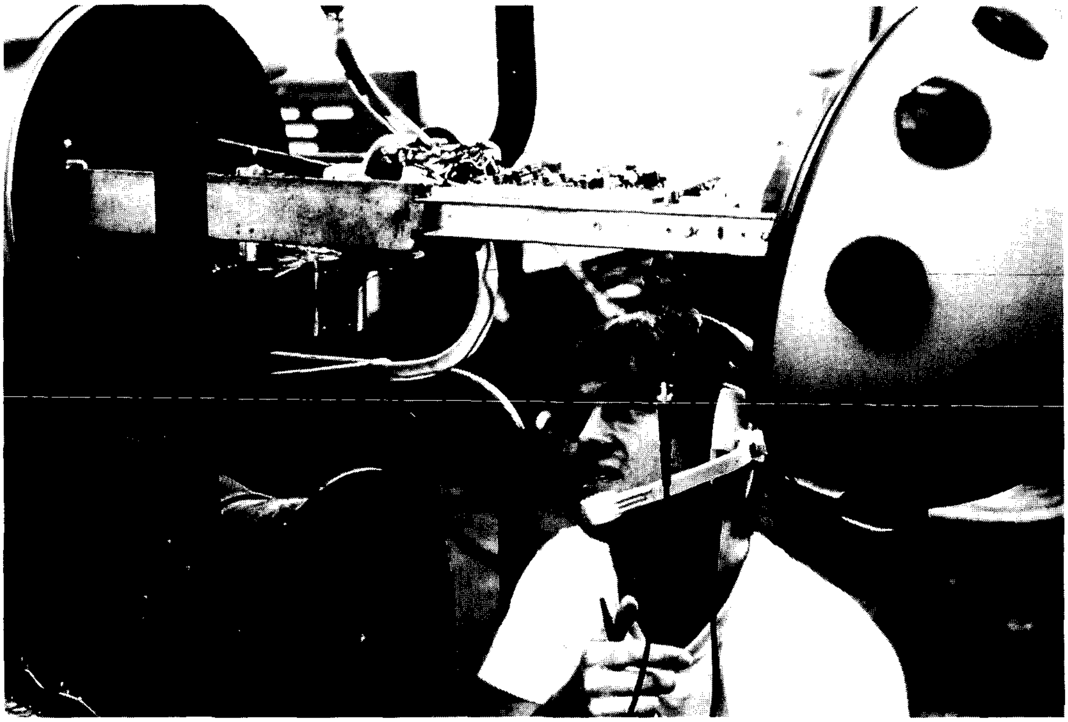
Recovery of the DEEP DRONE was accomplished in January 1982 using the CURV III unmanned vehicle operated at the time by the Naval Ocean Systems Center, San Diego. The majority of the DEEP DRONE's electronics had been destroyed as well as the frame and manipulator.

Utilizing all of the salvagable components, the system was completely rebuilt and commenced sea trials in March 1983. The new vehicle was fitted with more rugged pressure vessels which provided a side benefit of allowing it to operate to 6,000 feet. It was also equipped with a new CTFM sonar and its underwater navigation system, DEEPNAV, was substantially upgraded. Surface support systems, including the crane and operating huts, were refurbished/rebuilt. It was this refurbished vehicle which was used in the Korean Air Lines search.

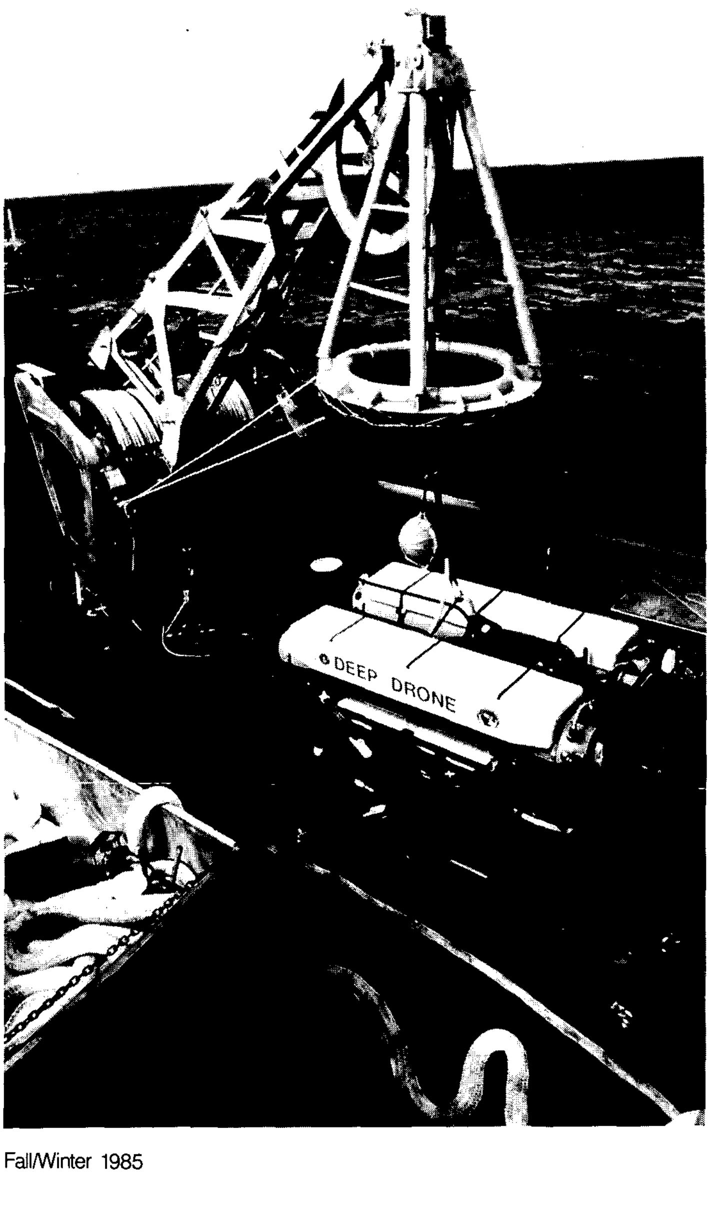
DEEP DRONE has since been used for a variety of salvage operations, including recovery of test targets and ordinance at St. Croix; cable, torpedo and instrument recovery on the AUTEC test range; and numerous aircraft salvage operations.

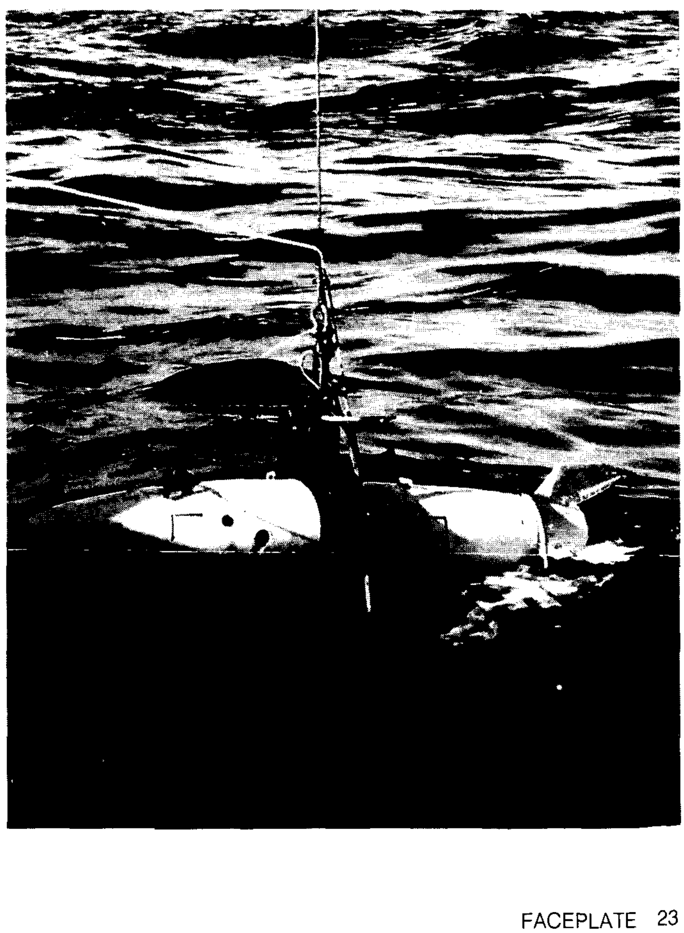
ROVs

Tethered, Free-swimming	powered and controlled through a surface-connected cable; self-propelled, capable of 3-dimensional maneuvering, with remote viewing through a closed circuit television (CCTV)
Bottom-crawling	powered and controlled through a surface-connected cable, self-propelled by drive wheels, capable of maneuvering only on the bottom, or a structure, with remote viewing through CCTV
Towed	powered and controlled through a surface-connected cable, propelled by a surface ship, capable of maneuvering only forward and up/down by cable winch, with remote viewing through CCTV
Untethered	self-powered, controlled by acoustic commands of preset course, self-propelled, capable of maneuvering in 3 dimensions, with no remote viewing capability



(Clockwise from upper right)
Electrical Engineer Alex Malison adjusts some of DEEP DRONE components prior to a dive off St. Croix;
Test ordnance emerges from the water after being raised by DEEP DRONE;
DEEP DRONE and its launch system prior to launch from the USNS MOHAWK.





Interview

Supervisor of Diving

Q: Could you tell us about your diving background and what brought you to your present position as Supervisor of Diving?

A: In 1959, as a Machinery Repairman Second Class (MR2), I attended Deep Sea Diving School in Washington, D.C. Next I served aboard USS GREENLET (ASR 10), a short TAD tour at the Submarine Escape Training Tank, Pearl Harbor, Hawaii and a tour at the Navy Experimental Diving Unit, Washington, D.C.

To me, the tour at NEDU was one of the most enjoyable tours of diving duty in my career. It was a tremendous challenge because there were so many new concepts under development. Saturation diving was here to stay. SEALAB I and II were completed and SEALAB III was soon to follow. There was renewed interest in deep mixed gas diving; and the U.S. Navy was actively involved. NEDU had conducted the deepest mixed gas dive in over 10 years, utilizing conventional diving equipment. The Explosive Ordnance Disposal community was making great strides with their new non-magnetic UBA Mark VI, as was the SPECWAR community with their Emerson O_2 closed circuit UBA.

Appointed to Warrant Officer (W-1) in 1966 and selection as one of the Aquanauts for the SEALAB III project presented a number of new challenges. Underwater Swimmers School, Key West, Florida provided plenty of work in the UBA MK VI. The Deep Dive System MK II Mod 0, onboard the DTV ELK RIVER (IX501), was our saturation support complex for SEALAB III, and the MK VIII and MK IX semi-closed circuit UBA's were the newest pieces of diving equipment. In addition, there was the opportunity to work with all of the latest underwater salvage and construction tools developed by the Naval Civil Engineering Laboratory, Port Hueneme, California.

Appointed Limited Duty Officer (Ensign) in 1969, I was assigned to Submarine Development Group One, San Diego, California. We conducted the OPEVAL for the UBA MK XI from the Deep Dive System MK 1 MOD 0 onboard the USNS GEAR.

After having worked the waterfront for a number of years, so to speak, I was assigned as Executive Officer of USS TRINGA (ASR 16). From TRINGA it was back to Submarine Development Group One, as Officer in Charge of the Mobile Dive Team, and a successful flyaway exercise and certification for the Navy's Flyaway Air Dive System (FADS II).

Next I was assigned as Commanding Officer of USS PETREL (ASR 14). And from PETREL, to Officer in Charge of Submarine Development Group One Detachment, Alameda, California. Finally, in 1985 I was assigned to the Naval Sea Systems Command, Washington, D.C. as Supervisor of Diving.

Q: What do you feel are your first priorities as Supervisor of Diving?

A: My first priorities as Supervisor of Diving are to be responsive to the needs of the fleet, and to ensure, to the best of my ability, that we are diving with the safest systems, equipment and procedures available to us. The bottom line is diver safety, and the fact that nothing is more important than diver safety. I would like to also emphasize that this is the unanimous attitude of the NAVSEA OOC staff. We have a staff of highly qualified technical engineers, fleet support officers and logistics support personnel with many years of experience in the diving and salvage business. Our staff is ready and willing to assist the operating forces in any way possible. We are aware of numerous problems that exist in our Navy diving program today and we realize that we can not solve all of the problems overnight. We do feel, however, that by working together with the operating forces we can continue to make the necessary strides to improve the working conditions for our divers.

Q: What do you see as some of the problems that we are faced with in the Navy Diving Program today?

A: Let me be right up front about some of the problems we have in our diving program today. The safety surveys conducted by the Naval Safety Center, the certification surveys conducted by NAVSEA and other informal reviews conducted by our various field activities indicate that we have serious problems in some of our diving lockers. We have found numerous unauthorized modifications to equipments that were previously certified or "Approved for Navy Use." We have found activities that are not performing the required PMS on their systems and equipments. We have found activities that are diving with non-certified or non-approved equipment. We have found activities that are diving without approved Operating and Emergency Procedures. And we have also found, in some diving lockers, a general careless attitude as to how business is conducted.

These are serious problems that should not be allowed to continue. The problems indicate a lack of understanding and appreciation for the NAVSEA System Certification Process, the NEDU testing process in support of certification or ANU, the configuration management process and, in some cases, a lack of leadership. The problems also indicate that the Type Commanders and Squadron Commanders may not be aware of the situations. The Commanding Officers, and Diving Officers may not be enforcing the policies and procedures that are required by existing instructions. And, in some cases, the Master Divers are not providing the level of expertise and leadership expected of them.

Now let me emphasize that we are not talking about all of our diving activities having these problems. I believe the majority of our diving operations are being conducted in a safe and proper manner. But I must also say, "if the shoe fits, wear it!" To those activities that are in violation of existing procedures and instructions, we will have no choice but to suspend their system certification and their diving operations. We can not and will not jeopardize diver safety.

One last point, the system certification process, the ANU process, configuration management, approved OPs and EPs, and proper PMS will not in themselves provide safe diving practices. They are only tools to get the command into a safety diving posture. They must be supported by the chain of command and integrated into an active and aggressive local diver training program.

Q: Many Fleet Divers are asking about the Superlight 17. NEDU has done testing on it. What is the status of the Superlight 17 for the Navy in the future?

A: NEDU has done extensive testing of the Superlite 17 helmet and we believe that there is a place for it within the Navy diving program today. The Superlite 17 helmet will provide the much needed dry head protection from the cold water encountered in deep saturation diving. Review of the NEDU test data and the operational data from some of our field activities indicate that the Superlite 17 is a superior helmet and meets the requirements to be placed on the "Approved for Navy Use" list under special application for saturation diving. The Superlite 17 will also interface with the new HydroCom or Tethered Divers Communication System, providing reliable dry communications as opposed to the wet and less acceptable communications of the MK I MOD S.

We intend to authorize a limited number of Superlite 17 helmets for our saturation divers because we believe that this helmet will greatly improve the Navy's saturation capability.

Q: What work is being done to improve the MK XII Surface Support Diving System (SSDS)? Would you give us a status report of the MK XII SSDS Mixed Gas rig?

A: There are a few improvements for the MK XII SSDS that will make it a better overall piece of diving equipment. We have a new set of helmet locking devices being manufactured. The new design will make it virtually impossible for the locking device to inadvertently unlock and dislodge the helmet from the breech ring. NEDU has recently completed testing of a second source MK XII outer dress, which is more durable and resistant to chafing. Also, we have recently procured enough HydroCom communications systems for the fleet which will interface the MK XII SSDS and greatly improve the divers' communications.

As for the MK XII SSDS mixed gas recirculator, our first issues to the fleet were in January and February 1986. We expect that by July 1986, all of the mixed gas diving activities will have received their allotment of new recirculators. Present plans call for the NAVSEA System Certification Authority to witness the 300 foot open sea certification demonstration dive the end of March 1986. This certification demonstration dive will be for the purpose of MK XII SSDS mixed gas class certification.

Q: What do you see as the future for the Navy Diver? What new challenges and opportunities do you see on the horizon?

A: I believe the future of the Navy Diver is a bright one. There will always be a need for underwater technicians in the Navy, whether it be ship husbandry, underwater construction, explosive ordnance disposal, salvage, combat swimmers or deep saturation divers. Even though many new underwater devices such as the one atmosphere submersibles and unmanned remotely operated vehicles have arrived on the scene, there will always be a need for the special application that only a diver can provide.

As for challenges, they have not changed. The challenge of exploring the ocean depths and working within its hostile environment is the same today as it was two thousand years ago. But as for new opportunities, todays divers will have the opportunity to work with all of the latest technology available, including the new submersibles and ROV's. As we continue to study the oceans and to understand man's limitations, todays divers will be able to dive deeper, stay longer, and work more effectively and safer than ever before.

Q: What other new diving systems or equipments are under development by NAVSEA for the diving program?

A: NAVSEA has recently procured 250 HydroCom units for issue to the fleet. The HydroCom provides round-robin communications between three divers and the surface tender. The HydroCom will interface with the MK I or XII SSDS. A helium speech unscrambler is available as an optional feature. Installation of the HydroCom has been completed at the Naval Diving and Salvage Training Center and a few other fleet activities. Installation of the HydroCom to the rest of the fleet activities will be accomplished by means of a Tiger Team and we expect to complete the task by December 1986.

As previously mentioned, there is a need to provide the saturation diver with a piece of equipment that will afford him head protection from the cold water, provide reliable communications and will be easily donned and doffed. The Superlite 17 helmet will interface with the newly procured HydroCom helium speech unscrambler system. NAVSEA intends to authorize a limited number of Superlite 17 helmets for use by the saturation diving activities.

There is also a need to provide a replacement of the Jack Browne mask for diving in submarine mud tanks and enclosed spaces. The AGA mask is a lightweight, full-face mask which will interface with existing umbilicals and the HydroCom. It will offer many safety and human factor advantages over the Jack Browne and has a much lower breathing resistance than the MK I MOD 0. NAVSEA intends to authorize a limited number of the AGA masks for use by those commands diving in submarine mud tanks and enclosed spaces.

The Navy Diving Work Boat is a modified 50-foot LCM, with the forward cargo area flat-fitted for the installation and removal of the Diving System Module (DSM). The DSM is contained within a portable, aluminum, box-like structure. It is self-contained with a diesel generator for power, an electric motor driven compressor, four H.P. air flasks for primary air supply and one for secondary air supply, a diver's control console, manifold and associated fixtures, valves and plumbing. The prototype DSM has been certified to 170 FSW. The intent is to provide a diving boat and a diving system that can be utilized by Shore Intermediate Maintenance Activities (SIMA) and can be lifted aboard and transported by AD and AS tenders. There are a total of 28 Navy Diving Work Boats planned for procurement out through 1992.

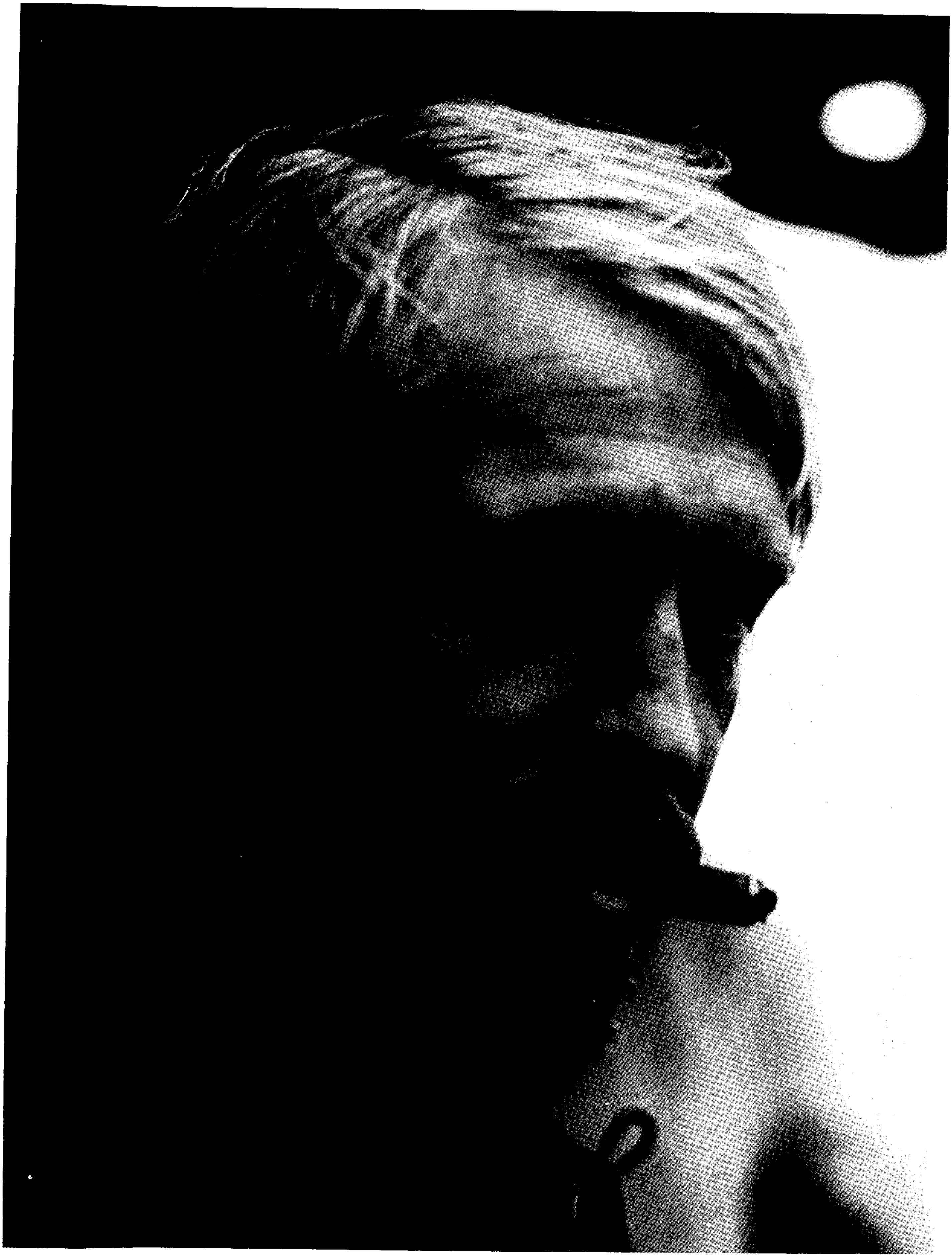
There are also two new diving systems under long-range development: one is the Lightweight Dive System, and the second is the Conventional Dive System. The Lightweight Dive System is for shallow diving, down to 60 FSW, to be used for underwater inspections, repair and maintenance. It will be portable and deployable from such platforms as trucks, small boats or vessels of opportunity. It will be a tethered diving system with a Navy version of the AGA mask, and will interface with the HydroCom communications system. The intent is to provide a Navy certifiable system through competitive procurement. Development of the system is out through 1988, with full production in 1989 and issue to the fleet in 1990.

The Conventional Dive System is an advanced, free swimming, mixed gas (N202/HEO_2) system. It will consist of a lightweight helmet, a mounted backpack; closed circuit carbon dioxide removal system; an open circuit demand come home capability; a dry suit; a through-water communications system; a sensor subsystem for life-support monitoring; and a in-water decompression support system. The system will emphasize reliability, maintainability and costs of maintenance. Development of the system is out through 1990 with full production in 1991 and issue to the fleet in 1992.

Additionally, we are in the process of rewriting Volume 2 of the Diving Manual and the Guide to Polar Diving. We are also in the process of updating several other technical manuals for Navy diving and we have recently updated and distributed the Master Divers Notebook.

In these days of austere funding, there is some concern that we will continue to receive the necessary money to support the projects that we have planned for the outyears. We can not afford to develop or procure systems that are not directly related to the improvement of diver safety and efficiency. Therefore, it is important that we manage our programs very carefully to ensure that we receive a dollars' worth for every dollar spent.

In closing I would like once again to say, we feel confident that there is a bright future for the Navy diver. There is much to be accomplished and we will continue to support every effort to intensify diver safety and to improve the working conditions for our divers.



NAVSEA 00C WELCOMES

Captain Charles A. Bartholomew

U.S. NAVY

Captain Bartholomew graduated from the United States Naval Academy in 1961, then served in several engineering billets aboard the guided missile cruiser USS PROVIDENCE (CLGG) and as Chief Engineer aboard the destroyer USS HOLLISTER (DD 788). He entered the Naval Construction Program at Webb Institute of Naval Architecture in July 1965, graduated in June 1968 and immediately entered the Navy Deep Sea Diving School at the Washington Navy Yard. His first assignment as an Engineering Duty Officer was at Long Beach Naval Shipyard where he served as Ship Superintendent and Naval District Salvage Officer.

In 1970, Captain Bartholomew was assigned to the heavy repair ship USS HECTOR (AR-7), serving as both Repair Officer and Diving Officer during a period of significant battle damage repairs and combat support operations in Southeast Asia. In 1972 he was ordered to the Naval Sea Systems Command where he held positions in the NATO Patrol Hydrofoil Guided Missile (PHM) Project and Supervisor of Salvage offices. In 1977 he was transferred to Panama City, Florida where he served as Commanding Officer of the Navy Experimental Diving Unit for over three years.

Captain Bartholomew was ordered to Pearl Harbor in 1980 to serve in the Comptroller Office of the Commander in Chief, U.S. Pacific Fleet where he managed all Fleet Maintenance funding. He next returned to Long Beach Naval Shipyard in 1983 where he was assigned as Repair Officer and then Production Officer.

In August 1985, Captain Bartholomew was transferred to NAVSEA located in Washington, D.C. where he relieved Captain C. S. Maclin as the Director of Ocean Engineering/Supervisor of Salvage and Diving.

Diver AIR SAMPLING Procedures

By NAVSEA Staff Writer

In 1977 the Naval Sea Systems Command established a program to test diver's air supply sources. Analyses are performed at all Navy diving activities, in addition to several U.S. Coast Guard, Marine and Naval Reserve Units and are required semi-annually. Diving Activities may request a Sample Kit whenever contamination of a diver's air source is suspected. Texas Research Institute, Inc. (TRI) is responsible for the analysis of the three types of samples taken: Diver's Air, Particulate, and Ambient Air (for compressor or recompression chamber samples only).

Before each sample due date, TRI sends each Diving Activity a specially tailored Sample Kit. The Sample Kit and samples are returned to TRI for analysis within three working days after the kit is received. If a Sample Kit has not been received within 15 days prior to the sample due date, the Program Administrator (Naval Coastal Systems Center, NCSC) should be notified. Each Sample Kit contains the needed equipment for the testing of the Diving Activity's air sources, instructions, data sheets, kit contents sheet, return postage tag, sampling apparatus, orifices, and spare o-rings. Different types of input source fittings and adapters for use with various types of air sources are available upon request. Diving Activities must choose from the Sample Kit the correct orifice size, filter union, and input fittings. Sample taking is done by a qualified diver within the activity, or in areas of the country where there are many diving activities (e.g., Norfolk, Panama City and San Diego), sampling may be done by TRI personnel.

At the TRI laboratory samples are tested for oxygen, carbon dioxide, carbon monoxide, methane, total hydrocarbons, and oil mist and particulates. Copies of the test results are sent ot NCSC and to the diving activity. If the results show the samples to be in excess of the Commander, Naval Medical Command specifications, NCSC is notified immediately and they in turn contact the Diving Activity. The contaminated air source is removed from service and when the problem is corrected, a new air sample is taken. After successful completion of the analysis, the air source can be returned to service.

To avoid lengthy delays in receiving Sample Kits, Diving Activities should remember and heed the following information:

- Fill out the data sheet provided in the Sample Kit completely. Many kits are unable to be analyzed because the time and the pressure of the test are not provided in the blocks indicated. The new data sheet incorporates a comments section which should be used to list any problems identified in the sample process and should be considered as the quality assurance form.
- Return the sample as soon as possible. Normally, the sample should be returned within three working days from receipt. There are a limited number of Sample Kits available and when kits are not returned in a timely manner, serious delays in reissue will occur.

Table 1
Guide to Selection of Orifice, Filter Union and Input Fitting

Type of Air Source & Capability	Sampling Equipment	Optimum Sampling Time (at 9 to 12 psig)
HPP Portable HP Compressors (Less than 8 scfm, 1000 to 5000 psig)	0.115 in. orifice (color coded, blue), URS (blue) SCUBA input fitting, 47 mm filter union	9 minutes
HP HP Compressors, SCUBA Charging Stations, HP Air Flasks (8 to 25 scfm, 1000 to 5000 psig)	0.200 in orifice, RS SCUBA input fitting 47 mm filter union	3 minutes
LP LP Compressors and Low to Medium Pressure Volume Tanks (Greater than 25 scfm, less than 1000 psig)	0.375 in. orifice, Deep Sea input fitting, 90 mm filter union, flow expander	2 minutes

• Remove the sampling caps from the sample bottle after use and ensure the shipping caps are replaced prior to shipment. Bottles with sampling caps left on or no caps installed will invalidate the test and require reissue of the Sample Kit.

• Open the valve slowly on the diver air source or charging whip. A sudden blast of air will damage the filters, prevent analysis for particulates and oil and will require resampling the air source by the Diving Activity.

• When taking the air sample, ensure the enclosed glass end of the sample bottle is pointed up and the white float rises to the top of the bottle. The sample bottle is filled with nitrogen. Unless the white float goes to the top of the bottle for at least one minute, an adequate exchange of gases for testing cannot be accomplished.

• Request only the amount of Sample Kits for air testing that are actually required. Requests for excessive amounts of Sample Kits only adds further delays to the air sampling program.

Before beginning sample taking, all equipment should be checked against the kit contents sheet for missing or damaged parts. NCSC should be notified if there are any problems. If the air source being tested is an air compressor, it should be warmed up to normal operating range before the sample is taken. A new, unused filter union must be used for each air sample taken. Table One gives the equipment required for each type of air source and the optimum sampling time. The sampling time is recommended for samples taken with a pressure reading of nine to twelve psig. If the pressure reading is lower, the sampling time should be increased.

To prevent glass fiber filter separation from the filter support screen, first slowly remove the small orange plug, and then the large orange plug from the filter union. Unscrew the orifice coupling and install the proper size orifice, inscribed numbers up. Replace the rubber gasket.

For High Pressure (HP) air sources (8 to 25 scfm, 1000 to 5000 psig) and High Pressure Portable (HPP) air sources (less than 8 scfm, 1000 to 5000 psig, see Figure 1):

• Connect the pin end of the flow section with the large end of the filter union, lining up the pins and slots. Push the filter union and the flow section firmly together and twist, locking the two parts. If the parts do not lock, remove the filter union. Keeping the large end of the filter union toward the flow section, rotate the filter union 180 degrees, lining up the pins with the opposite slots and try again. Put the pin end of the SCUBA input fitting into the small opening of the filter union and twist to lock in place.

Figure 1
Assembly for Sampling an HP Air Source

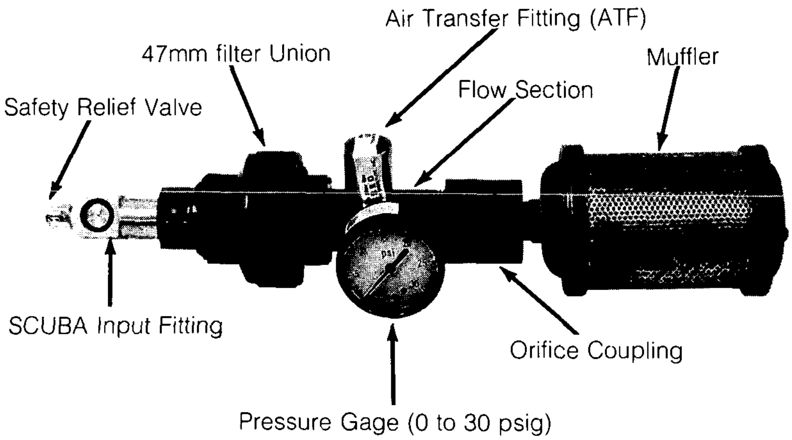
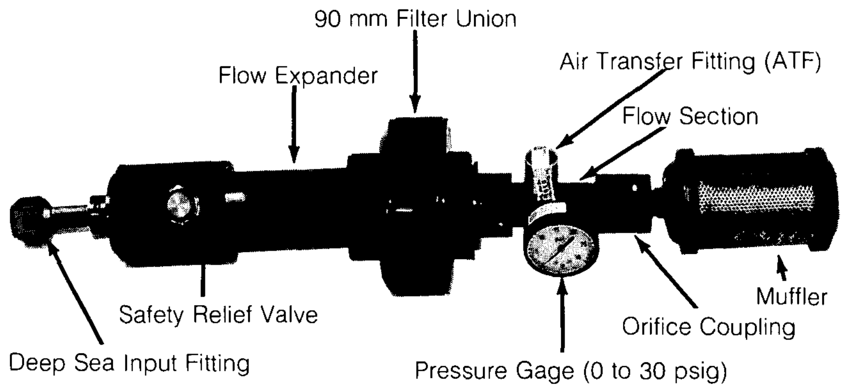


Figure 2
Assembly for Sampling an LP Air Source



Low Pressure (LP) air sources (greater than 25 scfm, less than 1000 psig, see Figure 2):

• Connect the pin end of the flow section with the small end of the filter union, lining up the pins and slots. Push the filter union and the flow section together. Twist to lock the parts. If the parts will not lock, remove the filter union. Keeping the small end of the filter union toward the flow section, rotate the filter union 180 degrees, lining up the pins with the opposite slots and try again. The large diameter filter for LP sources is always used with a flow expander, guaranteeing even dispersion of air flow and equal distribution of particulates and oil mist over the filter surface. Connect the pin end of the flow expander to the large end of the filter union and twist to lock. Put the pin end of the Deep Sea input fitting (or other appropriate input fitting) into the small opening of the flow expander and twist to lock in place.

• Blow out the air line for all sources to be sampled with a short burst of air. Connect the sampling equipment to the diver's air source outlet. Remove the shipping cap from one of the unused sample bottles and replace it with a sampling cap. Sampling caps have holes through their centers, allowing the needles of the air transfer fitting (ATF) to go

Figure 3
Sample Bottle and Associated Components

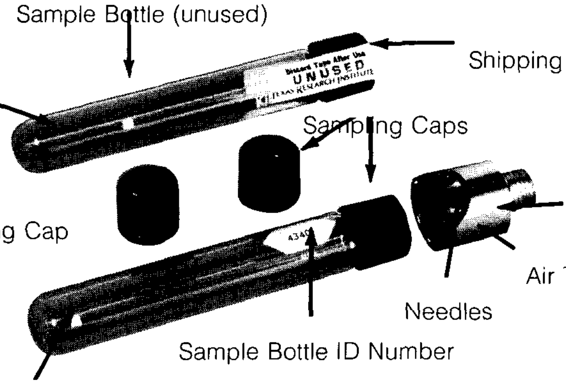
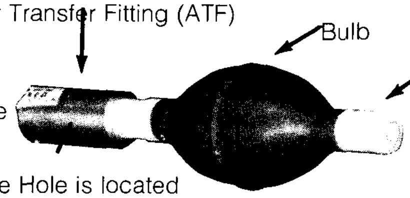


Figure 4
Ambient Air Sampler



through the rubber septum inside the sample bottle.

The Particulate Sample collected on the filter in the filter union is a timed procedure. The Particulate Sample can be collected at the same time that the Diver's Air Sample is being taken.

Carefully open the valve on the air supply system, which gives the best control over the flow rate. Increase the air flow through the sample equipment until the gage reads a steady 9 to 12 psig. The pressure should be kept constant throughout the sample taking.

The Diver's Air Sample is collected in a sample bottle (see Figure 3) at the same time that the Particulate Sampling is being done. Push the sampling cap end of the sample bottle straight into the ATF, being careful not to bend or twist the bottle. The enclosed glass end of the sample bottle must be pointed up. The white float should rise inside the sample bottle. If the float does not remain at the top of the sample bottle, no air is flowing. To start the air flowing, tap the bottle lightly or push it tighter (do not twist) against the ATF. If this does not work, pull the sample bottle straight out of the ATF, rotate it slightly, and push it back in.

Take the sample for at least one minute. Remove the sample bottle from the ATF, replacing the sample cap with a shipping cap. Continue the air flow through the sampling equipment until the Particulate Sample has been collected.

After the time for taking the Particulate Sample is up, shut off the air supply. Disassemble the sampling equipment. Replace the orange plugs (large one first) to prevent the glass fiber filter from being dislodged. Fill out completely the data sheet. The Ambient Air Sample is taken before the air compressor is shut down.

The Ambient Air Sample, collected in a sample bottle, is taken from the air near a compressor's intake while the compressor is running. The effectiveness of the compressor's filtration system and the purity of the air being drawn from the atmosphere can be determined from the sample. Samples from inside recompression chambers or other hyperbaric structures can also be collected.

The procedure for collecting Ambient Air Samples is the same for all types of air compressors or recompression chambers. Ambient Air Samples are not taken at SCUBA charging stations, HP air flasks, LP volume tanks, or any HP or LP air sources where there are no air intakes.

Replace the shipping cap of an unused sample bottle with a sampling cap. Push the sample bottle straight into the air transfer fitting (ATF) of the Ambient Air Sampler (see Figure 4). Place the small intake hole of the Ambient Air Sampler, found on the surface of the ATF, near the air intake of the compressor. Firmly pump the bulb of the sampler a minimum of 10 times, pausing between each pump to allow the bulb to fully inflate. The number of pumps must be recorded. The white float rises to the upper end of the bottle if air is flowing through the bottle properly. The white float should completely recede to the cap end of the bottle between pumps and before removing the completed sample. Do not breathe toward the Ambient Air Sample while collecting the sample. Remove the sample bottle from the ATF, replacing the sample cap with the shipping cap. Fill out completely the data sheet.

When all the diver's air sources have been sampled, repack the Sample Kit with the samples, data sheets, sampling equipment and instructions. Make sure all blanks have been filled in on the data sheets. Mail the Sample Kit back to the laboratory using the enclosed postage tag. NCSC point of contact is Wally Jenkins, AUTOVON 436-4482. 00C point of contact is Joe Williamson, AUTOVON 227-7606.

The OLD MASTER

The personnel listed below manage salvage and search and recovery projects for NAVSEA-OOC. In addition, they coordinate NAVSEA contractors when we are tasked to assist the Fleet in conducting an operation and provide advice in their areas of expertise. Although each Operations Specialist concentrates in one area, they are qualified to manage all types of salvage projects.

Tom Salmon manages the search and recovery contractors and all tasks assigned to them. He specializes in searching for and recovering aircraft and other objects and has three years of experience as a Naval officer and over ten years of experience in the search and recovery field.

Jerry Totten manages the ESSM bases, material in the bases and the contractor operating the bases and maintaining the equipment. Mr. Totten, who has 19 years of experience, specializes in salvage operations.

Jim Bladh is responsible for managing the NAVSEA hull contractor and works with the Fleet to schedule and plan cleaning operations. Also a specialist in salvage operations, Mr. Bladh spent 30 years in the military and has worked for the past ten years in the Office of the Supervisor of Salvage.

Bill Walker manages NAVSEA-OOC's oil and hazardous spill response operations, conducts training drills for the NAVSEA contractor and the Fleet and supervises the development and maintenance of oil spill equipment in the ESSM equipment pools. Mr. Walker has over 17 years of experience in the field and headquarters in his area of expertise, both in the military and as a civilian at SUPSALV.

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