FACEPLATE

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

Focus on EOD

Summer 1984
Volume 15, No. 2

FACEPLATE

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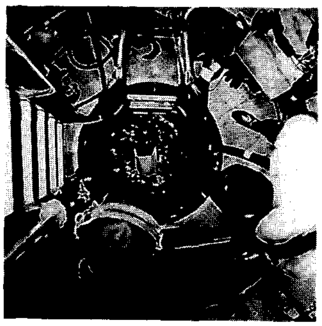
Page 6



Page 9

Page 16

FRONT AND BACK COVERS: An EOD diver wearing low magnetic signature gear uses a hand-held sonar.

photo credit - PH1(DV) Dave McNair

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SOUNDINGS

Service Squadron Five Change of Command

CDR John R. Drucker relieved CDR Archibald G. Campbell as Commander, Service Squadron FIVE. The Change of Command Ceremonies were held on 12 March 1984.

Prior to his assignment as Commander Service Squadron FIVE, CDR Drucker was Commanding Officer of the USS BRUNSWICK. During his tour, he graduated from Deep Sea Diving School, attaining Diving Officer qualifications. From 1978 to 1980, he served as Flag Secretary to COMNAVLOGPAC. He was Advanced Secretariat to the Military Armistice Commission (MAC), United Nations Command, in Panmunjom, Korea from 1977 to 1978.

CDR Drucker served as Executive Officer/Navigator of the USS BEAUFORT (ATS-2) from 1974 to 1977. Prior to that, he took an assignment as Operations Officer on the USS HIGBEE (DD-806). During that tour, he received the DESRON 27 Junior Officer Ship Handling Award for FY 73. He attended the Naval Inshore Operations Training Center, Vallejo, California and Destroyer School in Newport, Rhode Island. CDR Drucker's first sea assignment was aboard the USS TAKELMA (ATF-113) where he served as Operations Officer and Executive Officer/Navigator.

CDR John R. Drucker

CDR Archibald G. Campbell

CDR Drucker was commissioned into the Navy through the Reserve Officer Training Program on 9 June 1968. He has been recognized for outstanding service on several occasions throughout his career. Among his awards are the Meritorious Service Medal, Navy Commendation Medal with Gold Star, National Defense Service Medal and Navy Expeditionary Medal.

In March 1984, CDR Campbell was assigned to OPNAV in Washington, D.C. He assumed command of Service Squadron FIVE in January 1979. During his tour he was appointed to the Special Operations Community (1981) and received a Master of Science in Oceanography degree from the University of Southern California (1983).

Hydraulic Diver Tools Hoses and Quick Disconnects

Alternate hydraulic hoses have been approved for use with NAVSEA hydraulic tool systems. These will be included in the forthcoming edition of NAVSEAINST 9597.1. Use of the following equipment is authorized:

Tool whip: Aeroquip Hytrel Polyester FC373-08 (1/2 inch)

Supply and return hose: Aeroquip Kevlar Polyester SC375-12 (3/4 inch).

Screw Removal on the USS GALLANT

On 13 February 1984, the USS GALLANT (MSO 489) became fouled in a 1/2-inch stainless steel cable while operating off the Southern California Coast. Damage to the propeller proved so extensive that the ship could not be relocated for repairs as originally planned. Divers from Mobile Diving and Salvage Unit ONE removed the propeller and the ship was successfully moved to San Francisco, where a new shaft was installed.

The cable was caught on the port shaft between the hub assembly and strut. It had cut through the external shaft, leaving the hub assembly connected only by the internal pitch control shafting. A new shaft was ordered immediately and the GALLANT was scheduled for repairs in San Francisco in early March. Divers were requested to remove the port propeller blades or lock the propeller for the transit north.

On 22 February, Mobile Diving and Salvage Unit ONE Detachment divers prepared to remove the variable pitch blades from the damaged shaft. The damage was so severe, however, that the blades could not be rotated to the proper pitch. After discussions with the manufacturer, COMNAVSURFPAC ordered the shaft cut and the entire propeller removed.

USS GALLANT was moved to the west mole pier at 32nd Street Naval Station, San Diego, for the propeller removal. Mobile Diving and Salvage Unit ONE Detachment divers rigged a belly band and lifting strap around the screw. This was connected to the belly band and a stern wire from the MSO.

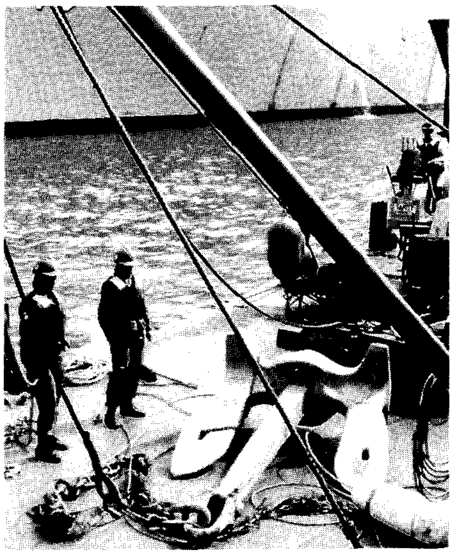
Divers moved a welding machine to the GALLANT and finalized all preparations for MK1 diving. Divers used an ultrathermic rod to cut the shaft into quarter sections. Although limited access between the screw hub and strut and a cloud of hydraulic oil seeping from the shaft hampered their work, they freed the screw and placed it on GALLANT's deck in 90 minutes.

On completion of this unique screw removal, the USS GALLANT was put to sea for San Francisco.

Anchor Salvage on USS BUCHANAN

USS BUCHANAN (DDG-14) was weighing anchor on 19 March 1984 when a detachable link on the outboard anchor swivel shot sheared. The anchor was lost, apparently because of a metal failure. Earlier, the anchor buoy had sunk and another had not yet been installed. On 31 March, Mobile Diving and Salvage Unit ONE Detachment was tasked to locate and recover the 6,000 pound anchor and attached chain.

USS BUCHANAN's anchor after successful search and recovery operations.



MOBDIVSALVU ONE DET reviewed USS BUCHANAN's navigational charts and bearing logs. With this information, the detachment and USS CONSTANT (MSO 427) searched the anchorage without success.

On 4 April, MOBDIVSALVU ONE DET divers and an EOD team from North Island, Coronado made a search dive using a hand-held sonar. One contact was held but lost due to the heavy surge. Stormy weather prevented further attempts until 9 April, when North Island EOD and MOBDIVSALVU ONE DET divers made additional unsuccessful dives. Further search efforts were curtailed until a MSO was available.

On Friday, 13 April, USS PLUCK (MSO 464) and MOBDIVSALVU ONE DET divers again searched the anchorage. USS PLUCK immediately identified an anchor-like contact and dropped a buoy. Divers investigated and discovered the buoy clump resting on the anchor. The anchor was marked with a wire strap.

On Monday, 16 April, MOBDIVSALVU ONE DET divers and a warping tug from ACB-1 recovered the buoyed anchor. The anchor was returned to USS BUCHANAN. This project saved the Navy $13,610 and offered the unit the opportunity to enhance its search and recovery skills.

LCDR James M. Evans receives Navy Commendation Medal for raising and resinking the BLUEGILL.

Reclaimer Officer Receives Award for Raising BLUEGILL

On 6 June 1984, LCDR James M. Evans, Commanding Officer, USS RECLAIMER (ARS 42), was presented the Navy Commendation Medal (Gold Star in lieu of Third Award). The medal was presented by Commodore P.D. Butcher, Commander, Naval Surface Group Western Pacific during a ceremony held on board RECLAIMER at Subic Bay, Republic of the Philippines. LCDR Evans received the Medal for his performance as the Salvage Master in the raising and re-sinking of the World War II Submarine ex-BLUEGILL (AGSS 242), off the coast of Lahaina, Maui, Hawaii in October/November 1983. (See FACEPLATE, this issue.)

Sixteen EOD Memorial Scholarships Awarded

CDR John Sedlak, chairman of the EOD Memorial Scholarship Committee, announced Monday, 21 May, that the Committee will award 16 $1,000 scholarships in 1984.

This year marks the 13th annual awarding of the EOD Memorial Scholarships. The fund was established in 1972, providing educational assistance to families of deceased, retired or active duty EOD personnel. Since the first scholarship was presented in 1972, 120 students have received them.

To be eligible for competition, applicants must have at least a 2.0 grade point average and they must be unmarried and under 21 years old (23 years old if currently a full-time student at an approved institution). Their parents or legal guardians must be either deceased, retired or active duty EOD personnel. Special consideration is given to sons, daughters, unmarried widows and widowers of EOD technicians killed in the line of duty on an EOD mission. Unmarried widows at any age may apply for the scholarship.

The winners, listed in the committee's order of preference, are: Michelle Stryzak, Cynthia Morrison, Lori McCormick, Arthur Gallegos, Brenda Mathes, Robert Fay, Lisa Wolfe, James Sullivan, Denise Bevaqua, Joseph DeStefano, Diana Butler, William Cook, Loretta Ussery, Lonnie Brown, Julie Jurek and Tracy Sopchick.

For further information and applications, write the EOD Memorial Scholarship Committee, Explosive Ordnance Disposal School, Indian Head, Maryland 20640, Attn: Administrative Officer or call (301) 743-4483, AUTOVON 364-4483.

MK XII Ordering Information

Temporarily, it is not possible to requisition MK XII outer garments, dry suits and boots using the Standard Naval Stock Number (NSN).

Activities ordering these items are directed to use a 1348 non-NSN requisition with their usual accounting data. This will be forwarded to an office at SPCC which has recently been established to deal with the needs of the diving community. List the items by name and size only and send the requisition to:

Ships Parts Control Center (SPCC)
Box 2020
Mechanicsburg, PA 17055
Attn: Code 05131/54

Any questions can be directed to Tom Masaitis at AUTOVON 430-6889.

View from the SUPERVISOR OF DIVING

By CDR Raymond Swanson

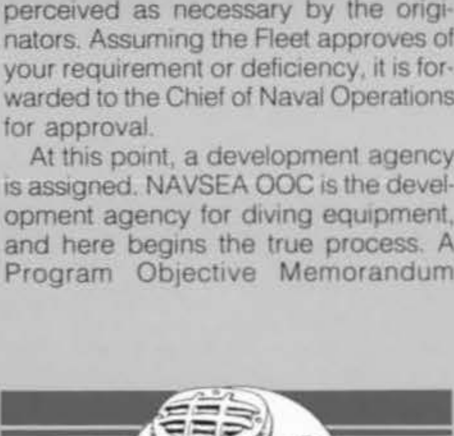
Many inquiries received by this office concern the acquisition or purchase of diving equipment by individual activities for their specific needs. I must frequently turn down these requests. A few words to clarify the acquisition process for diving equipment, as well as other equipment, may shed some light on the reason for our discussion.

Our mission is to prepare to respond to demands of a wartime environment. Everything in the Navy is aimed in this direction, even the supply system. Congress funds diving equipment with this philosophy in mind. But, within the Navy, opinions diverge. The headquarters commands are trying to get as much for each dollar as possible and provide the Fleet with safe, reliable and standardized equipment that can be properly supported. You, on the other hand, want equipment that best assists you in your work and the latest designs available in the marketplace.

Fulfilling both needs is difficult. Since diving is conducted in such a harsh environment, safety is more critical to us than it is in other fields. Consequently, all our life support equipment must be thoroughly tested and analyzed before it is approved. Obviously, to conduct work in an organized fashion, testing should be and is scheduled. In our case, the Navy Experimental Diving Unit is required by the Chief of Naval Operations to test diving life support equipment and work is already scheduled at least a year in advance. Only a limited amount of unscheduled testing can be tolerated by the system.

Getting back to the acquisition of major equipment, the typical process is multiphased, consisting of concept, validation, development, production, deployment and support. The process begins in the Fleet — usually at your level. Someone develops a concept of requirements for equipment or procedures to better assist you in the performance of your mission. As the requirement goes through the chain of command, each level weighs it against other needs of the ship, squadron or Fleet. Remember, Congress only allots so much money; therefore, not everything will be funded. Your needs are in competition with others which are all perceived as necessary by the originators. Assuming the Fleet approves of your requirement or deficiency, it is forwarded to the Chief of Naval Operations for approval.

At this point, a development agency is assigned. NAVSEA OOC is the development agency for diving equipment, and here begins the true process. A Program Objective Memorandum



(POM) is prepared and sent to the mission sponsor at CNO. The POM essentially justifies a development program and requests the necessary funding to bring the program through to its conclusion. The POM request, when approved, is for money to be allotted three years in the future. For example, the POM submitted today is for 1987 dollars. When the POM is approved, the requirement becomes a line item and is given a program element number.

The objectives of the conceptual phase are to identify alternative concepts to satisfy the requirement. Designs are explored, testing criteria investigated, production methods evaluated, operational requirements and affordability considered. If sufficient money is not available, more must be obtained, the number of units reduced or the program terminated. The selected concepts are then brought into the validation phase.

During the validation phase, the feasibility of continuing the program into full scale development is demonstrated. This is done through competitive analyses of the alternative concepts. Risks and uncertainties are assessed, cost estimates refined and an advanced development model constructed.

Your initial concept now enters into the full scale development phase where the actual design is developed, systems certification criteria met and logistic support determined. A limited number of engineering and technical testing models (prototypes) are made. Software in the form of technical mechanicals, training requirements, APLs, *etc.*, is developed and NEDU performs unmanned and manned testing on the equipment. Upon completion of testing by NEDU, the equipment is ready to go into TECHEVAL and OPEVAL.

The OPEVAL is the final approval test necessary before a contract can be made with a vendor to produce the equipment. The contracting process usually involves eight months. After contract award, the vendors build a First Article which will be tested by NEDU to assure it meets our standards and workmanship is adequate. Successful testing by NEDU allows us to have units manufactured and delivered to designated activities — you.

I did not mention any time frame in which this process takes place because I did not want to dampen your hopes. However, you may already have some insight into the length of time involved from the beginning of this article. The total process requires approximately eight years, including the three-year wait for funding. Since this is quite a lengthy process, new items come on the market and the temptation is always to use the newest technology. But, at the same time, the design must be frozen; no further changes can be made and production must be carried out. Otherwise, we will never get the end product.

With the delivery of equipment to the Fleet, spare parts are included. These parts are estimated to be sufficient for about 18 months, filling the void while the supply system is building up stocks. Upon delivery of the equipment, you become responsible for the spare parts by submitting usage data. Every time a replacement part is required, a requisition must be submitted or the supply system will assume that a part has never been replaced and they will cease stocking it. Remember, it takes approximately eight months to award a contract and then a specific amount of time is necessary to manufacture the part and get it into the supply system. This delay can be caused by going directly to vendors for your needs without giving data to the system. It may work fine in peacetime; but will certainly collapse in a wartime environment.

There is a shorter alternative to the full acquisition program described above. As with most short cuts, a penalty is involved, namely, lack of supply system support and configuration control. This alternative is the Approved for Navy Use (ANU) process.

The ANU process allows us to take commercial state-of-the-art equipment off the shelf, test it, and if it meets established criteria or an approved test procedure, authorize it for Navy use. The process was originated in 1970 and was intended only to lift the restriction that required all divers to use the aluminum twin 90's without a back-pack and with the Acquamaster regulator. This opened the door for Navy divers to use commercial SCUBA equipment with the logistic support provided by the vendor supplying the equipment.

The ANU process, like full acquisition, begins with a Fleet requirement for particular equipment. Upon approval, the Supervisor of Diving will task the Navy Experimental Diving Unit to procure the equipment and test it. A priority will be established based upon Fleet needs, and a date will be set for completion of testing. As I mentioned earlier, it is not without a penalty. Any immediate testing will cause a delay in some other scheduled testing. Assuming the equipment successfully passes all phases of testing and meets certification requirements where appropriate, a report is forwarded to the Supervisor of Diving recommending Approval for Navy Use. The equipment is then added to NAVSEAINST 9597.1, the ANU list.

At this point, you can procure the equipment locally, for awhile. Since we used a short cut, critical items such as drawings, design control, supply parts, *etc.*, are not under Navy control. When the manufacturer decides to make a design change, whether to better the equipment or to reduce costs, the Navy may not be informed and usually does not become aware of the change until a Fleet unit has a problem. What is our recourse? None. In most cases we have no contract with the vendor and must go along with his change. If life support equipment is altered, the equipment must be re-tested for breathing resistance, carbon dioxide build-ups, dead zones, *etc.*

Although this abbreviated description paints a negative picture of the ANU process, there is a brighter side. The Navy diver can choose many types of equipment, such as SCUBA regulators, wet suits and SCUBA cylinders, with which he is most comfortable and which meet his mission requirements. He can also obtain it more quickly than through the supply system; but remember, where appropriate, send in usage data so the system knows the equipment is needed. That local dive shop will have difficulty supplying needs when your ship is halfway around the world.

Because the acquisition process is lengthy, equipment must be multipurpose and capable of fulfilling our needs over a period of many years. If you look back, I believe you will find that your diving equipment does just that.

As the official magazine for the U.S. Navy diving and salvage community, FACEPLATE publishes information concerning the latest equipment, techniques and procedures as well as other newsworthy events.

For this purpose to be best served — and for you to be best informed — it is imperative that the magazine receive articles from all Fleet and shore-based activities. Without such support, FACEPLATE cannot adequately fulfill its mission.

Some suggested areas of interest include salvage operations where divers employed special techniques or completed a particularly difficult job, research and development of diving equipment, training programs in diving and underwater ships husbandry. Articles submitted for publication must be unclassified.

The deadline for submitting manuscripts for the winter issue is 15 November 1984. Although this office assumes the privilege of limited editorial license, significant changes to manuscript text will not be made without prior consent. Material considered unworthy for publication will be returned to the originator.

FACEPLATE's accounts of people, programs and operations become a part of the historical record of U.S. Navy diving and salvage. You can be part of it.

Point of contact at NAVSEA OOC is CDR Raymond Swanson (SEA OOC-3) at AUTOVON 227-7606/7/8 or commercial (202) 697-7606/7/8.

LET'S HEAR FROM YOU!

NAVEODTECHCEN SUPPORTS

EOD Minehunting

A Navy EOD technician does close-in reconnaisance on underwater unexploded ordnance (UXO).

By Larry Tierney,
Ocean Engineer, NAVEODTECHCEN
LCDR Richard Funk, USNR-R

A recent resurgence of mine warfare in the Navy has led to increased development of mine countermeasures. With the advent of the "smart mine," it is no longer possible merely to sweep mine fields. Individual mines must be located accurately. These increasingly complex assignments are carried out by the Navy EOD community.

A wide range of tools is needed to complete the minehunting mission, which extends from the beach to 300 foot depths. The Naval Explosive Ordnance Disposal Technology Center (NAVEODTECHCEN) provides the Fleet with improved means of locating and sweeping underwater ordnance. At NAVEODTECHCEN, the Research and Development Underwater Projects Division is tasked to develop and evaluate EOD tools and search equipment. Precise navigation equipment, nonmagnetic diving gear and sonars, magnetometers, computers, remotely operated vehicles and laser imaging systems are a few of the minehunting tools currently under development.

Area Point Search System

The Area Point Search System is a major contributor to the EOD minehunting mission. APSS is composed of two subsystems, the MK 2 MOD 0 Navigation System (by Cubic Western) and the MK 24 MOD 0 100-kHz Side Scan Sonar (by Klein Associates).

The Cubic Navigation System is a line-of-sight system featuring two

NAVEODTECHCEN personnel rig the CDD for deployment.

Photos by Larry Tierney.

responders in known locations. The interrogator and computer are located on a tow boat, enabling the boat to follow a predesignated search pattern and return later to the same location. An overlapping lane search pattern is frequently used when hunting for mines, assuring that the area is thoroughly searched. The operator obtains a number of pictures at different angles, helping the warranting diver to determine if investigation of an object is worthwhile. The system has demonstrated consistently that it is able to return to within three meters of a target location.

The Klein Side Scan Sonar is light weight and constructed in modules for easy deck handling and minor repairs. For its size and cost, it offers one of the best acoustic pictures of the ocean bottom currently available.

When a target of interest has been identified, the diver marks it by dropping a weight with a buoy near it. The weight should be dropped close enough to the target to enable the diver, descending the buoy line, to recognize the object of his search in a short time. It should not be dropped so close, however, that the weight or the diver might disturb a potentially dangerous mine. The newly developed AN/PQS-2A hand-held sonar will enable the EOD diver to locate the target. Unlike its predecessor, the AN/PQS-1, it is nonmagnetic and is easily held in one hand. The sonar has active and passive modes. The active mode has a range of 110 meters and emits sound waves which will reflect from objects underwater. The passive mode receives "pings" radiated from mines or other materials placed for practice. This unit will be available to the Fleet by the end of 1984.

The APSS has completed all operational testing and the initial systems have undergone first article acceptance testing. The system was forwarded to the Fleet in April 1984.

Modernization of the APSS is progressing in several areas. The navigation system is being improved to permit multiple users, and has a multi-shore station option. With the expanded system, personnel will be able to conduct continuous searches in areas with twisting, undulating topography. The system will accommodate more than one boat at a time in the geographic area being searched.

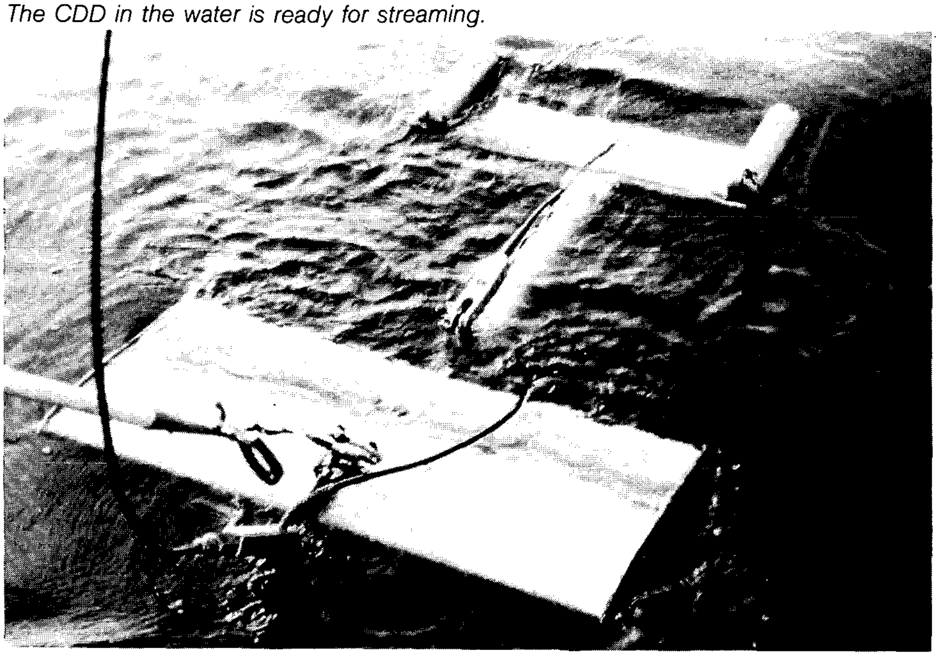
Magnetometer Search System

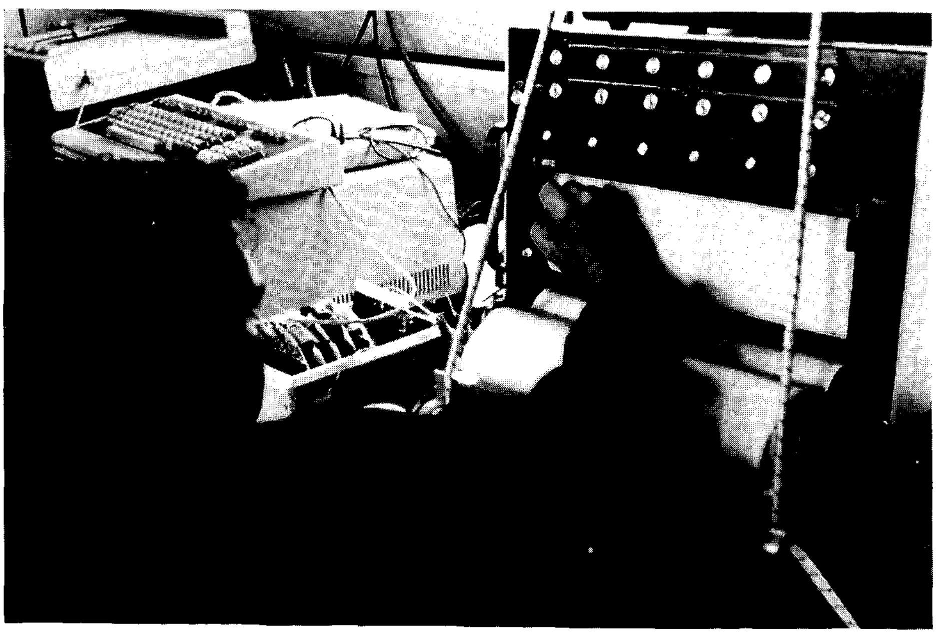
NAVEODTECHCEN is also expanding its range of sensors. While sonars are excellent for locating ordnance resting on or above the ocean bottom, buried ordnance requires a magnetometer detection system. The magnetometer measures the lines of force in the earth's magnetic field. These lines concentrate around ferrous materials, and the magnetometer registers the increased force, enabling personnel to identify materials containing iron.

Until recently, a magnetometry system had not been developed which would maintain a controlled height from the sea bottom. The EOD Magnetometer Search System (MSS) has this capability. Its central component is a cesium vapor magnetometer similar to that used in the MK 22 Ordnance Locator. The MK 22 features a Controlled Depth Depressor (CDD) with two modes. First, a specific water pressure point can be set to maintain the magnetometer at a constant depth. A fathometer may also be used to keep the magnetometer at a fixed height above variable terrain. The CDD resembles an aircraft with main wing, tail wing and vertical stabilizers attached to a cylindrical body. A pressure sensor and acoustic echo sounder provide depth and altitude data to a control loop inside the vehicle. This determines the angle of the entire main wing (actually a hydrofoil) and the magnetometer remains at the specified depth. The CDD, though sophisticated, is simple enough to operate aboard small "craft of opportunity," making it readily available for search and recovery operations.

The CDD has undergone pressure testing in NAVEODTECHCEN's hyperbaric facility to a simulated depth of 300 feet of water. The vehicle's center of buoyancy was measured in the NAVSCOLEOD 24-foot pool, an excellent facility for marine vehicle testing. The true test of the system was in open water, and the Potomac River, adjacent to the Technology Center, served as a convenient shallow-water test area.

The CDD in the water is ready for streaming.





A magnetic anomaly is made on the Cubic Navigation System's strip chart recorder.

Testing in deeper water was conducted in the Patuxent River near the Navy Facility in Solomons, Maryland. In 1981, NAVEODTECHCEN planted a field of 38 mine casings in water depths of 40 to 120 feet. The MSS has been evaluated extensively in this mine field to determine total system performance. Soon, tests will be conducted off the beach at Fort Lauderdale, Florida, with mines at 300-foot depths. In addition to plotting positions of mines with the MSS, markers will be dropped on the computed locations. Using a side scan sonar (MK 24 MOD 0), data will be gathered on distances between the mines and markers.

Designed strictly for the MSS, the CDD also has great potential as a platform for cameras, side scan sonar, color-imaging sonars and laser-imaging systems. With continued research and development, the Fleet will have the optimum combination of sensors for the undersea environment.

MK 25 MOD 0 Ferrous Ordnance Locator

A replacement for the MK 9 and MK 10 Ordnance Locators is being developed. The current locators represent 1950s state-of-the-art technology and utilize tone changes to indicate magnetic field disturbances. To enable the EOD diver to locate a buried item more accurately, a new MK 25 MOD 0 Ferrous Ordnance (underwater) Locator (a prototype undergoing conceptual testing) will incorporate several unique features. It will contain a battery pack which is nonmagnetic under system load as well as in the static mode. Warning tones will indicate when the batteries are low, when the sensor head is not up to operating temperature and if the head is not in the proper attitude. In addition, the MK 25 will talk the operator into the target with a computer-synthesized voice.

The staff at NAVEODTECHCEN has contributed to Fleet EOD capabilities with navigational equipment, side scan and hand-held sonars, the Magnetometer Search System and other equipment for work with ordnance. This continual dedicated effort ensures that the EOD technician in the field has the most up-to-date equipment, the widest range of options for a given scenario and the best chance for survival.

NEDU DEEP DIVE '84

By LCDR Michael D. Curley, MSC, USN

DEEP DIVE 84, an 850 feet of sea water (fsw) helium-oxygen dive, was recently conducted in the Navy Experimental Diving Unit's (NEDU) Ocean Simulation Facility (OSF) in Panama City, Florida. This 31-day saturation dive, involving rigorous work under pressure, was completed on the morning of 8 March 1984. Seven U.S. Navy saturation divers emerged from the living chambers of the OSF to receive greetings from NEDU's Commanding Officer, CDR Frank Eissing, and their families, friends and shipmates.

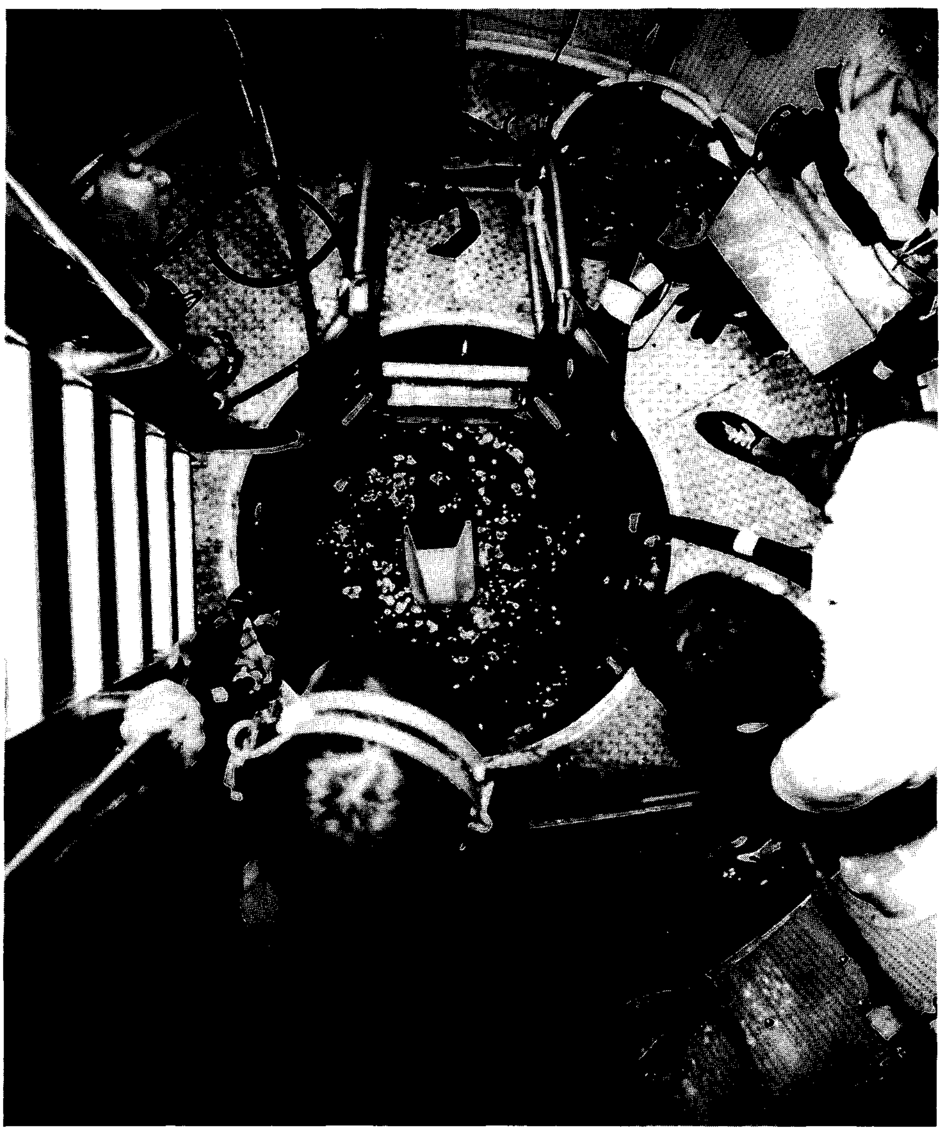
MK 14 CCSDS

During DEEP DIVE 84, manned data were gathered from the MK 14 Closed Circuit Saturation Diving System (CCSDS) which is currently undergoing development and testing. More than a dozen studies and experiments were carried out during the dive, demanding the most of each diver and all support personnel. Physiological data were gathered on the life support capability of the MK 14 CCSDS during graded exercise and canister duration studies at various depths. For each graded exercise, a diver wearing a NRV hot water suit pedaled a bicycle ergometer in 35°F water at work loads of 50, 100 and 150 watts. These studies were extremely demanding physically and the divers' successful performance reflected the rigorous pre-dive training program the team completed.

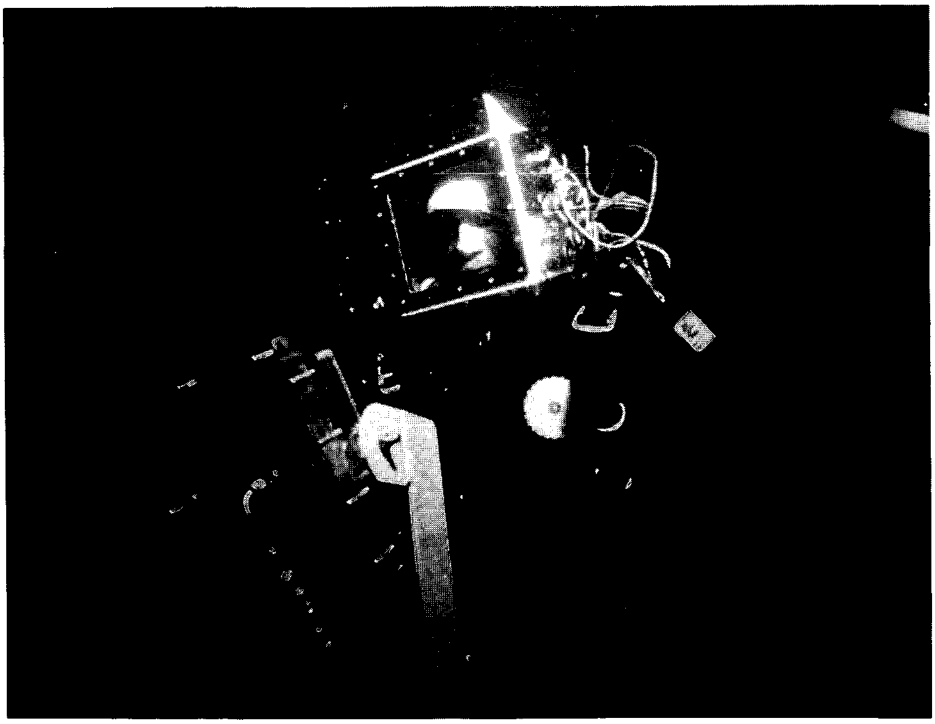
Underwater Sound Levels

For the first time ever, the U.S. Navy recorded sound levels from inside a manned diving helmet while the diver rested and worked underwater. The purpose of these studies was to gather information for use in safeguarding the divers' hearing. Audiograms were conducted on all divers during the dive to determine hearing shifts over time and at various depths in a helium-oxygen environment. All of the sound studies involved extensive pre- and post-dive equipment calibration, and attention to detail by divers and topside personnel.

Photos by PH1(DV) Noel Guest.



MK 14 diver enters 35°F water in the OSF's 55,000 gallon wet chamber.



(Above) BMC(DV) Munoz collects MK 14 gas samples using a Tissot spirometer.
(Upper left) EN1(DV) Watson challenges the SINBAD performance assessment system.
(Left) CDR Eissing of NEDU evaluates the MK 14 while pedalling the bicycle ergometer during pre-dive work-ups.

Superlite 17B Helmet

At 850 fsw the team evaluated the Superlite 17B helmet. The Superlite 17B is a commercially available open-circuit, dry helmet with an oral-nasal mask and demand regulator. Its mechanical systems are similar to the MK 1 Mod S Mask. The effects of oral-nasal valve failure on system performance and the ability of Superlite 17B users to exercise in the presence of elevated helmet carbon dioxide were studied. Using the Superlite 17B and the MK 1 Mod S Mask, a communications intelligibility test was administered during dives at 850 fsw. These tests were accomplished successfully.

Effects of Saturation Diving

The U.S. Navy monitors closely the short and long-term effects of saturation diving on divers' health and well-being. During DEEP DIVE 84 all divers completed a full neuropsychological assessment battery (*e.g.*, tests of brainstem functioning, memory, personality and perception) before and after the saturation dive. They also participated in selected tests of balance, information processing and word fluency at 850 fsw. This testing was completed to ensure proper documentation of the diver's neuropsychological state, and timely medical intervention if necessary. All divers were found to be in good health after the dive.

Complementing the neuropsychological testing was the diver performance testing, enabling investigators to evaluate and document the effects of a prolonged helium-oxygen dive to 850 fsw on cognitive, psychomotor and affective performance. Diver performance was assessed using the SINDBAD system (Systematic Investigation of Navy Diver Behavior at Depth), a computer-assisted test apparatus located inside one of the OSF's living chambers. Dive team performance was not significantly impaired at depth during this dive.

New Cold Water Survival System

The U.S. Navy conducted a major study for the British Navy, investigating the ability of two commercially available survival systems to protect a diver at 850 fsw with 2°C ambient temperature. Such a system might be used by divers trapped inside a diving bell, where extreme cold and resulting diver hypothermia create major problems for survival. In this test, one diver wore a passive (thermal) survival system and another wore an active (hot water) system. Both entered an OSF living chamber chilled to 2°C and rested quietly. Their thermal states were monitored for several hours by a series of heat flow transducers and probes.

Revised Upward Excursion Limits

During the decompression phase of the dive, revised upward excursion limits were tested from depths of 850, 650, and 200 fsw. These proposed new limits were designed to minimize the incidence of decompression sickness, especially during upward excursions from storage depths of 650 fsw or deeper. Also tested during the decompression phase were two hand-held carbon dioxide detector kits. Accuracy and ease of use were compared. The data gathered from these and all other studies conducted during DEEP DIVE 84 will be used to determine the procedures and equipment recommended for use by U.S. Navy divers. Results of these studies will be published in forthcoming NEDU Technical Reports.

The DEEP DIVE 84 Dive Team was directed by Team Leader, EMC(DV) Robert Novak from NEDU. Team members included MMC(DV) J.R. Jones (SUBDEVGRU-1), BMC(DV) William Dulaney (SUBDEVGRU-1), BMC(DV) Charles Munoz, Sr. (NEDU), EN1(DV) Bruce Watson (NEDU), MM1(DV) Ricky Wolvin (NEDU), and BM1(DV) Stephen Wargo (NEDU). The success of DEEP DIVE 84 required the dedicated efforts of more than 100 Navy and civilian men and women who supported the dive in such roles as cooks, computer operators and finance clerks. Saturation dives of this magnitude are not undertaken in a vacuum; they require the collaborative efforts of many Navy facilities and their resources. Personnel from several commands contributed to this dive, including individuals from the Naval Coastal Systems Center, Naval Aerospace Medical Research Laboratory, Naval Submarine Medical Research Laboratory, Submarine Development Group 1, and the Navy Environmental Health Center. These men and women can be proud of a job well done.

A Typical Day for Participants in DEEP DIVE 84

On a typical dive day, the divers were awakened at 0600. They immediately tested their emergency breathing apparatus, performed personal hygiene and linen change and consumed a hot or cold breakfast. They locked out the breakfast dishes and prepared for the day's diving, setting up the dive station in the OSF trunk for the particular rig (*e.g.*, MK 14, MK 1, Superlite 17B) to be used. Personnel meticulously calibrated physiological and sound transducers, requiring smooth interaction between divers and topside personnel. For sound studies, divers prepared the collapsible audiometric booth and were administered audiograms before and after each wet excursion. Those not involved in SINDBAD testing donned their NRV hot water suits and their rigs, and plunged into the OSF's 55,000 gallon wet pot filled with water chilled to 35°F. Dives lasted from one to three hours and involved graded exercise, canister durations or sound studies. Several dives were planned during the day and work often continued well into the evening. After diving was secured and post dive calibrations and audiograms were completed, dinner was locked in to the divers. This was followed by sick call, showers, daily cleaning chores and movies or TV. A call home and ear prophylaxis preceded lights out at 2200.

NEDU Watchstanding During DEEP DIVE 84

Although attention generally focuses on the dive team members, OSF watchstanders play a vital role during DEEP DIVE, monitoring the safety and well-being of the dive team and the material condition of the OSF and surrounding NEDU complex. Three watch sections stand daily 8-hour watches during a saturation dive, providing around-the-clock support to the dive team. Each watch section consists of a Dive Watch Officer, Dive Watch Supervisor, two Chamber Support Operators, a Gas King, an Atmosphere Control Operator, an Electrical/Communication Technician, a Log Keeper, Medical Deck Technicians and a Dive Watch Medical Officer who stands a 24-hour on-board watch. Support personnel on board at various times of the day include cooks, computer technicians and equipment specialists, all prepared to assist the dive team. During DEEP DIVE 84, watchstanders worked 32 days continously and participated in many weeks of pre-dive work-ups.

Instructing new personnel on a watch station is a serious task for watchstanders, made especially important by the complexity and sophistication of the OSF. Personnel striving to qualify on one of the OSF watch stations must complete a series of practical and written tasks under the guidance of experienced, knowledgeable watchstanders. A task book for each watch station outlines areas of instruction and specific goals to be achieved. Upon satisfactory completion of a task book, the prospective watchstander must pass an oral and written qualification board on the station. Only after demonstrating practical knowledge and successfully appearing before the board will the sailor be allowed to assume the watch. An entry is made in the member's service record describing this noteworthy accomplishment.

Prospective OSF Dive Watch Officers and Supervisors must qualify as Gas King and Chamber Support Operator before progressing to their final stations. These individuals must demonstrate a working knowledge of all watch stations, support tasks and computer operations. The rewards for the hard work expended in qualifying as an OSF watchstander are genuine. They include the safety and well-being of the divers, the respect of the watchstander's peers, and the knowledge that the successful watchstander is one of only a very few men and women qualified to conduct experimental dives in this sophisticated hyperbaric complex.

Mission: Submarine Rescue

By LT M.P. Smith
USS FLORIKAN

In January 1984, USS FLORIKAN, commanded by LCDR Jeff Tyler, assisted the Submarine Development Group ONE Mobile Dive Team in the required annual recertification of Submarine Rescue Chamber Twenty-One (SRC-21).

SRC-21 is a 21,000-pound version of the McCann Rescue Chamber. With its lightweight and highly portable support equipment, it is the only flyaway system of its kind in the world. This SRC uses water ballast rather than conventional lead weights, reducing its total weight during air transport. The SRC can be loaded quickly on various aircraft, including C-141s, C-5s and C-130s and flown worldwide to assist a submarine in distress. It can carry two operators and six passengers and is certified to 850 fsw.

FLORIKAN carries a submarine rescue chamber of her own (SRC-15), one of six in use in the U.S. today. This chamber and its related gear were removed from the ship prior to onloading SRC-21. The nineteen-man Mobile Dive Team, led by LT J.T. Compton, onloaded SRC-21 and its flyaway equipment, including umbilical, three high pressure air compressors, air bottle banks of compressed air, a control console and spare parts conex box. All equipment was securely chained and welded to the fantail under the supervision of Mobile Dive Team's ENCM (MDV) R.L. Cave.

USS FLORIKAN left her home port of San Diego and was secured in a multi-leg moor in approximately 400 fsw, the depth required for maintaining chamber certification.

Using FLORIKAN's main boom, the Team lifted the false seat, which simulates the hatch of a distressed submarine, off the fantail and over the side. The false seat rested on the bottom in 410 fsw. To prevent the SRC from hitting the ship's hull in case of an uncontrolled ascent, FLORIKAN heaved around on the starboard quarter leg of her moor

YBC SALVOPS
NAVSTA, Norfolk

By LCDR R. E. Nisley, USN
Mobile Diving and Salvage Unit TWO

On Christmas Eve 1983 a YBC (Barge Camel non-self propelled) sank in heavy weather. The barge was moored to the starboard side of USS FLYING FISH (SSN-673) which was outboard of the USS L. Y. SPEAR (AS-36) berthed at the Naval Station, Norfolk, Virginia. The barge rested on the bottom in 36 fsw at a 45° angle from upright. Her deck faced downward and her port side pinned FLYING FISH against the L. Y. SPEAR.

After several unsuccessful attempts to free FLYING FISH and L. Y. SPEAR, Mobile Diving and Salvage Unit TWO, under the operational command of Commander, Service Squadron EIGHT, was tasked to salvage the barge.

The salvage team arrived on scene 27 December and developed an initial salvage plan. The commercial heavy lift craft, SAMPSON, already on scene, would parbuckle the barge away from FLYING FISH. When the barge was free from the submarine, divers would reposition wires about the barge for a lift to the surface and dewatering.

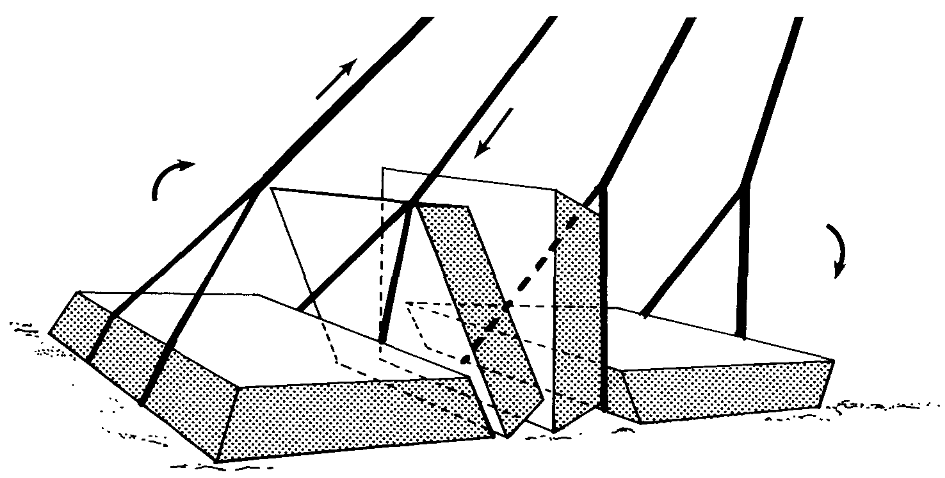
That evening at high tide, as the salvage team assembled the necessary equipment, the barge slipped free of FLYING FISH, and rested inverted on the bottom. This position presented a more direct approach to the salvage of the barge and the salvage plan was revised accordingly.

The revised salvage plan called for the placement of two messenger wires beneath the barge by water lance to ensure proper positioning and to avoid deck fittings on the barge. Divers would use the messengers to pass two tri-braided lifting slings around and beneath the barge. They would secure the slings to the heavy lift craft and parbuckle, lift and dewater the barge.

While preparations to assemble the salvage gear and diving equipment continued, FLYING FISH was moved from its position alongside L. Y. SPEAR. Divers cleared berths in the vicinity of the barge to prevent possible damage to craft and ships during the parbuckle and lift.

Fitted with radio communications and a ten-ton crane, the YSD-53, a self-propelled Seaplane Derrick from MOBDIVSALU TWO, was chosen as the main salvage platform. An LCM-8 was used as a support craft. The MK-12 SSDS was chosen for diving because of its suitability for cold water and heavy work. Team members staged salvage pumps and associated equipment on vehicles and readied them for transport to the salvage scene.

Parbuckling the barge was accomplished by heaving in on the outer hook and paying out on the miner hook.



and moved approximately 25 yards away from the seat. Personnel lifted the SRC from the deck and placed it alongside the ship.

For safety, the SRC maintains 1,000 pounds of positive buoyancy during descent and ascent. An air motor-driven winch pulls the chamber to the bottom by hauling it on a downhaul cable. Ascent is accomplished by paying out on this cable. In case of an emergency, such as air motor failure or fouling of the downhaul cable, a 7-inch Super-Esterlon line (wall rope) extending from FLORIKAN's stern to the SRC serves as a backhaul. This line is much easier and safer to handle than the 1-1/8 inch wire used previously.

Personnel completed a series of five dives under superb weather conditions, and SRC-21 was successfully recertified. The Mobile Dive Team and USS FLORIKAN's divers received excellent hands-on training in SRC operations, and they continue to stand ready to carry out their mission, submarine rescue.

Submarine Development Group ONE
Mobile Dive Team Participants

LT Compton
ENCM(MDV) Cave
ENCM(DV) Decker
HTC(MDV) Laurich
ENC(DV) Dawson
EN1(DV) Davis
ET1(DV) Nashton
EN2(DV) McLaughlin
IC2(DV) Stover
MN2(DV) Iacone
MM2(DV) Fleeman
GMT2(DV) Crumley
HT2(DV) Maceaux
QM2(DV) Wong
HT2(DV) Tibbs
FTG2 Mejia
MM3(DV) Cullum
STGSN(DV) Godbold

USS FLORIKAN
Participants

LCDR Tyler
LCDR Molsberry
LTJG Pehl
BMC(DV) Moore
MM1(DV) Miller
GMG1(DV) Hodgins
BM2(DV) Nugent
TM3(DV) McDonald

Adverse weather delayed salvage operations until 3 January 1984 when the YSD-53, carrying the salvage team, arrived on scene.

After an initial survey of the barge, divers determined that it rested parallel to the pier and L. Y. SPEAR. The western end was buried approximately 6 feet beneath the mudline; the eastern end rested in 1 foot of mud at its deepest point.

For several days divers attempted unsuccessfully to run water lances. They learned that a railroad rail or "Sally rail" was attached to the top edges of the barge, preventing placement of the lances. They decided to run the messenger beneath the corners of the barge by hand. The presence of large amounts of debris, including metal plate and angle iron, in the area made this method extemely difficult. However, the messenger was run. The ends were secured on the YSD-53 and a strain was taken on the forward and after capstans. The messenger was pulled through the mud and away from the end of the barge, stopping at the desired position.

Team members attached a 1-inch wire rope (150 feet in length) to each messenger. The SAMPSON's deck winch was used to pull it beneath the barge.

On Sunday, 8 January, with both lifting straps in position, team members secured the eyes of the two straps nearest the L. Y. SPEAR to SAMPSON's 75-ton hook. The YSD-53 was moored in a position clear of the parbuckle attempt and Sampson began to lift.

SAMPSON hauled in on her 75-ton hook and cradled the weight of the barge (110 long tons) in her 375-ton hook. The barge was raised off the bottom as expected and slowly rolled into a vertical position. As the top of the barge surfaced, the previously buried voids were uncovered and air rushed into the barge. The SAMPSON's master maintained a strain on the barge, allowing its newly acquired reserve buoyancy to keep it afloat.

The barge settled to an upright position and SAMPSON moved it alongside the YSD-53. Team members deployed yellow gear and completely dewatered the barge by 1800 that afternoon.

It is important to note that the parbuckling method employed, rotating the barge by heaving in on SAMPSON's outer 75-ton hook and paying out on the 375-ton miner hook, was relatively simple, safe and efficient. The major difficulty in this salvage operation was the placement of the messengers beneath the barge. The MK-12 SSDS proved completely satisfactory in the cold January temperatures.

The success of the operation was a direct result of the coordination and team effort exerted by military personnel and the crew of the SAMPSON.

YBC CHARACTERISTICS

Length	110'
Width	32'
Height	9'
Weight	110 LT (empty)

SALVAGE TEAM

Mobile Diving and Salvage Unit TWO

LCDR R. E. Nisley — Salvage Officer
HTCM(MDV) J.M. Leszczynski
MMCS(MDV) D.P. Buehring
BMCS(DV) A. Moon
EN1(DV) L.R. Bennett
ET1(DV) R.R. Curley
TM1(DV) R.H. Dushole
BM1 C.D. Huddleston
HT1(DV) D.H. Miller
BM2(DV) D.A. Brown
MM2(DV) J.R. Carter
EN2 D.M. Goodwin
EM2(DV) K.L. Jones
BM2(DV) E.F. Lah
BM2 T.D. Richardson
HM2(DV) M.B. Stearman
HT2(DV) D.W. Thrush
HT2(DV) V.D. Womack
ET3 R.A. Ashcraft
EN3 M.D. Bowers
MM3(DV) J. Schnoering
EN3(DV) M.L. Spence
EMFN E. Baker
SN T.R. Hensperger
SN E.L. Lashley
SN(DV) T.A. Pierce

Naval Medical Resear

By Don Chandler, Maureen Darmody and Ellen Hughes
NMRI
CAPT Mark Bradley, MC, USN
Scientific Advisor

Editor's Note: Research Scientists at the Naval Medical Research Institute (NMRI) are constantly seeking ways to improve diver safety and treat conditions resulting from underwater work. The following article describes a few of the projects currently underway at NMRI, and how the results of these studies are contributing to increased diver safety and greater understanding of human responses to the stresses of the undersea environment.

New Drugs for Embolism and "Bends" Cases

Studies by CAPT John Hallenbeck, NMRI and SURG LCDR James Sykes, NMRI, Royal Navy Medical Exchange Officer.

A diving task is nearly completed when the diver unexpectedly surfaces in a flurry of bubbles. He cries for help and immediately loses consciousness. The alert Master Diver diagnoses air embolism, a life-threatening diving emergency. The diving team reacts to the situation, and within moments, the affected diver is safely in a recompression chamber and showing signs of recovery. If all goes well, he will emerge from the chamber in a few hours, fully recovered and apparently normal.

Unfortunately, not every case of embolism responds to recompression therapy. The cause of air embolism, air in the diver's bloodstream which blocks the flow of blood to part of the brain, can result in permanent damage and possibly death unless the diver is treated rapidly and effectively.

To prevent this sequence of events, Naval and medical personnel must better understand the processes which cause brain cells to die when the blood supply is interrupted. Researchers at the Hyperbaric Medicine Program Center (HMPC) at the Naval Medical Research Institute (NMRI) are performing research on the mechanism of air embolism and brain cell death. In recent experiments, they have been able to influence the effect of air embolism on blood flow with therapeutic agents. Used in conjunction with conventional primary treatment (U.S. Navy Treatment Tables), these agents have the potential to improve considerably the adjuvant therapy for decompression sickness and cerebral arterial air embolism.

One current research project will test these methods. NMRI's Royal Navy Exchange Medical Officer is applying this successful experimental adjuvant therapy to treat experimental decompression sickness. He is also evaluating other drugs and treatment approaches.

SCUBA Disease

Studies by CAPT Mark E. Bradley, NMRI and CAPT Robert C. Bornmann, formerly of NMRDC.

Personnel, money and material have been committed, months of preparation and training are past. A dive team has arrived on scene after three days of familiarization SCUBA dives, preparing to complete a time-critical mission. Support facilities are in position. Everything seems ready — except the divers. Each is incapacitated with chills, nausea, vomiting, cough, general malaise, aching muscles and severe headache. There is no choice but to abandon the mission, regardless of its importance.

Such a critical loss of manpower seems unlikely, but it is possible. The divers in this story are afflicted with SCUBA Disease, and be assured, it can destroy an entire mission.

Under normal conditions, SCUBA Disease need not occur. It has, however, appeared in the Navy diving community. At least one case in 1958 resulted in death from pneumonia.

A paper was recently published discussing many cases of SCUBA Disease in the U.S. Navy, and similar cases in the Australian Navy. The infection is caused by an organism called pseudomonas, which enters the respiratory and/or gastrointestinal tracts through contaminated underwater breathing equipment. Although this was recognized as long as 15 years ago, cleaning and decontamination of underwater breathing equipment have not been routine tasks for divers.

Prevention of SCUBA Disease is relatively simple. If divers clean breathing hoses, bags, mouthpieces and regulators diligently, they will probably never have to worry about this condition.

Drugs May Help in Treating Spinal Cord Injury

Studies by Arthur I. Kobrine, M.D., Ph.D., George Washington University Medical Center, and NMRI Associates.

Things have been rather routine during decompression from this 1,000-foot saturation dive. The Master Diver waits for his five-man team to return to the surface after 30 days under pressure. He is suddenly informed that one of the divers has just collapsed.

Looking through the chamber port, he suspects a spinal "hit." In communications with the medical technician and dive team members, the suspicion is confirmed. Seconds count. Time makes the difference between a long, healthy life and permanent paralysis, perhaps even death. The depth gauge shows that the decompression chamber is 55 feet below the surface.

The Master Diver orders the victim carefully removed into an adjoining chamber. He calls the diving medical officer and instructs the Med Tech diver to ride with the victim and prepare for compression to a deeper depth.

When the medical officer arrives at the scene, he orders a treatment breathing gas and chamber compression to 100 feet. After examining the victim, he orders a prepackaged IV tray and a bottle of lidocaine.

MEDICAL ADVANCES FOR DIVERS

Soon the diver is conscious and appears to be answering questions as the IV is being prepared. Lidocaine is administered systemically.

The diver shows dramatic improvement. Eventually, he returns to the depth of the other divers and undergoes routine saturation decompression. His recovery is attributed to the administration of lidocaine.

Several researchers have conducted experiments showing that lidocaine administered systemically appears beneficial in treating spinal cord injuries. These injuries occur as a result of air bubbles that form in the nervous tissue of the spinal cord and the small veins and arteries of the blood circulation that supply blood to the spinal cord. The bubbles block blood vessels, and in this sense, spinal cord injuries resemble stroke. Animal research indicates that lidocaine may reduce the chance of hemorrhage in spinal cord tissue and promote the return of function to nervous system tissue. This reduces the risk of permanent spinal damage. Cautious clinical trials with humans should further support these findings.

High-Frequency Oscillation for Deeper, Safer Diving

Studies by John R. Clarke, Ph.D., NMRI, and Associates.

A 100-year-old man was asked the secret to a long life. Without hesitation, he replied, "Just keep on breathin', son, keep on breathin'." The man is describing one of the basic physiological functions — ventilation.

During the breathing process, exhaled CO_2 is exchanged for fresh air full of oxygen. Body systems function normally as long as this ventilation continues. When divers go to depths at the limits of both air and saturation (HeO_2) diving, however, ventilation becomes much more difficult.

The gas a diver breathes becomes denser the deeper he or she dives. The increased density overloads the diver's respiratory system, resulting in hypoventilation and hypercapnia, a high concentration of CO_2 in the blood.

A diver suffering from prolonged hypercapnia is in danger. The high level of CO_2 in the blood is toxic. In addition, hypoventilation and hypercapnia predispose a diver to greater risk of decompression sickness, increased susceptibility to the toxic effects of oxygen breathed at high pressure, and potentiate the narcotic effects of nitrogen breathed at high pressure. Until recently, the only immediate treatment was to send the diver to a shallower depth or have the diver stop working as hard, thereby decreasing ventilatory requirements. Research conducted at the Hyperbaric Research Facility has shown, however, that hypercapnia resulting from poor ventilation may eventually be eliminated.

Research on ventilation has shown that high-frequency oscillation (HFO) in experimental animals improves gas exchange, thus ventilation. Breathing aided by high-frequency oscillation ranges from 360 to 1,800 breaths per minute with a low volume of 20 to 30 cc per breath. (A normal breathing rate is 15 to 20 breaths per minute with a volume of 600 to 800 cc per breath.)

These studies suggest that further experimentation and increased knowledge of HFO may yield a device, installed in a diver's mask, which would emit the required HFO at predetermined density levels. This would eliminate hypoventilation and the resultant hypercapnia.

It is interesting to note that HFO was discovered by accident. Vietnam casualties, suffering wounds that induced poor ventilation, were transported to aid stations on helicopters. Upon arrival, the patients showed no signs of poor ventilation. Investigation revealed that the vibration produced by the helicopters caused the improved ventilation. The principle of this chance discovery is now a major thrust of medical research.

More on Diver Ventilation, from the Israeli Naval Hyperbaric Institute

Studies by LCDR Daniel H. Kerem, Israeli Naval Hyperbaric Institute, and Associates.

A researcher, on leave from the Israeli Naval Hyperbaric Institute (INHI), currently at HMPC, has reported on a study conducted at INHI. His research indicates that some individuals may be physiologically unfit for diving because of an abnormal tendency to retain CO_2 in the blood.

Researchers at the INHI report that no good screening test has been developed to eliminate those diving candidates who retain CO_2 abnormally. Until such a test is developed, they have some recommendations. First, more emphasis should be given to diver training with the aim of suppressing the tendency for CO_2 retention. Evaluating divers' ventilatory response to CO_2 should have independent value in closed-circuit diving candidates. It may take several years to establish a clear cause and effect relationship between diving accidents or near-accidents and low response to CO_2. However, they recommend that all diving candidates be tested and that very low responders be excluded from such diving.

Hypercapnia due to poor ventilation also enhances the onset of other diving problems, such as oxygen toxicity, nitrogen narcosis and heat loss. With the cooperation of all concerned, hyperbaric researchers are working hard to solve this problem.

A number of research projects directly related to diver safety and health are being conducted at NMRI. Conditions such as air embolism, SCUBA Disease and hypercapnia may have extremely serious consequences for divers. With recent breakthroughs and continued effort, these illnesses are being treated more consistently and effectively. Our goal is to help divers adapt to the harsh undersea environment, so they can carry out their missions more safely and effectively.

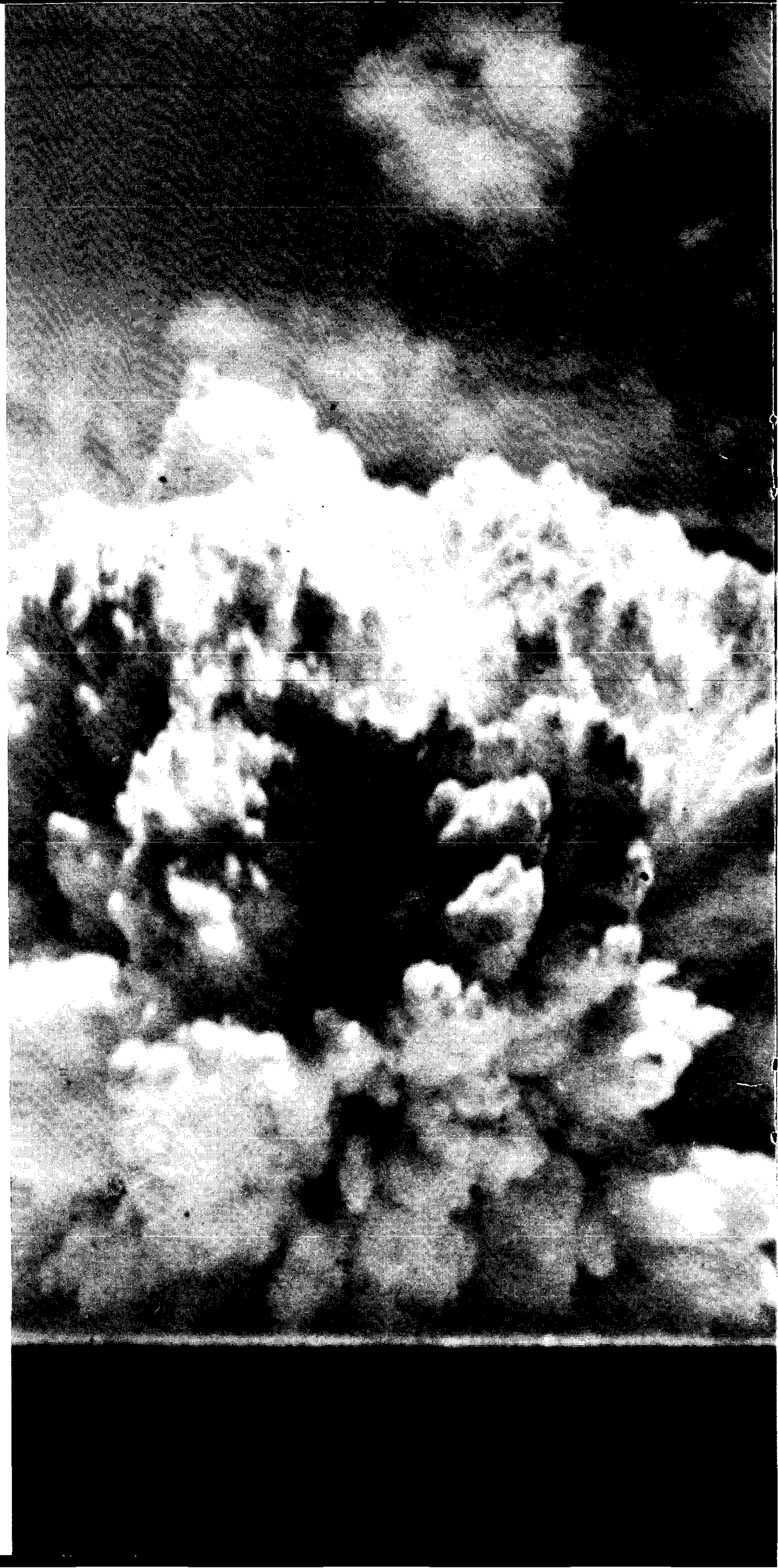
By CDR Michael Murray
Commander, EOD Group TWO

Navy Explosive Ordnance Disposal (EOD) Group TWO is located on the Atlantic Coast at Fort Story, Virginia. Housed in a dirt bunker built for the Army in World War II, COMEOD Group TWO coordinates EOD Mobile Unit TWO, consisting of 18 shipboard, 11 mobile and 4 amphibious detachments; Training and Evaluation Unit TWO at Fort Story; and 22 shore detachments. Located in the Atlantic, Mediterranean, Caribbean and east of the Mississippi River in the continental United States, these units carry out the mission of protecting civilian and military personnel from dangerous explosive ordnance, ashore and at sea.

Diving capabilities, small detachments and use of special underwater equipment distinguish EOD personnel in the Navy from other military EOD teams. Navy EOD personnel are tasked to render safe all live ordnance undersea and up to the high water mark. They are divers first. All receive training in shallow, SCUBA and deep-sea diving before they begin EOD training. Their unique mission is carried out by four-person units. (EOD teams in the other U.S. military services are composed of as many as 20 persons.) The deactivation or detonation of underwater ordnance requires the use of sophisticated underwater equipment, such as the Area Point Search System (APSS) and low magnetic signature tools. Each of these components has been developed for successful completion of Navy EOD responsibilities.

The EOD Mission

The rendering safe of civilian and military ordnance includes six major areas of responsibility: diving, underwater and surface demolition, disposal of conventional, nuclear and chemical ordnance, and deactivating improvised explosive devices. All Navy EOD personnel must be divers. Underwater and surface demolition is the most economical form of ordnance disposal. Where possible, ordnance is rendered safe by detonating it. Conventional surface and underwater ordnance includes such devices as mines, torpedoes and projectiles that fall into the ocean. Disposal of nuclear and chemical ordnance is rarely required. LCDR Terry Stark, Commanding Officer of EOD Group TWO's Training and Evaluation Unit, ex-



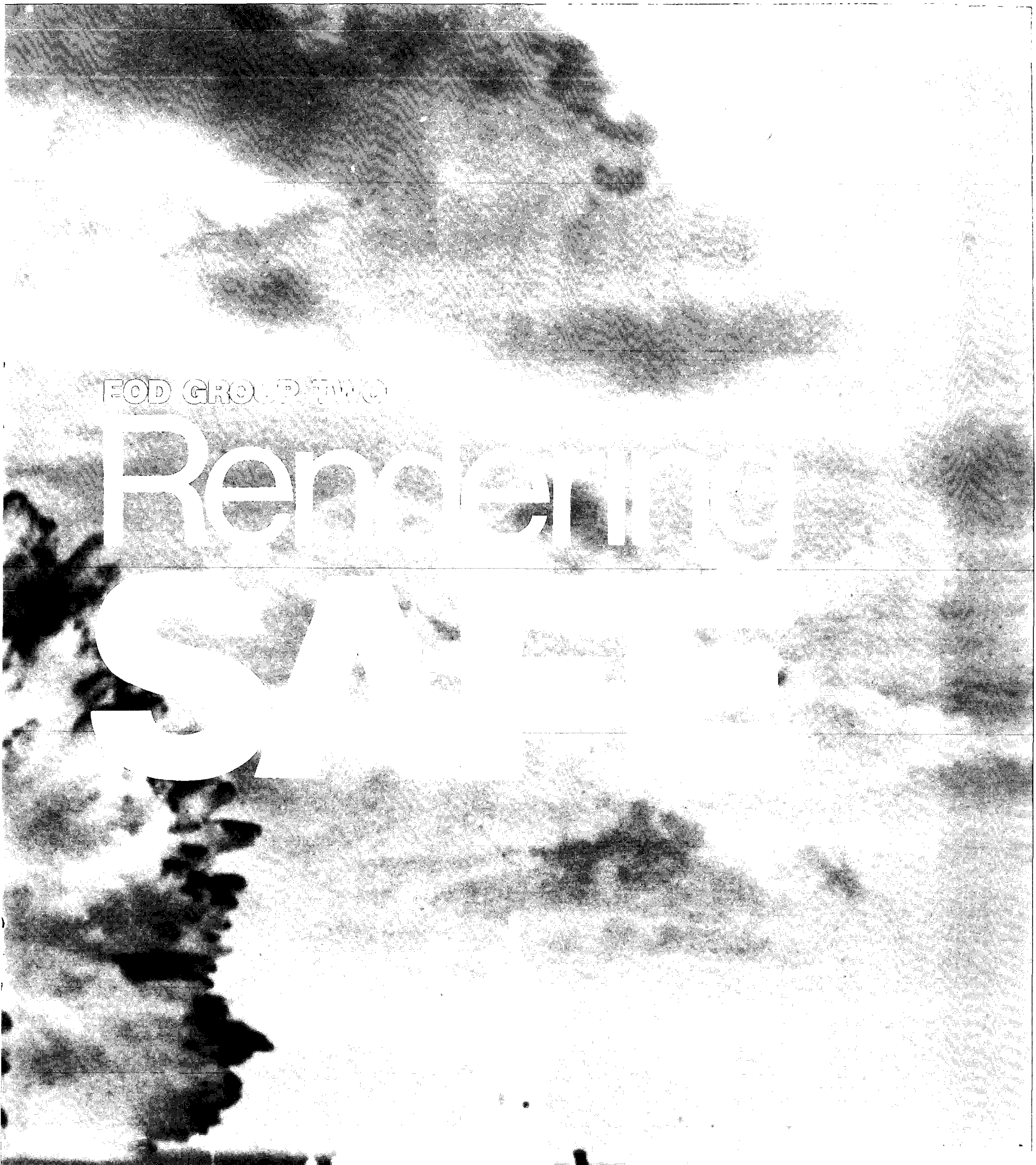

EOD GROUP TWO
Rendering

photo credit - JO1(PJ/SS) Peter D. Sundberg

Navy EOD technicians parachute from the ramp of an Air Force C-130.

plains that EOD personnel are thoroughly prepared to deal with nuclear and chemical weapons but, "you hope you never have to. The group is like a fire department. We constantly train in diving, demolition and deactivation of many types of ordnance. Then we wait until a job comes up. When it does, someone is in danger." In 1965, EOD personnel assisted in locating a lost H-bomb off the coast of Spain. This is the most recent example of EOD responsibility for nuclear ordnance. Finally, the EOD mission includes rendering safe of improvised explosive devices. The most prominent of these are homemade bombs used by terrorists. These provide a challenge because all are unique, and must therefore be handled with extreme care.

EOD personnel carry out several responsibilities indirectly related to rendering safe. These include scoring and recovering mines and missiles shot in Navy exercises. These tasks save the Navy money, because the practice ordnance can generally be reused. EOD personnel also perform shock tests to evaluate a new ship's ability to withstand nearby explosions. This is accomplished by detonating 40,000 pound charges near ships being tested.

Organization of EOD Group TWO

The Navy EOD mission is unique because the Navy is solely responsible for underwater ordnance disposal. An organization has been developed which is well-suited for work with the special dangers in the undersea environment.

EOD Group TWO, under COMNAVSURFLANT, consists of three components: Mobile Unit TWO with mobile and shipboard detachments, shore detachments and Training and Evaluation Unit TWO. The mobile detachments assist with fused and unfused ordnance in salvages or aboard Fleet ships. They provide limited diving capabilities to their assigned ships, including initial searches and deactivation of ordnance during salvage operations. Often, one mobile detachment is assigned to a battle group. This team is flown to various ships in the group as needed.

Shore detachments perform underwater and surface EOD assignments for civilian and military emergencies. Assigned to specific locations for their shoreside tours, these teams store equipment for rendering safe in trailers for quick response. The shore detachments dispose of ordnance that washes ashore and act as emergency response teams where no bomb squad exists.

The Training and Evaluation Unit at Fort Story provides refresher courses to all EOD Group TWO personnel. This training, required at 18-month intervals, introduces team members to the most recent technologies in rendering safe. LCDR Stark explains that within the same time frame, detachments are evaluated for general capability and the condition of their equipment. At 24-month intervals EOD detachments undergo mine readiness certification inspections. Each team is given a rendering safe scenario involving an underwater mine. As they deactivate the mine, their ability to handle the situation quickly, effectively and safely is tested.

EOD personnel are generally assigned to each of the above divisions. Following training at the EOD School in Indian Head, Maryland (See FACEPLACE, Winter 1983), they complete a tour with one of the mobile detachments, and then move to shore detachments. After this, they take positions as instructors at the training commands. LCDR Stark pointed out that, "The people in EOD tend to remain. Statistics show that the average stay in the EOD

photo credit - PH2 Mark D. Ball

community is longer than time served in other organizations." In fact, most EOD personnel stay until they retire. Recruited into the program at the E5 or E6 level, with five or six years experience in the Fleet, their tenures are approximately 15 years.

The Area Point Search System

The rendering safe of underwater ordnance requires special tools. The Navy has developed several tools to aid in locating objects in the sea, detonating and defusing ordnance, and handling explosive materials remotely. Among the most sophisticated of Navy EOD tools are the Area Point Search System and low magnetic signature tools and diving rigs.

The first task in most EOD underwater assignments is to locate objects, such as downed aircraft, sunken ships or ordnance. The Area Point Search System (APSS) provides data for finding these objects. The system is composed of the side scan sonar and a precise navigation system, and may include a towed magnetometer and hand-held (man-portable) metal detector. Components of the APSS have been used by the Navy for approximately 10 years. In 1984, the APSS was authorized as a system.

The side scan sonar tube ("fish") is towed through the water on an electronic cable. As the fish moves, it emits sound waves from its left and right sides. Objects within reach deflect the sound waves and return them to transducers on the fish. An impulse is transmitted through the cable to a machine on the boat. A visual image of the underwater object is produced on paper as it moves through the machine at a speed proportional to the release and return of the sound waves.

Accompanying the side scan sonar is a precise navigation system. Two points of reference are established on shore, where transponders provide lines of sight to the boat towing the sonar fish. Geometrics are applied to determine the exact location of the fish. In conjunction with the side scan sonar, the precise navigation system records the position of an object and the time its image was transmitted. It is effective up to 30 miles off shore. When a missing object is located, personnel mark it with a buoy for recovery.

EOD personnel have developed the Aircraft Search System, a variation on the Area Point Search System. When locating a very large object, such as a fallen airplane, or conducting a broad area search, personnel use a more common navigation device, the Loran Charlie, with the side scan sonar.

The Aircraft Search System is used frequently in aircraft recoveries. When SERVRON 8 is tasked with a salvage operation, EOD detachments locate the aircraft precisely with the system. They mark the position with buoys, the salvage ship moors and EOD personnel make initial dives to render safe any ordnance hazards (*e.g.*, ejection seats, live ordnance). An assignment is usually directed by the ship's commander, although EOD personnel may offer further assistance with diving.

Two optional devices, a towed magnetometer and hand-held metal detector, are included in the APSS package. The towed magnetometer is used with the side scan sonar to distinguish between metallic and non-metallic materials. Personnel are able to determine if objects reflecting sound waves are organic or metals they may be trying to locate. The hand-held metal detector is used in water where visibility is poor.

EOD personnel first tested the components of the APSS during the clearance of the Suez Canal in 1974. One group moved the shore transponders of the precise navigation system as they searched sections of the canal. They marked objects and another team followed to examine and clear ordnance. APSS equipment proved extremely valuable in the clearance of the 100-mile canal. EOD personnel detonated approximately 9,000 items and removed 200 tons of explosive material.

More recently, in conjunction with the Smithsonian Institution, Navy personnel used the APSS to locate sunken steamships in the Great Lakes.

Low Magnetic Signature Equipment

EOD personnel must often approach underwater explosive devices to defuse them, attach charges or move them to

photo credit - John Boyden

(Left) An EOD diver wearing MK 6 diving gear approaches a U.S. MK 36 mine in its transport rack.

(Above) An EOD diver ties together lines used for a circle line search.

photo credit - PH2 Mark D. Ball

SMC(DV) Marvin Dukes assembles an inert mine simulator prior to placing it in the bay. This will be used to test an EOD DET's ability to locate and render safe mines.

shore for investigation and deactivation. Ordnance is commonly detonated by contact with a magnetic field. To prevent explosions, divers use low magnetic signature equipment.

Low magnetic signature diving life support equipment, EOD tools and other unqiue EOD equipment do not contain electromagnetic fields, and electromagnetic fields cannot be induced into them, making them safe for work in close proximity with magnetically detonated devices. Generally, this equipment is constructed with materials such as beryllium, copper, stainless steel or special alloys such as inconel. High impact plastics may also be used. While this equipment is extremely difficult to produce, it is necessary for EOD work. LCDR Stark explains that, "You must always assume the worst condition at the beginning of an EOD job. As you learn more about the ordnance you're working with, you can relax a little with your techniques." If a device is unknown to divers, they must treat it as though it were magnetically detonated, and use low magnetic signature equipment.

Divers typically use low magnetic signature equipment to clear a mined channel or harbor. Personnel first locate the mine with side scan sonar, handheld sonar or a circling line search. They then identify it, employing low magnetic signature tools and diving gear. If the mine is believed to be activated by a magnetic field, divers continue to use this equipment. They either defuse the mine, beach it for investigation or attach charges to detonate it on location.

EOD Group TWO uses other specialized equipment to defuse or deactivate ordnance and handle explosives remotely. Rocket wrenches, tape and line and remote mechanical vehicles perform the defusing function. An underwater burning tool is designed to ignite and burn explosive materials very slowly. Remote equipment is used whenever possible. With these tools, divers minimize their direct contact with live ordnance. One such tool assists divers in moving objects out of the water. An uninflated balloon is attached by hand to an underwater explosive device. EOD personnel use remote controls to inflate the balloon and float the ordnance to shore, where experts examine it more closely.

The equipment available to the EOD Groups assists them in locating, identifying, detonating, moving and inspecting live ordnance. The Area Point Search System has been especially valuable in locating objects lost at sea. Low magnetic signature equipment permits the safe identification and deactivation of underwater ordnance. Still, LCDR Stark adds that, "The EOD diver's best tool is his common sense." Even with the most sophisticated equipment, rendering safe requires intelligence, courage and extreme caution.

Navy Salvors Raise the BLUEGILL

By LT George T. Brown, USN

USS BEAUFORT prepares to tow BLUEGILL to the final disposition site. Photos by PH2 Al Diaz and PH2(DV) Debbie Cottelessa.

The EX-USS BLUEGILL was first placed on the bottom of the ocean near Lahaina Harbor, Maui, in 1970. The Navy used the decorated World War II BALAO Class Submarine to train personnel in submarine salvage and rescue. Officials agreed in 1970, however, that the BLUEGILL would be removed from this site when it was no longer needed for training. The decision for removal was made in June 1983. On 5 November 1983, salvors successfully repositioned the BLUEGILL in deep water approximately 23 miles southwest of Lahaina.

COMTHIRDFLT designated COMSERVGRU ONE, CAPT M.H. Munsey, as the OSE for the operation. COMSERVRON FIVE, CDR A.G. Campbell was the Officer Conducting the Exercise (OCE) and Officer in Tactical Command (OTC). The On-Scene Commander was LCDR John Speer, Commanding Officer of the USS BRUNSWICK (ATS-3). The Supervisor of Salvage (NAVSEA Code OOC) provided salvage engineering support for the operation.

Sinking the BLUEGILL

In the fall of 1970, the State of Hawaii issued a Right of Entry to place BLUEGILL on the ocean bottom three fourths of a mile off Makila Point at Lahaina. BLUEGILL was stripped of her engines and batteries and her fuel tanks were emptied for the last time. She was specially rigged for the tow and controlled sinking. However, unlike the EX-HAKE, which had been raised in the Chesapeake Bay a few years earlier, BLUEGILL was not equipped with special provisions or fittings for eventual resurfacing. Future salvors would have to deal with the boat as she was designed. In December 1970, BLUEGILL was towed to the Lahaina site where salvage experts opened her ballast tanks to the sea. She sank slowly and gracefully to the bottom and settled in the soft sand. Two lightweight anchors were attached, securing her position against the gentle current.

For nearly 13 years the BLUEGILL provided an excellent platform for the training of young and old sailors alike. She was in relatively good condition, and was no longer needed for active service. Lahaina Harbor was a superb location for diver training. The warm, calm waters at this historic whaling harbor were crystal clear, soft sand


A Navy diver searches for air leaks in BLUEGILL's damaged conning tower. The damage was caused by an anchor several years earlier.

covered the bottom, and the weather was suitable for year-round training.

Navy officials decided to remove the BLUEGILL from its location off Maui in June 1983. They planned to resink her in much deeper water, according to their 1970 agreement. A number of factors were considered in reaching this decision. First, the BLUEGILL was no longer useful for submarine rescue training. Modern Navy nuclear-powered subs bear little resemblance to the structural design of the BLUEGILL. Second, located close to shore in relatively shallow water, she had attracted a number of amateur divers and a corresponding high incidence of decompression sickness. Finally, the condition of the sub was deteriorating. If it was not raised soon, a later salvage could be extremely difficult.

In early August 1983, a meeting was held in Pearl Harbor to develop an operational plan for raising the BLUEGILL. Attending the meeting were representatives of some 14 separate commands, each contributing their diving and salvage expertise.

The Plan

The results of the August meeting were published in September 1983 in a comprehensive operation order entitled PACSUBSALVEX-83. The plan encompassed operations from locating and surveying to the eventual towing and resinking of the BLUEGILL. Her new location would be an area about 23 miles southwest of Lahaina. The plan was divided into three major phases; lifting, raising and towing. First, a tandem heavy lift in a step fashion would be used to move the BLUEGILL to a water depth of 40 feet. This would be accomplished by utilizing the USS BRUNSWICK (ATS-3) and USS BEAUFORT (ATS-2), along with a 150-ton lift barge. Following a partial dewatering of the BLUEGILL's interior, the ATSs and the barge would heave around on four 1-1/2-inch X 150-foot chain lifting bridles, raising the submarine approximately 30 feet. BLUEGILL would then be moved toward shore by heaving around with the heavy lift barge winch on the bow leg until it touched bottom. This sequence would be repeated until the submarine was moved to the desired water depth. During the second phase, the salvage equipment would be rerigged and salvage air hoses would be connected to the main ballast and fuel ballast tanks.

A controlled sequence of blows of the ballast tanks would bring the submarine to positive buoyancy and she would surface. Once on the surface, additional tanks would be blown as necessary to bring the sub into correct trim and buoyancy. Salvage personnel could work on her safely and rig her for tow.

Preparation

Personnel accomplished the required preparations to get the salvage operation underway. This operation required several pieces of special equipment. Adapters were manufactured by Shore Intermediate Maintenance Activity (SIMA) Pearl Harbor to mate ATS salvage hose, which is metric, to National Pipe Thread (NPT) 1-1/4-inch submarine salvage fittings. Three salvage compressors, salvage hoses and a manifold were obtained from the Emergency Ship Salvage Material (ESSM) base in Stockton, CA. Mobile Diving and Salvage Unit ONE and ship's force personnel were tasked with collecting and verifying availability of pieces of the bow lift gear from sources at Pearl Harbor. SIMA and Pearl Harbor Naval Shipyard assisted in manufacturing pieces of bow lift jewelry. A mini-Ranger precision navigation system was procured from NUWES DET Hawaii to use in precisely positioning the legs of the moor. NAVOCEANWESTCEN, Pearl Harbor, provided a weather facsimile machine and an ocean current meter was obtained from NAVOCEANO Bay, St. Louis.

When the necessary equipment had been procured, the salvage team proceeded from Pearl Harbor to Lahaina. Upon arrival, BRUNSWICK began rigging the moor at the salvage site.

During this phase of the operation, several SCUBA dives were completed to mark off legs one and two of the mooring, which had submerged. Additional dives were made to conduct surveys and to photograph the event.

As BRUNSWICK secured herself in a five-point moor over the sub, BEAUFORT arrived at the salvage site and began laying four additional moor legs. These legs were originally specified in the heavy bow lift plan, to shift the moor into shallow water once the submarine was on the surface. However, the plan was changed and they would never be used.

A Change in Plans — Computer Assistance

Early in the operation it became apparent that the average daily surface swell at the site might cause dangerous dynamic loading conditions if the original tandem heavy lift was used. A plan to raise the submarine in place utilizing her own buoyancy was decided upon. An engineering support team was appointed. It was headed by LCDR Gary Tettleback of NAVSEA OOC, and consisted of two engineering duty officers and the COMSERVRON FIVE Special Projects Officer, LT Neil Hansen. They began making calculations for the lift, using a HeathKit Z-100 microcomputer. Accurate stability and buoyancy calculations were essential for raising the submarine in a controlled manner.

Using information obtained from the Philadelphia Naval Shipyard, a stability and buoyancy data base was developed and entered into the microcomputer. With the automated data base, manipulated by utility programs written for specific requirements, several alternative dewatering and ballast tank blow plans were examined in a relatively short time.

First, the team calculated the additional buoyancy required to surface the submarine. This was accomplished through considerations of both weight removal and added buoyancy. Assuming the pressure hull could be completely dewatered, weight removal calculations indicated that BLUEGILL would remain 147 long tons negative. Added buoyancy calculations indicated that 179 tons of additional lift would be required. This discrepancy of 32 tons was assumed to result from water remaining in internal "pockets" (fuel and hydraulic lines, machinery, *etc.*) and the buoyant contribution of the superstructure. These factors could not be quantified. The team therefore proceeded using the added buoyancy calculations as the basis for the lifting plan.

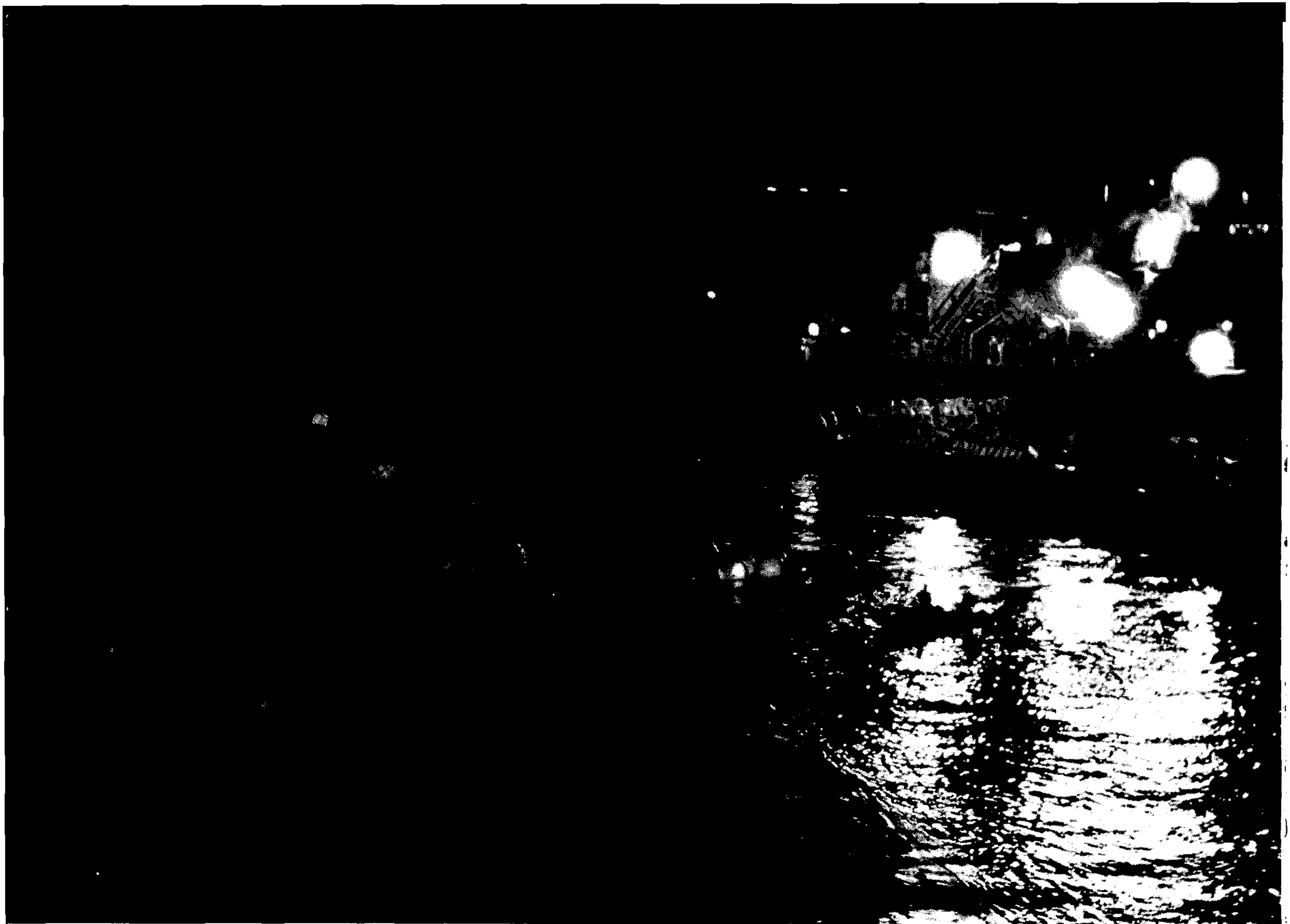
A major portion of a utility computer program was written to predict the submarine behavior through a given dewatering sequence. It was adjusted to account for the approximately 93.5 tons of seawater distributed through the pressure hull according to the known or estimated locations of the salvage fittings. The required buoyancy was to be gained from dewatering BLUEGILL's own ballast tanks. Nine 8.4-ton pontoons would be used to provide the necessary additional lift and stability and to control the ascent.

The plan involved first raising the stern to 50 feet using 7 pontoons rigged aft, and ballast tanks as required. The pontoons were rigged on 50-foot pennants to halt the ascent at 50 feet from the surface. The bow would then be raised from the bottom to the surface in one step, using two pontoons rigged forward. Bow ballast tanks would be blown as necessary. The remaining ballast tanks would then be blown to raise the stern and gain maximum reserve buoyancy. This procedure was thought to minimize any breakout force, and avoid "fluttering" and transverse stability problems associated with raising the submarine on an even keel. It would minimize free surface effects by limiting the trim angle to less than 11 degrees.

Salvage Master LCDR Jim Evans controls more than two miles of salvage hose through a specially modified air manifold.

In support of the plan, a dewatering sequence was adopted. The pontoons would be inflated or the safety tank blown after a given tank was blown dry, and then reflooded or deflated before blowing the next tank. This plan was designed to prevent uncontrolled ascent by adding buoyancy in small increments. The net positive movement of the stern would be minimized. Although tedious and time consuming, this approach provided maximum control of the submarine.

Computer-assisted calculations predicted that the stern would lift after blowing Main Ballast Tank 2 A/B, Forward Ballast Tank 4 A/B, Main Ballast



After surfacing, the BLUEGILL is brought alongside USS BRUNSWICK for rigging and repairs.

Tank 6 A/B, the safety tank and three pontoons aft. The bow would surface after blowing the bow buoyancy tank.

While the engineers struggled with the physics of the lift, divers from BEAUFORT and BRUNSWICK began to prepare the sub for surfacing. There was much to do. The years on the ocean bottom had taken their toll on the old submarine.

Marine growth, sea life encrustations and rust had jammed some hatches shut and others open. Survey dives revealed that the hatch between the conning tower and the control room was undogged, but could not be opened. This presented a significant obstacle. Free communication of water between the conning tower and the control room were necessary for stability after the sub surfaced. After several unsuccessful attempts to open the hatch using a chain fall, free communication was achieved by breaking the deadlight on the hatch. The encrusted forward escape hatch was sealed against leakage and subsequent backflooding by holding the hatch tight against the pressure hull with strongbacks and wire straps. This action would prevent salvage air from escaping around the hatch, and thus backflooding would be minimized by maintaining air pressure in the compartment below.

Lift Preparation — Diving Operations

Before the hoses could be connected, specially manufactured adapters were fabricated to fit the ATS's metric salvage hoses to the American standard salvage fittings on the sub. Also, noncollapsible hose designed to endure the 140-foot water pressure had to be procured and installed to permit proper depressurization of the sub. Patching and repairing the numerous leaks throughout the sub progressed, and divers began attaching the 31 salvage air hoses to the BLUEGILL's high and low salvage fittings.

Once all the hoses were connected and successfully tested, the divers attached seven 8.4-ton salvage pontoons to the stern and two on the bow of the sub. The stern pontoons were fitted to the trailing edge of the stern plane struts. These pontoons would be systematically inflated and deflated to add ballast and much needed control as the sub began to rise.

After 30 days of around-the-clock work, 700 dives and use of over 2 miles of hose, the BLUEGILL was ready for lifting. Divers attached control lines fore and aft and rigged them to the ATSs to provide maneuvering capabilities during the lifting and surfacing of the sub. Pneumofathometer hoses were rigged on the bow and stern and all salvage hoses were unfouled and rearranged for easy access. The sub was dewatered and vented to atmospheric pressure in preparation for the blow sequence. All eyes turned to the two pneumofathometers' gauges as each of the sub's ballast tanks was blown, awaiting confirmation that the sub was on her way up.

After applying various sequences of blows for several hours, the gauge needle remained steady—BLUEGILL had not moved. Examination revealed backflooding of internal compartments at an estimated rate of 30 tons per hour, and longer blowing sequences than had been expected. Water flowed back into the submarine too rapidly to permit positive buoyancy.

During the next two days divers located and patched leaks in the sub to slow the rate of backflooding. The salvage manifold was modified to accept supply from all three salvage compressors and USS BRUNSWICK through the 31 hoses attached to the submarine. A revised, less conservative blow plan called for the blow sequence to begin before the sub was fully vented. When these changes were completed, the sub was dewatered for the second time. She was again ready for the lift.

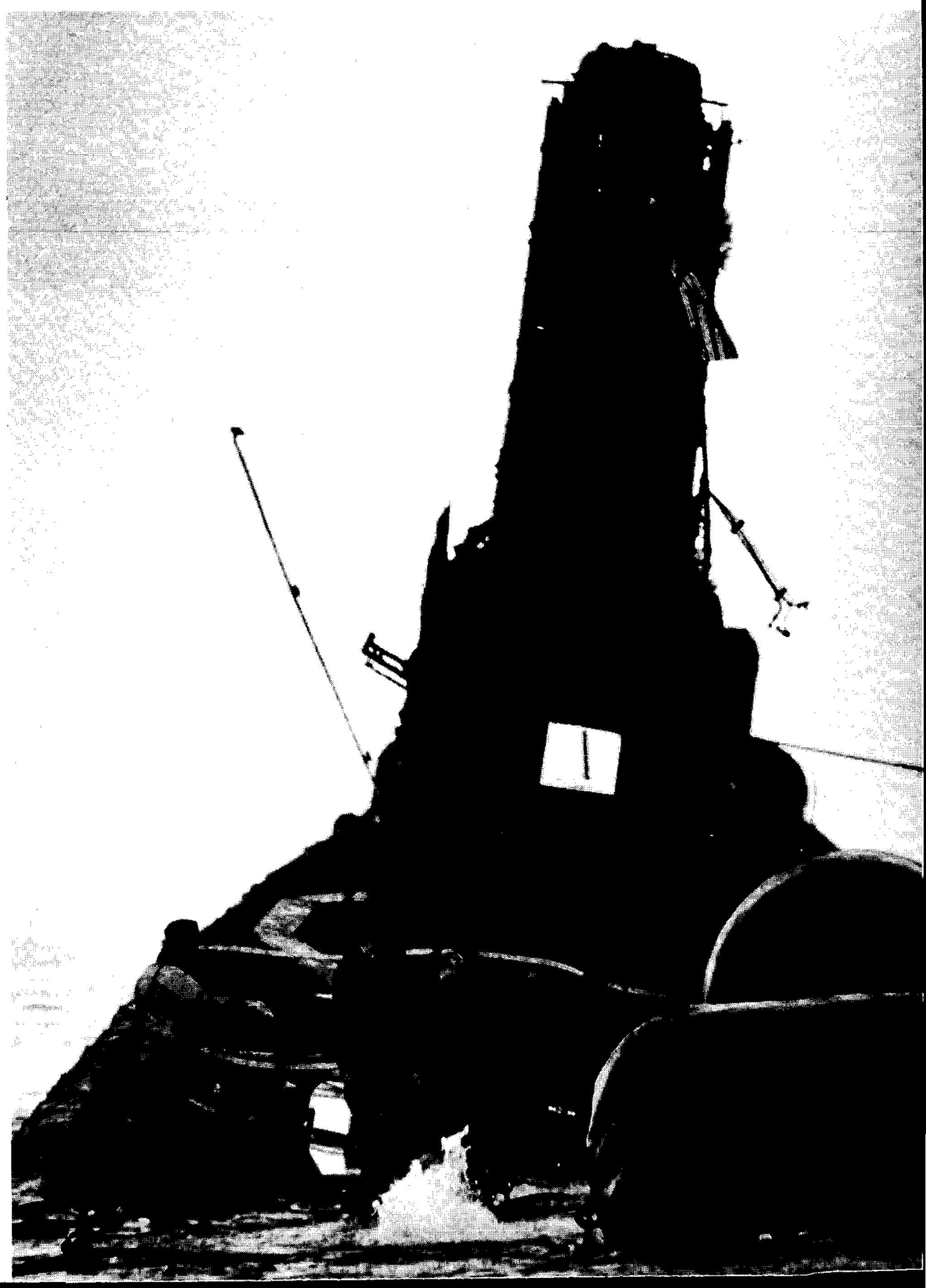
The blow sequence was begun by mid-afternoon on 3 November. Ballast tanks were blown in quick succession and by nightfall the computer indicated that positive buoyancy had been reached. The pneumofathometer needle began to flicker, then slowly rise. The seven aft pontoons broke the surface a few minutes later, bringing the stern within 50 feet of the surface. The bow ballast tanks were blown. Again the pneumofathometer needle began to rise. The normally calm ocean began to boil excitedly between the two ATSs. Suddenly, the bow of BLUEGILL emerged through the foaming ocean like a ghost from the past. Another blow of the after ballast tanks brought the stern up to trim. After nearly 13 years, the BLUEGILL rose proudly to the surface once again.

The Tow

The BRUNSWICK towed the BLUEGILL to shallower water on the morning after the lift. During the tow, an MBT vent on the submarine ruptured, causing her to start down by the stern. The hole was quickly patched. It became apparent, however, that the YC barge with the salvage air compressors would be needed to keep BLUEGILL afloat. A double tow was accomplished with a modified Honolulu rig. Two 3-inch salvage pumps were placed aboard the YC barge to provide cooling water to the compressors. Commanders carefully briefed the crew on emergency breakaway procedures.

At noon the BEAUFORT, with firehoses spraying a salute, began towing BLUEGILL to the sink site. The tow went smoothly until late afternoon, when the weather began to deteriorate rapidly. The sea had gone from a flat calm to 4 to 7 foot swells, and the wind blew at 20 knots. Although the sub was slightly short of the designated disposition site, the water was sufficiently deep. To continue would place crew members aboard the YC in undue danger. LCDR A.M. Nibbs, Commanding Officer of the BEAUFORT, decided to break away and let BLUEGILL sink at her current location. Emergency breakaway procedures were ordered and the crew on the YC disconnected hoses as quickly as possible. BLUEGILL went down by the stern almost immediately. Now old and corroded, the once sleek submarine slipped beneath the waves in just eight minutes. She had been a good and proud boat. She had served her country well, and would now rest, never again to be raised.

Salvors patch the #7 main ballast tank as the BLUEGILL begins to go down by the stern.



Operating Procedures for Kerie Cable

The Navy Experimental Diving Unit (NEDU) conducted testing in April on the CLUCAS Underwater Kerie Cable thermal cutting equipment at Mobile Diving and Salvage Unit One (MOBDIVSALUONE) Pearl Harbor, Hawaii. The Kerie Cable was found to be a reliable, safe and effective tool for underwater thermal cutting and has been approved for Navy use.

The CLUCAS Kerie Cable is an ultrathermic cable designed for quick, lightweight, continuous cutting of ferrous metals. The available lengths of cable and extension leads allow the diver to work without changing position for over 30 minutes.

Fleet training will be minimal. The cutting technique is easy to learn and applies on the surface and in the water. For rough cuts, divers need only a one-day orientation conducted as on-the-job training at their command to become proficient. During this training, divers read and understand the manufacturer's pamphlets and the Navy's procedure, and practice topside.

The Navy's procedures, stated in Appendix A of NEDU Report 7-84 (Evaluation of the Kerie Cable Thermal Arc Cutting Equipment) will be incorporated into the Underwater Cutting and Welding Manual, NAVSEA 0929-LP-000-8010. Until the manual is updated to include the Kerie Cable, refer to the following procedures:

1. Diver Training

- **a.** Read and understand manufacturer's operational manual which is provided.
- **b.** Brief divers on safety precautions.
  - (1) Keep equipment free of oil or grease.
  - (2) When cutting underwater in confined or poorly vented spaces, use only approved methods of preparation and venting.
  - (3) Do not attempt to cut any explosive materials, *i.e.*, concrete, *etc.*
- **c.** Conduct topside training using this procedure.

TABLE A1

OVERBOTTOM PRESSURE

Size of Cable	*Formula*
6 mm	D +(250 to 300 psi)* = OB psi
9 mm	D + (300 to 340 psi)* = OB psi
12 mm	D + (340 to 380 psi)* = OB psi

2. Equipment Set-up

- **a.** Connect three O_2 bottles together with the 10-foot high pressure (HP) hose manifold. Check HP gauge for bottle pressure. Turn OFF/ON valve to OFF. Turn regulator OFF.
- **b.** Connect HP hose manifold on the control unit to the fitting marked "high pressure O_2 in."
- **c.** Connect 100-, 200- or 250-foot extension hose and electric lead to the control unit fittings marked "LP cutting O_2 out" and "Neg. amps out" in that order.
- **d.** Connect two 12-volt car batteries in series. (Place batteries on wooden pallet.)
- **e.** Connect negative side of batteries to "Neg. amps in" on control unit.
- **f.** Open the knife switch.

3. Prepare Kerie Cable

- **a.** Cut open Kerie Cutting Cable and inspect for cracks or cuts in plastic coating.
- **b.** Recoil in large loops.
- **c.** Connect cable to extension leads with the appropriate reducer.
- **d.** Blow down hose thoroughly with 0_2 for approximately 20 seconds.
- **e.** Slide red plastic insulating sleeve along the Kerie Cable until it covers the joint between the cable and extension leads.

NOTE: Ensure red insulating sleeve is reinstalled when changing cable.

4. Prepare Work Site

- **a.** Install platform, hogging line as necessary.
- **b.** Secure striker plate to convenient spot.

5. Bottom Procedures

- **a.** Pressure Kerie Cable to 70 psi (if deeper than 60 FSW use 10 psi overbottom (OB) pressure).
- **b.** Diver leaves surface with cable and positions himself at work site.
- **c.** Diver requests "Gas on" (topside increase 0_2 to proper overbottom pressure for at least 20 seconds). (See Table A1 of Navy Approved Procedures for proper OB pressure and formula.)
- **d.** When diver sees an increase in the bubbles he requests "SWITCH ON" (topside will respond when knife switch is closed). Kerie Cable burns at about two feet per minute until oxygen is secured.
- **e.** Diver will touch the tip of the Kerie Cable to striker plate. The cable should ignite immediately.
- **f.** Diver will announce "I have ignition" (topside will respond by opening knife switch).

NOTES:

(1) The equipment tender will check the amp meter on the control console to ensure a good ground and to check when the diver tries ignition. The amp meter will read 0 when the cable is ignited.

(2) The equipment tender will ensure that the Kerie Cable is flushed with oxygen for 20 seconds before the knife switch is closed for ignition.

6. Cutting Procedures

- **a.** To cut, touch the ignited tip of the Kerie Cable to the spot to be cut.
- **b.** Point the cutting tip into the cut at 90° angle from work.
- **c.** Keep the tip in constant contact with the material.
- **d.** The diver's hands should be at least six inches from the cut.
- **e.** Keep tip moving into the cut. DO NOT force or poke the cable into the material being cut.
- **f.** When cutting steel plate, use a brushing motion and several passes to eliminate molten metal from the cut.
- **g.** When cutting thicker metal (2-1/2 inches and up) use a light, brushing motion to allow the metal surrounding the cut to cool enough to prevent molten metal. DO NOT speed process by creating a fire or inferno in the metal. Do not cut straight through.
- **h.** When cutting nonferrous metal, use a light, brushing motion. The brushing motion allows the metal surrounding the cut to cool enough to prevent molten metal and trapped oxygen from causing oxygen "pops." An oxygen "pop" is a trapped pocket of oxygen that pops molten metal, a definite operator hazard.

7. "Emergency off" safety procedures:

- **a.** Diver indicates emergency action required by:
  - (1) Calling out "emergency off."
  - (2) Sending one hand pull signal on the communication cable.
- **b.** Equipment tender turns HOKE valve to vent. The cable will flood and oxidation will stop immediately.

8. Safety Rules and Precautions. All diving will be conducted in accordance with the U.S. Navy Diving Manual. All cutting will be conducted in accordance with the Underwater Cutting and Welding Manual, NAVSEA 0929-LP-000-8010, this procedure and the manufacturer's (Seeler Enterprises, Inc.) instructions.

- **a.** Equipment Tender. The phone talker may be assigned the task of equipment tender.
  - (1) The tender will not close the circuit unless specifically directed by the diver. When so directed he will confirm each change with the diver.
  - (2) The equipment tender will ensure that the diver has the proper oxygen overbottom pressure in accordance with Table A1.
  - (3) The equipment tender will remain within reach of the console at all times.
- **b.** Ground/Cables. All connections should be tight and insulated with tape or other nonconductive material (*i.e.*, red plastic insulating sleeve).
- **c.** Diver Cutting Precautions
  - (1) Be aware of hazards involved with handling explosive gases and electrical circuits.
  - (2) Ensure gloves are secured at the wrist to prevent slag from getting in the glove.

Any additional information can be obtained by calling NAVSEA 00C21D, Donald Keane A/V 227-7403 or NAVSEA 00C3M, TMCM(MDV) William A. Gholson A/V 227-7606.

MASTER DIVER UPDATE:

Master Divers are among the most knowledgeable, experienced divers in the Navy. These individuals, having proven their fitness and intelligence by successfully completing the Master Diver Evaluation, are highly respected in the field. As dive team leaders, they are responsible for smooth operation and team safety on difficult and dangerous missions. The following is a current list of Navy Master Divers and their locations.

ENCS(MDV) Marion L. Alexander
Diving Locker
USS CANOPUS (AS 34)
FPO Miami 34087

BMCM(MDV) William B. Austin
Diving Locker
SIMA Mayport
Mayport, Florida 32228

QMC(MDVC) J.A. Behnke
Diving Locker
USS L.Y. SPEAR (AS 36)
FPO New York 09547

HTCM(MDV) Earl Bennett
Mobile Diving and Salvage
Unit TWO
FPO New York 09501

ENCM(MDV) Tommy Berry
USS RECLAIMER (ARS 42)
FPO San Francisco 96677

BMC(MDV) Ralph Bowdish
Diving Locker
USS HOLLAND (AS 32)
FPO Miami 34079

ENCS(MDV) Patrick Bowman
Naval Diving and Salvage
Training Center
Panama City, Florida 32407

MMCM(MDV) Donald F. Bradbury
USS CONSERVER (ARS 39)
FPO San Francisco 96662

SWCS(MDV) Joseph E. Bradshaw
Naval School Explosive
Ordnance Disposal
Indian Head, Maryland 20640

GMCS(MDV) William Brooks
USS KITTIWAKE (ASR 13)
FPO New York 09576

MMCS(MDV) David P. Buehring
Mobile Diving and Salvage
Unit TWO
FPO New York 09501

BMCM(MDV) Ernest E. Caltenback
SIMA Diving Locker
NAB Little Creek
Norfolk, Virignia 23521

ENCM(MDV) Robert L. Cave
Diving Locker
Naval Ocean Systems Center
San Diego, California 92152

BMCS(MDV) Gary M. Chancellor
USS ORTOLAN (ASR 22)
FPO Miami 34085

BMCS(MDV) Earl M. Clark
Diving Locker
USS DIXON (AS 37)
FPO San Francisco 96648

HTCM(MDV) John Conneen
Naval Military Personnel
Command/PERS 5112-401 DB
Washington, D.C. 20370

ENCS(MDV) John E. Cook, Jr.
Naval Civil Engineering Lab
(Code L41)
Port Hueneme, California 93043

CUCM(MDV) Charles Cope
Naval Civil Engineering Laboratory
(Code L41)
Port Hueneme, California 93043

BMCM(MDV) Harry Crotts
Navy Experimental Diving Unit
Panama City, Florida 32407

HTCM(MDV) David E. Debolt
Naval Medical Research Institute
National Naval Medical Center
Bethesda, Maryland 20814

SMCM(MDV) Jack Delauter
Naval Diving and Salvage
Training Center
Panama City, Florida 32407

QMCM(MDV) Gerald Draper
Diving Locker
USS PUGET SOUND (AD 38)
FPO New York 09544

EMCM(MDV) Paul Dubois
Diving Locker
USS ACADIA (AD 42)
FPO San Francisco 96647

HTCS(MDV) Bruce Earnest
USS OPPORTUNE (ARS 41)
FPO New York 09586

BMCM(MDV) Clyde Einhelling
Diving Locker
U.S. Navy Support Facility
Diego Garcia
FPO San Francisco 96685

BMCM(MDV) Michael Fomby
Diving Locker
USS FRANK CABLE (AS 40)
FPO Miami 34086

HTCM(MDV) Albert Frontz
Commander Submarine
Development Group ONE
139 Sylvester Road
San Diego, California 92106

MMCM(MDV) Charles Fulkerson
COMNAVLOGPAC (Code 4318)
Pearl Harbor, Hawaii 96860

TMCM(MDV) William A. Gholson
Command Master Diver
(SEA 00C)
Naval Sea Systems Command
Washington, D.C. 20362

HTCS(MDV) George Gilson
Diving Locker
USS EMORY S. LAND (AS 39)
FPO New York 09541

ENCM(MDV) Wesley J. Gummel
USS PETREL (ASR 14)
FPO Miami 34092

BMC(MDV) Keith Hansen
Naval Diving and Salvage
Training Center
Panama City, Florida 32407

BTCS(MDV) Jerry D. Henson
Naval Amphibious School
Diver 2nd Class Training
Department
San Diego, California 92155

ENCM(MDV) Rafael A. Hernandez
USS EDENTON (ATS 1)
FPO New York 09568

BUC(MDV) Joel Hierholzer
Underwater Construction Team ONE
NAB Little Creek
Norfolk, Virginia 23521

ENCS(MDV) Dennis Hima
USS FLORIKAN (ASR 9)
FPO San Francisco 96665

HTCM(MDV) Sam E. Huss
Navy Experimental Diving Unit
Panama City, Florida 32407

BMCS(MDV) Bradford Ingles
Diving Locker
USS SAMUEL GOMPERS (AD 37)
FPO San Francisco 96641

HTCM(MDV) Jerry D. Jennings
Diving Locker
Naval Ocean Systems Center
Panama City, Florida 32407

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Recovery of the SH-3H Sea King Helicopter

photo credit - Official Photograph, U.S. Navy

The Sea King is transferred from the starboard side of USS QUAPAW to the quay wall at North Island Naval Air Station, San Diego.

On 14 October 1983, the tail rotor on a SH-3H Sea King helicopter lost power. The helicopter went into the sea two miles off the south San Diego coast. All four crew members escaped from the wreck and were picked up by HELANTISUBRON 12. On 15 October Commander Third Fleet tasked Mobile Diving and Salvage Unit ONE Detachment and USS QUAPAW (ATF-110) to recover the downed helicopter.

Four hours after the crash, MDSU-1 DET divers began their search. They dropped a marker buoy from a helicopter at the last known position of the downed craft. The next day, USS ENHANCE located the aircraft in 85 feet of water. MDSU-1 DET divers inspected the wreckage, finding that the helicopter lay inverted with its rotor buried in the mud. One sponson and the tail section had separated from the fuselage.

On 15 October, USS QUAPAW arrived at Naval Station San Diego to rig a two-point moor, onload the Fly Away Diving System (FADS) and plan the salvage operation with MDSU-1 DET and ASWWINGPAC representatives. Commanding Officer, USS QUAPAW, was tasked as on-scene Commander.

The QUAPAW towed a YC Barge to the wreck site and moored over the helicopter wreckage. MDSU-1 DET divers made inspection dives to determine the best method to right the aircraft. The helicopter's center of gravity was near the top because of the weight and location of the engines. Also, the half-empty fuel tanks, located in the belly of the aircraft, were relatively buoyant. Both factors caused the helicopter repeatedly to return to its original inverted position.

A successful lift was accomplished when divers attached a lifting strap near the after landing gear and secured the broken tail section to the fuselage. USS QUAPAW lifted the helicopter until the fuselage extended above the surface of the water. The salvage team wrapped a lifting strap around the main rotor just below the water's surface, and hauled in until the helicopter was out of the water. The lifting strap was too long to permit the crew to place the aircraft on the YC Barge, so the USS QUAPAW placed the tail section on the barge, ran extra securing straps around the fuselage and secured the helicopter to the side of the ship.

Two hours after the recovery, QUAPAW delivered the wreckage to Naval Air Rework Facility (NARF), North Island, California. NARF workmen cleaned the aircraft to save as many parts as possible.

Aviation engineers at NARF discovered a defective connection which had caused the tail rotor failure. COMASWWINGPAC ordered all SH-3 helicopters to be inspected for the same defect. One helicopter crew located a similar problem in the tail rotor gear box of an operating helicopter.

With the quick reaction of the salvage team and the care taken not to cause further damage to the helicopter during recovery, NARF saved $1.6 million worth of parts from the wreckage. Inspection of the tail section revealed the cause of the failure and possibly saved another SH-3 helicopter, valued at $5 million, and her crew from a similar fate.

Participating Divers:

LT Frederick
LT McDermott
GMG1(DV) Richardson
HT2(DV) Kelly
MM2(DV) Parker
PH2(DV) Poche'
LT McLees
MMCM(MDV) Kilbury
QM1(DV) Palmer
HM2(DV) Starbeck
HM2(DV) Dunagan
HM2(DV) Nichols

NEDU REPORTS

Phase II Testing Decompression Algorithms for Use in the U.S. Navy Underwater Decompression Computer

CDR Edward D. Thalmann, MC, USN
NEDU Report 1-84

ABSTRACT:

Results of the second phase of man-testing a computer algorithm for computing decompresion profiles breathing 0.7 ATA oxygen in nitrogen are presented. This algorithm is primarily for use with the MK 15 or MK 16 closed circuit UBA. This Phase II testing was designed to lengthen the no-decompression limits established in the previously reported Phase I testing and to gain more experience in the 100-150 fsw depth range. Some 228 man dives resulting in 11 cases of Type I decompression sickness were conducted. During Phase II testing, the decompression model had to be changed. Initially, the model for Phase I testing was used (exponential gas uptake and offgassing, 9 tissues ranging from 5 minutes to 240 minutes halftime), but testing showed this model predicted inadequate decompression profiles for repetitive dives. The Phase I model was modified so gas uptake was exponential but gas elimination was linear. This linear offgassing modeled the elimination of a gas phase with instantaneous diffusion in a well-mixed compartment. Three different sets of ascent criteria produced an acceptable algorithm with an expected maximum incidence of decompression sickness of less than 3.5 percent assuming that occurrence followed the binomial distribution at the 95 percent confidence level. The report gives complete details of the decompression model derivation as well as detailed flow charts for all algorithms. All tested ascent criteria and test profiles are presented along with complete descriptions of all cases of decompression sickness.

Evaluation of a Carbon Dioxide Scrubber in a Two-Lock Recompression Chamber

H.J.C. Schwartz, M.D.; P.H. Robinson, M.D.;
D.K. Schram
NEDU Report 6-84

ABSTRACT:

An unmanned study of a carbon dioxide scrubber in a standard U.S. Navy two-lock recompression chamber is presented. Tests were conducted at the Navy Experimental Diving Unit to determine canister air flow and durations at various depths and initial carbon dioxide concentrations, using a Kinergetics, Inc. Scrubber, Model DH-10. Air flows were 262 LPM, 274 LPM and 270 LPM, at 15 fsw, 30 fsw and 60 fsw respectively. For the canister duration studies an initial load of carbon dioxide was introduced into the chamber, then carbon dioxide was added to the chamber at a rate of 2 standard liters per minute to simulate 3 human occupants. Canister durations under steady state conditions of a long treatment were estimated to be 3.46 hours at 30 fsw, 1.89 hours at 60 fsw and 1.16 hours at 165 fsw.

NEDU Reports
— Continued

Purging Procedures for the Draeger LAR V Underwater Breathing Apparatus

LCDR F.K. Butler, Jr., MC, USNR;
CDR E.D. Thalmann, MC, USN
NEDU Report 5-84

ABSTRACT:

The U.S. Navy SEAL teams currently utilize the Draeger LAR V closed-circuit oxygen Underwater Breathing Apparatus (UBA) for clandestine combat swimmer operations. Prior to beginning a dive with a closed-circuit oxygen UBA, a purge procedure is carried out to remove inert gas (nitrogen) from the breathing mixture. This study seeks to establish an optimal purging procedure for the Draeger LAR V. Twenty-four purges were conducted using the current standard Three Fill/Empty Cycle purge procedure; the average oxygen percentage obtained in the breathing mix was 85 percent with a high of 96 percent and a low of 73 percent. Fifty-four Single Fill/Empty Cycle (SFE) purge procedures resulted in an average oxygen percentage of 74 percent with a high of 89 percent and a low of 50 percent. Forty No Fill/Empty Cycle (NFE) purge procedures resulted in an average oxygen percentage of 55 percent with a high of 82 percent and a low of 20 percent. Eighteen two-hour dives using the two experimental purge procedures showed no significant inert gas buildup during the course of the dive. Conclusions from this study are: (1) the NFE purge procedure was not found to reliably produce adequate oxygen levels in the Draeger LAR V UBA and should not be used operationally; (2) the SFE purge procedure did reliably produce oxygen levels adequate to prevent hypoxia; (3) the standard purge procedure produced higher levels of oxygen than the SFE procedure but is considered less desirable than the latter procedure because: (a) these higher oxygen levels are not required to prevent hypoxia; (b) higher oxygen levels increase the probability of encountering central nervous system (CNS) oxygen toxicity; (c) the extra Fill/Empty Cycles consume additional oxygen, thus depleting the gas supply in the UBA; (4) inert gas buildup was not observed to be present during the two-hour dives, thus eliminating the need for additional purging during the conduct of the dive. It is recommended that these additional purges *not* be performed for the reasons enumerated in paragraph (3) above, and to minimize the possibility of the diver being detected because of escaping bubbles; (5) the SFE purge procedure without any additional purging during the dive is felt to be the optimum purge procedure for the Draeger LAR V.

MK 16 Deployment Procedures

K.W. Wright
NEDU Report 10-83

ABSTRACT:

The Navy Experimental Diving Unit conducted manned open water testing to evaluate deployment procedures for mixed gas self-contained underwater breathing apparatus (SCUBA: MK 16 MOD 0 UBA) in June 1983. In water, decompression was conducted day and night in ambient water temperature ranges of 58 to 70°F.

The new procedures proved fully compatible with in-service U.S. Navy equipment. In addition, the procedures were used to deploy self-contained divers to 205 fsw for a bottom time of 25 minutes and safely perform requisite decompression in water using minimal surface support.

The OLD MASTER

When was the last time you had to investigate a diving accident only to find that the diving equipment had been disassembled and put away? Inspection of the equipment is often critical to the investigation, enabling qualified personnel to determine whether the cause was diver error or equipment malfunction.

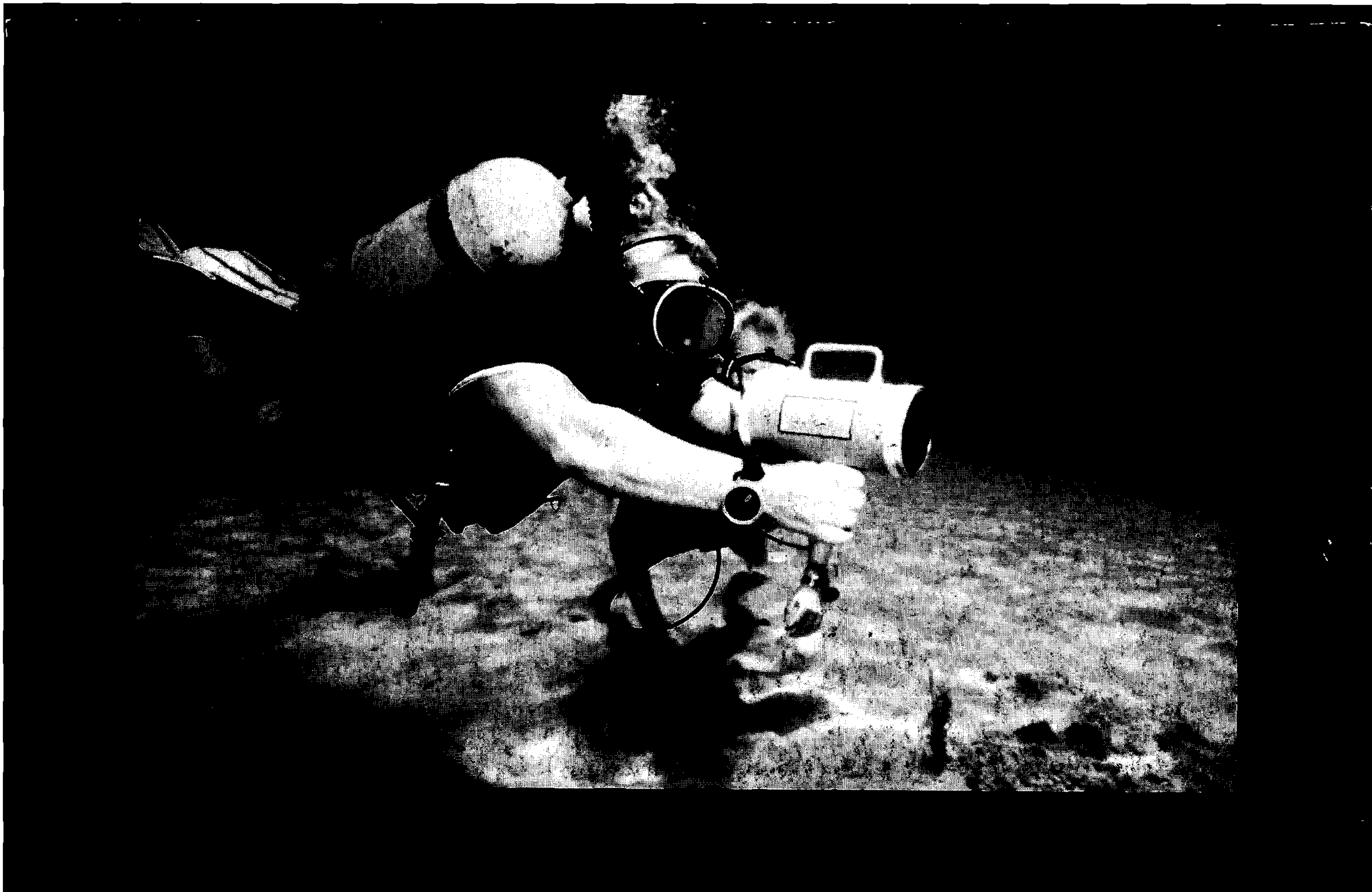
Diving supervisors must make every effort to maintain the integrity of the involved equipment. As much as possible, it must be properly handled and maintained intact, permitting the investigating activity to make a thorough inspection and a more accurate determination of the cause of the accident.

The U.S. Navy Experimental Diving Unit (NEDU), Panama City, Florida, is available for diving equipment failure analysis and operation testing. In the event of a diving casualty, equipment requiring a thorough inspection may be forwarded to NEDU. The equipment must be placed in sealed plastic bags and shipped in appropriate containers.

If this is not possible, supervisors should document clearly, in writing and with photographs, the initial condition of the equipment (appearance, cause pressure, function, *etc.*) and steps taken upon contact with the equipment (secured gas, electronics, *etc.*) It is important not to try to fit broken pieces together, as this may destroy vital information that can be obtained from fractures analysis. If personnel cannot maintain the involved equipment intact, a complete inspection of the equipment must be conducted by a competent authority, usually the diving officer or master diver, and a technician qualified to maintain the equipment. This must be fully documented.

In addition to teaching proper handling of equipment, diving supervisors must stress the necessity of reporting any mishap or failure of the equipment, even when no injury has occurred. Equipment failures should be reported on OPNAV 9940 forms and on failure analysis report forms.

The OPNAVINST 5102.1 series and NAVSAFECEN 5102.9 provide complete instructions on accident investigation procedures.



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