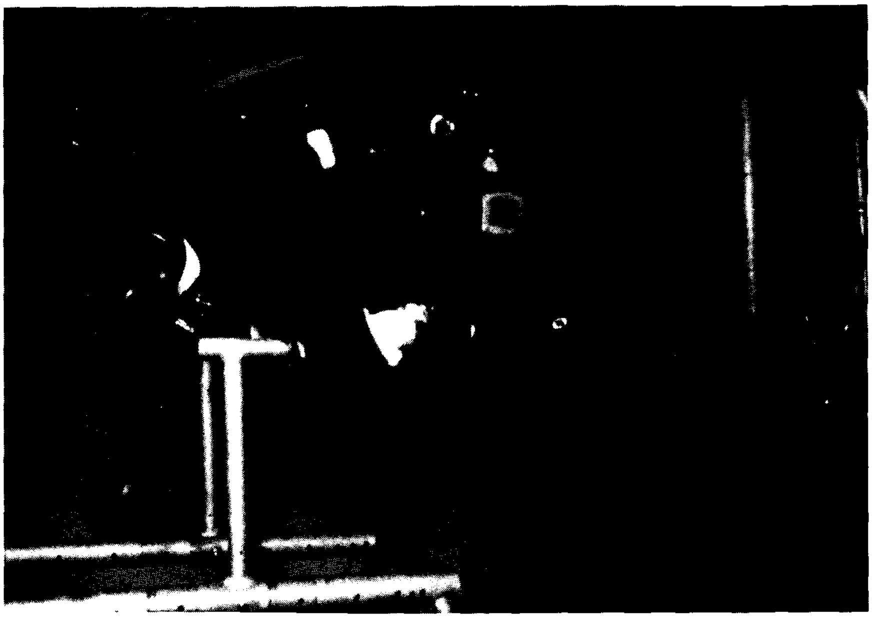
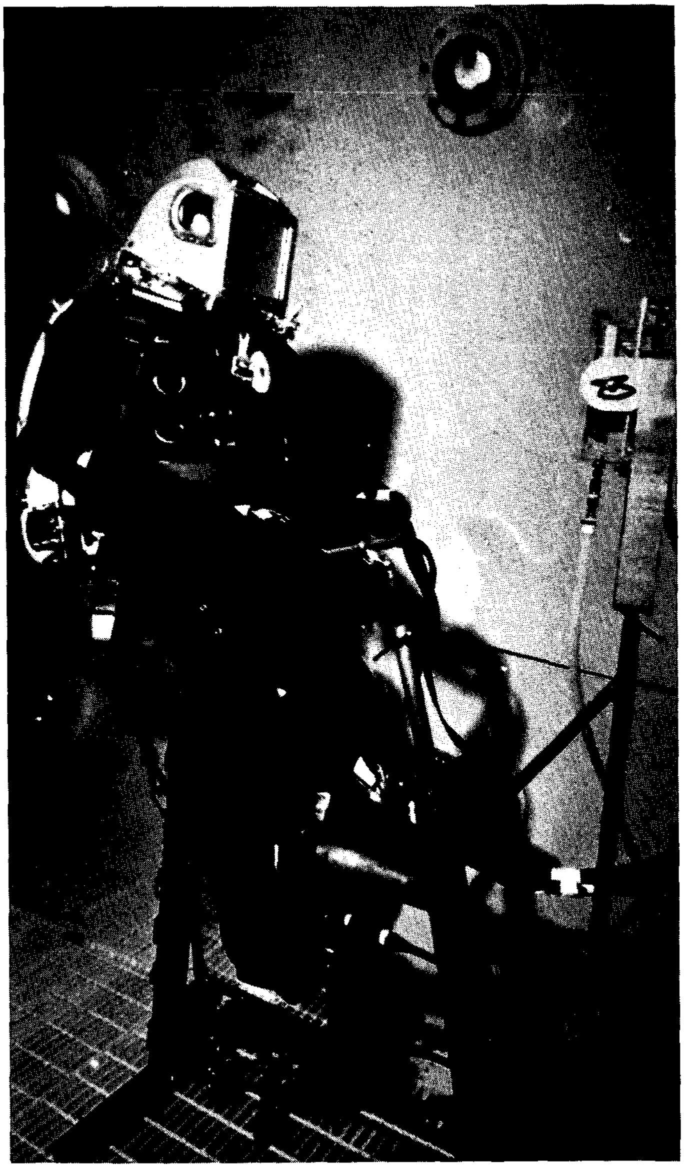
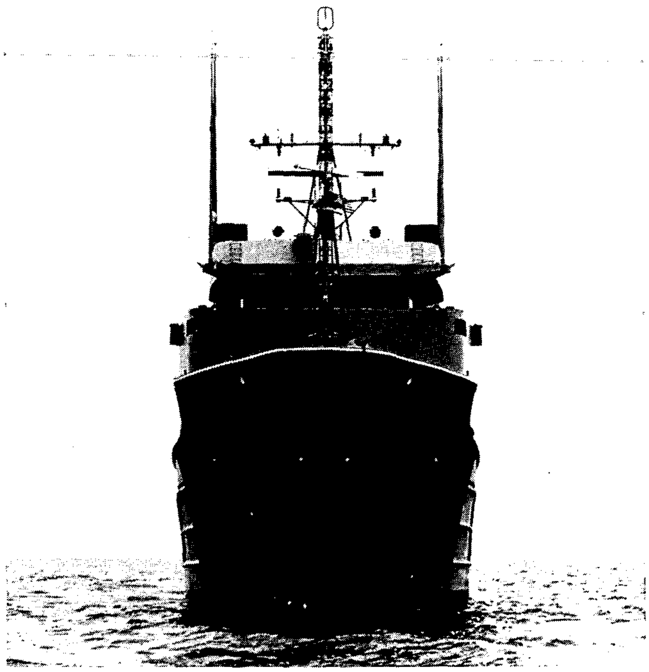

FACEPLATE
WINTER 1980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FACEPLATE

. . . the official magazine for the divers of the United States Navy

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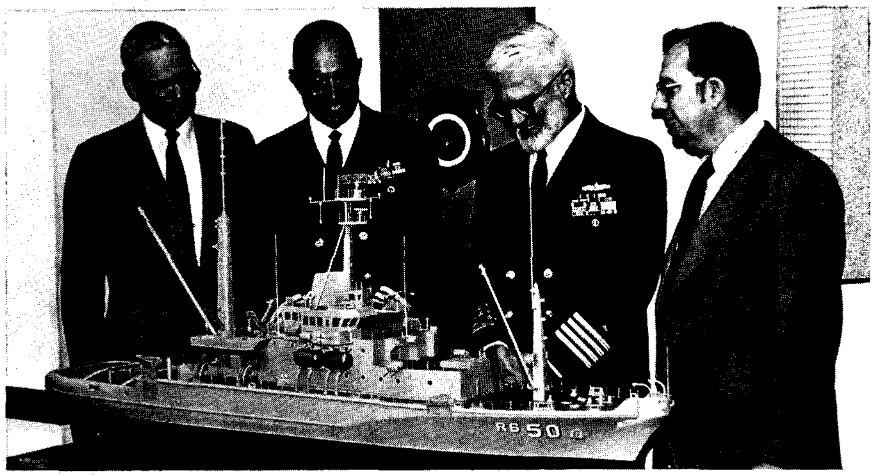
Cover: Mk 12 diver surveys sunken German submarine. Inside cover: Clockwise from top left: fireboat is lifted to surface; Mk 15 diver on horizontal ergometer in the OSF; T-ATF CATAWBA; BUD/S diver escape training; Mk 12 diver on vertical ergometer. Back cover: Mk 12 diver inspects another area of sunken German sub.

SOUNDINGS



Viewing a model of the ARS-50 Class ship are (left–right): ADM T. M. Hopkins, Deputy Commander for Ship Systems (SEA-05); CAPT Colin M. Jones, Director of Ocean Engineering, Supervisor of Salvage (SEA-OOC); CAPT Peveril Blundell, Executive Director, Ship Design and Integration Directorate (SEA-03); and CAPT Edmund C. Mortimer, Project Manager, Auxiliary/Special Mission Ship Acquisition Project. This gathering occurred at the ceremony for the approval and signing of the specifications and the contract drawings of the ARS-50. The Design Manager for the ARS-50 is SEA-03; the Acquisition Manager is PMS-383.

CDR Bob Bornholdt (left), CO of NEDU congratulates LtCDR Harper.

CORRECTION

A sentence on page 6 of the Fall issue was inadvertently left out of the first NEDU abstract, which may or may not have caused some ambiguity. The Superlite 17B met and exceeded all MIL SPEC requirements. The actual report goes on to state "this helmet should provide the diver with a high performance piece of life support equipment under even the most demanding conditions." The Superlite 17B is not authorized for Navy use since the Navy has no requirement for this type of equipment in addition to its own Mk 1 Mod 0 mask."

LCDR MELAMED, ISRAELI NAVY, VISITS NEDU

From August 21 through September 16, 1980, LCDR Yehuda Melamed, MD, of the Israeli Navy was a guest of the Navy Experimental Diving Unit (NEDU). Doctor Melamed is Commanding Officer of the National Israeli Hyperbaric Institute, which is responsible for all of Israel's diver equipment testing and hyperbaric research. His tour at NEDU was spent working closely with the Medical and Test and Evaluation Departments to get first-hand experience in saturation diving techniques and unmanned diver equipment testing. He arrived in the United States in January 1980, visiting various university, commercial, and military diving facilities to gain state-of-the-art knowledge for the Israeli Military diving community.

CAVE DIVING

Cave diving appears to have great appeal to many sport divers, including some Navy divers. Three Navy men were recently lost in a cave diving casualty, a most regrettable occurrance. Cave diving is not encouraged in any way. However, if Navy personnel persist in this activity in their off duty hours, they should realize that additional training is required. An excellent pamphlet entitled "Cave Diving Safety" is available from the National Speleological Society, Cave Avenue, Huntsville, Alabama 35810.

HARPER MAKES LTCDR, RELIEVES HARWOOD AT NEDU

Stu Harper, Royal Navy, was recently promoted to LtCDR at his new posting, the Navy Experimental Diving Unit, Panama City, Florida. LtCDR Harper relieved LtCDR Mike Harwood as the RN Personnel Exchange Program Officer in diving on September 17, 1980.

LtCDR Harper has served in the Royal Navy for 12 years. He has been an MCD (Mine Warfare and Clearance Diving Officer) since 1974. Before his arrival at NEDU, he was a Principle Warfare Officer aboard the anti-submarine frigate HMS Dido.

LtCDR Harwood returned to the UK after participating in the advancement of several USN EOD-related projects, including the Mk 16 Underwater Breathing Apparatus, the Portable Recompression Chamber, and the Mk 4 Divers' Life Vest. He is presently assigned to the Admiralty Underwater Weapons Establishment in Portland, England.

CAPT Dunbar and HTCM(MDV) Mundy.

HTCM(MDV) MUNDY TO FLEET RESERVE

At ceremonies held at the Naval Explosive Ordnance Disposal Technology Center (NAVEODTECHCEN) at Indian Head, Maryland, CAPT R.M. Dunbar, Commanding Officer, presented HTCM(MDV) Jon Mundy the flag and an engraved Boatswain's pipe as lasting mementos as he enters the Fleet Reserve after 23 years of Naval service. Master Chief Mundy was also awarded the Navy Commendation Medal in recognition of his achievements while serving as Command Master Diver. Most noteworthy of his accomplishments were in the certification of the Technology Center's hyperbaric facilities as one of the finest in the Navy and the successful Fleet acceptance of the Area Point Search System (APSS) developed at NAVEODTECHCEN.

NEW CANADIAN FORCES EXCHANGE OFFICER ARRIVES AT NEDU

LT Ed Pahl, Canadian Forces, relieved LT Moe Coulombe as Canadian Exchange Officer at the Navy Experimental Diving Unit on August 1, 1980.

LT Pahl was commissioned from the ranks in 1975, after 13 years enlisted as a clearance diver. He attended the First Class Divers Course at the Naval School of Diving and Salvage (NSDS) in 1972, during which he attained salvage and HeO_2 training. His last 2 years of duty had been as Training Officer at the Fleet Diving Unit, Pacific in Victoria, B.C.

LT Coulombe was commissioned from the ranks in 1969, after 11 years enlisted as an underwater weaponsman. He attended NSDS for the Salvage Officers course in 1973. His duty at NEDU has been as the Project Officer for the Mk 12 SSDS, where he saw successful completion of the mixed gas mode development in Technical and Operational Evaluations. LT Coulombe returned to Fleet Diving Unit, Atlantic in Shearwater, Nova Scotia, as Training Officer.

FLYAWAY RECOMPRESSION UNIT BUILT AT WEST LOCH

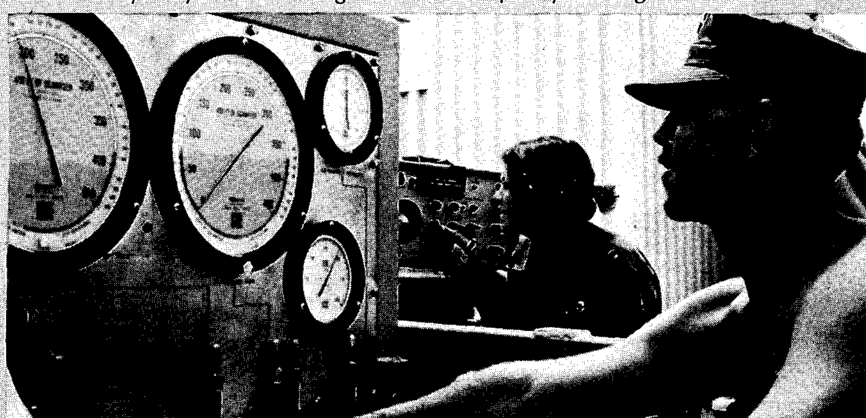
Using bold initiative and rising above and beyond the call of duty, Navy divers of the Explosive Ordnance Disposal Training and Evaluation Unit ONE (EODTEU-1) built a mobile Flyaway Air Diving and Recompression Chamber System—the only one of its kind in the vast Pacific. Led by Master Diver Dennis Wiley, they undertook this unique venture because they saw its on-site potential in salvage and rescue operations.

Countless donated man hours on the part of EODTEU-1 and some industrious engineering and technical research went into building the system. The Navy Department recognized their efforts through the issuance of Navy Achievement Awards. Along with Diving Officer LT John G. Honer (now retired) and Gunners Mate Stan Ryley, Jr., Master Diver Wiley was commended for his vital role.

The main objective was to get the complete system to fit a standard, 74-foot "Mike Boat" (LCM-8), without any modifications to the craft.

The module is portable, it's flexible, and can be taken apart. It can be picked up, placed on a van, carried aboard ship, fitted on a barge, or even lifted via helicopter to wherever distressed Navy divers may be coping with the bends or air embolism.

The divers received full certification from Commander Naval Sea Systems Command (NAVSEA). In fact, the first review by the inspecting panel gave a flawless "zero discrepancy" rating.



Scuba Diver Seaman Jennifer Bushur (background) talks to a diver through the "scrambler" intercom, while Chief Boatswain's Mate Diver John Sheadel operates the console.

NSWC: ANOTHER ANGLE ON THE MK 12 DEVELOPMENT

Packaging the Mk 12 for shipment.

This article is reprinted from "On the Surface"—weekly newsletter for the Naval Surface Weapons Center. The author is Ms. Ann Revercomb.

Unplug the old system, plug in the new—an almost effortless procedure that in its simplicity belies the extensive work required to develop a concept into a usable, more efficient product.

The new Mk 12 Surface Supported Diving System is no exception. As 40 complete diving outfits were delivered this calendar year to operational Fleet units, new ship constructions, and shore installations, trained military personnel will be "plugging in" the Mk 12 system to existing onboard equipment. Each delivery culminates a 4-year effort to provide the Fleet with an alternate to the old Mk 5 diving system, adopted more than 60 years ago as the standard system for use by all Navy divers.

The Naval diving community is already finding the new Mk 12 system an improvement in many ways. For the past year, Mk 12 outfits have been used in Navy diving schools across the country for training purposes. As anticipated, the Mk 12 is proving to be more comfortable and safer for divers, while allowing them greater mobility and flexibility of tasks.

The modernization project was initiated through the encouragement of the Navy Experimental Diving Unit (NEDU), Panama City, Florida, the originators of the basic concept for the new system. In the late 1970's, full sponsorship was shifted to NAVSEA, with guidance provided by Program Manager Jack Stockard (OOC) and CDR James E. Roper, USN, Supervisor of Diving. Lending its design and engineering expertise to the effort was the Naval Coastal Systems Center (NCSC), Panama City, Florida.

The role of the Naval Surface Weapons Center (NSWC), Dahlgren, Virginia, began during the preliminary design phase in 1976 and has extended throughout the development and procurement stages, according to Bill Furchak (G52), NSWC's former Mk 12 Project Manager.

"We started out as a technical support agent for NEDU and NCSC," he explained. "Our responsibilities include providing design review; preparing software documentation; performing environmental testing; and conducting reliability and maintainability analysis. We were subsequently designated as system configuration manager and as system acquisition agent for NAVSEA. In this capacity, one of our most significant accomplishments was to develop the procurement package for commercial production of the Mk 12."

"In essence, our contributions in this phase helped to get this equipment to the Fleet faster and in a more mannerly and organized fashion," he continued. In addition to these functions, NSWC is involved in design and redesign of various components for the Mk 12 system and in providing technical expertise to Fleet units using the system.

June 20, 1980, was a red-letter day for personnel from the Engineering Branch (G52), who had worked diligently on the project. Assembling and packaging two Mk 12 outfits were completed on this day, and the first shipment to an operational Fleet unit—Harbor Clearance Unit ONE, Pearl Harbor, Hawaii—was under way. Thirty-eight additional outfits will be shipped to 23 locations by the end of the year, completing the FY78 procurement schedule.

NSWC personnel are also handling Fleet procurement contracts for the FY79 and FY80 buys. With 29 Mk 12 outfits purchased for 1979 and 27 for 1980, component equipment arrives regularly at Dahlgren and is stored in the Seaplane Hangar until Fleet deliveries are executed.

As each outfit is delivered, it is hooked up to on-board equipment previously used in support of the old Mk 5 diving system. The efforts of many individuals have been, and continue to be, necessary for the Mk 12 system to reach this final stage. Five Center engineers have participated on the project over a period of 4 years: Don vonAdlerhoch (SEA-05J), Project Manager from 1976 to 1978; Jim Mallis (G51); Bill Furchak (OP-051C), Project Manager from 1978 to August 1980; Jim Rasor (G52), the current Project Manager; and Cary Chen (G52).

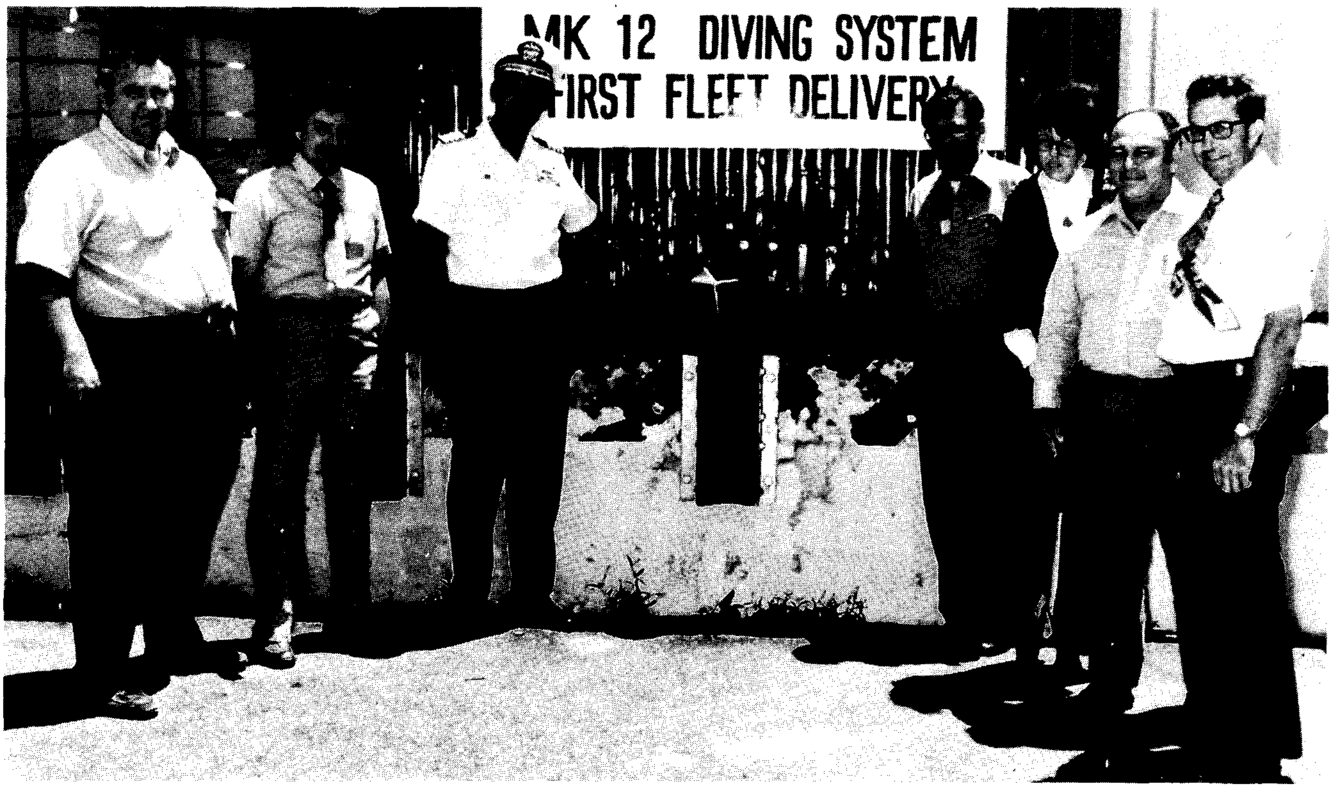
Able assistance has also been provided by civilian employees and Navy personnel detailed or loaned to the Engineering Branch of the Survivability and Applied Science Division, where the program resides. Included among them are: Curtis Sisk (G23), a co-op student; Barbara Hall (M31), detailed from Travel Claims; Dorothy Bowers (S12), who provided contracting support; EMC Wayne Walker, USN; and BMC (MDV) "Pete" Petrasek, USN (Ret.).

EMC Walker's services have been especially noteworthy, explained Furchak. "While being regularly assigned to Yardcraft (G63), Chief Walker has managed to perform his duties there as well as lend some of his electronics expertise for the development of test procedures and for the packaging and assembling of Mk 12 electronic equipment."

Essential support has also been provided by Petrasek, added Furchak. "Before his recent retirement, BMC Petrasek was the diver detailer for the Navy. He came aboard for 6 months in 1979 to coordinate the detailing of Diving Supervisors to Dahlgren so that they could learn assembly procedures for the new equipment, preventive maintenance measures, and corrective actions. He also coordinated the delivery of equipment to the diving schools, allowing the Diving Supervisors to train other divers in the use of the Mk 12 system."

Especially appreciated was the work of ENC Clark P. Grover, USN, and ENC Gene Ganske, USN. These chiefs, detailed to NSWC for a short period, handled the breakdown of bulk shipments into individual items, repackaging into individual outfits, and boxing of the outfits for shipment.

The Mk 12 system has already proven its worth to the Navy. It has been used in salvage operations in the Great Lakes; on the salvage of USCG BLACKTHORN, sunk in Tampa Bay; and on dives to remove explosive ordnance from the sunken German submarine U-352. Divers involved on this last operation stated that only the Mk 12 made this dive possible.



NSWC management team, l-r: Jim Rasor, Bill Furchak, CAPT Paul Anderson, Dr. L.L. Hill, Dorothy Bowers, Pepe Sanchez, and David Malyevac.

Mk 15 Update

LCDR Dennis Baber, USN
Navy Experimental Diving Unit

Several important achievements have been realized in the Special Warfare Community concerning the development of the Mk 15 Underwater Breathing Apparatus (UBA). In April 1980, the Chief of Naval Material granted Approval for Service Use (ASU) for the Mk 15 UBA and the Full Face Mask after the successful completion of their operational evaluation. In addition, the Mk 15 UBA Tables were revised, resulting in a better set of diving tables with which a diver can remain at depth for a longer period of time.

The Mk 15, developed and manufactured by Biomarine Industries, is designed to support Special Warfare operations. To date, 100 units have been delivered to the Fleet; and it has been one of the diving rigs used at the Basic Underwater Demolition/SEAL training course at the Naval Amphibious School in Coronado, California, for approximately 2 years.

The Mk 15 is a closed-circuit, self-contained, underwater breathing apparatus which circulates the diver's respiratory gas through a carbon dioxide absorbent canister. Biologically consumed oxygen is made up and automatically mixed with the diluent gas (air or nitrogen) through an electronic oxygen sensor array to maintain a preset 0.70 ATA constant partial pressure of oxygen regardless of depth. The N_2-O_2 breathing medium extends Special Warfare mission durations and facilitates in-water decompression when required.

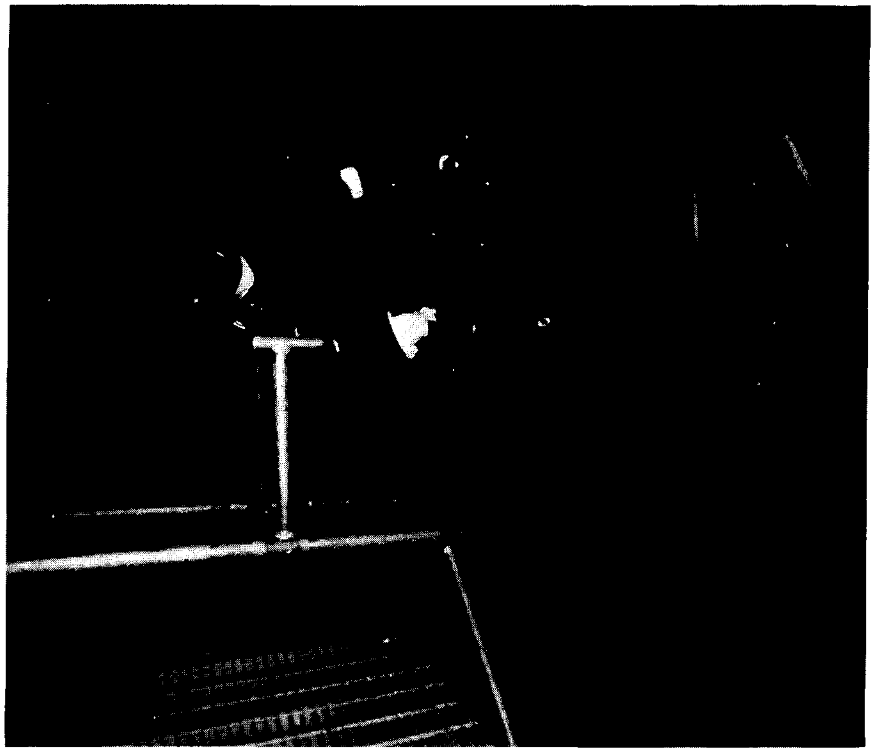
An arm-worn Underwater Decompression Computer (UDC) for use in concert with the Mk 15 UBA and Full Face Mask is currently under development. During the summer of 1980, 24 Special Warfare combat swimmers from Underwater Demolition Teams ELEVEN, TWELVE, and TWENTY-ONE, and SEAL Team ONE participated in an experimental dive series at the Navy Experimental Diving Unit (NEDU). During this series, 204 man dives were conducted in the NEDU Ocean Simulation Facility (OSF) hyperbaric chamber complex. The purpose of this study was to revise the initial Mk 15 Decompression Tables. A significant achievement of this program was the extension of no-decompression limits at 40, 50, 60, 80, 100, and 120 feet of seawater (FSW), respectively. The resulting longer no-decompression limits will provide Special Warfare divers with the flexibility needed for both training and operating scenarios. Data collected by NEDU medical personnel will ultimately be incorporated into the UDC software program.

All dive profiles tested multiple, repetitive "working" dives in cold water with 60- to 80-minute surface intervals during which the divers vigorously exercised. Each dive profile totaled 5 to 6 hours in duration. The 100-FSW no-decompression dive profile (water temperature was 60°F) is representative of the multiple, repetitive dives conducted in the OSF wet chamber (below).

During the course of testing, the algorithm used for computing Mk 15 UBA diving tables was revised. Full details of the modified algorithm along with the complete findings of the testing will be the subject of a future NEDU report. Revised decompression times for Mk 15 UBA diving will be promulgated in a forthcoming change to the U.S. Navy Diving Manual.

DEPTH (FSW)	STOPS (Minutes)	ACTIVITY
100	17	
0	80	3.2 Mile Run
100	17	
0	80	Rest
100	17	
0	80	3.2 Mile Run
100	17	

Dive Profile.



Photos show scenes from Mk 15 UBA study in the Ocean Simulation Facility, during which decompression tables were revised.

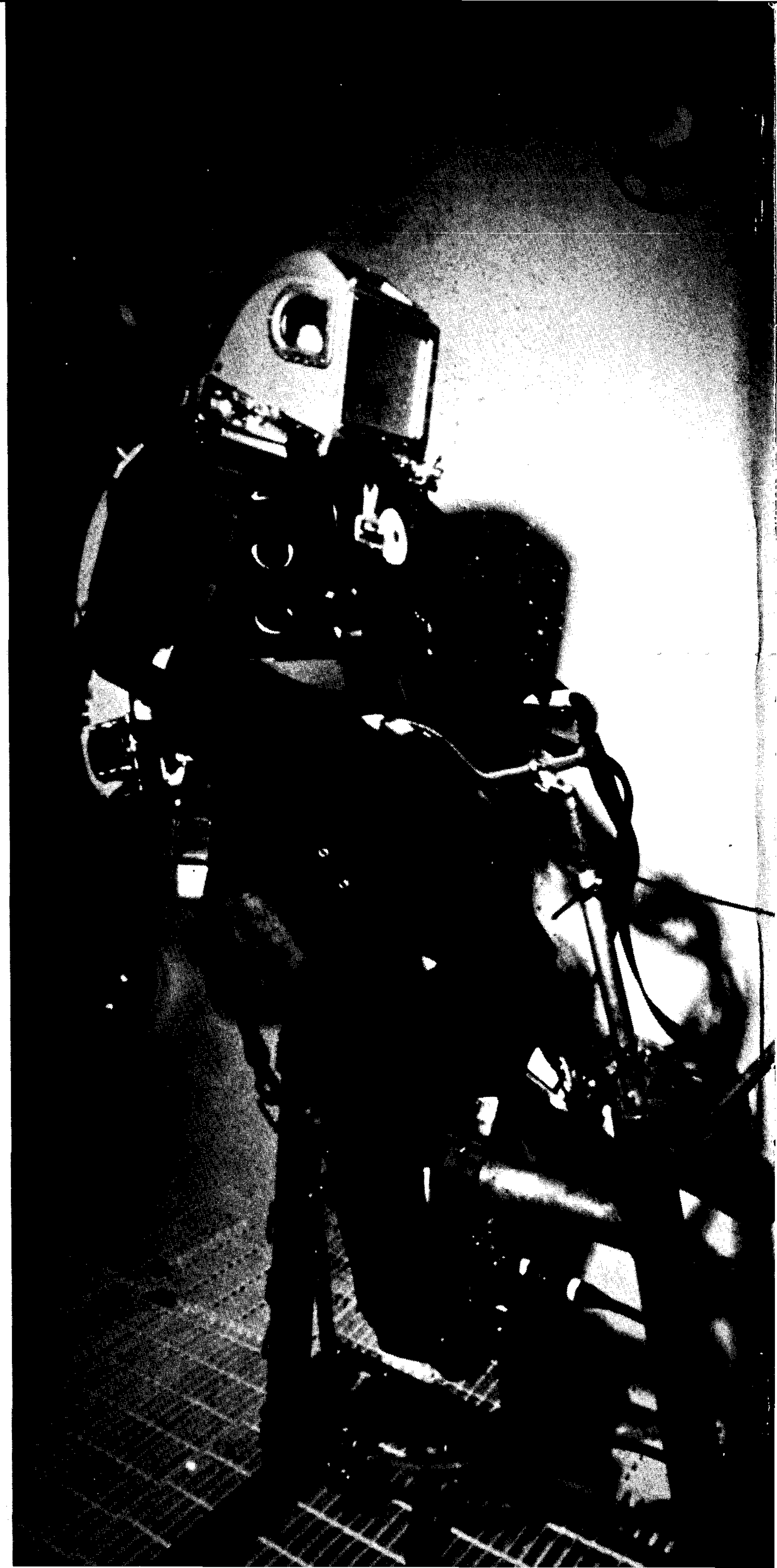
DEEP DIVE '80

LCDR J.T. Harrison, USN
Navy Experimental Diving Unit

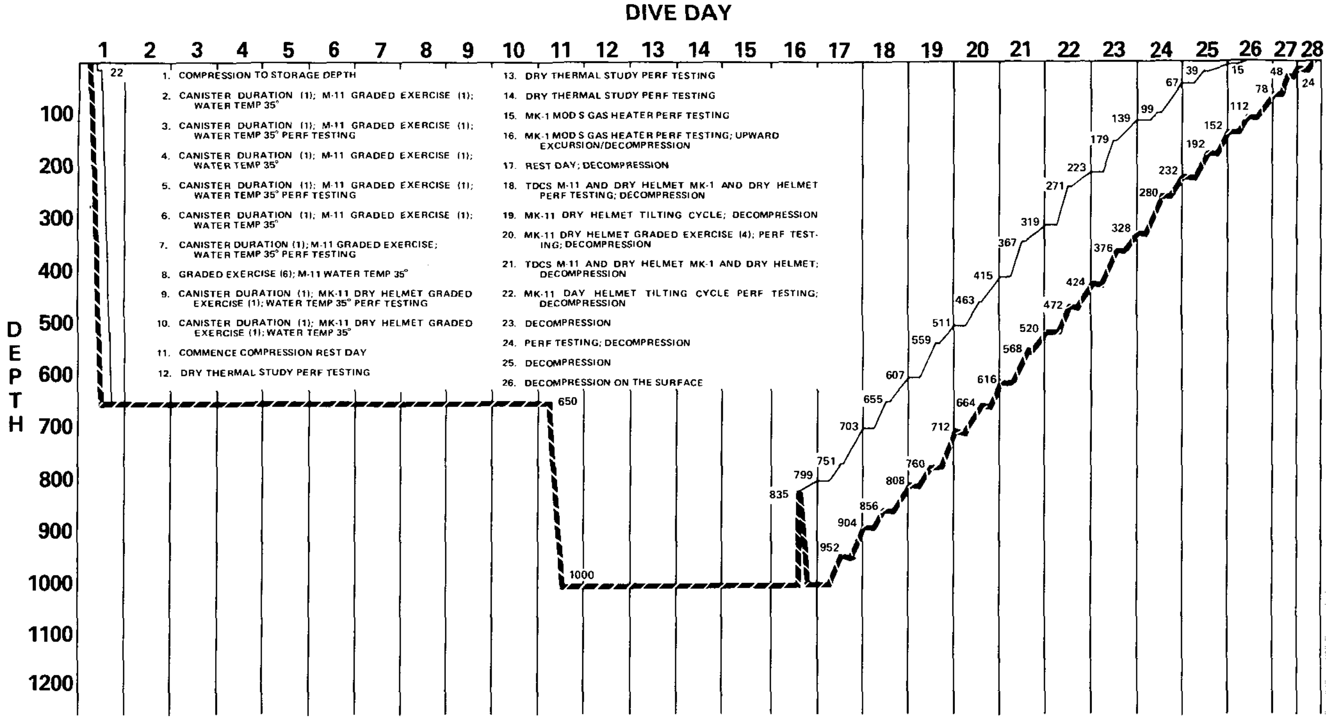
The initial push for DEEP DIVE 80 commenced in December 1979, immediately after the completion of DEEP DIVE 79. Although no further dives have been planned that would approach the complexity or the historical achievement of the 1,800 feet-of-seawater (FSW) DEEP DIVE 79, it was known that a dive of lesser depth would be required within the next year to verify the life-supporting characteristics of the Mk 11 Underwater Breathing Apparatus (UBA) to a depth of 650 FSW.

During the ensuing year, personnel at the Naval Coastal Systems Center (NCSC) developed what appeared to be a reliable change to the Mk 11 UBA breathing loop. After full unmanned testing in the NCSC Hydrospace Lab, the equipment was considered ready for manned testing.

1 September 1980, marked the selection of a seven-man Dive Team and the beginning of 12 weeks of extensive, detailed, and exhaustive training. During the first 5 weeks, the Diver-Subjects never exceeded 15 FSW in the Ocean Simulation Facility (OSF) test pool, but they worked constantly towards equipment familiarity and physical conditioning in preparation for the dive. All seven members, plus two dive supervisors, had to become intimately familiar with the Mk 11



NEDU DEEP DIVE 1980



Above: Projected and actual Dive profile. Below, top row, left-right: CE1(DV) Anderson, ENC (DV) Daigle, EN2 Carolan. Bottom row, l-r: HTC (DV) Baiss (Dive Team Leader), EM1(DV) Patterson, EM1(DV) Moldenhauer, BM1(DV) Bouchey.

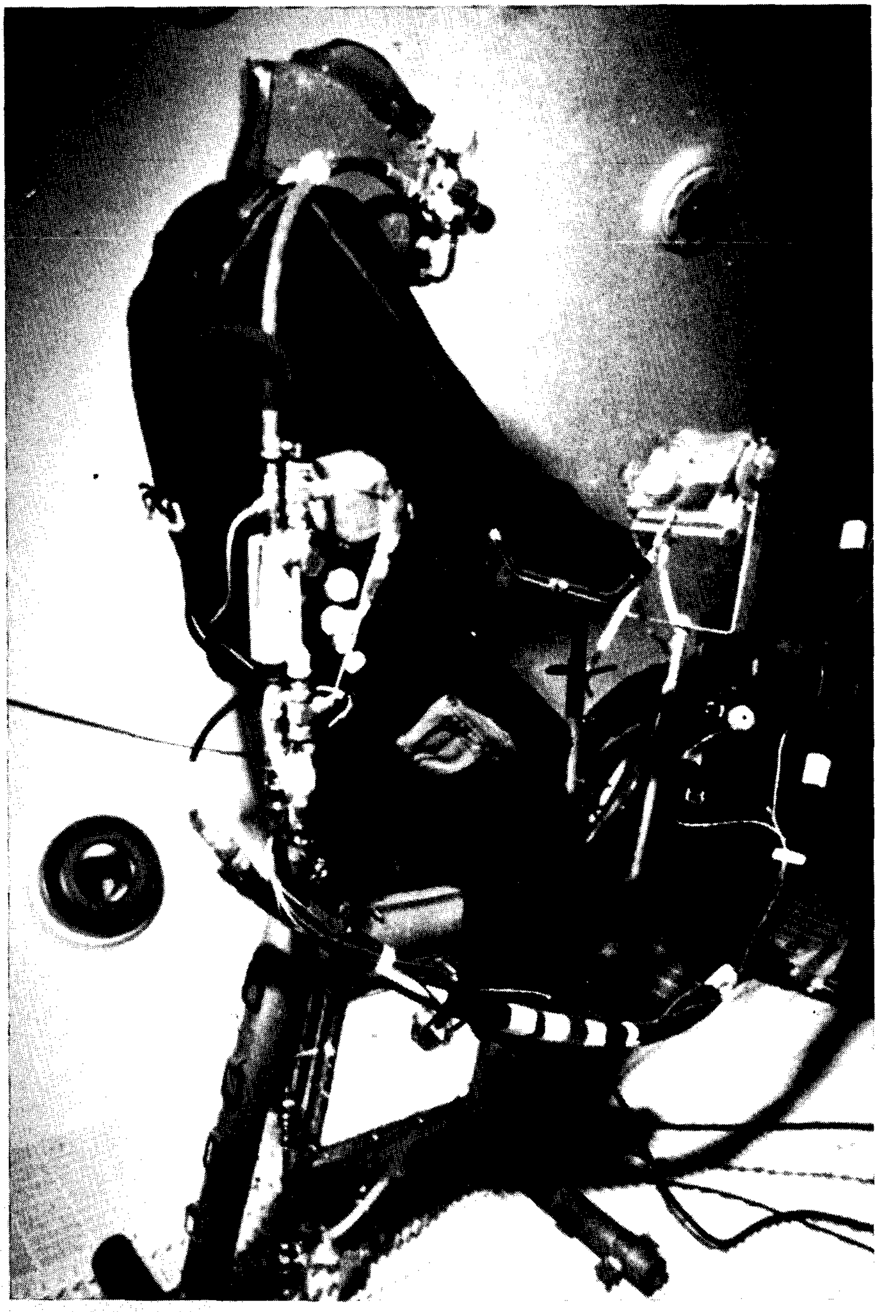
UBA, the Mk 11 Dry Helmet, the Mk 1 Mod S, and the Non-Return Volume (NRV) Hot Water Suit. Nominal familiarity with the equipment is standard, but NEDU requires that Diver-Subjects be thoroughly prepared for any and all emergencies that may occur. The only way to attain such an extensive level of training is to log many in-water hours with the dive rig—repeating drill, after exercise, after drill.

Following the 5 weeks of pool training, the OSF watchstanders turned to the job at hand. For the ensuing 4 weeks, all seven dive participants were compressed to 30 FSW daily inside the OSF complex. The purpose of this daily pressurization is threefold: First, medical studies require at least 28 psi pressure to supply sample gas to equipment to monitor divers' oral/nasal

and CO_2 canister gas content. Second, the divers are introduced to what will become their home for the actual saturation dive, and by having them at depth within an enclosed environment, they are able to adjust to the reality of total confinement. Third, it afforded realistic training to the OSF watchstanders.

The OSF is the largest and most sophisticated hyperbaric complex in the world, with 3,076 cubic feet of dry living area and a 55,000-gallon wet chamber. It has six Environmental Conditioning Systems (ECS), five mixed gas lines to each chamber, an elaborate fire suppression system, and an extensive communications network. As a result, the start-up operational procedures are extensive, and the total, undivided attention of each watchstander is required. Although all watchstanders have received qualification training and have been duly certified by the NEDU Qualification Board, familiarization training is always conducted for all hands before divers enter the chambers. This practice ensures that watchstanders are aware of any changes that may have been incorporated into the system since previous training diving operations.

Diver wearing Mk I Mod S, using a Kinergetics heater.



After the 5 weeks of pool training and 4 weeks of training within the OSF, DEEP DIVE 80 was ready to proceed. The chamber was pressurized to 650 FSW on Dive Day 1 (November 4, 1980), and for the next 9 days, CO_2 absorbent canister duration and graded exercise studies were conducted. Dive Day 10 included pressurization to 1,000 FSW. For 5 days, the divers conducted dry cold thermal studies and wet Mk 1 Mod S dives for gas heater studies, using the Kinergetics Model 3375-3 heater.

After completion of the work at 1,000 FSW, an initial experimental upward excursion of 170 FSW was conducted. This resulted in vestibular decompression sickness to one of the seven Diver-Subjects, who was successfully treated upon recompression back to storage depth. The following morning, 12 hours after the excursion bends, Standard U.S. Navy Saturation Decompression was practiced and proceeded without incident for the next 11 days to the "surface."

During the decompression phase, the studies were continued with the Mk 11 UBA, the Mk 11 Dry Helmet, the Tethered Diver Communications System (TDCS), and human physiological studies to measure mental attitude and aptitude. The divers "surfaced" on 1 December in good condition.

DEEP DIVE 80 was considered a great success because of the amount of reliable test data obtained from the medical studies and the overall performance of the Diver-Subjects. NEDU's next planned deep saturation dive to 1,000 FSW is scheduled for the July/August 1981 timeframe.

BUD/S: STEP ONE FOR A "SPECIAL" CORPS

Above: small boat exercise. Below: mud-caked HELL WEEK participant.

There is a certain mystique about the U.S. Navy Special Warfare Community and its members. It is one of adventure, of physical and mental toughness, and--at times--of intrigue. These men have been described as "part commando, part bushman, and part SCUBA diver . . . who know the risks and take them . . . . Men to count on."

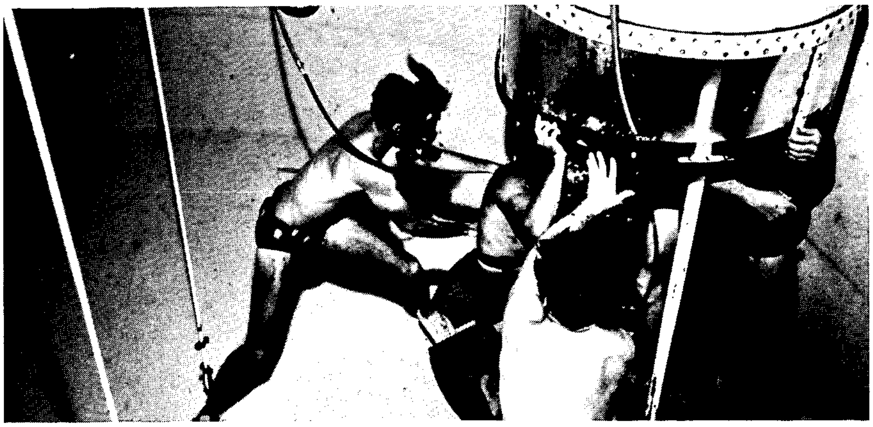
Fact, fiction, or a little of both? Any attempt to answer this question must first include a look at where it all begins: BUD/S, the Basic Underwater Demolition/SEAL training course taught at the Naval Special Warfare Training Department, Naval Amphibious School, Coronado, California.

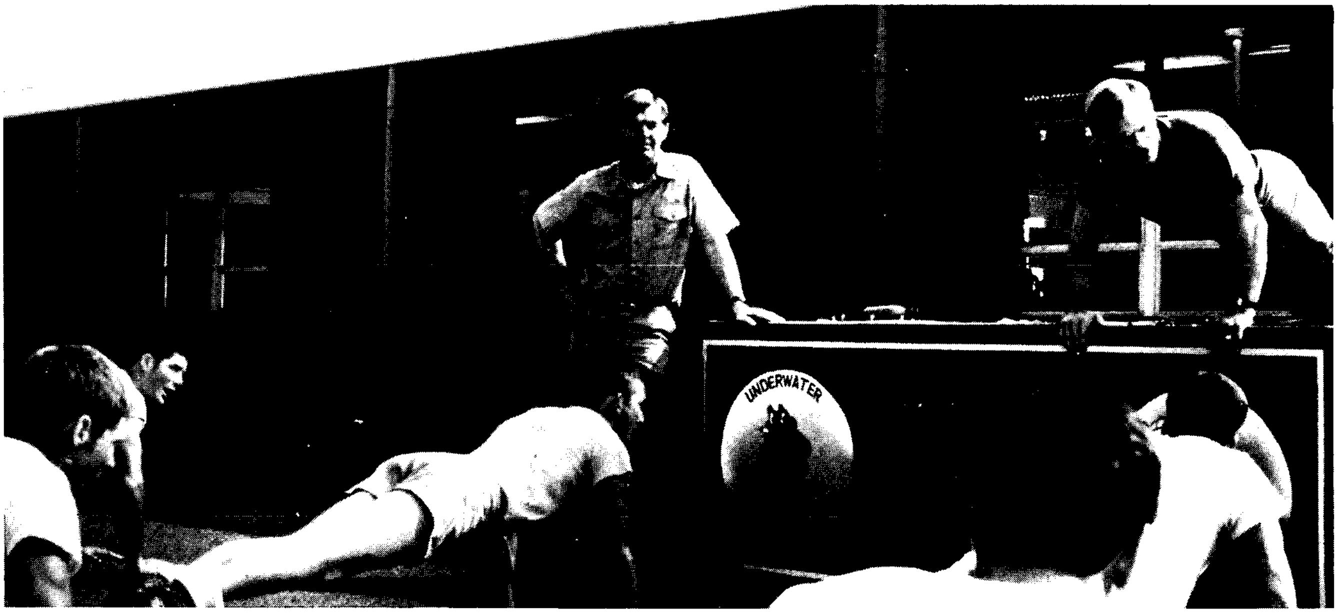
BUD/S' mission is, simply, to train motivated U.S. and--on occasion--assigned allied personnel as Navy volunteers for duty with the Naval Special Warfare Units: The Underwater Demolition Teams (UDT) and the Sea Air Land (SEAL) Teams. The term "motivated" is key here because personal drive and determination are essential not only to complete the rigorous 23-week course, but just to enter it.

Prospective candidates for BUD/S volunteer from the following sources: The Naval Academy, Officers Candidate School, Navy ROTC, Boot Camp, "A" Schools, Shore and Fleet Units, and occasionally from allied nations. To apply, one must be male and 30 years of age or younger.

Those who are medically qualified, meet the administrative requirements, and are capable of passing a physical screening test may enter BUD/S from a Recruit Training Center after "A" School or submit a Special Duty Request (NAVPERS 1306/7) via their command to the Chief of Naval Personnel.

The physical testing for entry includes: Swimming 300 yards within 7-1/2 minutes using the sidestroke or breaststroke, followed by a 10-minute rest period (standing in an upright position); doing 30 continuous pushups in 2 minutes, followed by a 2-minute rest period; doing 30 continuous situps in 2 minutes, followed by a 2-minute rest period; performing six continuous pullups, with palms facing away, followed by a 5-minute rest period; and finally, running 1 mile within 7-1/2 minutes wearing full length trousers and either combat boots or high-top "boondocker" shoes.





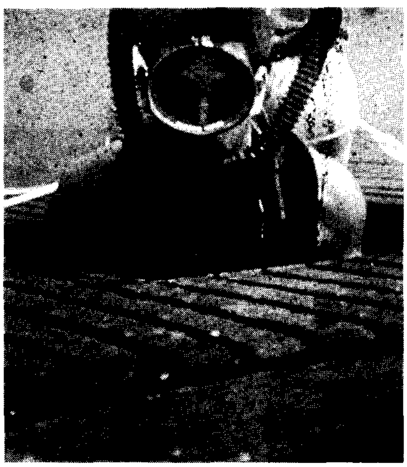
More than a course in basic UDT/SEAL skills, BUD/S can be described as a highly intensive training experience--both physically and mentally. After acceptance into the program and before the actual commencement of BUD/S, students undergo a 2-week indoctrination period that emphasizes physical conditioning and academic review. During this time, the proper underwater recovery swimming stroke techniques and proper exercise and running techniques are taught--skills that will be put to increasingly difficult testing as the course progresses.

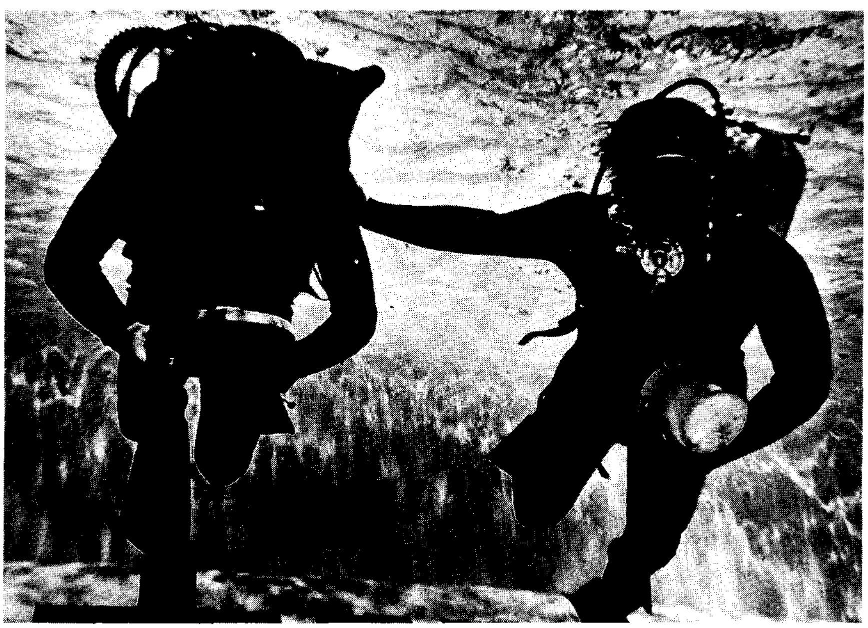
Phase I of training is 7 weeks long and concentrates on developing the participants' mental and physical abilities and on testing individual determination and the ability to

Top, left: Diver training; right: HMCS Hubbard and QM1 Fuller. Middle: CDR Nelson watches exercise session. Bottom: LT Simmons explains Mk 15 UBA during diving phase.

work as a team. It also focuses on the use of basic UDT/SEAL equipment as students progress through long distance running, calisthenics, obstacle course drills, pool and ocean swimming, surf passage, and seamanship in inflatable rubber boats. In addition, the skills of drownproofing, flashing light, semaphore, knot-tying, map and compass, and a high speed boat cast and recovery are taught. Culminating this phase is "HELL WEEK," designed to test each student's ability to operate under adverse conditions for extended periods of time.

Working in small boat crews and with a total of 8 hours of sleep for the entire week, the candidates run, swim, and engage in competitive races against other boat crews--all performed in an abundance of sand, surf, and heavy mud. "HELL WEEK" is such that, when a student completes this period, he is considered to be well on the way to graduation from BUD/S. According to CDR Tom Nelson, the Director of the Special Warfare Training Department: "'HELL WEEK' is termed such because it is carefully designed as the ultimate test of a student's mental and physical capabilities while in the first





Photos above show various scenes of BUD/S physical, diving, marksmanship, and reconnaissance training.

phase of BUD/S training. Contrary to popular opinion and the myths generated by preceding classes, separating the physically weak from the physically strong is not one of the goals of HELL WEEK. Rather, it is designed to instill in the BUD/S student the qualities and personal characteristics which are so important in becoming a professional in the Special Warfare Community: determination, courage, level-headedness, self-sacrifice, and a strong team spirit."

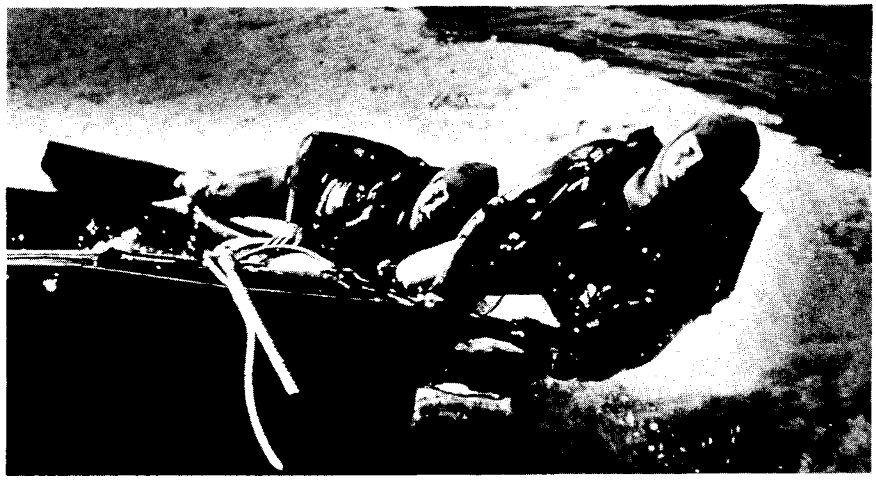
Phase II, which lasts 8 weeks, is the diving phase. Diver training for BUD/S students differs from basic Navy diving training because of the more specialized mission of the Special Warfare Community. Diving Officer LT Larry Simmons notes that "Naval Special Warfare diving is unique in that it stresses the clandestine infiltration of enemy shores rather than deep or working dives." One could say that the emphasis is more on horizontal transit on or below the surface, rather than on vertical movement underwater.

Phase II qualifies students in the care and use of open-circuit SCUBA (using compressed air), the closed-circuit Emerson rig (using 100 percent oxygen), and the closed-circuit Mk 15 Underwater Breathing Apparatus (UBA)--a variable, mixed gas apparatus that is relatively new to the Fleet. Free ascent, diving emergency procedures, and submarine escape trunk training are also conducted during this period. The diving phase demands academic ability as well as physical stamina. Comprehensive classroom studies of diving physics and medicine are given before pool indoctrination and open water swims.

Small boat exercise. Below: Enjoying lunch in the mud.

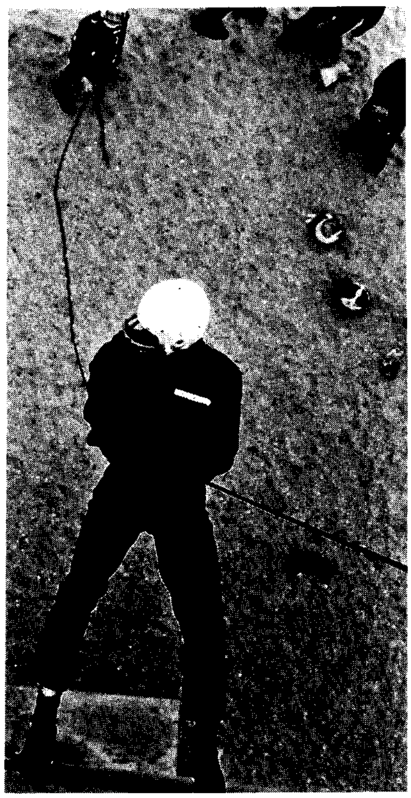
Phase III is 10 weeks long and concentrates on land warfare, including small unit tactics, weapons, all types and uses of explosives, hydrographic reconnaissance, communications, and navigation through various types of terrain under day and night conditions. Practical application of this training is conducted during a 20-day period at the BUD/S training facility at San Clemente Island off the southern coast of California. Here they practice heavy demolitions, make live demolition raids, and complete a series of long swims--the final one being a distance of 4 to 6 miles.

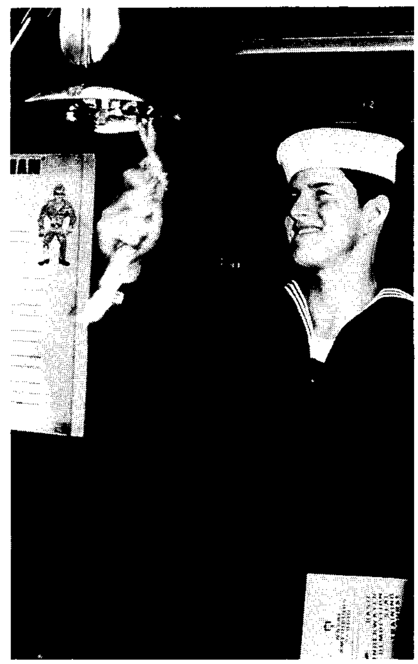
A student must make a firm commitment to the training program and must dedicate himself mentally and physically to achieving the ultimate goal of graduation. It is not easy. Only 50 percent of those candidates that report for BUD/S indoctrination eventually graduate from the course. For those who do, there are 3 additional weeks of parachute training at Fort Benning, Georgia, before reporting to either a SEAL or UDT unit. Also, an extra 2 weeks of instruction are provided for the Special Operations Technician students following their graduation. During this time, the hospital corpsmen are given additional training in diving physics and underwater physiology to give them a more thorough understanding of the effects of pressure on the human body, acci-



dent prevention, gas analysis, mixed gas diving, treatment of diving diseases, and use of the recompression chamber.

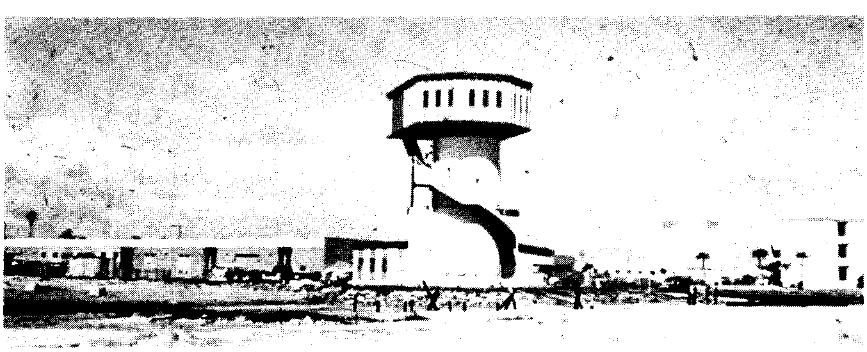
After serving a 6-month probationary period with a UDT or a SEAL unit, graduates are at last entitled to wear the Naval Special Warfare insignia. They have proven that they are qualified to be members of this elite corps.They have proven that they are worthy of maintaining that "special" mystique.





History:

Special Warfare teams trained their own replacements until the early 1950's, when BUD/S was started on both coasts to meet the requirements of the Korean War. In May 1971, the east coast training facility closed and all instruction was consolidated at the Naval Amphibious School in Coronado, where it has remained. The School also provides training in various other areas in addition to BUD/S: Swimmer Delivery Vehicles, Special Operations Technician, Diving Supervisor, Indoctrination to the Service Academy, and escape training for submariners, Navy divers, and other qualified personnel who wish to learn escape training, lock in/lock out, buoyant ascent, and other related subjects.



Top, left: explosives handling; right: high speed boat cast and recovery. Middle, left: rapelling; right: student "rings out" after graduation ceremony. Above: diving training tower at BUD/s.

T-ATF: A New Addition to the MSC Fleet

The Ocean Fleet Tugs (T-ATF-166 Class) are new ships that combine some of the capabilities of the U.S. Navy's tugs, ATF's, and the commercial offshore tug/supply boats. They are an intended replacement of the aging World War II ATF's, last constructed in 1946.

As a unit of the Mobile Logistics Support Force, the mission of these new ships is to take in tow ships of the Fleet that are battle damaged or non-operational. To accomplish this, the T-ATF is capable of performing towing tasks using permanently installed equipment that is operated by the civilian Military Sealift Command (MSC) crew.

Also, the ship can accomplish very limited diving and salvage operations with portable equipment operated by U.S. Navy salvage and diving personnel, and can engage in oil spill cleanup tasks with portable equipment operated by NAVSEA OOC pollution contractor personnel. Portable equipment is brought aboard from shoreside equipment pools. The salvage, diving, and pollution abatement personnel are also not on board, but embark when needed as transients to provide the expertise necessary for a particular mission.

The T-ATF propulsion system is made up of twin 20-cylinder diesels driving through reduction gears to separate shafts with controllable pitch propellers in nozzles. The tow-

ing equipment consists of a towing and a traction winch, which, when combined with the large open after main deck, provides a platform for performing towing and limited salvage and diving portable payload missions.

T-ATF operations can be classified in two general areas: full-time ship functions--for which the MSC crew uses the permanently installed equipment—and portable functions--which are performed with equipment loaded on board for specific operations, under the control of Navy transient salvors.

The T-ATF's are equipped to respond quickly to a call from a ship in danger without having to return to port first. Full-time functions include the following capabilities:

- Wire rope towing: The ship is capable of taking various types and sizes of vessels for long distance tows. Two- and one-quarter-inch wire rope, 2,500 feet in length, is spooled on a single drum winch that is driven by its own diesel engine.
- Synthetic hawser towing: The towing capability of the T-ATF is increased through the use of a traction machine and the use of synthetic hawsers of up to a 15-inch circumference.

The combination of the conventional wire tow with the traction machine for synthetic hawsers offers simplicity and increases the reliability of the system.

- Quick reaction system: This system provides the T-ATF with an ability to prevent beaching or broaching of another vessel or to conduct debeaching operations. In the event the T-ATF receives a call to assist a ship that has been beached or is in danger of being beached, the first attempt would be to pass a towline and pull with the ship's engines and/or towing winch or traction machine. The bow thruster may also be used, depending on the extent of the grounding, to swing the T-ATF through arcs from port to starboard. Should this method fail, or if the T-ATF cannot maintain headway because of wind and/or current conditions, the Moorfast anchor would be deployed.

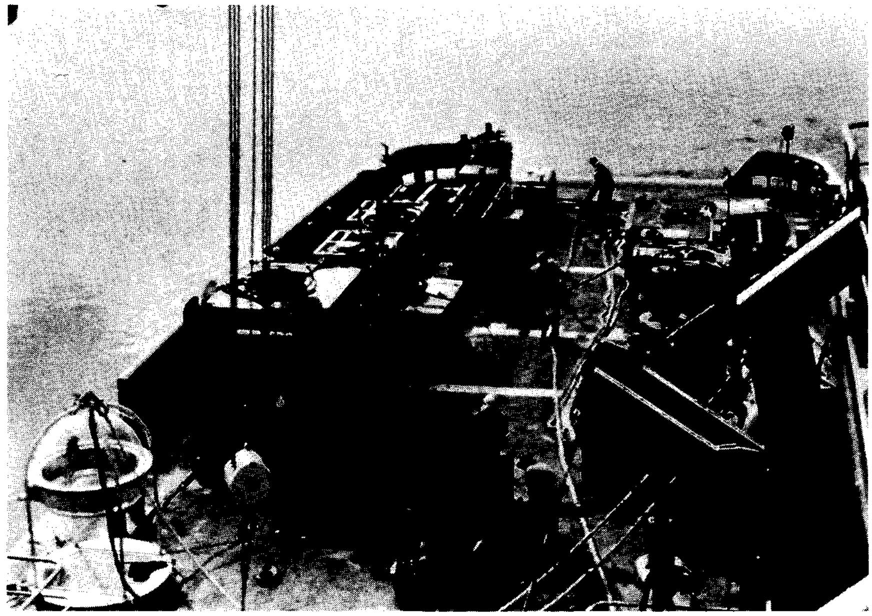
The Moorfast anchor can be used to hold the ship's head while pulling with the main engines and towline.

- Mooring: The T-ATF is capable of taking up position and adjusting within a multi-point moor of up to four legs that has been laid by another ship.
- Firefighting and dewatering: Firefighting is accomplished using the installed fire monitors in the superstructure and two diesel driven 1,500-GPM pumps with or without using the installed protein foam system. Located on the main deck aft are two manifolds, each of which can handle up to five standard 2½-inch hoses. Connecting the hoses to the installed manifolds and to the tug's portable eductors placed on a distressed vessel enables the crew to dewater a flooded ship.

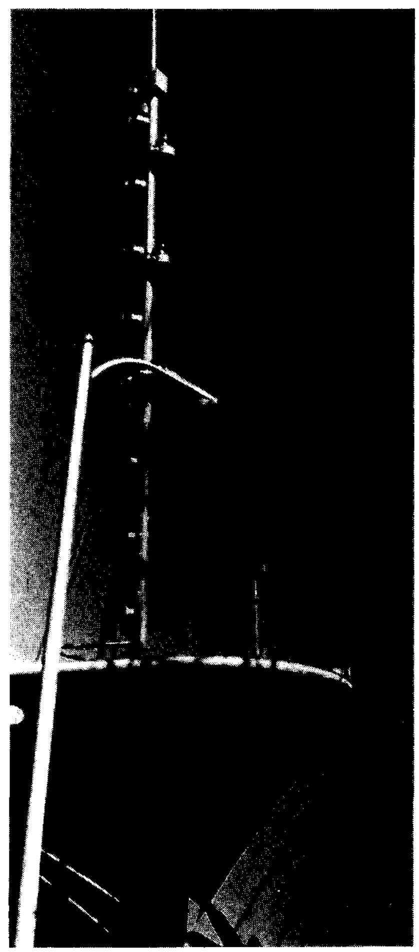
With portable equipment and additional Navy and/or contractor personnel, the T-ATF is capable of performing the following tasks:

- Salvage: When the T-ATF is assigned to a salvage mission, portable salvage equipment such as a work boat, salvage compressors, salvage welding machines, hydraulic pullers, etc. are loaded on board using the ship's crane. U.S. Navy salvage teams specially trained to operate this equipment board the T-ATF and work in concert with the MSC crew to carry out the task.
- Diving: When assigned a diving mission, portable diving gear is loaded on board. This equipment could include diving compressors, HP air banks, diving stage or diving bell, two-lock recompression chambers, etc, which are operated by U.S. Navy diving teams. The T-ATF can support SCUBA diving, surface tended Mk 12 hard hat diving, and surface tended diving using the USN Mk 1 diving mask. In all diving missions, the function of the MSC crew is to secure the T-ATF in a moor after arriving at the diving site and to provide living accommodations. Once at the site, Navy divers will conduct the actual operations.
- Oil spill control system: The T-ATF can support a Navy offshore oil spill control response team in spilled oil containment/deflection recovery and in vessel oil offloading operations. Specialized spill control equipment from one of the four strategically located Emergency Ship Salvage Material (ESSM) Bases can be deckloaded on the fantail of the T-ATF. A NAVSEA OOC contractor response team boards the ship at a convenient port of embarcation.

The offshore spill control equipment includes oil containment/de-



Fantail set up for diving ops.



Moorfast anchor is stowed in the hull. Page 21: Fantail loaded with oil spill equipment during exercise in San Francisco Bay.

flection boom and boom mooring systems; oil skimmer vessels and recovered oil storage barges or portable bladders; hydraulic submersible oil offload pumping systems; and workboats, lightering fenders, shop vans, and other ancillary support systems to ensure self-supporting operations. The MSC crew is responsible for getting the spill control equipment to the operations area after it has been loaded aboard and for providing general platform support.

The T-ATF 166 Class ship is arranged in five main levels or decks: the bridge deck, the upper deck, the foc'sle deck, the main deck, and the hold. In addition, there is the top wheelhouse deck, the firefighting platform, and the shelter deck at the bow.

Equipment that is permanently installed is used during the conduct of various diving and salvage tasks, and is not associated with any one particular job. The three major items in this category are the crane, Monark workboat, and bow thruster.

The crane has a telescoping boom that can extend 64 feet and is capable of handling a 10-ton load at 35 feet during a 7-degree roll of the ship from upright to extreme port or starboard in a duration of 12 seconds. It is used for shipping the portable bulwarks on the port and starboard sides and also in handling all portable diving and salvage gear. The ability to rotate the boom without vangs and the self-stowing capability of the retracting boom represent an improvement over the king post and boom arrangement of the older ATF's. The crane requires only one man to operate it.

The Fleet Tug's workboat, a 24-foot all-aluminum V-hulled craft, is used during mooring operations to carry the hawsers to the buoys for hookup and when slipping the moor to disconnect from the buoys (weather conditions permitting). The boat may also be used during salvage operations for limited transfer of men and equipment.

The bow thruster is used during mooring operations to adjust the ship's position within the moor. Also, if conditions permit, it is used to work a distressed vessel out of its grounded position by swinging the T-ATF through a wide arc while going ahead on the main engines.

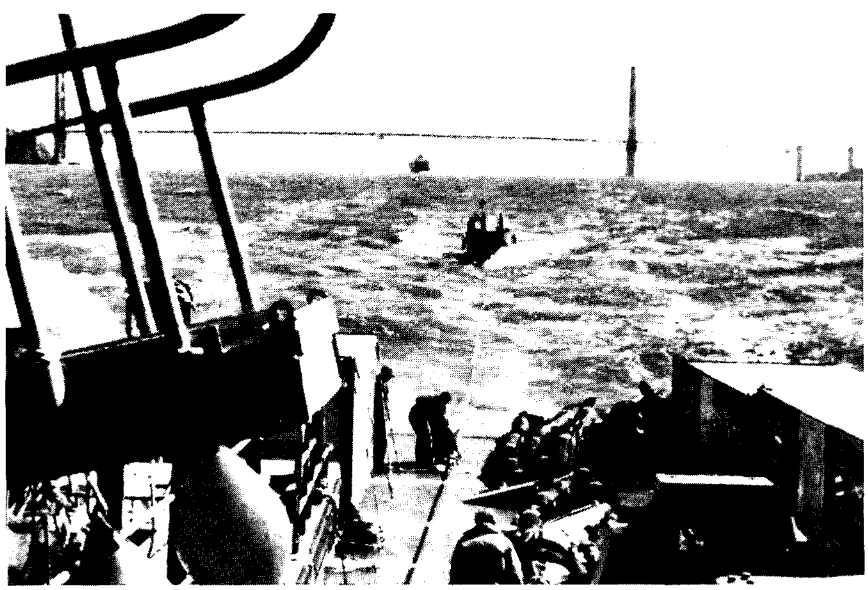
Another important item aboard the tugs are the capstans. Actually, there are five on this ship—one permanent on the main deck, two portable capstans, and two anchor windlasses/capstans on the foc'sle deck. The permanent one is a 2-speed electric motor-operated vertical capstan. It is capable of handling 11-inch nylon and is rated for 30,000 pounds pull at 20 feet per minute and 15,000 pounds pull at 40 feet per minute. Two 2-speed electric motor-operated portable capstans are sized for 6-inch nylon and are rated for 5,000 pounds pull at 20 feet per minute. The two anchor windlasses are rated at 27,000 pounds pull at 20 feet per minute.

The T-ATF 166 Class ships are manned by a crew of 16 MSC and four Navy communications personnel. The MSC crew are civilian employees who are licensed or certificated in accordance with the Code of Federal Regulations governing merchant marine personnel. The Navy communicators are Navy personnel assigned to the T-ATF as a duty station.

The T-ATF ships POWHATAN and MOHAWK are assigned to the Naval Surface Forces Atlantic. CATAWBA, NARRAGANSETT, and NAVAJO are assigned to the Naval Surface Forces Pacific. Two T-ATF's--SIOUX and APACHE--are scheduled for delivery to the Fleet in early and mid summer.

All delivered vessels have completed diving and salvage training exercises in conjunction with Harbor Clearance Units ONE and TWO and with Service Squadrons FIVE and EIGHT, respectively. During 1980, NARRAGANSETT and CATAWBA completed oil pollution abatement exercises in the San Francisco Bay area and offshore in the Pacific Ocean, while POWHATAN conducted the same tests offshore in the Atlantic Ocean.

POWHATAN has been involved in several missions within the last year. In April 1980, using the Shell "SOCK" skimmer, it provided outstanding support for the only intentional oil spill tests in U.S. coastal waters (off the New Jersey coast). This 10-day operation included the dispersal and retrieval of 50 cubic meters of crude oil. POWHATAN's versatility and the cooperation of its MSC crew contributed to the successful execution of this task. In June 1980, POWHATAN—with the SUPSALV DEEP DRONE and Special

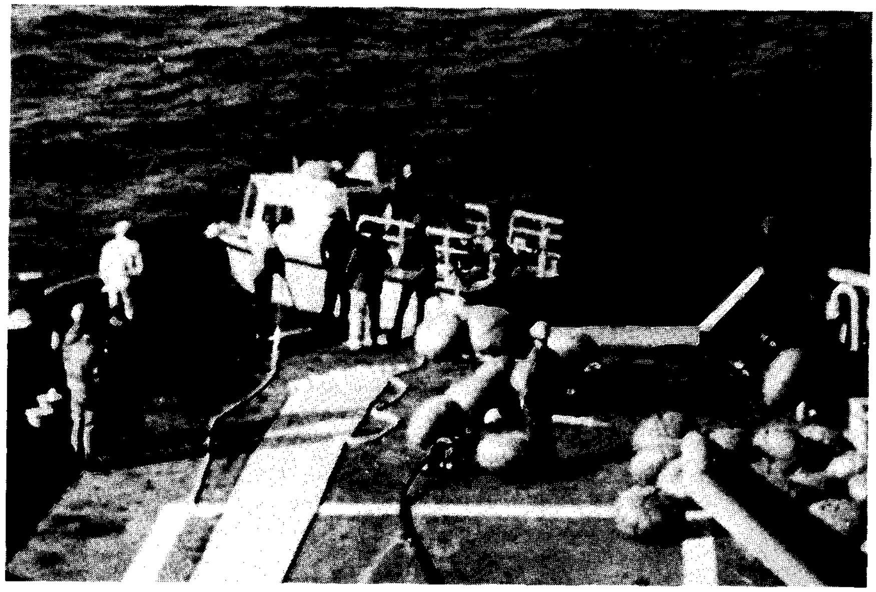


Warfare Group (SPECWARGRU) TWO divers aboard--was involved in the recovery of a helicopter off St. Croix. The deck space available on POWHATAN's fantail proved to be more than adequate for the DEEP DRONE system, SCUBA dive team, and the recovered helicopter wreckage.

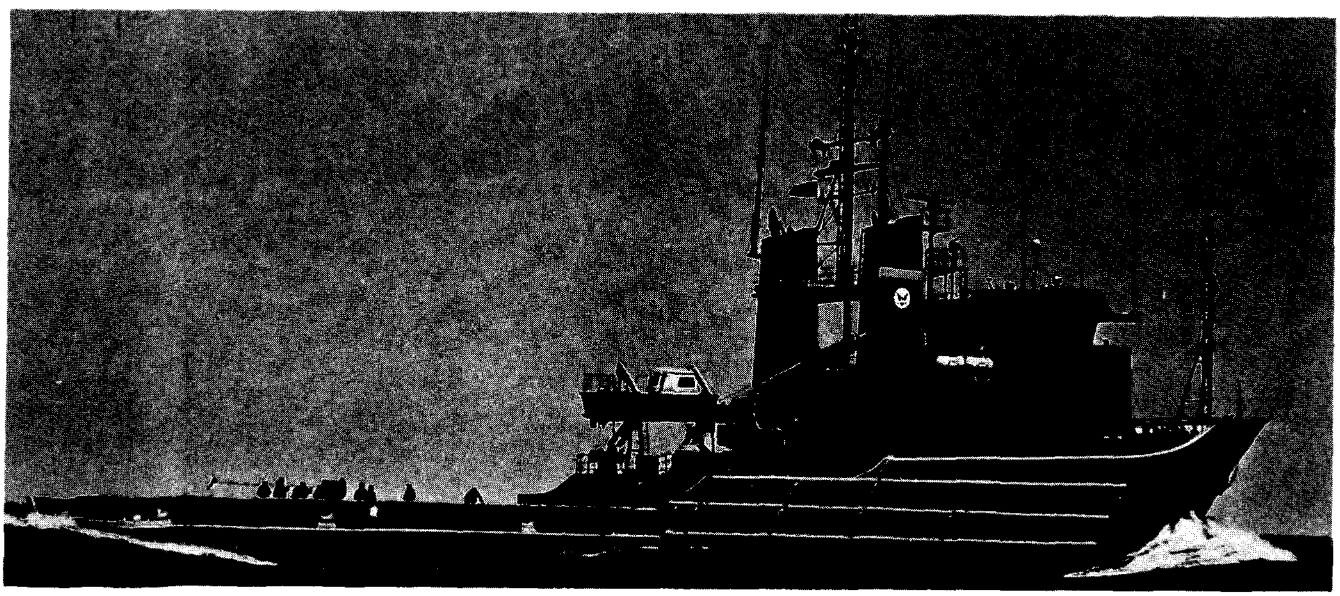
Because the water depth was approximately 3,000 feet, the ship was required to keep station dynamically while DEEP DRONE, an unmanned tethered vehicle, was operating. To avoid cable entanglement, POWHATAN's Master used the port screw and the bow thruster to maintain station within 600 feet (horizontally) of the vehicle. For the recovery of heavy objects, a 6,000-foot 4½-inch nylon hawser was used in conjunction with POWHATAN's traction machine. Lighter objects were brought to the surface by DEEP DRONE, where SPECWAR SCUBA divers transferred the objects to POWHATAN's 10-ton crane and the lift aboard was completed.

Most recently, POWHATAN completed towing operations involving Navy pontoons in the Azores. After the successful conclusion of the salvage portion of this task, conducted by Harbor Clearance Unit TWO, the pontoons were barge loaded and one was towed to Norfolk, Virginia, by POWHATAN. In January 1981, NARRAGANSETT illustrated the versatility of the T-ATF ships when it completed a task as a cargo vessel. Though T-ATF's were not originally designed with such a capability in mind, NARRAGANSETT transported a rather large amount of cargo (on the main deck) to Diego Garcia from Subic Bay.

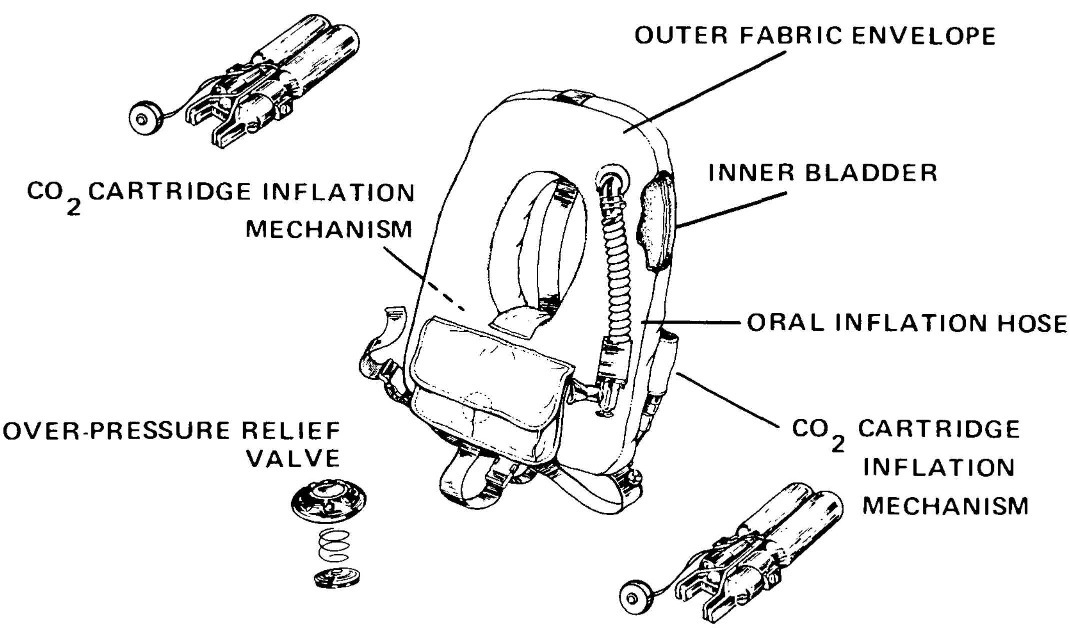
It appears that the T-ATF 166 class ships will be a useful addition to the MSC Fleet.



T-ATF workboat assists at back end of fantail.



POWHATAN underway.



Mk 4 Diver's Life Preserver

BMC(DV) J. H. Bloechel
Navy Experimental Diving Unit

The Mk 4 Diver's Life Preserver (DLP) was designed to provide safe and dependable support for all open and closed circuit SCUBA (the Mk's 15 and 16 Underwater Breathing Apparatus) diving operations to depths of 200 feet of seawater (FSW).

The Mk 4 DLP is a yoke-type garment that utilizes a single urethane inner bladder, which is enclosed in and protected by a lusterless black nylon fabric envelope. A non-metallic zipper in the neck opening provides access to the inner bladder for inspection and/or repair. The harness assembly is of black nylon construction with plastic quick-releases on both the spine/crotch and waist straps for ease in donning and removal. The oral inflation hose with its mouthpiece and manual oral inflation valve is held in place by a Velcro tab and is readily available to the diver for oral inflation purposes. The over-pressure relief valve is mounted low on the front of the DLP and is protected by the utility pocket. The over-pressure relief valve is designed to lift at 2–2.5 psig over bottom pressure. The two CO_2 cartridge inflation mechanisms are the same type employed by the Mk 3 DLP and require the same care and maintenance as before to ensure proper operation. It should be noted here that the problems with the Mk 3 inflation mechanisms have long been recognized and that a new non-magnetic device is being developed. All materials used in the construction of the Mk 4 DLP are non-magnetic. When the DLP is used by Explosive Ordnance Disposal personnel, it should be used with Type II MIL-C-16385 CO_2 special non-magnetic cartridges.

The Mk 4 DLP, utilizing four 31-gram CO_2 cartridges, will provide approximately 20 pounds of positive buoyancy at 200 FSW. This will provide sufficient lifting buoyancy to start a diver with a completely flooded Mk 15 or Mk 16 UBA to the surface from a depth. On the surface, a fully inflated Mk 4 will provide 42 pounds of buoyancy and will support an unconscious swimmer in a face-up position in sea conditions up to sea state 3.

Since the Mk 4 DLP is a safety device, properly performed scheduled maintenance is essential to maintain a high reliability level and user confidence. Before any dive, all equipment will be carefully inspected. The pre-dive inspection of any life preserver must be the personal concern of each diver.

The life preserver support package—with its Mk 4 DLP, Operation and Maintenance (O&M) Manual, repair, test and spare parts—is now being issued to the Fleet. With any new equipment package, mistakes are likely to turn up, particularly in the O&M instructions. Fleet divers can help make this a viable system by reporting mistakes found in these instructions to the Navy Experimental Diving Unit in care of BMC (DV) Bloechel.

HCU-2: AIRCRAFT RECOVERY

LT Coleman Kavanagh, USN
Harbor Clearance Unit TWO

"Thou are wedded to calamity...."
— Shakespeare

Could the great playwright have been describing Harbor Clearance Unit TWO in 1598? Most unlikely. However, HCU-2, as the Atlantic Fleet's quick response diving and salvage team, often plays a vital role following an unfortunate turn of fate.

On Friday afternoon, November 14, 1980, a pilot attached to Air Test and Evaluation Squadron FOUR (VX-4) at the Naval Air Test Center Patuxent, Maryland, was flying over the upper reaches of the Chesapeake Bay near Bloodworth Island. His aircraft was the Navy's FA-18 Hornet, the first in a new generation of single seat multi-mission tactical aircraft. Sleek and fearsome, the Hornet could handsomely complement the movie set of the next Hollywood outer space shootout.

Shortly after 1500, the pilot radioed to report that he was having serious problems with the aircraft and would have to eject. The pilot was "plucked" unhurt from the chilling waters of the Chesapeake Bay by a SAR helicopter. The crippled Hornet spun down into the bay, finally coming to rest in 20 feet of murky brackwater approximately 3/4 of a mile west of low, marshy Holland Island.

A search of the area was conducted by a SAR boat and divers from the Naval Surface Weapons Center, Solomons, Maryland. The divers arrived after dark and searched without success—only minor floating debris was recovered that night.

On Saturday morning, a helicopter joined the SAR boat in searching for the downed FA-18. Locating and buoying the wreckage site in the late afternoon, the NSWC FAC divers awaited the ex-Coast Guard Buoy Tender BRIAR. Using BRIAR as a platform, a survey dive was conducted at dusk and additional marker buoys were attached.

Commander, Service Squadron EIGHT tasked HCU-2 with providing a salvage master and support divers. LT Donald R. Goins and three divers arrived that night at the Solomons Facility and were briefed on the overall situation.

On Sunday afternoon, November 16, BRIAR returned to the wreck site, established a two-point moor, and conducted one survey dive before darkness. Despite visibility of 1 to 3 feet and a water temperature of 45°F, this dive recovered the aircraft recorder and one instrument box. The aircraft was discovered to be in three major pieces: engine and tail section, port wing and fuselage, and starboard wing. Numerous smaller components littered the hard sandy bottom.

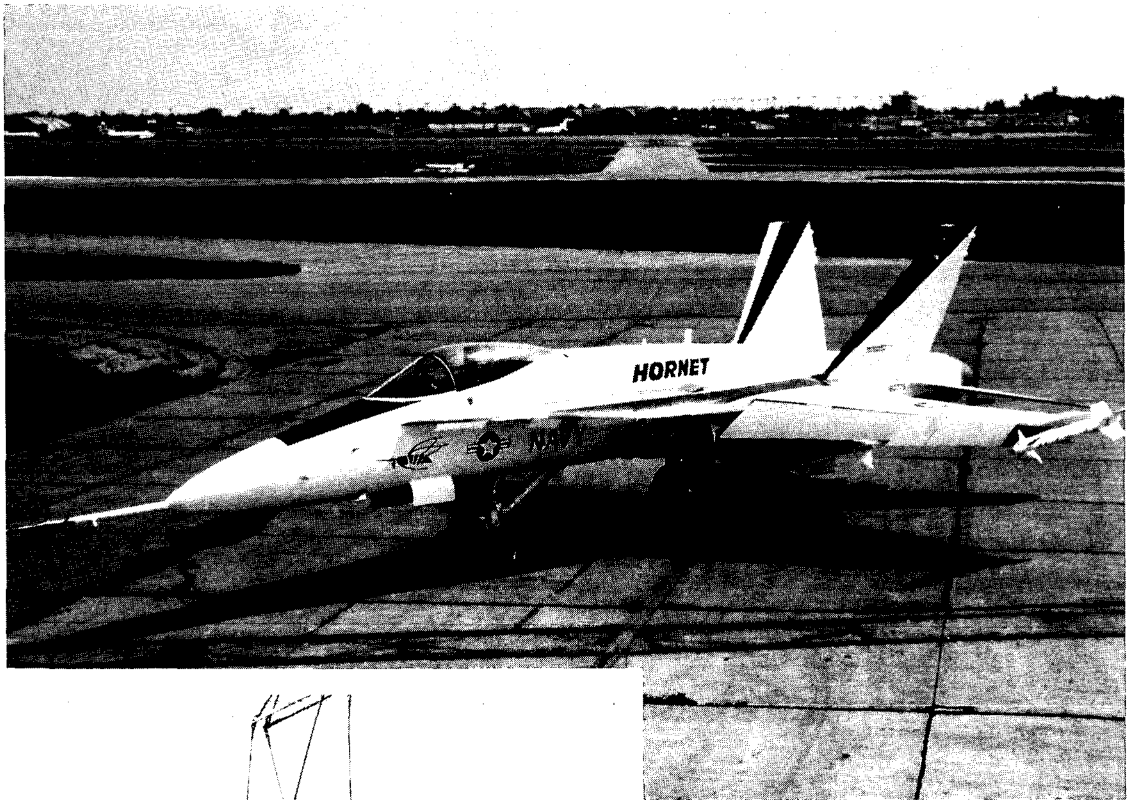
An underwater video-recorder was brought up from Norfolk, Virginia. Using the Mk 1 Band Mask, hot water suits, and compressors from a Fly-Away Dive System (FADS), the divers conducted a complete videotape recording of the major wreckage and the immediate area for the Investigation Board. While awaiting the arrival of the floating crane YD-233, in tow from Norfolk, the three remaining instrument boxes were recovered.

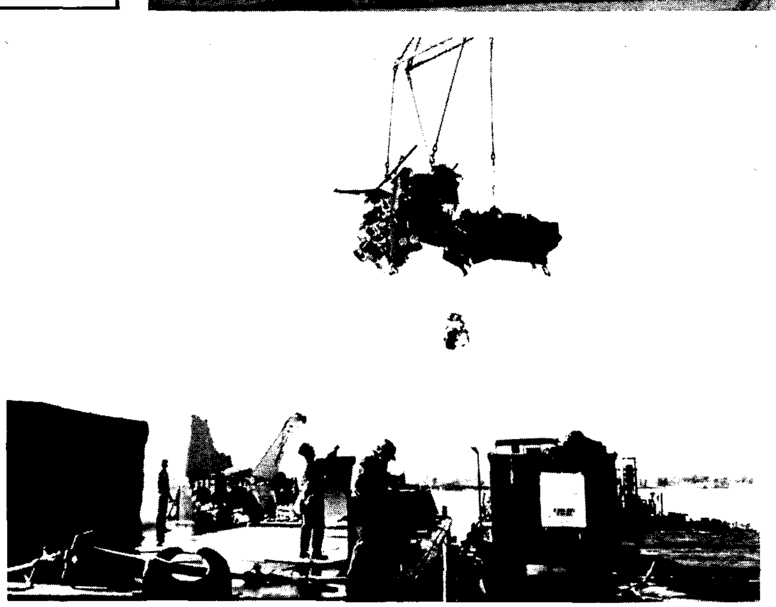
It was fortunate that salvage operations had gone so smoothly. Shortly after the arrival of the YD-233, high winds and heavy seas precluded further operations. The floating crane was positioned in a three-point moor with BRIAR alongside.

When the wind and seas had subsided somewhat, the YD-233 was remoored into a more favorable position that provided a lee for diving operations. By Wednesday afternoon, the divers had rigged the major pieces of the aircraft for lift. The nose section broke off just aft of the cockpit during the lift and was recovered separately.

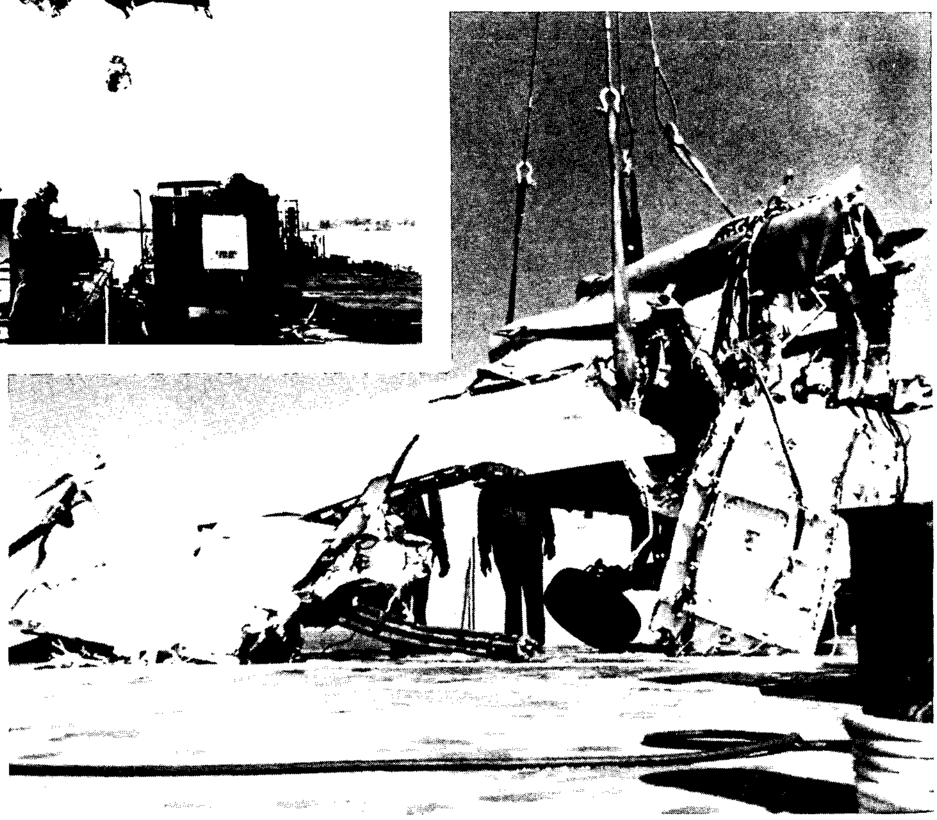
It was estimated at the time that approximately 27,000 pounds of wreckage were recovered by using the crane. The NSWC FAC and HCU diving team utilized SCUBA and a jack stay to comb the cloudy bottom for additional debris. The methodical use of the jack stay permitted recovery of all remnants within a 100-foot radius of the impact area. Attempts were made to locate the ejection seat, an item greatly desired by the Accident Investigation Board; but the high probability area was swept with a drag line towed between two Boston Whalers without success. All recovered wreckage was delivered to NSWC FAC Solomons, where skilled investigators began to piece the puzzle together.

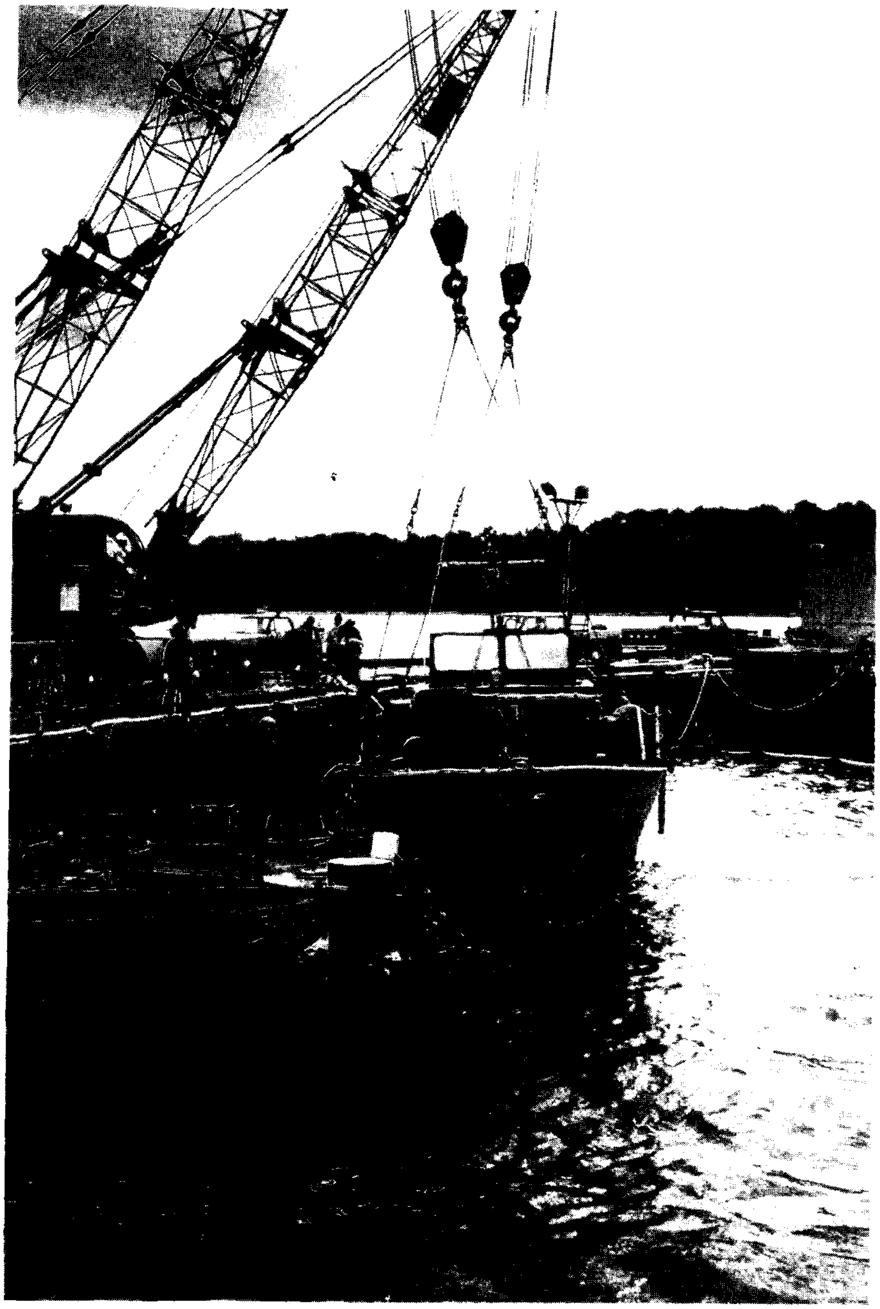
The harmonious and efficient salvage effort by Harbor Clearance Unit TWO and Naval Surface Weapons Facility Solomons personnel once again exemplifies the comradery and singleness of purpose that exist throughout the Navy Diving and Salvage Community.





Above: FA-18, Left and below: FA-18 wreckage retrieved from Chesapeake Bay.





HCU-2 "Unsinks" a Fireboat

LT(jg) F. P. Magaraci, USN
Harbor Clearance Unit TWO

During the predawn hours on October 10, 1980, a civilian security guard at the Naval Weapons Station, Yorktown, Virginia, was making his normal rounds and discovered that the 60-foot (49-ton) station fireboat had sunk.

Upon notifying all concerned, immediate action was initiated by the Public Works Department to contain any fuel that might leak. The Ordnance Department was directed to conduct an initial assessment dive using Weapons Station (EOD) diving personnel.

Results of the initial dive determined that the boat was resting upright in 28 feet of water, with the stern in the mud approximately 4–6 feet. The starboard side was tight against the pilings of the finger pier where she had been moored. Commanding Officer, Harbor Clearance Unit (HCU) TWO was tasked by COMSERVRON EIGHT to conduct the salvage of the craft.

A five-man diving team arrived on scene by early afternoon on October 10 to survey the sunken craft. Their first priority was to determine the extent of the problem and the assets necessary for recovery. Based on the results of the initial survey, a tentative salvage plan was discussed that would involve the combined lift of two 50-ton mobile cranes and dewatering of the craft's internal compartments once it was on the surface. On October 11, HCU-2 personnel, assisted by Reserve Harbor Clearance Unit (RHCU) TWO personnel from DET 506, Norfolk, Virginia, and DET 813, Chicago, Illinois (the latter being on duty for weekend WET training), were mobilized to conduct the salvage attempt. By noon that day, all diving and salvage equipment was in position for the initial salvage effort. Diving assets included SCUBA and the Mk 1 Bank Mask with the new RHCU surface supplied diving system. The portable diving system provided by RHCU-2 DET 506 proved ideal for the job. Other salvage assets included two mobile 50-ton cranes, two sets of 50-ton spreader bars, four nylon lift straps, three 2-1/2-inch homelite stripping pumps, eight 10-inch DC plugs and four 3/4-inch wire messenger straps.

After finalizing the salvage plan, it was decided that a wire messenger could be swept under the stern aft of the rudder after scouring out mud approximately 4 feet deep. The same procedure was to be repeated forward, but would not be as difficult since the bow was not imbedded in the mud. Once the messenger wires were passed under the boat the nylon straps would be connected at one end and rendered around the hull, utilizing the mobile cranes. When this was accomplished, the spreader bars and legs would be attached to the two eyes of the nylon straps. A light strain would be put on the straps and, using nylon preventers, the strap legs would be hogged in against the hull at the gunwhale to prevent fore and aft slipping of the slings. This basic plan was achieved after some modification.

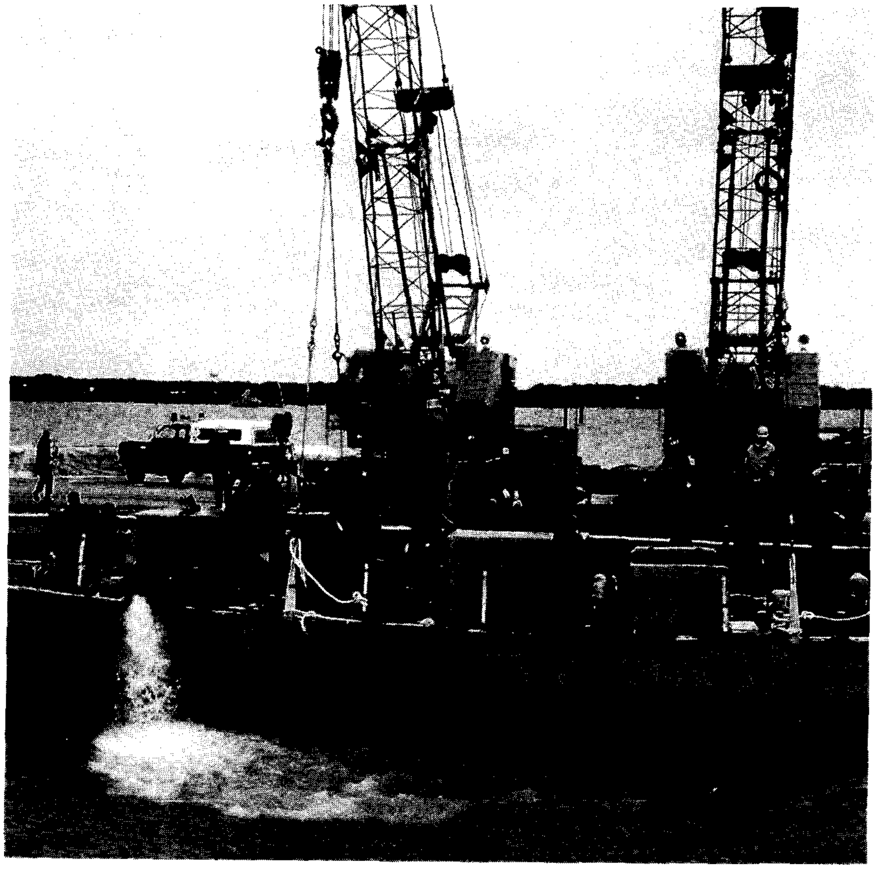
On the first working dive, two divers scoured out mud around the stern and succeeded in passing a 3/4-inch wire messenger strap. It was apparent that this was not the ideal location for the final lift, but it was all that was accessible under the circumstances. It was conceivable that the stern could be lifted out of the mud using another strap repass in a better location forward of the screw between the shaft and hull. A messenger strap was also passed forward with much less difficulty.

On October 12, the lift straps were connected to the messenger straps and, using the mobile cranes, the straps were rendered around the hull and connected to the spreader bars. The lifting legs were secured at the gunwhale to prevent fore and aft movement. The lift then commenced. As the stern came up, the boat began to slip aft, causing the forward strap to chafe against the pilings and part the preventers. This allowed the forward strap to start slipping. The friction of the starboard side against the pilings caused the boat to render around in the slings to approximately 40 degrees starboard. The forward sling ultimately slipped off and the boat righted. It was now apparent that the forward sling had to go farther aft and the aft sling had to go farther forward to prevent rendering.

Since the boat was steel hulled, it was calculated that spreader bars would not be required to limit lateral compression on the hull. (Aluminum boats would not withstand this force without damage.) The increased lateral pressure on the hull would keep it from rolling. Using a 2-inch wire strap passed through the bullnose, the bow was listed until it was in sight at the surface with the stern still resting on the bottom. The lifting strap was now easily repositioned. The bow was set back down on the bottom. The same procedure was repeated at the stern using the aft towing bitts as the lift point. It was lifted just clear of the bottom and a lift strap was passed forward of the screw between the shaft and the hull, and the stern was lowered back down.

The hook was disconnected from the strap on the towing H-bitts and reconnected to the repositioned strap. All slack was now taken up on the rig, and 2-inch nylon pre-

Page 26: Fireboat has been lifted to surface. Above: Dewatering operations.



Dewatering continues on fireboat.

venters were passed around the slings at the gunwhale to prevent fore and aft slipping. All pumps were started, and four swimmers were standing by with 10-inch DC plugs to secure open port holes. Pumping teams were readied to commence dewatering the boat upon surfacing. A defueling pump truck was also standing by. The cranes were repositioned so that the boat would slide aft as it was lifted.

Lifting commenced at 2:45 p.m. As the boat came up, it slid gradually aft (as anticipated) until it was clear of the finger pier. The mobile cranes were now able to "top up," bringing the boat in next to the main pier. This maneuver also reduced the angle on the boom, alleviating problems of the crane outriggers lifting off the deck. At 3:05 p.m., the boat was on the surface and dewatering, defueling, and patching commenced. Patching consisted of plugging the eight portholes with 10-inch DC plugs and manufacturing a gasket for the sea-chest cover plate, which was found adrift in the bilges of the engine room. At 1800, custody of the 60-foot fireboat was turned over to the Naval Weapons Station, Yorktown, successfully concluding the operation.

The rapid response and timely completion of this job demonstrated HCU-2's mobility, which is necessary when a potential ecological problem is present. In this case, it was averted since the fuel tanks, which contained 800 gallons, stayed intact and watertight. It also gave participating HCU-2 reserve units an excellent experience in "reaction" salvage.

The new Aqua-air portable LP air system that has been procured for all Reserve Harbor Clearance Unit Detachments was ideal for this operation. Although only certified to support diving to 30 FSW, the unit will give reserve detachments an excellent capability and has a definite use in the active duty diving community.

The Reserve Harbor Clearance Detachments have frequently augmented HCU-2 personnel on operational commitments with total effectiveness. This effort typifies the team spirit and expertise underscoring the total viability of this reserve program.

Participating Personnel:

HCU-2

LCDR S. W. Delaplane (CO, HCU TWO)
LT(jg) F. P. Magaraci (Salvage Master)
BMC(DV) A. W. Moon
BMC(DV) D. L. Jongquist
EM2(DV) A. G. Tschida
EN2(DV) K. R. Jobes
BM2(DV) R. D. Smith
BM1(DV) T. W. Miles
EN3(DV) J. E. Pattenaude
EM3(DV) Marie Carol Beatie

RHCU-2 DET 506:

HTC(DV) Putnam
RM1(DV) Anderson
EO2(DV) Bowman
BM3(DV) Stepura

RCHU-2 DET 813:

CDR S. D. Chubb
CDR J. F. Meyer
LCDR N. K. Morrison
LCDR R. E. Sacia
LT D. A. Shank
LT C. B. Laporte
SK2 J. Z. Stajuie
MM2 D. A. Yost
EN2 J. T. Estep
IS2 R. J. Castro

Carpenter Stoppers:
The History of Their Use and Development

CAPT W. F. Searle, USN (Ret.)
CDR T. N. Blockwick, USN (Ret.)
Mr. N. B. Davis

Introduction:

Ever since the introduction of wire rope into U.S. Naval service, the need for a device to hold or grip this rope has existed. Over the years the U.S. Navy has used carpenter stoppers (also referred to as wire rope grips) to fill this need. As the Navy's applications for carpenter stoppers have become more demanding, a number of operational problems and failures have occurred. To solve these problems, the Navy has periodically made improvements in the design of this salvage tool.

The evolution of Navy stoppers can be grouped into three generations: "old World War II (WW II) style," "improved 1948 style," and "modified-improved 1968 style." The "old WW II style" and earlier stoppers were basically made in accordance with James Carpenter's 1899 U.S. patent. In 1948, a major redesign was performed at the former Boston Naval Shipyard (BNS). The most significant improvement made was shifting from a cast steel to an all forged steel construction, because forged stoppers did not have the same catastrophic tendency as cast stoppers to explode when subjected to shock or impact loads. The most recent improvements were made in 1968, again at the BNS. These changes were fairly minor modifications of the 1948 design.

As the new generations emerged, several attempts were made to purge the older "obsolete" stoppers (specifically the "cast" WW II style) from the Navy supply system. However, these attempts met with only limited success. In fact, some of the unsafe stoppers, which were scrapped, were subsequently sold as surplus to the commercial market and are still in use today.

This article outlines the origin of the carpenter stopper and its development and evolution within the U.S. Navy. It discusses some of the problems and failures of Navy stoppers over the years, including the difficulties encountered in purging the "old WW II style" stoppers from the Navy system. Finally, detailed descriptions and figures are presented for all three generations of Navy stoppers, including the current U.S. Navy standard design ("mod-improved 1968 style").

Enough description is provided in this article to enable the positive identification of 1948 and 1968 style Navy stoppers. The Navy has already been directed to destroy all its "old WW II style" stoppers and it is hoped that, in the interest of safety, commercial users of these outdated "cast" stoppers will follow suit by removing them from service and destroying them.

The Origin and Evolution of the Carpenter Stopper Within the U.S. Navy:

The carpenter stopper derives its name from its inventor, James Carpenter of Portsmouth, England. Carpenter received a U.S. Patent (No. 639,520) in 1899 for his "Apparatus for Holding Cables, Wire Ropes, and etc". The purpose of the device, according to the inventor was as follows:

> "This invention relates to devices for holding wire rope; and it has for its object to provide a simple and improved device of this character which will effectively and automatically adjust itself to variations in the strain on the rope and which can be readily disengaged under the heaviest strain without any injury to the rope."

The British soon put this early carpenter stopper to use in various applications. Some years later, in a pre-WW II inspection visit to the U.K., the USN Supervisor of Salvage saw carpenter stoppers (sometimes called Boullivant Clamps) in use and recommended that they be added to the U.S. Navy's salvage equipment. Following his recommendation, the first U.S. Navy stoppers were built at the BNS using British plans and specifications. These early stoppers were made from cast steel and provided only a relatively low gripping power. They were not intended to develop the full breaking strength of the wire rope they gripped.

The U.S. Navy put these stoppers to use in salvage work, towing, and minesweeping. However, while the increased use of wire rope made stoppers indispensible, they proved to be far from satisfactory when used in such demanding applications. By the end of World War II, it was clear that there was a need for a more reliable and efficient stopper. To this end, in August 1946, the BNS was tasked to undertake the development and design of an improved carpenter stopper. In addition, the development program was to include the design of a satisfactory adapter type stopper for use with two or more sizes of wire rope. Although adapter stoppers were successfully developed, they have not been used extensively and are therefore not discussed here in detail.

Improved 1948 Style:

The first task of the development was to define what the general requirements of the new and improved carpenter stopper would be. They were as follows:

- The holding power would be equal to or greater than the yield strength of the wire rope used, i.e., two-thirds of the ultimate strength of the rope.
- The stopper would hold the rope so that there would be no permanent deformation to the rope.
- The stopper would open when under strain.
- The size and weight of the stopper would be as small as was compatible with its strength and duty requirements.

Next, a critical analysis of the design and methods of manufacture of the original stopper revealed the following primary reasons for its poor performance:

- Lack of protection of the wire rope under load,
- Excessive friction between wedge and body, and
- Low strength of parts.

To correct these deficiencies, the BNS made the following changes to the "old WW II style" stopper:

- Length of Grip: The length of the gripping portion of the smooth wedge block in the old stoppers was in ratio varying from 6 to 1 to 8 to 1, compared to the rope diameter. The latter ratio was used in proportioning the new stopper.
- Location of Pulling Eyes: In order to obtain a direct pull, the stopper eyes were raised to coincide with the rope centerline. They were also materially strengthened by a more gradual fairing into the stopper body.
- Cover: This was reinforced with ribs to prevent bending under the high transverse loads. The hinge pin hubs were extended to assist in carrying the internal loads.
- Lock: On the smaller sizes of stoppers, the original design of the lock was retained. On the larger sizes a special design was evolved for safety as well as convenience. To open, this type required a heavy downward blow on the cover locking lug. The striking surface at the top of the lock was designed to deflect the hammer outside the path of the suddenly released cover.
- Wedge: This part became a die forging and had its rope grooves formed during the forging process. The grooves had a pitch (or lead) slightly greater than before to conform to that of the rope at its greatest amount of stretch. The cavity ends and helix ridges were well rounded over to prevent injury to the rope. The forward end was bevelled to prevent "digging in" as it slid into the stopper. No shoulder was required at the large end since the gap opening determined the maximum amount of travel. To resist indentation of the cavity by the wire rope, steel of a slightly greater hardness than the rope was used.
- Smooth Wedge Block: To resist scoring and abrasion of the cavity by the wire rope, steel of nearly the hardness of the rope was used. However, by using a steel somewhat softer than the wire rope, abrasion of the rope was avoided.
- Forgings: To obtain the maximum strength, all body parts were drop forged instead of cast. In the design of the different parts, every effort was made to eliminate any undesirable local stressing. All corners, fillets, and adjacent surfaces were well rounded and faired for maximum strength.

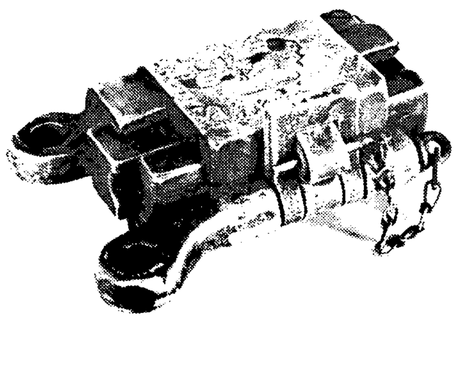


Figure 1 "OLD WW II STYLE"
Navy Carpenter Stopper

The stopper resulting from these changes is referred to as the "improved 1948 style." The two most significant changes were the shift from (somewhat brittle) cast steel to tougher forged steel construction and the addition of reinforcing ribs on the stopper cover.

Tests were conducted to assure that the improved stopper met all the general requirements that had been formulated. It did—the most notable of which was that of weight. The stopper was shown to have a safety factor of 2 at the ultimate breaking strength of the wire rope. Such close design attested to the fact that the weight of the stopper had been made as small as possible consistent with the strength and duty requirements. This was favorable because the reduced weight would facilitate handling and use at sea where the conventional 5:1 factor of safety could not be afforded. The "improved 1948 style" carpenter stopper truly proved to be more efficient.

For a number of years, "improved 1948 style" stoppers were manufactured at the BNS and used throughout the Navy. Each stopper that was made at the BNS was tested. This included a proof test and a release under reduced load. After a stopper passed, it was stamped with "BNS" and the date of test.

Modified-Improved 1968 Style:

In the 1950's there occurred at least two noteworthy failures of carpenter stoppers during employment on a salvage job. During subsequent series of tests at the BNS, several weaknesses were revealed which would result in operational failure of the stopper and bridle under high loads. These material and design deficiencies led to the following failures during testing:

- A shear failure of the hinged cover under high loading,
- Bending of the cover hinge pin and deformation of the cover hinge pin holes and loose wedge block,
- Scoring and galling of the wedge bearing strip and shearing of its retaining screws,
- Shearing of the wedge retaing screw in the larger size stoppers, and
- Failure of the rope in the wire rope bridle.

Because of the outcome of these tests, the BNS was in 1968 once again tasked to evaluate the existing carpenter stopper design. Following the evaluation, BNS recommended that to alleviate the causes for carpenter stopper damage and thus improve operational reliability, it would be necessary to:

- Initiate quality control procedures during the manufacture of carpenter stopper parts to ensure that stress concentrations such as those causing cover failures would be prevented.
- Modify the loose wedge block and cover with a shelf for an energy absorbing pad and an impact surface, respectively. This included making the cover hinge continuous. In this way, deformation of the cover hinge pin and associated damage would be prevented when a loaded stopper is opened.
- Use a suitable extreme pressure lubricant on the wedge-bearing strip interface and ensure that the carpenter stopper is correctly lubricated before each operation. A molybdenum disulfide paste type lubricant was recommended.
- Provide an abraded surface for the bearing strip loose wedge block interface.
- Change the material requirements for wedge retaining screws to MIL-S-890, Alloy No. 2 for increased strength and add a second retaining screw on the opposite side of the wedge on carpenter stoppers of size 5/8-inch and larger.
- Use only independent wire rope core (IWRC) rope of 6 X 37 WARRINGTON-SEALE construction in the fabrication of wire rope bridles to provide the strand support, flexibility, and strength required.

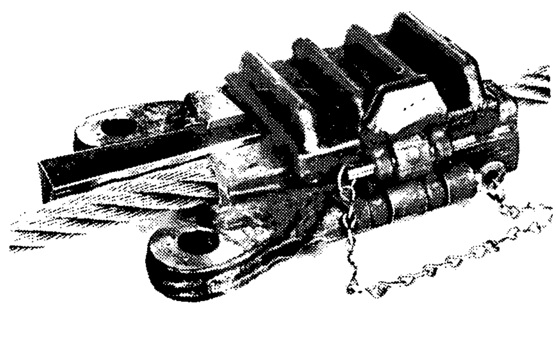


Figure 2 "IMPROVED 1948 STYLE" Navy Carpenter Stopper

These recommendations were incorporated into several carpenter stoppers which were subjected to extensive testing. The program's end product was the "modified-improved 1968 style" carpenter stopper, which could be safely and repeatedly operated up to the wire rope's breaking strength. This stopper has been adopted as the standard U.S. Navy design and is covered by Military Specification MIL-S-24584. It does not differ markedly in appearance from the "improved 1948 style."

The final task of the BNS, accompanying the stopper improvements, was the preparation of two additional documents: 1) "Carpenter Stopper, Operation and Maintenance Instructions-Technical Manual" (NAVSHIPS 0994-004-8010) and 2) "Wire Rope for Use with Carpenter Stoppers" (BNS Report No. TR - 57). Both of these documents are available through NTIS.

Discussion of Problems and Failures:

The culmination of over 30 years of work by the U.S. Navy has resulted in a carpenter stopper that is an effective and efficient device for gripping and holding various sizes of wire rope. This effort, however, has not been without problems. The forging, machining, and testing of each stopper has been costly. Also, with the closing of the BNS in 1973, the Navy ceased to manufacture carpenter stoppers; yet the Navy still requires and regularly uses carpenter stoppers in towing, lifting, and ship salvage (both surface and submarine).

Heretofore, this discussion has been related to U.S. Navy carpenter stoppers. It is thus prudent to point out that carpenter stoppers have also been made commercially and used extensively throughout the world. The carpenter stopper principle is routinely used in mechanisms such as hydraulic pullers and wire holding devices. In most operational uses, the requirements are not as rigorous as those of the Navy. Therefore, commercial stoppers generally are manufactured and tested to different specifications and plans. Often, these stoppers are cast rather than forged because of lower cost. It is therefore common practice to use a 5:1 safety factor (much higher than the Navy's typical 2:1) to compensate for the poorer impact strength characteristics of cast steel. Unfortunately, this 5:1 safety factor is sometimes inadequate to prevent brittle fracture under the severe dynamic loads encountered in offshore operations.

There have been failures of carpenter stoppers in commercial use recently. In some cases the stopper has literally "exploded." It is not known for sure whether these failed stoppers were originally Navy stoppers or commercial cast types. However, these is a good possibility that some of the failures were due to the use of "old WW II style" Navy stoppers.

The following is a possible chain of events leading to some of these commercial stopper failures. When the BNS completed the development of the "improved 1948 style" stopper, all "old WW II style" stoppers were replaced with the newly designed ones. The "old WW II style" stoppers were disposed of as surplus. As a result many appeared in commercial channels. In fact, some were eventually sold back to the Navy and reappeared on the Navy's supply shelves. While the Navy has repurged these "old WW II style" stoppers again, this time with direction to destroy them, it is likely that some of these obsolete and unsafe cast stoppers will exist in commercial salvage equipment pools—an accident just waiting to happen! It is therefore most important that these stoppers be identified and destroyed.

The salient identifying feature of the "old WW II Style" stopper is its flat hinged cover (see Figure 1) as compared to the ribbed cover of the "improved 1948" and "mod-improved 1968" stoppers. The shape of the stopper bridle ears are also a give-away. None of the cast steel stoppers had the elongated ear reinforcement that is characteristic of only forged assemblies (see Figure 2). The most important deficiency of the "old WW II style" stopper is the fact that it is "cast" steel and thus highly susceptible to brittle fracture when subjected to an impact load.

Description of Carpenter Stoppers:

Old WW II Style: These stoppers have flat, unribbed hinged covers (See Figure 1) and were manufactured by the BNS until replaced by the "improved 1948 style" stopper. Because of their cast steel construction, these stoppers are no longer authorized for and have thus been removed from U.S. Navy service.

Improved 1948 Style: These stoppers, shown in Figures 2 and 3, have characteristically ribbed hinged covers. They were also manufactured and tested at the BNS. "Improved 1948 style" stoppers are completely forged from steel and, while they can be improved upon by incorporating the 1968 modifications, they are still authorized for Navy service. Most of the carpenter stoppers in use today by the U.S. Navy are of the "improved 1948 style." All Navy-built carpenter stoppers of the "improved 1948 style" are clearly stamped "BNS" and date of manufacture.

Modified-Improved 1968 Style: These stoppers are almost identical in appearance to the 1948 style stoppers however, several subtle differences exist. On 1968 stop-

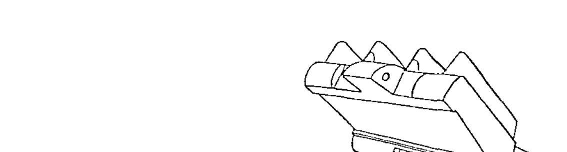


Figure 3 "IMPROVED 1948 STYLE" Carpenter Stopper Assembly pers of 5/8-inch and larger, a second retaining screw has been added on the opposite side of the wedge. Also on 1968 stoppers of 1-3/8-inches and larger, a rubber energy absorbing pad has been added to the loose cover hinge pin when the stopper is opened under load. Further, the cover hinge has been made continuous. Finally, the test date stamped on "mod-improved 1968 style" stoppers would be 1968-1973. Because the BNS was closed in 1973, only a few 1968 stoppers were made there. Current procurement at Baldt is, however, to this design.

Figure 4 illustrates the general assembly of the "mod-improved 1968 style" carpenter stopper. This stopper is composed of five basic high strength alloy steel forgings: (1) hinged cover, (2) smooth wedge block, (3) loose wedge block, (4) the wedge, and (5) the cover lock. The loose and smooth wedge blocks are joined together by the hinge pin (6), which is retained by a pin (7). The cover is joined to the loose wedge block by the cover hinge pin (8), which is retained by a pin (9). The cover lock is joined to the smooth wedge block by the lock hinge pin (10), which is retained by a pin (11). The bearing strip (12) is secured to the loose wedge block by four countersunk screws (13) staked in position. The wedge is retained by retaining screws (14) and (15) on all stoppers 5/8-inch and larger; however, smaller stoppers have only screw (15). The cover lock is secured in a closed position to the cover by means of the locking pin (16). The locking pin is secured to the lock hinge pin by means of wire rope (17) and two swaging sleeves (18).

Carpenter stoppers manufactured after 1969 in sizes 1-3/8-inches and greater have a rubber pad (19) installed on the loose wedge block. The rubber pad is retained by four countersunk screws (20). Note that the assembly of the "improved 1948 style" stopper is the same as shown in Figure 4 minus parts (14), (19), and (20). Also note the change in the cover hinge (1) from 1948 (Figure 3) to 1968 (Figure 4).

Adapter Type Stopper - Mod-Improved 1968 Style: The construction of the adapter type carpenter stopper (see Figure 5) is similar to the "mod-improved 1968 style" carpenter stopper. In place of the smooth wedge block of the standard carpenter stopper there is an adapter block (21). There are four adapters (22) for different sizes of wire rope. The adapters are secured to the adapter block by means of two screws (23). There are four wedges (24) for different sizes of wire rope. The wedges are retained in a manner identical to the 1968 carpenter stopper. While the adapter style carpenter stopper has proved to be a successful design, it has not been widely manufactured. It is not used frequently.

All U.S. Navy carpenter stoppers are identified with their respective size by an inscription on the side of the sliding wedge.

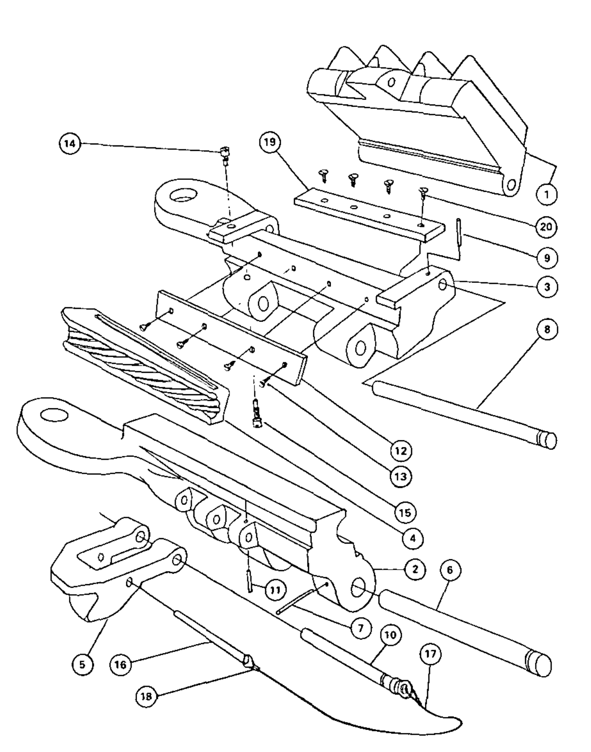


Figure 4 "MODIFIED-IMPROVED 1968 STYLE" Carpenter Stopper Assembly

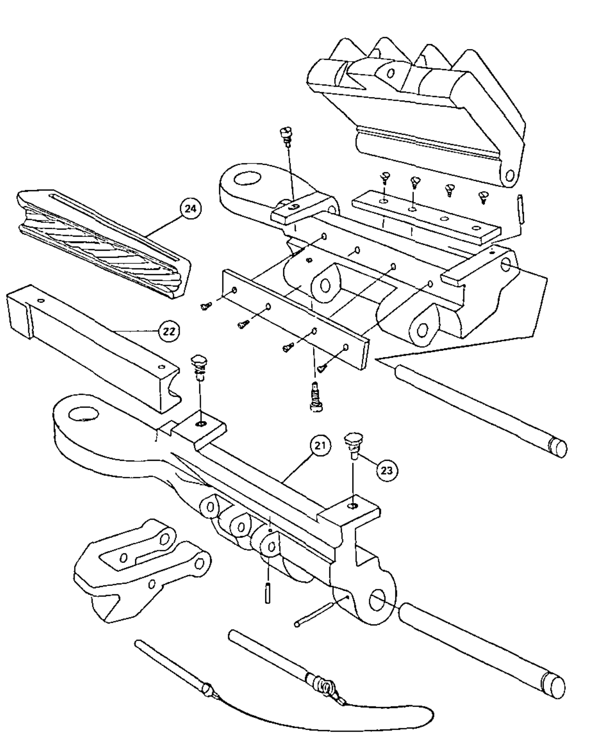


Figure 5 "MODIFIED-IMPROVED 1968 STYLE" Adapter Type Carpenter Stopper Assembly

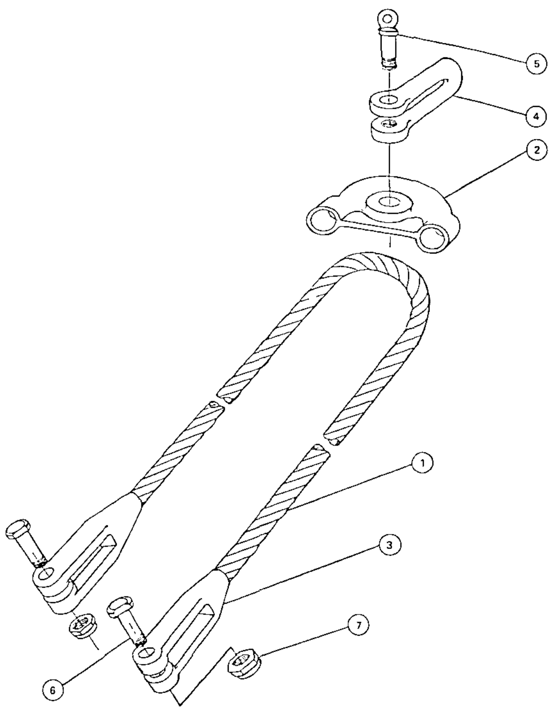


Figure 6 Wire Rope Bridle Assembly

Description of Equalizing Bridles:

An equalizing bridle is an integral part of any carpenter stopper. Without it, a balanced load can not be applied to the wire rope under tension. For this reason, the two primary types of bridles, wire rope and chain, are described below.

Wire Rope Bridle: The wire rope bridle, shown in Figure 6, comprises three basic high strength alloy steel forgings permanently assembled together on a length of wire rope (1). These parts are the equalizing thimble (2) and two sockets (3). The sockets are secured to the wire rope with zinc poured plugs. The shackle (4) is secured to the equalizing thimble by the shackle pin (5). Two socket pins (6) are secured in the sockets by lock nuts (7).

Chain Bridle: The chain bridle is an alternative to the wire rope bridle. While some chain bridles do exist in the Navy's Emergency Ship Salvage Material (ESSM) Pools, they are infrequently used. This is primarily because of their greater weight and handling difficulty.

Summary:

This paper provides adequate information to identify "old WW II style" Navy carpenter stoppers. A brief development history has been provided so that the difficulties inherent in the design, fabrication, and use of this highly loaded component can be appreciated. It goes without saying that the maintenance and operating aspects are of great importance if carpenter stoppers are to be safe and effective pieces of equipment. It is believed that the difficulties and problems encountered in the development of this stopper by the Navy will provide valuable information for the design, fabrication, testing, and use of carpenter stoppers and related equipment by the Government and commercial enterprises. Because of the low safety factors and high loadings normally associated with ship salvage, it is particularly important to identify "old WW II style" or other inadequate cast carpenter stoppers to prevent disastrous consequences in the course of these operations. Specifically, it should be ascertained whether a stopper is forged or of cast construction. If it is the latter, it should not be used for high load applications such as ship salvage and similar operations.

Editor's Note:

This article was prepared gratuitously by the authors as a public service. It is based on their nearly 75 man-years of experience with carpenter stoppers.

CAPT Bill Searle will be remembered by many readers as the Philippine Area Salvage Officer (1954-'56), Engineering and Research Officer at the Navy Experimental Diving Unit (NEDU, 1956-'59), Pacific Fleet Salvage Officer (1962-'64), and as the Supervisor of Salvage (1964-'69). Since retirement in 1970, CAPT Searle has served both as a Senior Visiting Lecturer at the Massachusetts Institute of Technology and as a consultant. He is Chairman of the firm Searle Consortium, Ltd., international consultants in ocean engineering, ship salvage, diving, towing, and rigging.

CDR Tom Blockwick became involved with Navy salvage during World War II, when in 1942 he attended the original U.S. Naval School, Salvage, at Pier 88 in New York, alongside the sunken liner NORMANDIE. He participated in various harbor clearance operations in North Africa, Europe, and the western Pacific. He was Engineering and Research Officer at NEDU (1947-'51); Technical Officer of JTF 7.3, involving deep ocean moorings and salvage related to weapons testing (1959-'-61); Seventh Fleet Salvage Officer (1961-'64); and Chief of Production Engineering at the Boston Naval Shipyard (1964-'66). He will be especially remembered as Site Commander of SEALAB II. During his tour at BNS, he and CAPT Searle (then SUPSALV), initiated and managed the project which led to the 1968 modifications to the Navy carpenter stoppers. Since retiring in 1966, CDR Blockwick has been involved in various ocean engineering, salvage, towing, and ocean mooring projects at General Electric Co., Ocean Systems Inc., and Searle Consortium Ltd. He is currently Senior Ocean Engineer at Mar Inc., Rockville, Maryland.

Brye Davis has both a BS degree in Mechanical Engineering and an MS degree in Ocean Engineering from MIT, where he studied under and participated in summer projects afloat with CAPT Searle. After graduation in 1978, he served as an Ocean Engineer with Seaward International Inc., of Falls Church, Virginia, and Searle Consortium Ltd. Since 1980, he has been an Ocean Engineer with Mar Inc., where he specializes in mooring, salvage, and towing components and systems design.

the OLD MASTER

Generally, when a serious recompression treatment or diving-related matter arises, you, as the individual charged with diver supervision, do not hesitate to seek professional guidance or assistance. It is well known that a telephone call, day or night, to the Navy Experimental Diving Unit (NEDU) will put you into direct contact with a staff of qualified and experienced hyperbaric medical experts who are committed to quick-response advice and/or solution to your problem.

Besides diving medical inquiries, however, NEDU handles many other concerns related to overall diver well-being, including recompression chambers; diving apparatus and apparel; compressors, filters, and storage flasks; hyperbaric plumbing, components, lubricants, and cleaning.

For the most part, Navy personnel responsible for diving safety are knowledgeable and experienced and are routinely guided by official Navy publications such as the Diving Manual. Often when in doubt, they will go to NAVSEA or NAVFAC in search of technical answers. In as many cases, though, they hesitate to ask for assistance at the headquarters level because of professional pride or concern with the thought that calling on the certification authority might adversely affect their particular system or operational situation. As a result, problems thought solved by a "best guess" or "seat-of-the-pants" approach later re-occur, sometimes with dangerous consequences.

In addition to a staff of medical experts, NEDU has a team of hyperbaric experts who continually provide technical and operational guidance to the Fleet in diving. Consisting of Master Divers, Diving Officers, test engineers, and hyperbaric specialists, this team understands your immediate need for the direct, no-hassle approach to your diving problems on hardware and procedural matters.

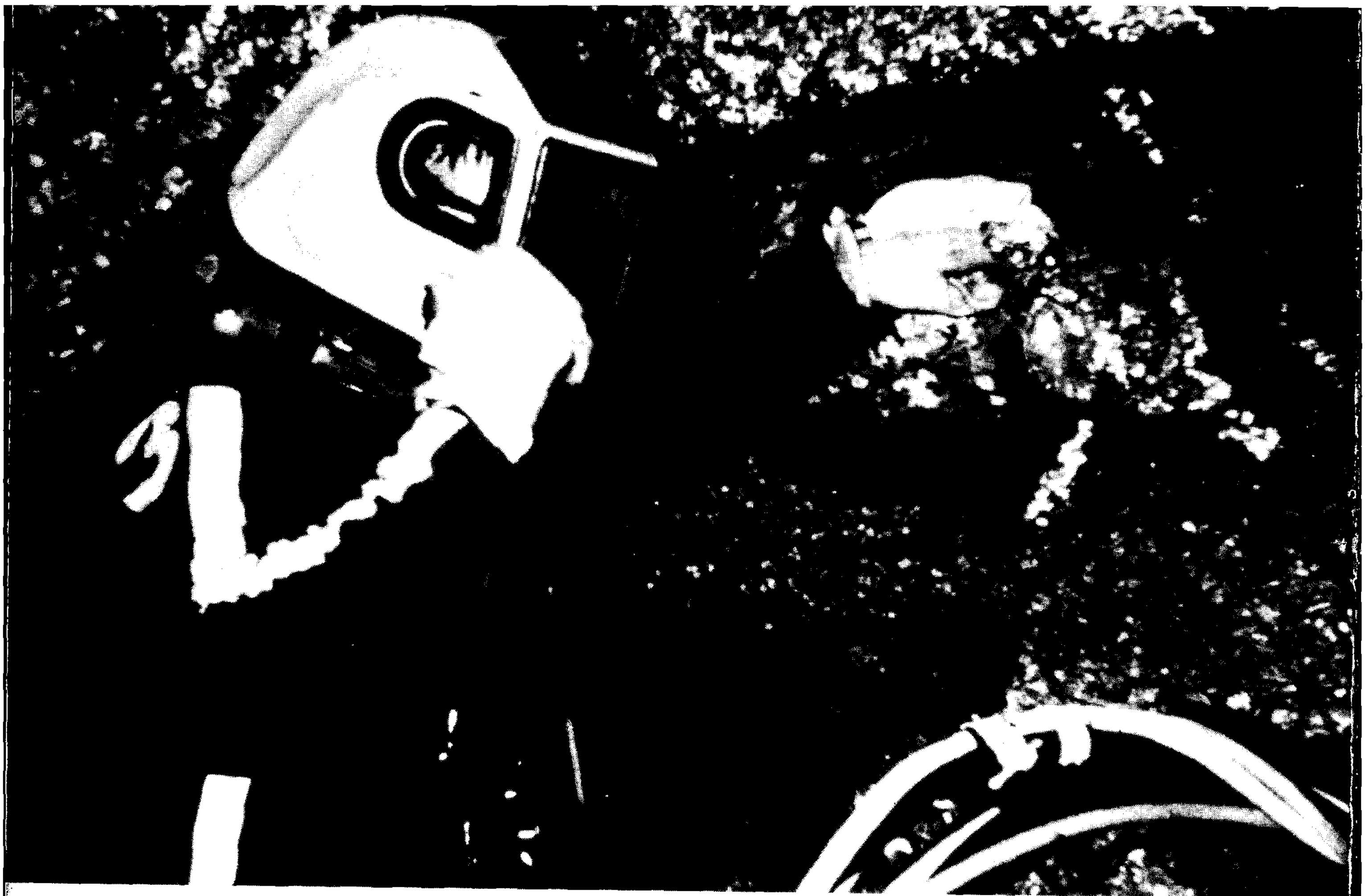
Each year, NEDU spends many man hours on testing and evaluating diving support hardware. Included recently are new commercial SCUBA regulators, compressors, filters, life vests, depth gauges, the decompression computer, the Mk 12 SSDS mixed-gas mode, the Mk 14 CCSDS, a diver respiratory gas heater, and a new recompression chamber, to name a few.

In the area of procedures, NEDU conducts a great number of controlled manned dives yearly in the Ocean Simulation Facility (OSF) Hyperbaric Chamber Complex to optimize decompression schedules and saturation excursion limits and to test and validate new breathing mixtures. All of this is designed to extend our diving capabilities both shallow and deep and to provide greater diver safety and versatility through revisions to the Diving Manual, decompression tables, and other diving-related and safety reference documents and publications.

NEDU provides answers to the Fleet on diving technical problems or direction as to where the answers may be found. In addition, NEDU serves as a clearing house point-of-contact where the Fleet sailor may bring, and in fact is urged to submit, his ideas and beneficial suggestions as a contribution to a safer and better Navy Diving Community.

"Service to the Fleet" remains NEDU's proudest and most concerning mission function. For routine matters, NEDU may be contacted through the Office of the Supervisor of Diving, Naval Sea Systems Command, autovon: 227-7606 or commercial: (202) 697-7606. Urgent matters may be referred directly to NEDU at autovon: 436-4351 or commercial: (904) 234-4351. NEDU's mailing address is:

The Commanding Officer
Navy Experimental Diving Unit
Panama City, Florida 32407



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