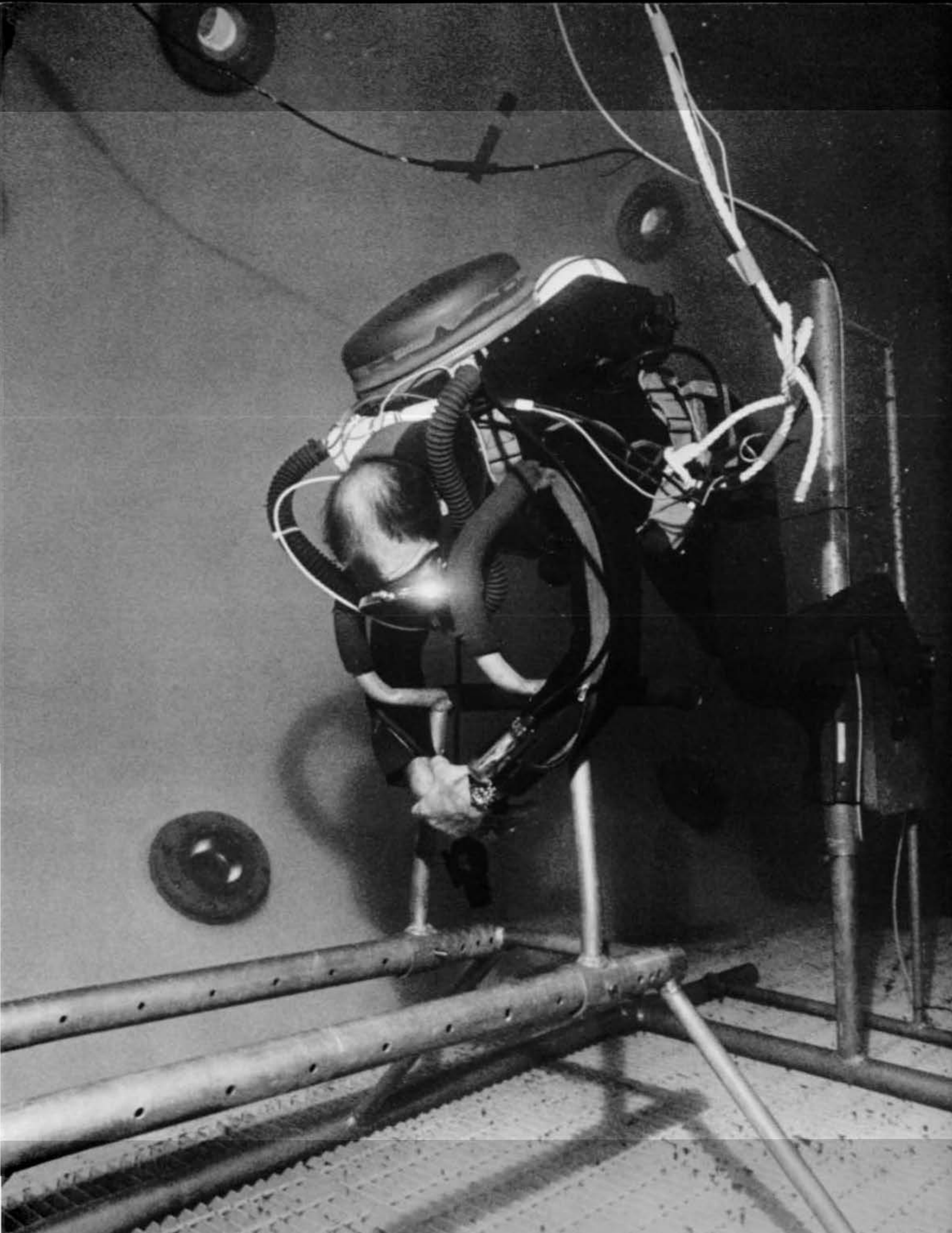
FACEPLATE

WINTER 1976



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FACEPLATE

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

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

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Front cover shows an artist's concept of a Mk 12 SSDS diver at depth in the open sea.
Inside front cover features another new item of equipment, the SLSS Mk 1. Diver is on an underwater ergometer in the OSF chamber during a test dive. Story on page 25.
Back cover photo was taken during chamber testing of the Mk 12 SSDS in the OSF. Story on page 15.

LT RANK, CF, REPLACES LCDR RIDGEWELL, CF, AT NEDU

LT Gordon Rank, CF, relieved LCDR Barry Ridgewell, CF, on September 1, 1976, as the Canadian Exchange Officer at the Navy Experimental Diving Unit, Panama City, Florida. As a Project Officer at NEDU, LCDR Ridgewell was instrumental in the development of the new Mk 12 Surface Supported Diving System (SSDS). LT Rank also serves as a Project Officer with the Mk 12.

LT Rank came to NEDU from the Fleet Diving Unit, Atlantic, where he qualified as a Submersible Pilot on a Canadian diver lock-out submersible, the SDL-1. His most recent duties before moving to Panama City included serving as Commanding Officer of YMT-12, a fleet diving tender, and also as the Commanding Officer of the SDL-1. He participated in the SDL-1 trials in the Arctic and in various other cold water dives near Halifax. During the Olympic games in Montreal last summer, he was the leader of the Bomb Disposal Team, which was part of the Olympic Security forces. LT Rank has attended U.S. Navy schools in salvage and mixed gas diving and in explosive ordnance disposal.

WHO'S DOING THE NAVY'S WORKING DIVES?

During the 5-year period of 1971-1975, divers aboard AR, AD, and AS type ships conducted approximately 42,000 *working* dives. This figure represents 84 percent of all Navy working dives, which numbered approximately 50,000 for the *entire* fleet (i.e., ships and Harbor Clearance Units). Of these 42,000 dives, 41,000 were performed in 0-60 feet of seawater.

Approximately 57 percent of the dives were conducted in scuba gear, and approximately 43 percent had the diver in lightweight gear.

These statistics came from Naval Safety Center, Naval Air Station, Norfolk, Virgina. The Supervisor of Diving wants to encourage all commands to feel free to request any diving statistics they desire. The facts are there for the asking!

SECOND NAVY DIVER REUNION AT PANAMA CITY BEACH

The second Navy diver reunion has been scheduled for March 4, 5, and 6, 1977 in Panama City Beach, Florida. The goals of this gathering include forming a National Diving Association that will work toward the establishment of a National Diving Museum in Panama City. The attendees will also be honoring the 50th Anniversary of the Navy Experimental Diving Unit and will witness NEDU's change of command, during which CDR J.M. Ringelberg will be relieved as Commanding Officer by CDR C.A. Bartholomew.

All past or present Navy divers or friends who wish to attend this second reunion are encouraged to do so. Brochures are being distributed describing the events scheduled. Those who do not recieve a brochure are still urged to attend and should contact Master Chief Tolley at NEDU (904-234-4351) or Mr. Bob Barth (904-785-1750).

LT MACDOUGAL RELIEVES LT HALL AT OOC

LT Richard MacDougal has joined the staff of the Supervisor of Diving as the Diving Equipment Project Officer. LT MacDougal reported to his new post in mid-December 1976 to replace LT William M. Hall.

LT MacDougal previously served at the Navy Civil Engineering Laboratory, where he designed and developed a unique deep ocean current sensor.

LT Hall has taken over the duties of Executive Officer at Underwater Construction Team One in Little Creek, Virginia.

INTERNATIONAL DIVING SYMPOSIUM—'77

The seventh annual International Diving Symposium, held in New Orleans, Louisiana, on January 18-20, 1977, was the largest and most informative of these meetings to date. Representatives from more than 15 foreign countries joined with United States civilian and military organizations to discuss a wide range of topics relevant to recent developments in diving technology.

The U.S. Navy diving community was well-represented in the 3 days of presentations. CDR C. A. Bartholomew, Supervisor of Diving, NAVSEA, presented a broad overview of the U.S. Navy diving program today. CAPT W. H. Spaur, Senior Medical Officer at NEDU, next discussed the new saturation excursion tables. HTC R. H. Fine and MMCM A. J. Parfinsky, also from NEDU, discussed "O_2 Clearing of Hyperbaric Facilities" and "Navy Diving Accidents—1975", respectively. The Naval Medical Research Institute sent two participants for the Biomedical Support section of the program. A. J. Bachrach, Ph.D., and CAPT J. Vorosmarti, M.D., spoke on "Human Bioengineering of Hyperbaric Equipment" and "Decompression from Steady State Exposures to 250 Meters," respectively.

The program was sponsored by the Association of Diving Contractors in cooperation with the Undersea Medical Society, the Oceaneering Division of the American Society of Mechanical Engineers, and the Associated Builders and Contractors, Inc.

Divers' Gas Purity Symposium

Experts from all areas of the Navy and civilian diving community attending the 1976 Divers' Gas Purity Symposium agreed on the need to officially revise the purity standards for divers' breathing air. The symposium, held at Battelle Memorial Institute, Columbus, Ohio, on Novermber 17-18, 1976, was sponsored by the U.S. Navy Supervisor of Diving. The third in a triennial series begun in 1970, this conference once again brought more than 100 representatives of Navy, industrial, and medical organizations together to exchange the latest ideas and information on the subject of gas purity.

As in the previous two meetings, the 1976 symposium provided an excellent forum for current researchers in the fields of diving, engineering, medicine, and science to discuss the results of their most recent work as it relates to the diver's breathing gas. Also as in the past, the papers were printed for distribution to attendees before their arrival at Battelle. This provided a topic familiarity that effectively aided the question/answer and discussion periods.

The keynote speaker for the symposium was Dr. Arthur J. Bachrach, Ph.D., of the Naval Medical Research Institute, Bethesda, Maryland. Dr. Bachrach discussed the "Scientific and Operational Considerations in the Development of Diving Standards." CDR J.M. Ringelberg, USN, NEDU's Commanding Officer, was the Chairman of this year's gathering. The Program Committee included Mr. O.R. Hansen, Office of the Supervisor of Diving; Dr. E.D. Thalmann, Navy Experimental Diving Unit; and Mr. H.F. Link, Battelle Columbus Laboratories.

Copies of the 1976 Divers' Gas Purity Symposium Proceedings may be obtained from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. The cost per copy is $20.00.

The following is a list of the topics (and their authors) presented at the 1976 symposium:

Fundamentals of Respiratory Air Processing
Edward J. Naddy
Robbins Aviation, Inc.

Specific Case Histories of Contamination of U.S. Navy Divers' Breathing Gas Systems
R.D. Neal and Aubrey W. Trigger
Naval Surface Weapons Center, Dahlgren Laboratories

Protective Treatment of High Pressure Gas Systems
M.A. McMahon
Parry-Colson Ltd.

Life Support Air Sampling Equipment
Scott Thornton
Texas Research Institute

New Shipboard Compressors
John R. Ward
Naval Ship Research and Development Center

Gas Analysis Requirements to Reach Depths in Excess of 1,800 Feet
A. Purer
Naval Coastal Systems Laboratory

Rationale for Breathing Gas Requirements of the NIOSH Recommended Standard for Commercial Diving
Robert W. Hamilton, Ph.D., *Tarrytown Labs, Ltd.*, and Alan H. Purdy, *National Institute for Occupational Safety and Health*

Carbon Monoxide Induced Alterations in Pulmonary Alveolar Macrophages at Ambient and Elevated Pressures
Dr. M. Val Roloff,
Naval Medical Research Institute

Calculation of Carbon Monoxide Toxicity Under Pressure Pressures
Dr. Peter E. Erickson
Taylor Diving and Salvage, Inc.

U.S. Navy Cleaning Proceedures for Diving Gas Systems
HTC(DV) Raymond H. Fine, USN
U.S. Navy Experimental Diving Unit

The Use of Non-Explosive Breathing Mixtures of Hydrogen and Oxygen for Deep Diving
William P. Fife, MD ; Mark Edwards; and Michael Mezzino
Texas A&M University and University of Houston

Breathing Dynamics of a Diving Helmet with a Neck Seal
Peter S. Riegel
Battelle Columbus Laboratories

Some Design Considerations for Hyperbaric CO_2 Scrubber
Raymond L. Bentz
Naval Coastal Systems Laboratory

Compressor Application in Diving Systems and Its Operation to Enhance Divers' Air Purity
LT W.M. Hall, CEC, USN, and Mr. O.R. Hansen
Office of the Supervisor of Diving

Synthetic Microlubrication of Reciprocating Compressors—A Route to Gas Purity and Safer Operations
J. William Miller
CPI Engineering Services Inc.

Compression Produced Gas Contaminants
D.S. Slack and W. S. Gault
Rix Industries

AIG MESSAGE SUMMARY UPDATE

NAVSEA 082243Z OCT 76: USN Diver's Mask Mk 1 Mod S and T Safety Harness Hook (AIG 239 FY77-4).

NAVSEA 091324Z OCT 76: Diving Equipment Service Approved/Authorized for Navy Use (AIG 239 FY77-3).

NAVSEA 261918Z OCT 76: Approved Diving Equipment (AIG 239 FY77-5).

NAVSEA 091458Z NOV 76: Scuba Diving Manning Levels (AIG 239 FY77-6).

CNO WASHINGTON DC 091404Z NOV 76: AIG Modification 239/5 (AIG 239 FY77-7).

NAVSEA 102020Z NOV 76: Certification of Diving Systems (AIG 239 FY77-8).

NAVSEA 121931Z NOV 76: USN Diver's Mask Mk 1 Mod O Ops (AIG 239 FY77-9).

NAVSEA 301514Z NOV 76: USN Diver's Mask Mk 1 Mod O Field Change No. 1 (AIG 239 FY77-11).

NAVSEA 012037 DEC 76: Diving Safety (AIG 239 FY77-10).

CHANGE of COMMAND at HCU-2

LCDR Roper (second from left) has relieved CDR McColgan (end right) as CO of HCU-2.

CDR J. F. McColgan was relieved as Commanding Officer of Harbor Clearance Unit TWO (HCU-2) by LCDR (CDR Selectee) J. E. Roper in ceremonies held on November 5, 1976, at the Naval Amphibious Base, Little Creek, Virginia. Guest speaker CAPT J. H. Lytle, Commander Service Squadron EIGHT, cited CDR McColgan for the completion of a highly successful tour of duty as Commanding Officer of HCU-2.

LCDR ROPER has served on the following ships and duty stations: Deck Department, USS BAYFIELD (APA-33); Operations and Diving Officer, Naval Ordnance Laboratory Testing Facility, Solomons Island Maryland; Executive Officer, Diving and Salvage Officer, USS ARIKARA (ATF-98); Operations Officer, USS COWELL (DD-547); Commanding Officer, River Patrol Division 514; Commanding Officer, River Patrol Division 572; Training Support Officer, Service School Command, Great Lakes; Commanding Officer, Coastal River Division 21; and First Lieutenant, USS MIDWAY (CV-41).

During his Naval Career, LCDR ROPER has been awarded the Bronze Star with Gold Star and Combat Distinguishing Device, Navy Commendation Medal, Navy Achievement Medal, Combat Action Ribbon, National Defense Medal, Armed Forces Expeditionary Medal, Vietnam Service Medal, Vietnamese Staff Training Medal First Class, and the Republic of Vietnam Campaign medal.

CDR McColgan is now enroute to USS FRANCIS MARION (LPA-249), homeported in Norfolk, Virginia, where he will assume the duties of Executive Officer. Before taking over the Command of HCU-2, LCDR Roper served as the First Lieutenant on board USS MIDWAY (CV-41), homeported in Yokosuka, Japan.

A Few More Words from SUPDIVE

CDR Charles A. Bartholomew, USN
Supervisor of Diving

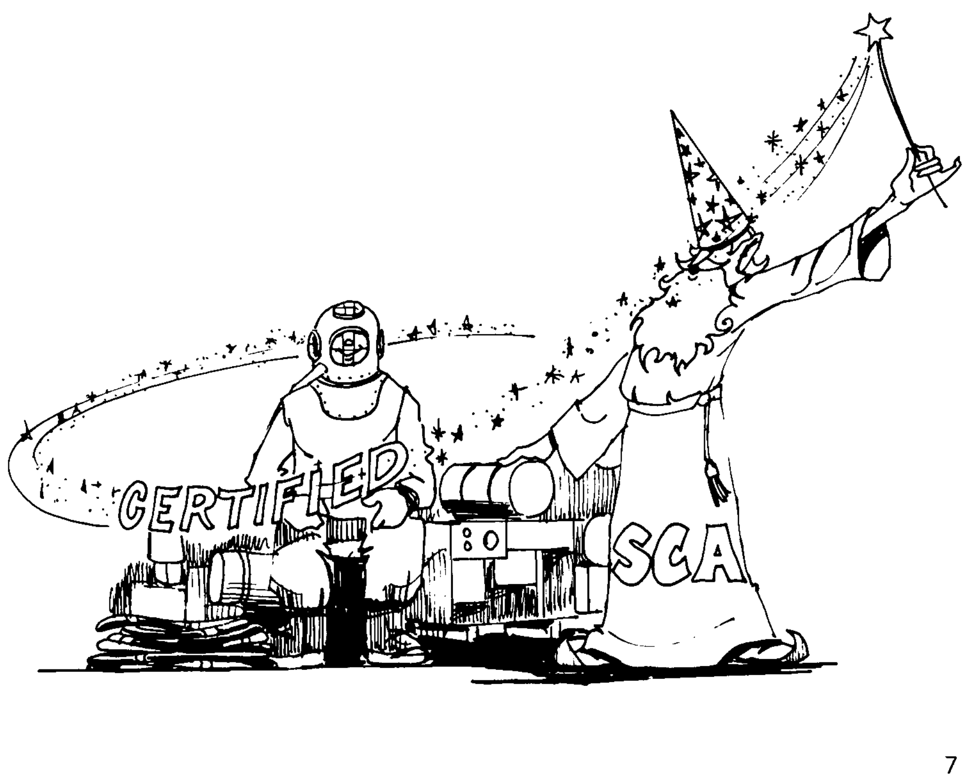
In the last issue of *Faceplate*, I took the liberty of commenting on a host of programs/issues facing the Navy diving community. One broad topic that I did not address was "certification." The goal of the Navy certification program as described in NAVMATINST 9290.1 is to provide maximum assurance that all deep submergence systems used by Naval personnel are materially and procedurally adequate to safely carry out specified operations. The certification process must be initiated and completed by just about every diving activity in the U.S. Navy—salvage and rescue ships, tenders, Naval shipyards, laboratories, and Naval stations are just a few. The process itself is discussed in Paragraph 6 of NAVMATINST 9290.1. It is initiated when your Command formally requests a certification review. To date, only 151 activities (or approximately 72 percent) have requested this review. Only 45 (approximately 20 percent) can actually claim title to certified diving systems.

What is the certification status of your diving locker? If you don't know, find out. If the process has not been started get a copy of the aforementioned instruction and initiate a certification request through your chain of command.

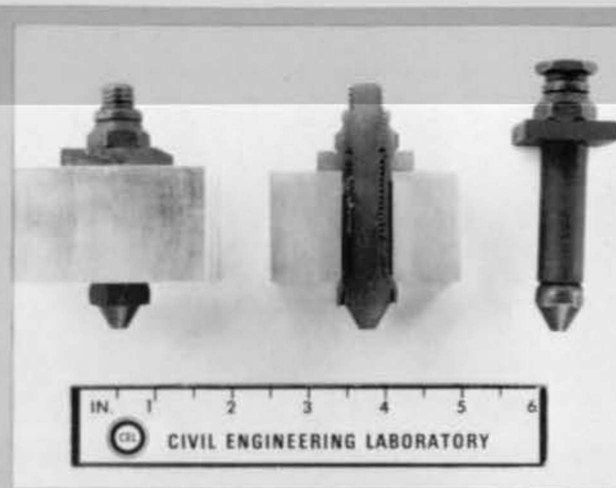
Certification procedure entails an exchange process between individual commands and the System Certification Authority (SCA). (Actually, there are three SCAs—SEA OOC for diving equipment and shipboard diver support systems, PMS 395 for manned submersibles, and NAVFAC for shore installations.)

Certification is a effort to provide the Navy with the assurance that safe diving systems and equipment are being operated in the safe manner. It is not intended to needlessly complicate Navy diving or to pose requirements which are technically or economically unattainable. If undertaken with the proper attitude, certification should materially and procedurally upgrade your present diving systems, improve the new ones, and make diving a safer Navy profession.

Getting equipment certified is not as simple as waving a magic wand; but, on the other hand, it is not impossible if the proper steps are taken.



CEL Develops New Tools



A blind bolt designed by CEL is shown at the right, ready for installation. The cut-away bolt in the center reveals the torquing central mandrel expanding the sleeve bottom. At the left is a fastener installed in a test block of aluminum.

The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, California, has developed a new blind-bolt fastener and a new tool to install an existing one-piece fastener. Both are designed to reduce the time-consuming assembly of underwater split pipe.

Split pipe protects cables laying underwater near shore. It is important that protection remain intact for long periods of time. However, failure of conventional fasteners has become a major cause of frequent and costly repairs. Corrosion and vibration are two main contributors to premature breakdowns.

The present method of fastening pipe halves is with standard nuts, bolts, and washers. In addition to being unreliable, this operation poses problems in lost time, repairs, and maintenance. It takes about 4 minutes for two divers to install one 3-foot section of pipe. Often divers have difficulty in reaching the underside of the pipes because of sand and rock obstruction.

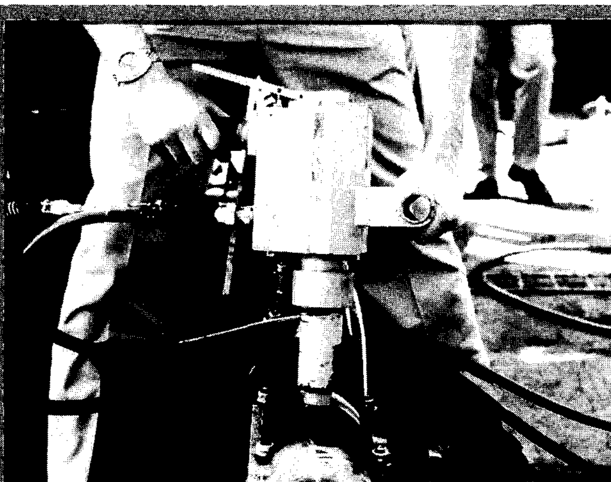
The Laboratory was tasked to develop split pipe hardware and installation techniques that would minimize underwater assembly time and extend the life of fasteners. CEL faced two alternatives. Either design a new blind-bolt (one piece) fastener for split pipe, or design a new diver installation tool for an existing blind-bolt fastener. CEL engineers accomplished both.

A torque bolt fastening system specifically designed for split pipe was developed. Presently the fastener fits only one size, 5/8-inch-diameter with a 1-1/2-inch grip length, according to Mr. R. L. Brackett, mechanical engineer in charge of the torque bolt project. The introduction of the CEL blind-bolt fastener is expected to make installation simpler and quicker.

The torque bolt was made commercially to Laboratory specifications. The fastener is installed as one unit using a hydraulic torque wrench. Torquing the nut causes the central threaded mandrel to pull up through the outer sleeve. A square collar prevents the fastener from rotating on the split pipe as the nut is tightened. As the mandrel is pulled together, it expands the sleeve bottom against the work piece, locking the fastener into place. The installation nut breaks off at a predetermined torque of 800 to 900 inch-pounds. The completed fastener installation essentially becomes a one-piece nut and bolt assembly. Tested with two off-the-shelf fastener methods, the CEL concept proved the easiest to install.

While researching potential split pipe fasteners, it became apparent that in order to use one commercial fastening system, a completely new installation tool would have to be designed. Mr. Wayne Tausig, mechanical engineer in charge of the project at CEL, has noted that the existing tool prevented proper installation. It was triggered through an electronic solenoid, which is undesirable for underwater use, and the ejector system interfered with the pipe flange, which also prevents proper installations.

Designed to provide a convenient, workable diver tool for installation of blind one-piece fasteners, the CEL version consists of a hydraulic ram assembly, tool adaptor assembly, and hydraulic control assembly. The tool works by pulling a central mandrel up through the outer sleeve with a hydraulic ram. The CEL concept features a hollow piston that allows each spent mandrel to be shoved up, through, and out the back of the tool. This improvement offers two distinct advantages. Without the need for an ejector, the nose piece could be shaped to fit into the recess of the split pipe flange. And, with a hollow piston, a bolt of any length could be used since the bolt mandrel could extend up inside the piston.



The CEL-developed blind bolt fastening tool installs four commercial fasteners on split pipe. Note the mandrel is bolt at lower left. It will be removed when bolt is fastened by the tool.
Top right photo shows divers using new manual nut splitter.

The Laboratory is conducting a long-range evaluation of blind-bolt fasteners. A total of 600 were installed on split pipe at a depth of 40 feet in the ocean. The system will be inspected twice a year for 5 years. The ocean tests were started after detailed in-house tests were conducted with satisfactory preliminary results.

The improved method of using blind-bolt fasteners has many potential applications, such as salvage work (placing attachment points, padeyes), underwater structures requiring fastening by divers (I-beams, plates), and various underwater repair operations. According to CEL, the blind-bolts could prove stronger and more durable than nuts and bolts in many instances.

Included in the criteria that must be met to develop an acceptable fastener installation are: Quick and simple installations, as few parts as possible, and access required from only one side of the pipe. In addition, it must be strong enough to hold pipe halves together under all conditions, resist loosening (vibration) even if the pipe partially corrodes, and it must be made of corrosion-resistant material or be cathodically protected by sacrificial anodes.

MANUAL NUT SPLITTER AVAILABLE

A manual nut splitter is the latest in a family of underwater tools developed by the Civil Engineering Laboratory (CEL), Construction Battalion Center, Port Hueneme, California, for Navy construction divers. Four sets recently were delivered to Underwater Construction Teams (UCT's) for inclusion in their underwater tool kits. Like other CEL-developed tools and techniques, the splitters were developed to increase the effectiveness and efficiency of the working diver.

Divers have repeatedly experienced problems in removing nuts and bolts that hold cast iron split pipe sections together. The pipe protects submarine cable systems installed from the beach to depths of 120 feet. Abrasion, corrosion, and marine fouling often make it impossible to remove nuts from damaged pipes. The former method involved a hydraulically powered grinder. This procedure was time-consuming, dangerous, and required two divers.

The Naval Facilities Engineering Command (NAVFAC) assigned the task to CEL. Mechanical engineers Mr. Stan Black and Mr. Steve Sergev developed a splitter that safely cuts a stainless steel nut up to 1 inch across the flats in less than 1 minute. The older method took approximately 15 minutes to remove a nut. The high speed grinder also posed the danger of either injuring the operator or cutting his air line.

Engineers redesigned an existing commercial nut splitter (3/4-inch jaw opening) with a larger and stronger jaw to accommodate a 1-inch nut. Harder and wider cutters (S-I tool steel) also were developed. An SAE-8 high strength bolt was used for the drive screw with a ball bearing attached to the end. The original screw had lacked sufficient strength to withstand high stresses developed by more than 30,000 pounds of driving force.

The modified nut splitter was tested both on the work bench and in the CEL seawater diving tank. Normally, the tool is operated by a hand socket ratchet wrench that turns the drive screw. It takes a diver a few minutes to split one nut. If he wants to do the job quicker (30-45 seconds), he can use a hydraulic impact wrench to turn the drive screw.

The small, compact tool was specifically designed to operate in confined areas. However, larger splitters capable of removing units up to 2 inches across the flats also were delivered to UCT's by CEL.

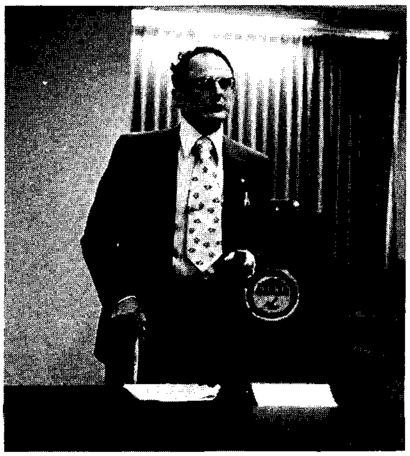
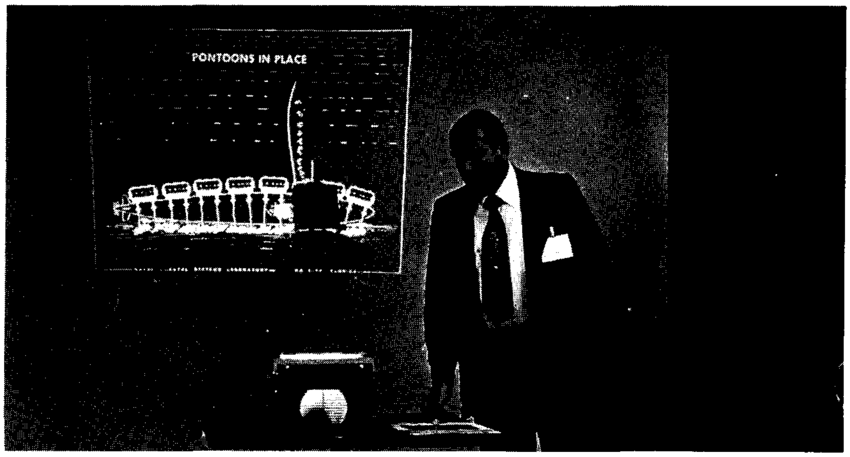
Above, l-r: CAPT Spaur, USN, and CDR Ringelberg, USN, receive awards from LCDR Cox, CF. Below, left, CDR Ringelberg gives the opening remarks. Below, right, CDR Milwee, SURFPAC Salvage Officer, describes PACFLT salvage/diving operations.

C-21 Information Exchange

The third annual meeting of the Information Exchange Program (IEP) on Diving and Salvage between the United States Navy and the Canadian Forces was held on October 14-15, 1976, at the Naval Coastal Systems Laboratory (NCSL), Panama City, Florida. Representatives from the U.S. Navy Atlantic and Pacific fleet salvage forces, special warfare teams, NEDU, Naval School of Diving and Salvage, and NCSL gathered with their Canadian diving counterparts to exchange data from their respective diving programs. This particular exchange project, entitled IEP C-21, was initiated when NEDU and the Canadian Defense & Civil Institute of Environmental Medicine (DCIEM) realized that both commands would benefit from joint research in order to share accumulated knowledge and to avoid duplication of efforts in reaching for similar goals.

The IEP C-21, which provides for the use of each country's diving facilities, equipment, and personnel for the purpose of extending operational diving expertise, is a very active exchange program. In accordance with the C-21 guidelines, four sets of newly developed powered diving tools were shipped to Canadian fleet diving units in 1976. NCSL tool specialists traveled to Canada to conduct cold water tests on the tools and to train both the Atlantic and Pacific Canadian Diving Unit personnel in the use of the equipment. More recently, the Canadian Forces successfully completed their first saturation


Above, l-r: LCDR Cox, CF, gives DCIEM Review; LCDR Busby, CF, gives the status of the CF diving support ship and the Deep Diving Program; LCDR Malec, RN, discusses the NEDU 1,400 fsw dive. Below, l-r: Dr. Grodski describes the DCIEM breathing machine; Mr. Tom Odum talks about the LOSS Program.

Program Convened in Panama City

dive in cooperation with NEDU at the Ocean Simulation Facility (see *FP*, Summer 1976). A team of nine Canadian divers traveled to Panama City for 2 weeks of training and indoctrination before making a 350-foot dive, which included excursions down to 456 feet of seawater.

The 2-day meeting featured many in-depth presentations on both U.S. Navy and Canadian Forces commands, diving programs, and past and future projects. The conference, which was chaired by CDR J.M. Ringelberg, NEDU's Commanding Officer, also included tours of both the Ocean Simulation Facility and the Large Object Salvage System (LOSS), which currently is being tested at NCSL. During the DCIEM Review, LCDR Frederick Cox, CF, Commanding Officer of the Canadian Dive Team and Diving Unit, presented an award to CAPT W.H. Spaur, MC, USN, and CDR Ringelberg in appreciation for their efforts in the Canadian saturation dive in the OSF last April.

In his C-21 "Forecast," LCDR Cox discussed such plans as maintaining the CF relationship with NEDU (including continuing the diving schedule through June 1977 and joining with NEDU in breathing machine problem studies); participating in a human engineering study with NCSL; and looking into the possibility of exchanging diving statistic information with the Naval Safety Center. LCDR Cox also extended an invitation to NEDU to participate in a cold water dive planned for late March or early April 1977.

The concluding remarks included the announcement that the next IEP C-21 meeting will be held in the fall of 1977 at DCIEM in Toronto.

Waterborne Hull Cleaning: Efficient and Economical

Mr. Clark Mallder
Office of the Supervisor of Salvage

During the past 12 months approximately 48 Navy ships have had their hulls cleaned while waterborne. These ships ranged in size from destroyer escorts to fleet oilers. The most recognized and appreciated benefit of waterborne hull cleaning is the cost savings in fuel consumption and operating efficiency. A long range objective of this hull cleaning program is to extend a ship's drydock interval from 3 years to 5 years. This can be accomplished through the rejuvenation of the ship's anti-fouling paint, which results from proper hull cleaning. An additional benefit of waterborne hull cleaning is the ability to perform a thorough hull inspection (a requirement of Planning, Estimation, and Repair Activities (PERA) for the pre-overhaul test and inspection of ships scheduled for drydocking.

The involvement of the Supervisor of Salvage in hull cleaning began when it became evident that Type Commander's (TYCOM's) and PERA's were routinely cleaning the surface of ship hulls using waterborne techniques. TYCOM's, of course, are interested in fuel cost savings during a ship's deployment while PERA's interest is in pre-overhaul test and inspections. Each TYCOM and PERA operates independently and accomplishes its objective through master ship repair contracts or contracts let through Naval Supply Center. Approximately 30 ship hulls have been cleaned by various private contractors who have used machines ranging from the hand held pneumatic rotary brush to the fully automatic hydraulic "diverless" machines. Consequently, there has been little or no quality assurance imposed on the contractors, and everyone generally has gone his own way.

Currently, NAVSEA is sponsoring a project to combine research, operational, and maintenance activities' requirements into a comprehensive master program aimed at providing the fleet with improved hull coatings, compatible waterborne inspection and cleaning and repair techniques. This program should improve energy conservation and extend drydocking intervals to 5 years. It is expected that the majority of the equipment and techniques developed for underwater hull cleaning will be implemented by the fleet's diving assets.

The Annapolis Division Naval Ship Research and Development Center (NSRDC) has been assigned two tasks. The first is to develop new anti-corrosive and anti-fouling coatings that can be applied while the ship is waterborne. The second task is to develop the procedures of how and when to clean ship hulls to achieve the maximum rejuvenation of the anti-foulant toxicity with minimum deterioration of the thickness of the coating. The successful completion of both of these tasks is required to achieve the objectives of fuel conservation and extended drydocking. NSRDC has also expanded their research to determine what effect waterborne hull cleaning will have on the ocean floor environment. This effort is important because of the number of times this in-water cleaning will occur; it is anticipated that in the future *all* ships coming out of drydock will have the keel block areas cleaned and painted with anti-corrosive and anti-fouling coatings. This will be followed with periodic waterborne hull cleaning on a 6- to 9-month basis, depending on the geographic location of the ship.

As an interim approach until waterborne hull cleaning can be implemented by Navy divers, the Supervisor of Salvage has tasked its Diving Operations Branch manager, Mr. James C. Bladh, to direct and coordinate all waterborne hull cleaning techniques and to ensure quality assurance.

To date, the Diving Operations Branch has supervised the waterborne hull cleaning of 18 U.S. Navy ships in the Atlantic and Pacific Fleets using the services provided under the diving services contract. The diving services contractor, who is not geared to perform waterborne hull cleaning, has sub-contracted this task to a company using the SCAMP R automatic hull cleaning machine. The cleaning procedure calls for the use of the SCAMP R machine to clean the main hull area first, followed by the use of hand-held rotary brushes to clean the curvature of the bow, rudders, screws, shafts, and appendages. The SCAMP machine cleans a swath approximately 5 feet wide on each pass. For a ship the size of a fleet oiler (640 feet), waterborne hull cleaning normally involves 1 working day for the SCAMP machine followed by 1 day to finish the appendages with the hand-held machines.

With four or five ships to clean "back to back," the automatic type machine is a great asset. It is estimated that 500 to 600 ships a year will be cleaned while waterborne. With this in mind, it is not unreasonable to forsee some kind of a fully automatic "ship wash" in the near future. Until that time, available assets will be used; and presently, the SCAMP is giving the most cost effective service.

The geographical location of the ships cleaned has ranged from Norfolk, Virginia, on the east coast to as far west as Pearl Harbor, Hawaii. The hull cleaning on the east and west coasts of the United States has been supervised by Mr. Donald (Blackie) Keane and Mr. Clark Mallder in the SUPSALV Office. Pearl Harbor tasks have been supervised by BMC(MDV) H. T. Harper, from SUPSALV's West Coast Team.

According to current indicators, it looks like the Diving Operations Branch is going to have a busy year ahead. The west coast TYCOM's have already indicated that 15 to 20 ships are scheduled for hull cleaning in the first 3 months of 1977. (The largest of these ships will be the USS ENTERPRISE.) The east coast TYCOM's have not made their future plans known as of this writing. It can be anticipated that SUPSALV will be requested to clean six to 10 ships in the first quarter.

It has already been recognized that considerable cost savings in fuel consumption have been realized and operating efficiency has been increased by using waterborne hull cleaning techniques. In view of this, and with the high cost of labor and lack of available drydocks, it appears certain that waterborne hull cleaning will soon become a part of the Navy diver's everyday life.

The following messages are two of many received that have reported increased operating efficiency and fuel savings after waterborne hull cleaning was performed:

> Utilizing the Scamp Waterborne Cleaning had a two-fold effect on GOMPERS. It resolved the heating problem on the main engine condensor by removing the marine growth congesting the scoop injection opening. A 2-knot speed increase over the ground was observed at standard speed, 100 rpm, and a 12 percent reduction in fuel use.
> –From CO, USS SAMUEL GOMPERS (AD-37).
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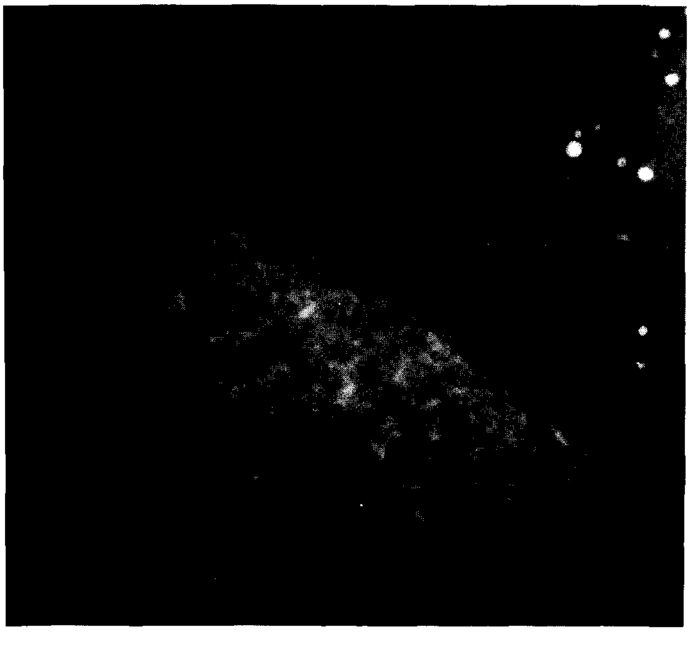
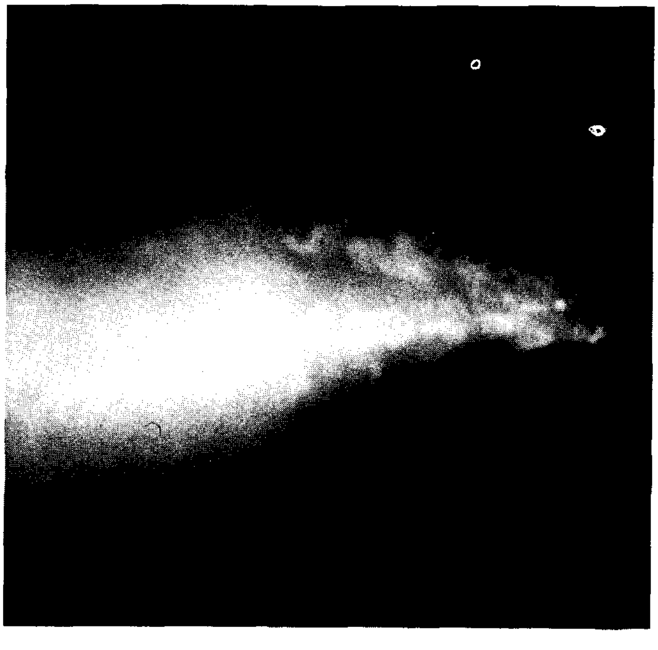
>
> DUBUQUE speed increased 1 to 2 knots after cleaning using the same power. The difference between fuel consumption at 16 and 18 knots is approximately 430 gallons per hour.
> –From CO, USS DUBUQUE (LPD-8).

Dunce cap of USS SAMUEL GOMPERS (AD-37) before cleaning.



Dunce cap of SAMUEL GOMPERS after waterborne hull cleaning.



NEDU REPORTS:

Navy Experimental Diving Unit Report 4-74. *Evaluation of SINBAD Tests.* E.C. Bain, III, LCDR T.E. Berghage, MSC, USN.

Abstract: This paper presents the baseline results and analysis of the SINDBAD (Systematic Investigation of Diver Behavior At Depth) data gathered at the U.S. Navy Experimental Diving Unit. Fourteen of the tests in the SINDBAD battery were administered in a dry hyperbaric chamber at one atmosphere absolute pressure to 27 U.S. Navy first clas: divers. Eight additional tests from the same battery were taken by 16 of the same divers under similar conditions. Factor analysis of the results revealed that each test was measuring a unique ability. The normative data was gathered on each test for use in comparative studies in both wet and dry hyperbaric environments.

Navy Experimental Diving Unit Report 6-74. *Biomedical Instrumentation for the 1973 EDU Dive to 1,600 Feet.* W.R. Braithwaite, M.D.

Abstract: This report documents the major components of the biomedical instrumentation used in the 1973 EDU dive to 1,600 feet. The general principles, as well as the specific instrument connections used, are discussed in a way designed to assist the biomedical experimenter in understanding the instrumentation and how to avoid problems in future use. It is not intended to substitute for dive protocols or instrument operating manuals.

Navy Experimental Diving Unit Report 10-74. *A Prophylactic Program for the Prevention of Otitis Externa in Saturation Divers.* LT E. D. Thalmann, MC, USNR

Abstract: A prophylactic regimen for the prevention of otitis externa was tested on five saturation dives. The dives totaled 78 days, no dive being shorter than 10 days. A total of 26 subjects participated in the dives.

The regimen consisted of irrigating the ear canals with a 2 percent acetic acid in aluminum acetate solution each morning and evening and after each head immersion. When compared to a set of base period dives of similar length, during which no ear prophylactic regimen was used, the incidence of otitis externa was markedly lower in the test dives.

The initial success of the prophylactic regimen is attributed to the strength of the acetic acid solution used and the regimented manner in which the irrigations were administered.

A review of the literature revealed that preparations similar to the one used in this study have been used successfully to prevent otitis externa during dives when the subjects were cooperative and used the preparations in a consistent and systematic way.

Navy Experimental Diving Unit Report 15-74. *Evaluation of Diver's Hand Held Underwater Lights Fara-Light, Allan Light, and Margolis Light.* BM1(DV) R. Radecki, MR1(DV) F. Atkinson.

Abstract: Three commercially available hand-held, rechargeable underwater lights were submitted to the Navy Experimental Diving Unit for test, evaluation, and possible qualification for the Navy Approved Products List. The lights were tested for illumination output in both wet and dry environments, battery duration, watertight integrity, and maximum operating depth. Two of the lights performed satisfactorily and were recommended for addition to the Approved Products List.

Navy Experimental Diving Unit Report 16-74. *Determination of the Adequacy of Helmet Ventilation in a Prototype Navy Mk 12 and the Mk 5 Hard Hat Diving Apparatus.* LCDR E.D. Thalmann, USN; LT J.C. Crothers, MC, USN; LT M.M. Knott, MC, USN.

Abstract: The adequacy of ventilation of a prototype Navy Mk 12 diving apparatus was tested in the open-circuit mode under exercise conditions of increaing severity. The tests were performed on the submerged diver at a simulated depth of 100 feet of sea water in a hyperbaric complex.

During exercise, the diver's heart rate and helmet CO_2 level were measured. Analysis of the data revealed that helmet CO_2 level was linearly related to heart rate over the range of exercises performed. Further analysis gave an estimate of a maximum exercise CO_2 production of 3 liters/minute. The maximum allowable helmet CO_2 level is established as 2 percent and the reasons for establishing this level are discussed. The minimum helmet flow rate needed to keep the helmet CO_2 level below 2 percent under practically all exercise conditions was calculated to be 6 acfm.

Comparison of the ventilatory capacity of the Mk 12 with the Mk 5 is also made.

These research reports have been issued by the Navy Experimental Diving Unit, Panama City, FLA. Non-DOD facilities desiring copies of reports should address their requests to National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151. DOD facilities can obtain copies from the Defense Documentation Center (DDC), Attn: DDC-TSR-i, Cameron Station, Alexandria, VA 22314. Prices vary according to the individual report.

Mk 12 SSDS Completes OPEVAL

The sense of satisfaction that results from a difficult job well done is evident at the Navy Experimental Diving Unit, Panama City, Florida, after the successful development of the Mk 12 Surface Supported Diving System (SSDS). This replacement for the Navy's veteran Mk V "hard hat" rig has completed a major milestone in its journey to the fleet. During June 1976, an operational evaluation of the Mk 12 SSDS in the air mode was performed at sea aboard USS HOIST (ARS-40). In an interim report of the evaluation, Commander, Operational Test and Evaluation Force (COMOPTEVFOR) has recommended that the Mk 12 be approved for service use for air diving operations.

This will be welcome news to those divers who have had the opportunity to dive the Mk 12 during the air mode Technical Evaluation (TECHEVAL) and Operational Evaluation (OPEVAL) phases. This group unanimously acclaimed the Mk 12's mobility, versatility, and, above all, its comfort. The only criticism was that it was not yet available in the fleet.

The production model of the helmet has been improved in several ways to simplify maintenance and fabrication. The procurement schedule will make the first air systems available in limited quantities in late 1977. The first Mk12s produced will go to diver training facilities, with FY78 production models distributed to fleet units, replacing the existing air mode Mk Vs. Those diving facilities with mixed gas requirements will be provided with the Mk 12 recirculator when it is available. At that point, the Mk V will be on its way to becoming a memory.

The mixed gas mode TECHEVAL is scheduled to commence in early March 1977. The first phase will be conducted in NEDU's Ocean Simulation Facility at the Naval Coastal Systems Laboratory in Panama City. The second phase will be performed from NCSL's offshore stage No. 1 or from a to be determined fleet asset. The dives will be manned by NEDU personnel and divers from fleet units. OPEVAL of the mixed gas mode is slated for June 1977 and will be staged from an ASR, possibly in the Gulf off Panama City. Divers that participate in the evaluations will be given an indoctrination course in the use of this system by NEDU Mk 12 project personnel.

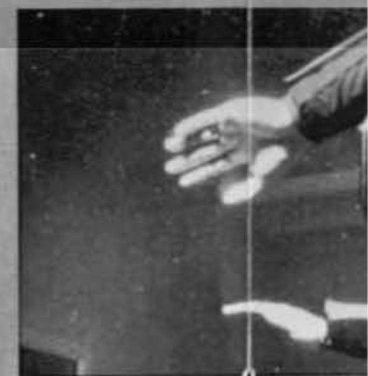
The Mk 12 system includes the dual purpose helmet, neck dam and breach ring assemblies, a recirculator, an assortment of dry suits and outer garments, suit weights, boots and gloves, jocking harness, umbilical hose, a communication cable/strength member, communications station, and support equipment.

The helmet can be used as an open-circuit air system or as a semi-closed mixed gas system in conjunction with the back pack recirculator. In the air mode, the system can be tailored to specific job requirements ranging from cold, heavy work on the bottom in a dry suit and outer garment with boots and weights, to warm water swimming using a neck dam, swim suit, and fins.

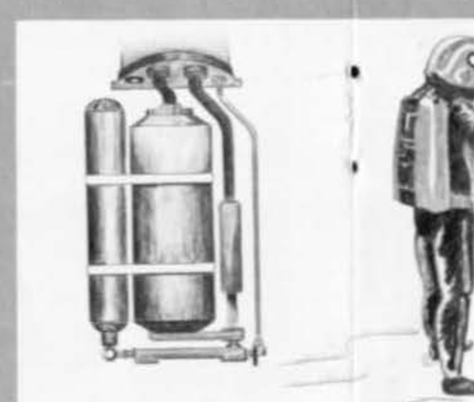
The helmet itself is neutrally bouyant. When wearing the dry suit, buoyancy control is fine enough to permit hovering. The design of the outer garment and jocking harness together with improved weight distribution prevents inverted blowup.

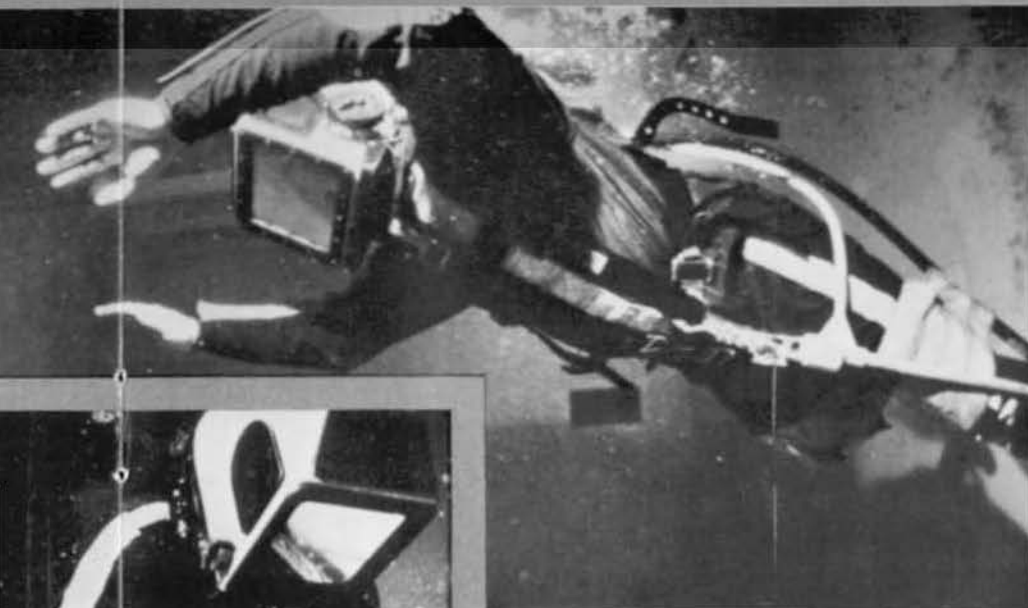
A lightweight, impact-resistant polyethylene shipping/storage container with interior padding is provided for each helmet. Similar unpadded containers accommodate the rest of the equipment. A test set mounted in the removable upper section of one container provides the instrumentation required to test and adjust the helmet for air mode operations. Tools required for field maintenance and operation of the system are stored in the lower section of the test set container

The Mk 12 communication circuitry is designed to function with either the Helle Model 3315 Diver Communication Station now in the fleet inventory or the Mk 12 Diver Communication Station developed at NCSL. The Mk 12 Station, which provides "party line" communication between three divers and the diving station, is under evaluation but is not programmed for procurement with the Mk 12 hardware. Both will be further evaluated during mixed gas mode TECHEVAL and OPEVAL. A new communi-



Photos above show various scenes of chamber testing the Mk 12 SSDS in the Ocean Simulation Facilit shows diver wearing Mk 12 during an open sea trial; note welding shield raised for normal viewing. Ph welding shield attached to helmet. Artist's concept below center shows interior of backpack and exterior wh back under water. Photo below right shows the Mk 12 SSDS test set container.





Ocean Simulation Facility. Photo at far right
l for normal viewing. Photo below left shows
backpack and exterior when mounted on diver's

cation cable/strength member is being examined as a substitute for the present cable, whose polyurethane outer sheath was subject to abrasion during the air mode TECHEVAL.

The recirculator, presently being tested at NCSL's Hydrospace Lab, consists of a cylindrical canister with a capacity of 12 pounds of baralyme, a "come-home" bottle with a single stage regulator, and an ejector, all mounted on a manifold that contains the operating valves. The recirculator is designed to support a diver for 9 hours in 70° F water. If the recirculator should malfunction, the diver can operate the manifold valves to bypass the recirculator and shift to open-circuit operation, controlling gas flow with the helmet supply valve.

A welding shield than can be easily attached and detached by the diver is provided. When the frame is mounted firmly in place with two spring clips, the shield can be flipped down into the working position or up for viewing. The light filters, made of gold foil sandwiched in Lexso, are provided in three densities and can be changed quickly.

The boots selected to correct problems in sizing are made of black rubber, are 10 inches high, and have corrugated soles, a steel protective toe cap and shank, and a lead-weighted heel. The boots open at the front in a normal manner and are secured with Velcro straps around the top and across the instep.

Size problems experienced with the dry suit and outer garment have been analyzed. Patterns for the Mk 12 were produced by the Navy Natick dress laboratory.

In summary, the Mk 12 SSDS is nearing production. By all accounts, the system makes heavy underwater work an easier task for the diver. Soon the Mk V hard hat will be a nostalgic memory along with the Jack Browne rig and the "old" school at the Washington Navy Yard.

F-4N Recovered off Key West, Fla.

A. U.S. Navy F-4N aircraft crashed into Gulf of Mexico waters northwest of Key West, Florida, on August 6, 1976. The aircraft, BUNO 151422 from VF-101, U.S. Naval Air Station, Boca Chica, Florida, impacted the water in a vertical attitude at an estimated velocity of 500-600 knots. Both crewmen were killed.

FIGURE 1
CHARTLET OF OVERALL AREA

An accompanying aircraft (also an F-4N), immediately notified the base of the accident and recorded a Tactical Air Navigation (TACAN) line of position from NAS, Boca Chica. Other forces, both Navy and Coast Guard, rushed to the scene and recorded additional positioning information over surface debris. A moored barrel was also set in a position near floating debris approximately 5 hours after the crash.

An initial search was mounted using local Explosive Ordnance Disposal (EOD) divers. However, this effort was almost immediately terminated because of the reports of large sharks in the search vicinity of the divers.

The U.S. Navy Supervisor of Salvage was contacted for assistance on August 13. Seaward, Inc., the primary search and recovery contractor for the U.S. Navy, was placed on standby alert to furnish a search team for the task when required. Official authorization to proceed was issued on August 15; and that evening, Mr. R. E. Kutzleb proceeded to Miami, Florida, to rendezvous with LCDR W. J. Tageson, USN, the designated Supervisor of Salvage representative (SUPSALVREP).

LCDR Tageson and Mr. Kutzleb traveled to Key West the next day to interview VF-101 personnel and to obtain all available positioning and background data on the loss. A long range navigation system (Decca Hi-Fix) was ordered, as was Seaward's sonar subcontractor. Arrangements were also made for search team personnel sufficient to conduct a 24-hour search effort.

USS ESCAPE ARS-6, commanded by LCDR Lars Okeson, USN, departed Mayport, Florida, on August 17 to act as the search and recovery platform for the task. Decca navigational personnel and equipment also proceeded to south Florida to commence shore site selection and equipment installation.

USS ESCAPE arrived at Key West, Florida, the afternoon of August 19, and search equipment installation was initiated on board. Tropical Storm Dottie was over the area at this time, which delayed the erection of the shore navigational antennas at the sites selected, Cape Romano and Cape Sable, Florida. (This same storm had also caused ESCAPE to arrive later than intended because of very heavy transit weather.) Accordingly, an underway time of August 21 was set to provide time for shore equipment installation.

A second review of all information germane to the search task was conducted before departure, and arrangements were made for a U.S. Coast Guard SAR helicopter to meet ESCAPE on scene and confirm positioning details.

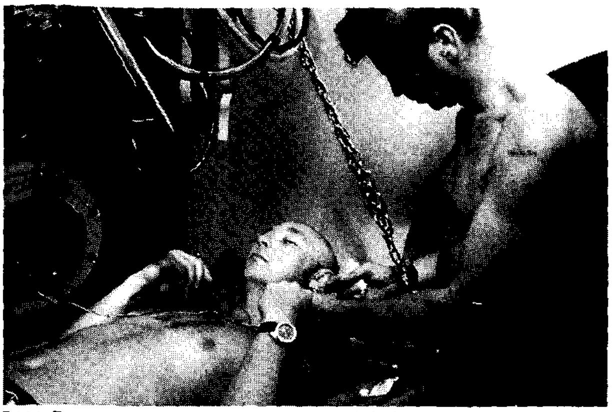
USS ESCAPE was underway at early August 21 for transit to the site, stopping at Pulaski Shoal Light structure (at Dry Tortugas) to initiate Decca equipment calibration. This was accomplished and ESCAPE then arrived in the search area and set a local calibration and Decca reference buoy. The Coast Guard SAR helicopter also arrived shortly thereafter and set two smoke markers for visual reference that were "tied in" to the search navigation system and recorded.

The sonar was put in the water and the bottom search commenced that night and continued until early the following morning when a contact was acquired by sonar which, though poorly defined, was obviously foreign to the bottom and had to be checked visually. Upon searching the bottom area, divers reported finding engines, trawl boards, and portions of an old previously sunken fishing trawler. The aircraft search was then continued until early August 24, when a firm, definitive contact was acquired by sonar and its position and pattern were defined during several succeeding "runs." A buoy was set and ESCAPE moored nearby to permit diver verification. The sonar contact was confirmed as the missing F-4N aircraft and wreckage recovery commenced by divers from USS ESCAPE, augmented by the Explosive Ordnance Disposal Team at Key West.

ESCAPE divers participating in this operation were: LTjg R.A. Hinderer, ENS T.E. Stanton, ENS S.C. Duba, BMC(DV1) D. Brown, MM1(DV1) K.W. Hearth, MM1 (DV1) S.L. Smith, HT1(DV1) K.D. Doty, BM1(DV1) C.D. Pate, BM1(DV1) T.N. Dowland, HM1(DV1) S.E. Tripp, MN2(DV1) G.R. Zawacki, SK3(DV2) R.B. Hernandez, HT3(DV2) R.G. Rohn, ENFN(DV2) S.C. Miers, and ENFA(DV2) R.H. Powers. The EOD Det. Key West divers assisting were CWO T.H. Brennan, GMGC A.F. Trevillo, EN1 F.D. Ball, and EN1 M. Lundberg. The depth of the dives varied from 92 to 100 feet. Scuba equipment was used exclusively when rough seas made it difficult for the divers to hold their position while wearing the Mk 1 Bandmask.

Initial demobilization of the search equipment and personnel commenced August 26, with final equipment offloading (navigation gear) accomplished the following day. All personnel were en route to their home stations on August 28, thus successfully completing the search and recovery task.

This search and recovery task was successfully concluded through the dedication and enthusiasm of all the activities concerned, coupled with enough crash position information to well define the initial search area.



BM1 Euteneier attaches electrodes to HMC Boyce.

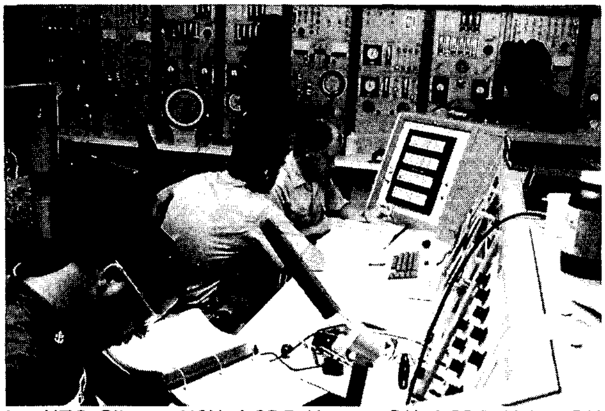
BM1 Euteneier prepares for the finger tremor test.

1,400-Foot Saturation

LT R.C. Carter, MSC, USN *Navy Experimental Diving Unit*

BM2 Stevens performs *tremor test* for HPNS during the dive.

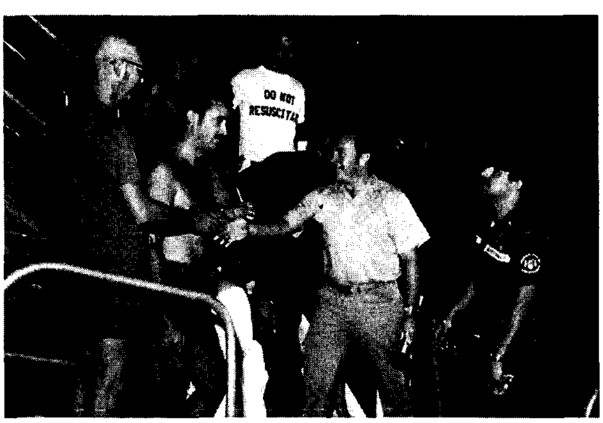
Below: HTC Gibson (left) and BMCS(MDV) *Ramos* at control panel during baseline studies.



L-r: HTC Gibson, USN; LCDR Norton, RN; LCDR Malec, RN, Dive Officer; BMCS(MDV) Ramos at control panel during dive.

Dive at NEDU

Above: EN2 Harkins tries to load ball bearings in HPNS study. Below: CDR Ringelberg (center) with divers just before the start of the dive. BMCS(MDV) Ramos is at right.



The Navy Experimental Diving Unit (NEDU), Panama City, Florida, successfully conducted a saturation dive at 1,400 feet from August 27, to September 26, 1976. The 30-day dive was accomplished in the NEDU-operated Ocean Simulation Facility. Six U.S. Navy divers participated in medical experiments and equipment evaluations during the 13-day bottom time and the 17 days of compression and decompression.

The dive was designed to study the diver's ability to perform useful physical work in the water using available underwater breathing apparatus and an adaptation of U.S. Navy diving procedures and to collect, record, and analyze biomedical and equipment data important to deep operational diving.

Compression to 1,400 feet was carried out in two stages. On the first day of the dive, the OSF was compressed to 1,208 feet in 12 hours. Two successful excursions from 1,208 feet to 1,020 and 1,000 feet in the next 3 days, followed by a 7-hour compression to 1,400 feet.

Investigators from the Naval Medical Research Institute, Bethesda, Maryland, monitored the divers for signs of High Pressure Nervous Syndrome (HPNS) during compression. When men are compressed to pressures greater than 1,000 fsw, tremor, dizziness, and depression in electrocortial activity are among a distillation of change (called the High Pressure Nervous Syndrome) that occurs within the Central Nervous System (CNS) and the Peripheral Nervous System (PNS). In this dive, the intent of NMRI, Duke, and the University of North Carolina was to quantify tremor and dizziness and to better describe changes that may be going on in the CNS or PNS before, during, and after HPNS onset. Although little physiological evidence of HPNS was found, presumably because of the slow compression rate, some of the divers did experience mild nausea and lethargy for several days after the compression to 1,400 feet.

Additional medical experiments were carried out by the NEDU staff and investigators from Duke University, the University of North Carolina, and the Canadian Defense and Civil Institute for Environmental Medicine. These included the measurement of several respiratory parameters and the measurement of body heat loss in a diver while wearing a hot-water suit.

The respiratory experiments showed the effects of dense compressed helium on the divers' breathing. To compare the work capability and respiratory function of divers supported by Navy underwater breathing apparatus, a low resistance laboratory apparatus of bag-in-a-box design was installed. By using this apparatus, oxygen consumption, carbon dioxide production, minute ventilation, tidal volume, respiratory rate, and tidal carbon dioxide and heart rate could be measured on the exercising, immersed diver.

NEDU 1,400 fsw divers, l-r: BM2(DV) C.E. Stevens, HMC(DV) W.M. Boyce, BM1(DV) E.L. Euteneier, CAPT W.H. Spaur, EN2(DV) D.B. Harkins, LT J.N. Mares.

The heat loss studies measured the insulating properties of thermal protection garments and the heat loss of the divers both in 40°F water and during exposures to cold helium-oxygen in the dry chambers. During the immersed exposures, the diver's ability to perform underwater tasks was examined. Test results indicated that standard U.S. Navy hot water suits could keep a diver satisfactorily warm in 40°F water, but that unrecognizable, slow developing hypothermia (low body temperature) may develop if the diver's breathing gas is not heated adequately. During this study, the USN Mk 1 Band Mask with two different inspired gas heaters were examined while the divers performed graded exercise in cold water. The Mk 1 Band Mask has proven it can support divers performing moderate work to depths of 1,600 feet. These studies measured the breathing resistance (as has been done previously) and the adequacy of the essential inspired gas heaters.

Another method of measuring diver performance in this dive was through the System for the Investigation of Diver Behavior at Depth (SINDBAD). SINDBAD, as used on this dive, consisted of a set of psychological tests presented using a slide projector. These tests were performed by the divers in wet and dry conditions at a 20-foot depth before and after the dive, at the deepest depth of the dive, and at an intermediate depth. The divers' responses will be examined to indicate which, if any, mental abilities may be affected by deep helium-oxygen diving.

Additional investigations important to operational diving included during the 1,400-foot dive were communications tests of the Mk 12 and Mk 14 helmets, hearing studies, helium speech adaptation, high pressure neurological syndrome measurements, and studies of pulmonary mechanics. Also, the development of the Unlimited Duration Excursion Tables and Procedures for Saturation Diving were continued. Excursions between the depths of 1,000 feet of seawater, the current certification depth limit of U.S. Navy systems, and 1,208 feet of seawater were among the depths studied.

This 1,400-foot dive was scheduled at the end of a 2-year period of continuous operation of NEDU's new hyperbaric chambers in Panama City. During this same calendar period, the U.S. Navy performed the deepest open sea dive ever accomplished, diving to a depth of 1,148 feet of seawater. In support of this deep open sea diving, the U.S. Navy has performed only a single experimental dive to a deeper depth. This was the 1,600-foot dive performed by NEDU in 1973 at the facilities of Taylor Diving and Salvage in New Orleans, Louisiana (see *FP*, Fall 1973).

These controlled studies of experimental diving are a necessary predecessor to open sea diving. Equipment and procedures that provide gases for respiration, capability to perform underwater work, protection from cold, and compression and decompression rates must not be left to discovery in the open sea.

CNO Presents Awards to NEDU Divers

Above right: CAPT Spaur, BM2(DV) Stevens, HMC(DV) Boyce, BM1(DV) Euteneier, EN2(DV) Harkins, and LT Mares at award ceremony. Below: ADM Holloway (right) views new equipment as CDR Ringelberg describes NEDU's role in testing and evaluating diving hardware.

During a special ceremony on October 29, 1976, ADM James L. Holloway III, the Chief of Naval Operations, presented medals to the six Navy Experimental Diving Unit divers who took part in the 1,400-foot dive in the Ocean Simulation Facility from August 27, 1976 to September 26 (story on preceeding pages). CAPT W. H. Spaur, MC, USN, received the Navy Commendation Medal for his efforts in the project. The Navy Achievement Medal was awarded to each of the other team members—LT J. N. Mares, HMC(DV) W. M. Boyce, BM1(DV) E. L. Euteneier, BM2(DV) C. E. Stevens, and EN2(DV) D. B. Harkins.

In addition to presenting the medals, ADM Holloway was given a tour of the Ocean Simulation Facility. CDR J. M. Ringelberg, NEDU's Commanding Officer, briefed ADM Holloway during the tour on the facility itself and on past accomplishments and present projects at NEDU.

The CNO's visit to NEDU was part of a larger tour of the Naval Coastal Systems Laboratory. Accompanied by the Chief of Navy Education and Training, VADM James R. Wilson; NCSL Commanding Officer, CAPT James V. Jolliff; and NCSL Technical Director, Gerald Gould; ADM Holloway was taken through various areas of NCSL to see firsthand the advanced research development projects under way and some of the fleet operational equipment developed there. Mr. Gould briefed ADM Holloway and VADM Wilson on all aspects of the Laboratory during the tour. Transported from Pensacola, Florida, by helicopter, the visiting group was given the opportunity to see the projects being conducted in the Gulf of Mexico in addition to an aerial view of the offshore stages and overall laboratory property.

Photos above and below show photographer/divers at work.

PACFLT Camera Group: — 25 Years of Underwater Photography

JO 2 Bob Haagenson
Pacific Fleet Camera Group

Inside, the submarine bells and sirens blared, signalling crash dive. Outside the submarine, two Navy Photographers Mates started filming the dive as they lay lashed to the deck. This took place in the 1950's, and the ensuing film gave the Navy some of its first glimpses of how a submarine looked and reacted during a crash dive. Braced on a specially constructed platform, another photographer filmed a torpedo firing. The torpedo whizzed past his head at approximately 45 miles per hour.

The movies "Run Silent, Run Deep," "Up Periscope," and "The Enemy Below," gave people in the United States a view of underwater warfare that they had never seen before. Hollywood obtained much of the footage from a Navy command located in San Diego, California–the Pacific Fleet Combat Camera Group (PFCCG).

During the 25 years since PFCCG got its start in the 1950's, the diving locker of the unit has continued to develop and expand its capabilities and expertise.

Today, the diving locker has First and Second Class as well as scuba divers assigned to it to handle practically any job they are tasked with. Whether it is a Navy training film documenting a new program, providing coverage of an operational test of a newly introduced piece of gear, or even providing complete underwater television videotape capabilities, the command can get the job done in a timely and efficient manner.

The PFCCG divers have a vast array of photographic equipment at their disposal. A diver using a Nikon-F 35 mm still camera incased in an "Ocean-eye" with a motor drive can easily capture a fast sequence of events on film in either a color or black and white transparency or print. Another photographer/diver using a mapping camera can survey large areas of the ocean floor for construction and test site analysis. Further, the footage shot with a 16 mm Milliken DBM-9/1 or DBM-5 motion picture camera can be used to record a difficult or unusual repair procedure used by Navy hull technicians.

With the various lighting devices, either battery or cable powered, a PFCCG photographer/diver can effectively measure oxidation processes, tidal-stress factors, or a variety of other necessary scientific experiments that the Navy might require. Thus, the versatility of the unit is literally unlimited.

The Pacific Fleet Combat Camera Group is located at the Naval Air Station North Island, San Diego, California 92135. The telephone number is (714) 437-7944, Autovon 951-7944. PFCCG has a detachment in Subic Bay, Republic of the Philippines, and currently has a three-man detachment in Antarctica.

Swimmer Life Support System (SLSS) Mk 1

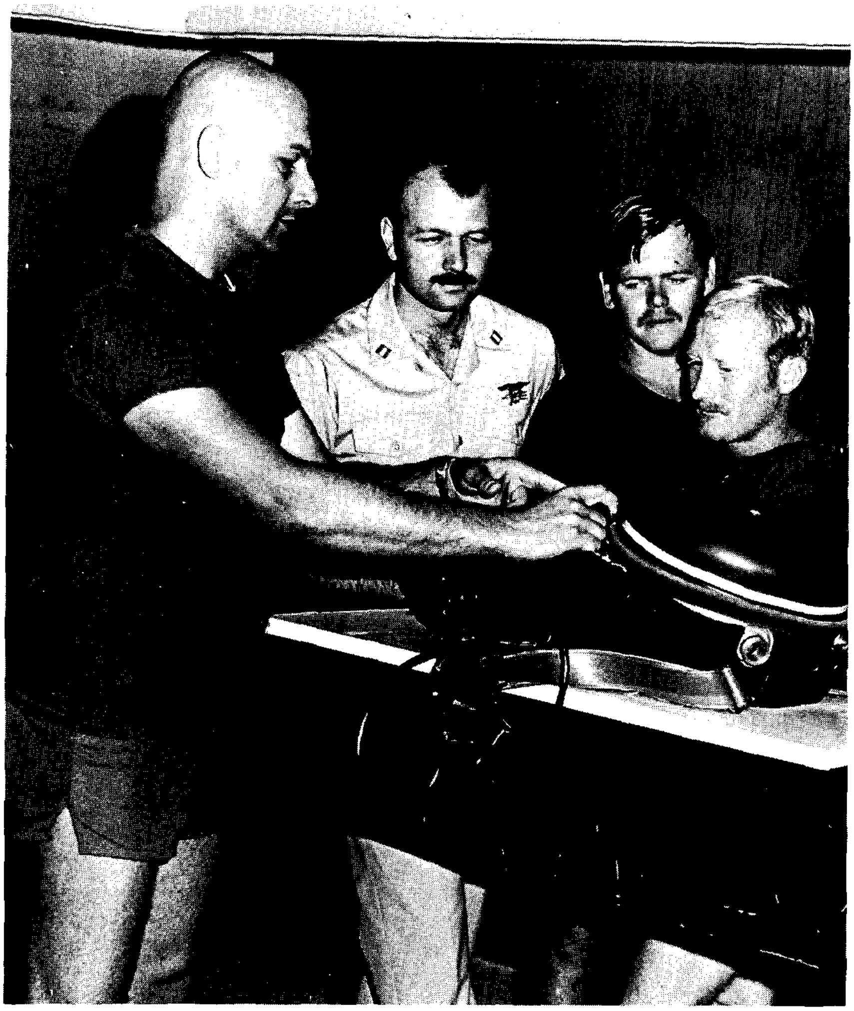
Mr. Lenny Milner
Office of the Supervisor of Diving

The Swimmer Life Support System Mk 1 (SLSS) is one of the new diving equipments that will soon be available to the fleet. These new equipments are not intended to just replace the older diving outfits, but are intended to increase diver capability, minimize equipment maintenance, and enhance reliability.

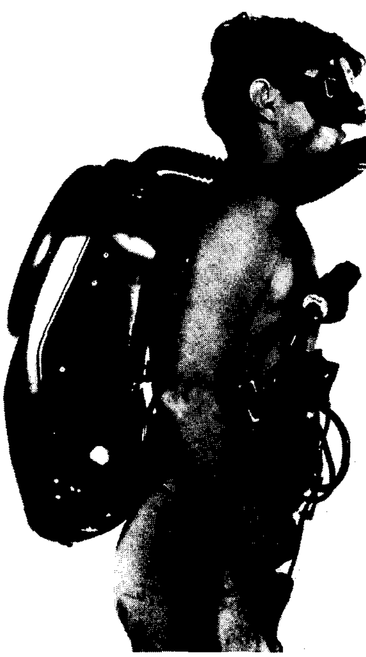
Specifically, the SLSS Mk 1 will replace both the semi-closed mixed gas Mk VI scuba and the closed-circuit O_2 Emerson rigs used by the Special Warfare (UDT, EOD, SEAL) community. This apparatus is intended to fulfill one of the requirements of the Specific Operational Requirement 38-02 for a mixed gas closed-circuit scuba, with performance characteristics compatible with the typical mission profiles of swimmer delivery vehicles (SDV).

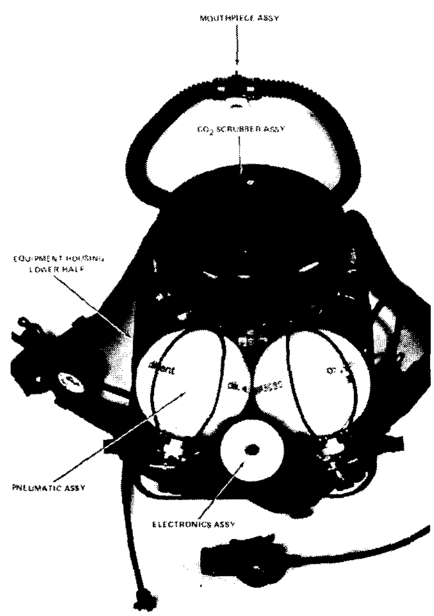
The SLSS Mk 1 is truly a mixed gas self-contained scuba. This unique apparatus is electronically controlled to provide the swimmer with a predetermined, fixed partial pressure of oxygen (PPO_2) instead of a fixed oxygen percentage, as provided by conventional closed-circuit scubas. To do this, a cluster of three independent oxygen sensors (located in the system's breathing assembly) measures the existing PPO_2 and then compares this measured value with the desired predetermined PPO_2. The oxygen sensors then report the comparison to the system's prime electronic component, the Electronics Control Module (ECM). Should the comparison show an O_2 deficiency, the ECM will activate the solenoid valve in the Oxygen Pressure Flask System to supply O_2 within $\pm$ 10 percent of the predetermined PPO_2. Oxygen excesses in the system are compensated for by the swimmer's metabolic consumption or by the manual addition by the diver of a diluent gas.

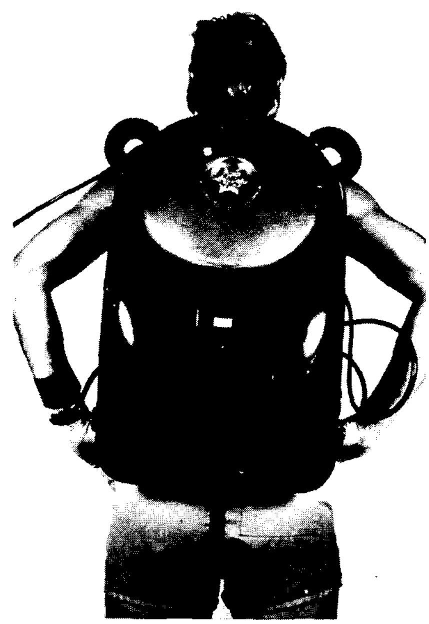
Diver conducts tank testing of SLSS Mk 1.



Upper left photo shows several key personnel: BTC Jarvi (Assistant Project Director), LT Stubblefield (NAVSPECWARGRU TWO RDT&E Officer), GMG1 Myers, and HT1 MacDonald. Above: LTjg Paulson (Project Officer) *inspects equipment.Photos below* show side, interior, and back view of SLSS Mk 1 equipment.







The swimmer may continually monitor the PPO_2 in the breathing loop by viewing either a battery powered primary display or an independent secondary display system that is powered by the oxygen sensors themselves. In the highly unlikely event of an ECM failure, a primary display failure, battery failure, or the failure of any two of the three PPO_2 sensors, the SLSS Mk 1 may still be manually operated and manually PPO_2 controlled as long as any one of the PPO_2 sensors is operative.

The SLSS Mk 1 consists of four basic, independent subsystems. These are:

1. Electronic assembly consisting of a disposable battery power supply, oxygen sensors, electronics control module, and primary and secondary displays.
2. Pneumatic assembly consisting of oxygen and diluent gas storage flasks, oxygen and diluent gas flask pressure gauges, stainless steel plumbing, solenoid valve, first stage regulator, filter, flow restrictor, accumulator, and manual bypass valves.
3. Breathing assembly consisting of a CO_2 removal system, flexible breathing diaphragm, moisture absorber, and a mouthpiece and flexible hose.
4. Equipment case assembly consisting of a mounting base for all subassemblies and diver's harness and a protective outer case.

Physically, the SLSS Mk 1 is a relatively compact, hydrodynamically styled unit that is contoured to the general shape of a swimmer's back. The unit is 24 inches long by 15 inches wide by 8 inches high and weighs 57 pounds in air. When submerged in sea water with the diluent and O_2 flasks halfcharged and with the breathing diaphragm halfextended, the SLSS is approximately neutrally buoyant.

Under the direction of the SLSS Mk 1 Project Officer, LTjg Howard "Ponce" Paulson (SEAL/UDT Liaison Officer at the Navy Experimental Diving Unit), verification tests on the first SLSS Mk 1 commenced on March 24, 1976, and continued through April 16. During this period, unmanned tests were conducted at NEDU to determine whether the rigs delivered complied with the contract specifications. Factors such as breathing resistance and cannister breakthrough for various work rates at various temperatures were carefully evaluated. During these unmanned tests, the first units were subjected to a total of 45 hours of evaluations. No discrepancies with the physical requirements of the equipments were noted. All performance characteristics were met, with the exception of a slightly higher than expected breathing resistance under moderate to heavy work conditions. The old Mk VI type of mouthpiece and hoses that were used with the rigs were found to be the primary cause of the resistance.

The Technical Evaluation (TECHEVAL) of the SLSS Mk 1 commenced on May 12, 1976, and continued until June 12. Personnel assigned to the first TECHEVAL phase of testing (DT III A) were from the Naval Special Warfare Groups 1 and 2. These personnel were carefully indoctrinated in the care, maintenance, and minor repair of the rigs before the first manned tests. Following the indoctrination period, the rigs were subjected to a total of 124 hours of bottom time. Of this time, 63 hours were spent during a saturation dive scenario to 225 feet. The remaining 61 hours were devoted to open tank and other swims. During this manned testing phase, only two minor problems arose, both of a quality control nature. The first problem was an electronics malfunction that caused a misreading on the primary display of one rig. The cause of this malfunction was determined to be a poor solder joint in a circuit board. The second problem was a minor water leak around the face of one of the pressure gauges on an O_2 storage flask. Examination of the gauge revealed that the gauge face probably had not been tightened sufficiently to compress its seal.

The final TECHEVAL phase, DT III B, commenced July 6, 1976, and was completed August 5, 1976. This phase of the testing, conducted at the Naval Base, Roosevelt Roads, Puerto Rico, was conducted by the same personnel assigned to DT III A. The rigs were subjected to a total 535½ hours of bottom time. Individual dives ranged in length from 2 to 7 hours. During these dives, there were no malfunctions of the electronics control system; however, several features requiring physical modifications were noted, most of which were accomplished before the completion of this phase. The successful completion of both the DT III A and DT III B phases of testing resulted in the approval from the Chief of Naval Operations to proceed with the Operational Evaluation (OPEVAL) testing of the SLSS Mk 1.

The OPEVAL phase was conducted by the Commander, Operational Test and Evaluation Force (COMOPTEVFOR). These evaluations, also conducted at the Naval Base Roosevelt Roads, Puerto Rico, were held from September 7-23, 1976. During this mode of testing, emphasis was placed on the use of the SLSS Mk 1 in conjunction with the SDV and submarine operations. An additional 110 hours of successful bottom time was accumulated with no major additional faults uncovered.

Currently, NAVSEA is in the documentation process required for obtaining both "System Certification" and "Approved for Service Use" status for the SLSS Mk 1.

Photos on pages 28-29 show various stages of RHCU training, which includes open sea diving, tank diving (for equipment familiarization and testing), and salvage diving.

RHCU Update

Mr. George Michelson
Office of the Supervisor of Diving

The Reserve Harbor Clearance Unit (RHCU) program was formally established in June of 1974. RHCU's were designed to provide a cadre of qualified diving and salvage personnel in the event of fleet mobilization. Ten units were formed and placed at various locations throughout the continental United States. RHCU's were divided into small and large units. Large units consisted of 5 officers and 30 enlisted men; small units of 4 officers and 17 enlisted men.

At the outset it was desired to find qualified Salvage Diving Officers and He-O_2 Diving Officers to fill the command billets. In areas where Salvage Officers were unavailable, explosive ordnance disposal officers and underwater demolition team officers were invited to fill officer billets. In most cases, the officer's diving qualifications had lapsed for over 1 year; thus, a retraining program was necessary.

Enlisted personnel presented a different set of situations to the RHCU program. There seemed to be adequate scuba and 2nd Class divers available from submarine and tender duty, but there was a limited quantity of 1st Class divers and no Master Divers available at all to accept supervisory responsibility. As in the case of the officers, almost all enlisted divers had to be retrained because more than a year had passed since their last requalification dives. Only minimal records of divers released from active duty have been kept, which makes recruiting efforts very difficult.

At present, there are still officer and enlisted billets available in the RHCU program. Officers must have been a previously qualified Navy Diving Officer, and preference for billets will go to Salvage Officers. The divers that the RHCU program desires are NEC codes for scuba, 2nd Class, 1st Class, Diving Medical Technicians, and Masters.

At the beginning of the RHCU program, enlisted personnel without previous Navy Diving School training were accepted and sent to the schools; but this only made up approximately 10 percent of the total RHCU personnel. The program no longer accepts Navy person-

nel who were not trained at a Navy school. As the program becomes better known, more and more divers are attracted to the Reserve diving program.

The current program structure is designed to upgrade all scuba divers to a 2nd Class qualification. The training course for this process will take place at the Deep Sea Diving School at the Navy Yard in Washington, D.C. It is planned that the second and third phase of 2nd Class School will be taught in the summers of 1977 and 1978, respectively.

Any Navy school graduate who would like to participate in this new and exciting diving program may apply at the nearest RHCU or Naval Reserve Readiness Command. It must be kept in mind, however, that though the training is at present mainly oriented to diving, eventually the training and orientation will move closer to the salvage mission of the Salvage Navy. Diving, for salvors, is primarily a tool to be used to accomplish the salvage mission. As the Reserve divers become more adept and their training levels improve, they will assume more and more salvage training responsibility.

Those who are on active duty may know of a qualified diver who left the active Navy prior to retirement and who most likely is qualified to join the Reserve Harbor Clearance Unit Program. If interested, he should contact his closest RHCU or Reserve Readiness Command recruiter.

UNIT	PHONE NO.
HCU 104 (Philadelphia, PA) CAPT Karabell	(215) 755-3321
HCU 208 (Jacksonville, FL) LCDR Sage	(904) 772-2684
HCU 419 (San Diego, CA) LCDR Jones	(714) 225-5115
HCU 420 (San Francisco, CA) LCDR Nugent	(415) 765-5725
HCU 1001 (Portsmouth, NH) LCDR Parker	(203) 439-1000 ext. 1971
HCU 1106 (Little Creek, VA) LCDR Haley	(804) 460-1685
HCU 1210 (Corpus Christi, TX) LCDR Petering	(512) 939-2241
HCU 1313 (Chicago, IL) CDR Shanahan	(312) 642-7733
HCU 1419 (Long Beach, CA) LCDR Weaver	(213) 547-6076
HCU 1522 (Seattle, WA) LCDR Ziegler	(206) 623-6970

RESERVE HARBOR CLEARANCE UNIT PERSONNEL REQUIREMENTS

OFFICER

- Recent Active Duty Diving Officer 1105, 1405
- Salvage Officer
- $He\text{-}O_2$ Officer
- EOD Officer
- UDT/SEAL Officer
- Diving Medical Officer

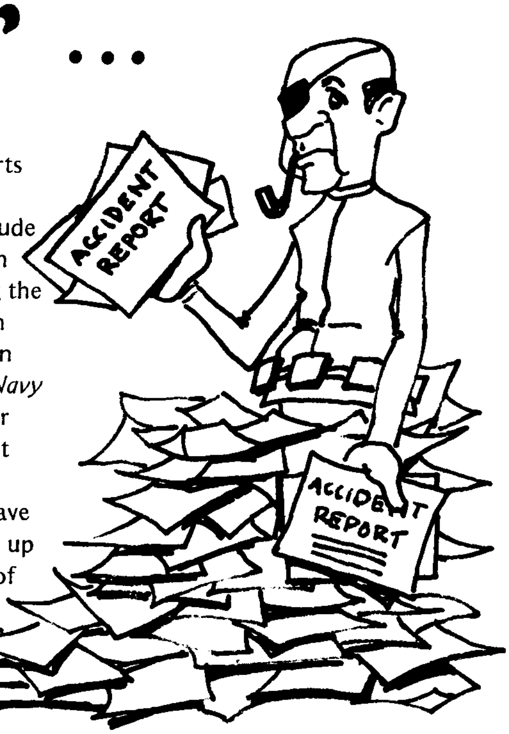
ENLISTED

- Recent Active Duty Diver
- Graduate of Navy Diving School
- Scuba
- Second Class
- Diving Medical Technician
- First Class
- Master Diver

Retired personnel are not eligible in either category.

The Old Master . . .

I thought I might take time this issue to show you a few of the "incidents" happening in fleet diving. Looking over the Naval Safety Center's accident reports for a 2-1/2-year period, I find an amazing number of cases where someone got "bent" because an inadequate decompression table was chosen. A frequent prelude to this error was a situation in which the decompression table followed had been pushed to near its maximum limit of depth and/or time during the dive. Cutting the figures too close like this leaves *no* room for depth gage error or for variations in environmental conditions effecting the diver underwater. Any miscalculation can result in a decompression schedule that is insufficient. Change One to the *U.S. Navy Diving Manual* recommends going to "the next *longer* table when work is cold or arduous." I might even add to that: When the dive has gone to a maximum limit for a decompression table. Now I know that I have told y'all before about considering the next longer table if there is any doubt at all. I hope you don't have to learn it the hard way—like some of the following divers have. Remember—it's up to you to take the "ounce of prevention"—unless you want to risk the "pound of cure!"



A diver was making a 120-foot qualification dive in a diver training school. As he neared the bottom he became dizzy. While on the bottom (where he stayed for 15 minutes) he remained dizzy and surfaced still reporting dizziness. He was taken to the nearest dispensary for examination. While being examined, he developed double vision and numbness of the hands. He was returned to the school, recompressed to 60 feet breathing pure oxygen, and started on a Treatment Table 6. When symptoms did not clear after 20 minutes, he was taken to 165 feet and shifted to a Treatment Table 4. Symptoms except for double vision cleared at 125 feet on descent. On the advice of the Navy Experimental Diving Unit, treatment was shifted to Table 6A. While completing this Table, double vision cleared at approximately 70 feet, and the diver completed the treatment clear of all symptoms.

This is a case of decompression sickness (with CNS involvement). Although the reporting activity stated the cause as unknown, the fact that this dive was at the maximum depth and bottom time for a no decompression schedule is the most immediate probable cause. The accuracy of an "in calibration" depth gage is ± 1 percent of full scale reading. If this were a 400-foot gage, the actual depth could be as much as 124 feet on this dive, placing this diver in the position of requiring decompression. The basic cause may be experience. The supervisor failed to consider the gage accuracy when selecting the appropriate Table. Diving supervisors must be continually aware of the many variables that may affect the selection of a decompression schedule (such as sea state, depth, bottom time) and how accurately they can be measured, and then resolve all of these in selecting the safest Table for the diver.

●

Two second class divers made a working dive in open-circuit scuba on an ASR to attach a line to the false seat. Seas were 6 feet, and the current was 1 knot. They were instructed to leave the bottom (124 feet) upon completion of 15 minutes of bottom time and follow a 130/20 Standard Air Decompression Table, which requires a 4-minute stop at 10 feet before surfacing. Both said they followed these instructions. Twenty minutes after surfacing, diver one complained of pain that developed into a headache and dizziness. At the same time, diver two complained of pain in the right shoulder. After a short surface examination, both divers were placed in the recompression chamber and taken to 60 feet breathing pure oxygen. Symptoms for both divers abated somewhat on reaching 60 feet. After 18 minutes on oxygen, diver one developed symptoms of oxygen poisoning and was placed on air. After 15 minutes, he was placed back on oxygen and the Table 6 was completed with no further symptoms. Upon surfacing, both diver one and diver two were essentially symptom free, although diver one had some residual soreness in the right foot. This cleared in 12 hours, and no further difficulty was experienced by either man.

Since both divers were affected on this dive, metabolic difficulty can probably be ruled out. Also, the dive was well within the parameters of the decompression schedule followed. The most likely cause is the adverse environment. It is nearly impossible to maintain exact depth at 10 feet for the required 4 minutes in Scuba with 1 knot of current and 6-foot seas running. Even if a descending line or stage is used, depth will vary. So, here again we have inadequate decompression as the immediate accident cause, with inadequate planning and failure to follow established procedure contributing to the accident. But the basic cause was apparently behavioral, i.e., the fact that it was more convenient to use scuba rather than deep-sea equipment. Page 4-16 of the Diving Manual limits scuba normal working depth to 60 feet for 60 minutes and maximum working limits to 130 feet for 10 minutes. These men were at 124 feet for 15 minutes, *if* their depth gage was *exactly* correct. In addition, page 4-15, paragraph 4.4.1 states that "The scuba diver must remain within the limits of No Decompression Tables except in an emergency." There is no indication that this dive was other than routine, and the ship is equipped with deep sea air and He-O_2 diving equipment. It appears safety was sacrificed for expediency.

●

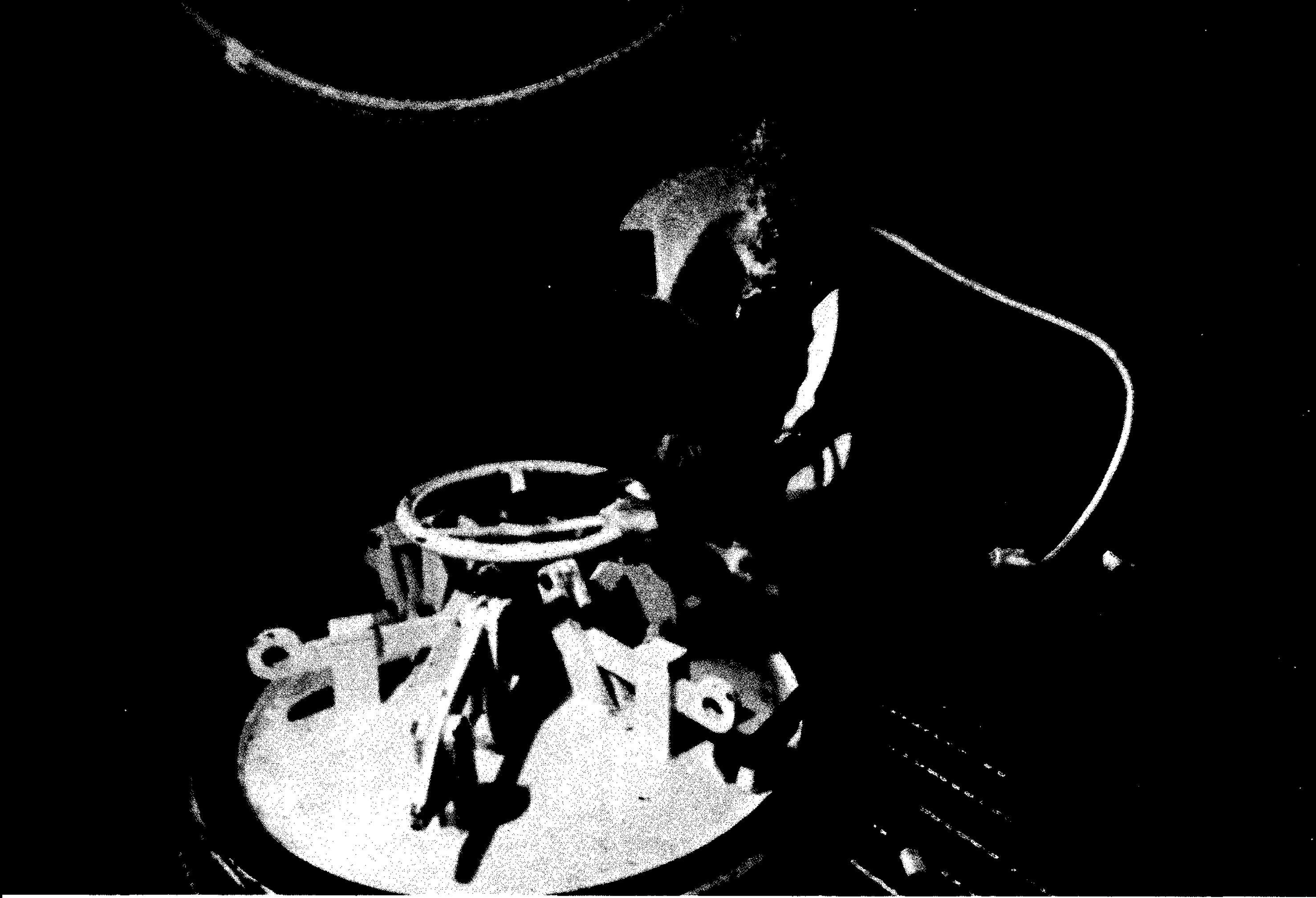
This case occured after a diver had made a 4-minute, 120-foot dive wearing open-circuit scuba. He had made a previous dive to 120 feet for 6 minutes with a 10-minute surface interval before this dive. He surfaced from this 4-minute dive on a "no-decompression" schedule. Fifteen to 20 minutes after surfacing, the diver noted a sharp, persistent pain in the left shoulder blade area slowly increasing in intensity. He reported to a recompression facility 2 hours and 40 minutes later with the pain still present, and a muscle twitching which had generated in the left elbow. Surface oxygen was administered for 5 minutes before commencing recompression treatment on a treatment Table 6. The shoulder pain was relieved within 3 minutes at 60 feet and all symptoms were gone after 35 minutes. The treatment was completed with no further complications.

The cause of this accident was omitted decompression. Working a repetitive dive sheet shows that this diver should have taken at least the 120/20 Table because of the residual nitrogen time from the first dive. The diver was also using the no decompression table to the maximum depth limit and not allowing for any error in the depth gage. Whenever the surface interval between dives is less than 12 hours, the repetitive dive tables must be used. In addition, diving the tables to the limit of depth and/or time should be avoided wherever possible to allow for inaccuracies in the depth gages (± 1/2-percent at mid-scale).

●

Two divers made a 10-minute 199-foot dive, wearing Mk V deep sea air rigs, in a pressure complex at a diving school. They were decompressed on a 200/10 exceptional exposure air table. Within 5 minutes after surfacing, diver one reported mild right shoulder pain and numbness over the right forearm. Diver two reported pain in the right shoulder after 3 minutes on the surface. He had previously (while on the bottom) reported some difficulty with the assigned project, which required him to exert himself considerably. Within 10 minutes on the surface the pain had subsided into a dull ache. In the meantime, diver one's symptoms disappeared completely over the next 20 minutes, and his physical examination at that time proved normal. During the 10-minute interval after examination, diver one developed a knotted rash over the right upper back and chest. Both divers were recompressed on a Treatment Table 5. Diver one completed the Table 5 symptom free; however, diver two had residual soreness of the right shoulder and arm, which was attributed to muscle strain because of the hard work involved.

This looks like another case of decompression sickness, based on the symptoms, table used, and results of treatment. The cause was personnel error in selecting the decompression schedule used. This is another case of pushing the decompression schedule to the maximum bottom time and within 1 foot of the maximum depth (recall our discussion of depth gage accuracy previously). Add to this the heavy work and you have all the ingredients for an accident. If the next longer table (200/15) had been used, it would have more than doubled the decompression time. Remember the safety of the diver is of prime importance. In this case, a saving of 10 minutes decompression time cost 2-1/2 hours of treatment time.



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