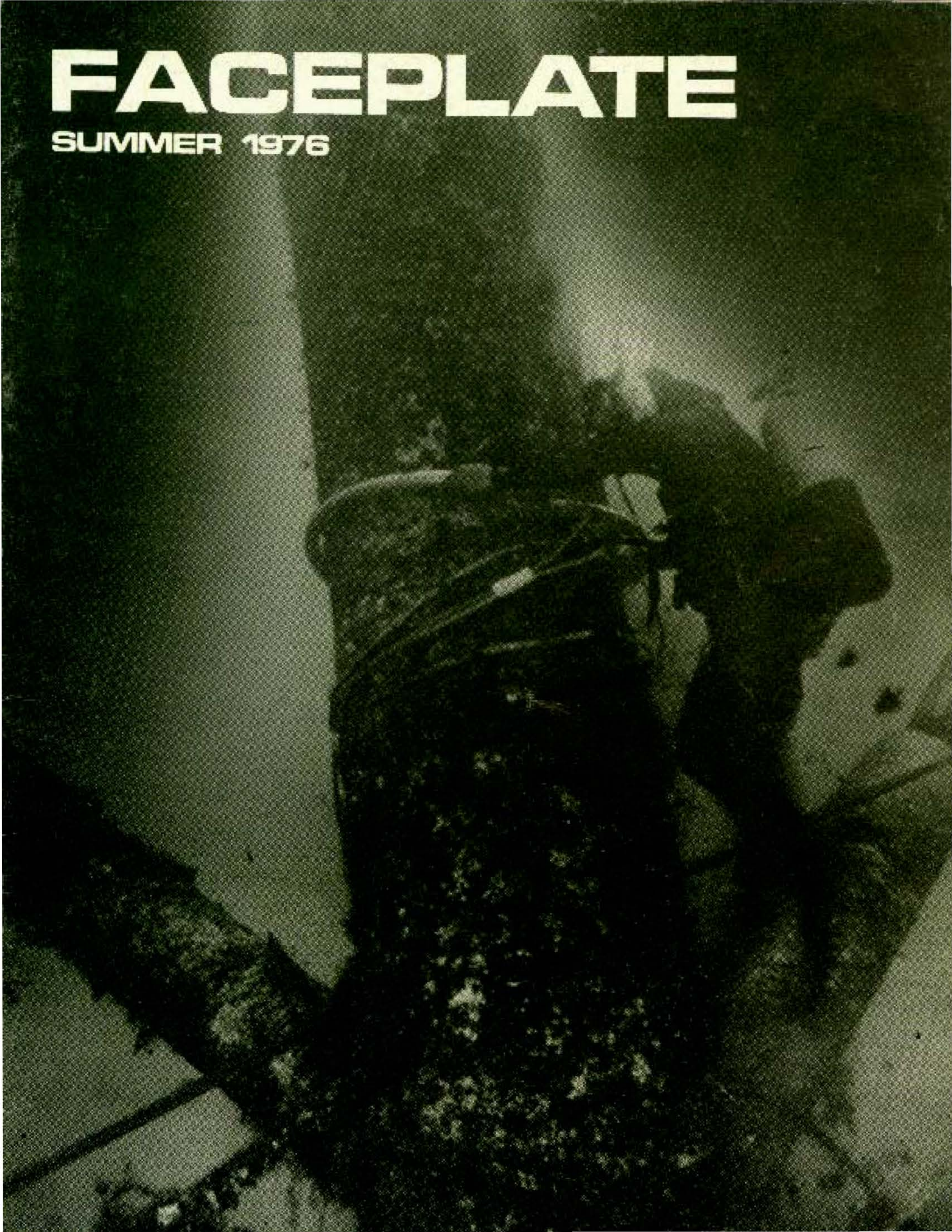
FACEPLATE

SUMMER 1976



FACEPLATE

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

VOLUME 7, NO. 2

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: Photo shows diver working on tower leg during the Argus Island Tower demolition operation. Story on page 16.
Inside front cover: Gerard McHale refastens valve flange at 1,600-foot depth equivalent during "Predictive Studies IV" at the University of Pennsylvania. Story on page 12.
Back cover: Photo shows diver in the Mk 12 SSDS during a test and evaluation chamber dive. Story on page 25.

SOUNDINGS

MK I DIVER'S SYSTEM CORRECTION

The Spring 1976 issue of *Faceplate* reported that the Mk I Diver's System included four umbilicals (page 7). This figure is incorrect. Please note that, instead, each Mk I outfit comes with three umbilicals.

NEW EOD LIAISON AT NEDU

BMC James H. Bloechel, USN, has taken over the duties of Explosive Ordnance Disposal (EOD) Liaison at the Navy Experimental Diving Unit, Panama City, Florida. BMC Bloechel can be reached at autovon: 436-4356, or commercial: (904) 234-4356.

BMC HARTMAN RETIRES

BMC Dudley B. Hartman, USN, retired in ceremonies held at the U.S. Navy Experimental Diving Unit on April 30, 1976, after completing 31 years of Naval service. Principal speaker at the ceremony was CDR J. Michael Ringelberg, USN, Commanding Officer of the Navy Experimental Diving Unit, Panama City, Florida.

Chief Hartman entered the Navy in 1945 and went through basic training at the Great Lakes Naval Training Center in Illinois. He attended 2nd Class Diving School and the Salvage School in 1949, and the 1st Class Diving School in 1952. Chief Hartman served aboard several diving ships in his career, including USS GRAPPLE, USS COUCAL, and USS DELIVER.

He attended the Explosive Ordnance Disposal (EOD) School in 1956, and has served at the EOD Facility, EOD Group One, EOD Group Two, and several EOD Detachments in addition to shipboard EOD Teams. He was stationed with the EOD Team at the Naval Coastal Systems Laboratory before going to NEDU.

Chief Hartman wears a total of 17 decorations and awards. Among them

are the Navy and Marine Corps Medal, Navy Commendation Medal, and eight Good Conduct Awards. In addition, he wears the Presidential Unit Citation from Korea and Vietnam.

TO NAVAL SHIPYARD DIVING SUPERVISORS:

An indepth survey was recently taken by SUPSALV on the diving capabilities at all Naval shipyards. The findings show that the shipyard Diving Locker personnel are capable of conducting extensive and difficult underwater tasks that result in a sizeable operational cost reduction. However, the survey also finds that a communication gap exists between individual shipyards. One effort to bridge this gap is being undertaken by SUPSALV through *Faceplate*. All shipyard Diving Supervisors are urged to inform SUPSALV of accomplishments, new practices, suggested equipment usage or changes, and discussions of any unsuccessful operations. A complete address from the shipyard involved is necessary. In this way, SUPSALV plans to improve and upgrade ship husbandry operations in Naval Shipyards by sharing lessons learned throughout the fleet. (This project has been discussed with each Diving Supervisor during the aforementioned survey.)

Donald R. Keane (OOC 221)
NAVSEASYSCOM (Code OOC)
Washington, D.C. 20362

CAPT MOSS IS NEW SUPSALV

Before becoming SUPSALV last May, CAPT Robert E. Moss, USNR, had served as the Deputy Director of Ocean Engineering (Supervisor of Salvage) for 5 years, serving concurrently since 1973 as Head, Ocean Engineering Support Department, U.S. Navy Experimental Diving Unit. Before this assignment, CAPT Moss served as Production Officer, U.S. Navy Ship Repair Facility, Subic Bay, Republic of the Philippines.

CAPT Moss received his B.S. in General Engineering from Washington State College, Pullman, Washington, in 1952. In 1952 and 1953, CAPT Moss attended the U.S. Navy Officer Candidate School, Newport, Rhode Island, and the U.S. Naval School, Diving and Salvage, Bayonne, New Jersey.

He served aboard USS MENDER (ARSD-2) from 1953-1955, and engaged in salvage operations in Korea and Bikini. During 1955-1957, he was on the staff of the Pacific Reserve Fleet, San Diego Group.

In 1957, CAPT Moss was released to inactive duty in the Naval Reserve until 1967, when he was recalled to active duty. (See page 9.)

SUPDIVE CHANGES THE WATCH

CDR James J. Coleman, USN, has served as Supervisor of Diving, Naval Sea Systems Command, for 3 years. On July 23, 1976, he detached from this post to take on his new duties as the Force Maintenance and Salvage Officer for the Commander-in-Chief, Naval Forces Europe. CDR (selectee) Charles A. Bartholomew, USN, replaces CDR Coleman as Supervisor of Diving. CDR Bartholomew previously served as Assistant for Salvage to the Supervisor of Salvage, NAVSEA.

CDR Coleman was assigned the newly established position of Supervisor of Diving in 1972, soon after he became Officer-in-Charge at the Navy Experimental Diving Unit, Washington, D.C. (see *FP*, Spring 1972). Significant progress has been made in diving technology under his leadership as the first SUPDIVE. This progress includes the development and construction of the open diving bell, including in it an emergency breathing system for enhanced safety; the development of a portable recompression chamber; and the establishment of the Fly Away Diving System, which was used extensively during the recent Argus Island demolition operation. (See page 16.)

Other advances include the assignment of the Mk 1 Deep Dive System to a fleet unit and the Mk 1's world-record-breaking open sea dive to 1,148 feet (see *FP*, Summer 1975). In addition, a Mk 2 Mod 1 Deep Dive System has been installed aboard both the new catamaran-hull ships PIGEON (ASR-21) and ORTOLAN (ASR-22). The saturation diving system (SDS) 450 has undergone refurbishment and has been upgraded to meet fleet standards. Also, the final version of the long-awaited Mk 1 Bandmask has been developed, combining the best features of commercial models. Navy publications promulgated during CDR Coleman's tour as SUPDIVE include the *U.S. Navy Diving Operations Handbook*, *U.S. Navy Air Decompression Table Handbook*, *U.S. Navy Recompression Chamber Operator's Handbook*, and a revision of the *U.S. Navy Diving Manual*.

Faceplate extends best wishes to its former Editor-in-Chief in his new assignment in London.

L-r: MMC(DV) Yarley, CDR Ringelberg.

MMC(DV) W.E. YARLEY REENLISTS AT NEDU

MMC(DV) William E. Yarley was reenlisted in the U.S. Navy on April 23, 1976, by CDR J. Michael Ringelberg, USN, Commanding Officer of the Navy Experimental Diving Unit, Panama City, Florida (See photo). The ceremony was performed in NEDU's Ocean Simulation Facility test pool, with both participants dressed in the Mk 12 Surface Supported Diving System. MMC(DV) Yarley has served 15 years in the Navy, and is currently the Assistant Project Director for the Mk 12 at NEDU.

COMINGS AND GOINGS

CDR William Klorig, USN, arrived in July 1976, to take over the duties of Deputy Director of Ocean Engineering/Supervisor of Salvage in the Naval Sea Systems Command, Washington, D.C. He relieved CAPT R.B. Moss, USNR, who became the Director of Ocean Engineering(Supervisor of Salvage) on May 28, 1976. CDR Klorig previously served as Maintenance Officer at Submarine Development Group One, San Diego, California.

CDR (Selectee) Charles A. Bartholomew, USN, has assumed the duties of Supervisor of Diving in the Naval Sea Systems Command, Washington, D.C. He previously served at NAVSEA as the Assistant for Salvage in the Office of the Supervisor of Salvage. His replacement is LCDR F. Duane Duff, USN, who comes from duty with Commander Service Group One, where he served as the Assistant Maintenance Officer.

LCDR Martin A. Paul, USN, has detached from the Navy Experimental Diving Unit, Panama City, Florida, where he served as the Executive Officer. LCDR Paul now goes to the Naval Torpedo Station, Keyport, Washington, where he will be the Diving/Range Officer. His relief at NEDU is LCDR Bruce C. Banks, USN, who previously served aboard USS CHARLES P. CECIL (DD-835).

LT Joseph Criscitiello, MSC, USN, has detached from his duties as Supply Officer at NEDU to go to the Naval Aerospace Medical Institute in Pensacola, Florida. His replacement is LT W.S. Bentley, MSC, USN, who formerly served at the Naval Aerospace Medical Institute in Pensacola.

LT Mike Hadbavny, CEC, USN, has also departed from NEDU this summer. He has now joined the Staff of the Chief of Naval Material in Washington, D.C., as Program Administrator for Diving, Salvage, and Certification Construction. LT Hadbavny relieved LT Scott Stevenson, CEC, USN, who has now moved on to the Naval Medical Research Institute in Bethesda, Maryland.

AIG MESSAGE SUMMARY

The Supervisor of Diving has had many inquiries regarding the message traffic sent to Addressee Indicator Group 239 (AIG 239). For the information of those interested, the following summary of messages is provided.

NAVSEA 181837Z FEB 76: Life Preserver yoke type MK III NSN 1H4220-00-051-3078.

NAVSEA 042328Z MAR 76: Stewart-Warner Portable diver air compressor.

NAVSEA 171545Z MAR 76: Safety of Stud Driver Model NUD-38 and NUD-38 MOD 1.

NAVSEA 181401Z MAR 76: Lightweight diving hose.

NAVSEA 191333Z MAR 76: Designation of Stud Driver NUD 38, NUD 38 MOD 1.

NAVSEA 252231Z MAR 76: Revised operating guidelines for the USN Divers Mask MK 1 MOD O, MOD S, and MOD T.

NAVSEA 300505Z MAR 76: Underwater stud drivers.

NAVSAFECEN 051747Z APR 76: F-14 Aircraft Salvage Operations Safety Advisory. (not in file)

NAVSEA 221707Z APR 76: Revised operating guidelines for the USN divers mask MK 1 MOD O, MOD S, and MOD T.

NAVSEA ltr OOC: WRB: If Ser 802 of 18 May 76: Safety of SCUBA Diving Operations.

NAVSEA 271933Z MAY 76: Lubricating oils in divers air compressors.

NAVSAFECEN 281255Z MAY 76: Diving safety advisory.

NAVSEA 041813Z JUN 76: Standard recompression chamber relief valves, gagging of.

NAVSEA 051445Z JUN 76: Diving recompression chambers.

New Ergometer Ready

The Navy Experimental Diving Unit (NEDU), Panama City, Florida, and Battelle Memorial Institute, Columbus, Ohio, have completed modifications to the Collins Pedal-Mode Ergometer. Modifications were made to this standard ergometer (which was not originally constructed for underwater use) to make the item watertight and suitable for use at high ambient pressures. The modified ergometer will be used by NEDU to measure work rates and to provide a means of assessing physiological functions of divers under water. Diver work rates under water were formerly measured by NEDU with an underwater trapeze device and, later, with a specially modified Monark Bicycle Ergometer.

The modification process was accomplished in two phases. NEDU launched the initial effort in 1971. A workable unit was produced, but problems with leakage and pressurization could not be overcome completely. The job of completing the modification was then tasked to Battelle in 1973. Battelle's final design featured a completely redesigned housing, Bal-Seals, and a stainless steel shaft. However, all modifications to the basic Collins system only involved measures necessary to meet the environmental and ambient pressure requirements. No functional or operational changes were made to either the ergometer assembly or to the control unit.

The basic system consists of a pedal unit and a control unit. The pedal unit includes a bicycle frame with seat, handle bars, and a pedal braking system by which precise work loads are obtained and controlled electronically. The control unit controls the braking system. The ergometer system presents the same workload to successive subjects or gives a precisely timed and varied workload to the same subject.

The modified Collins pedal-mode ergometer developed jointly by NEDU and Battelle has proved to be a rugged, dependable unit for imposing work rates on subjects during physiological experiments and equipment tests. With its ability to function in both a dry environment and below water at shallow or saturation depths, and with its ability to give reproducible work rates as desired, the unit is a vast improvement over earlier ergometer devices used by NEDU. A detailed account of the modification and subsequent testing efforts are described in a forthcoming NEDU Research Report.

Two Canadian divers with underwater puzzle.

Canadian Forces Complete Sat Dive at NEDU

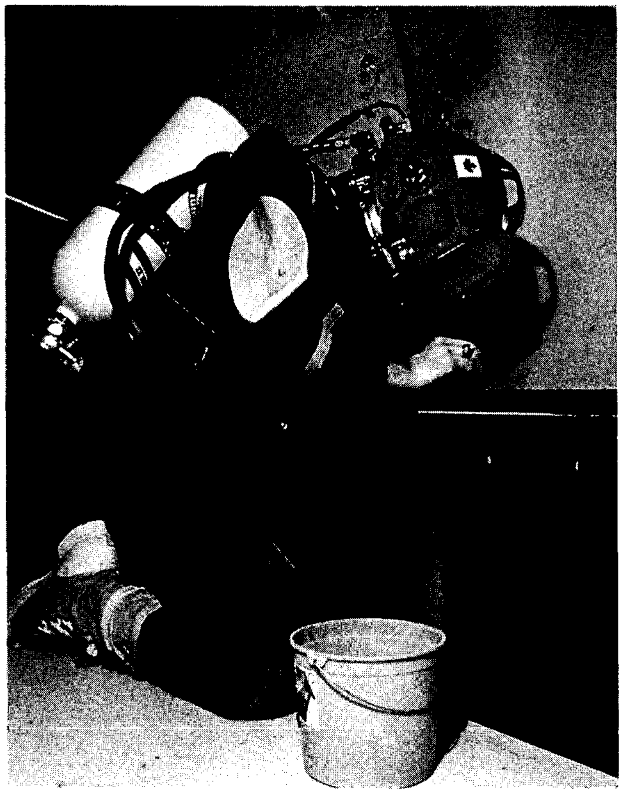
The Canadian Forces have successfully completed their first saturation dive in cooperation with the Navy Experimental Diving Unit (NEDU) at the Naval Coastal Systems Laboratory, Panama City, Florida. An Information Exchange Program between the United States Navy and the Canadian Forces provides for the use of each country's diving facilities, equipment, and personnel for the purpose of extending operational diving expertise. Under this agreement, a team of nine divers arrived in Panama City on April 4, 1976, from the Defense & Civil Institute of Environmental Medicine (DCIEM) in Toronto, Canada. The Canadian Forces team included LCDR Fred Cox, Commanding Officer; LT Peter E. Hill, Executive Officer; LCDR Ian Buckingham, Diving Medical Officer; Chief Warrant Officers Ray Goulard and Robert Larson, Master Divers; and divers Petty Officer Archie Rose and Leading Seamen Charles Wilson, Lorne Pittman and Gary Crawford. Dr. L. Kuehn, a Canadian scientist internationally renowned for his studies on thermal physiology, participated in medical experiments during the dive along with U.S. Navy Medical Officers.

The first two weeks of April were used for training, equipment set-up, testing, and indoctrination of the Canadian team in the use of NEDU's Ocean Simulation Facility. On April 19, 1976, four Canadian divers, (Goulard, Rose, Pittman, and Wilson) entered the chamber with an NEDU diver, Chief Machinist Mate R. L. Pershin, USN, as Team Leader. The five men were then pressurized to an equivalent depth of 350 feet of sea water. Excursion dives were conducted on successive days to a maximum depth of 456 feet. The daily dive protocol called for four-man dives to evaluate diving equipment, measure thermal stress in 40° F water, and to conduct physiological experiments. The validation of the U.S. Navy saturation excursion tables was another objective of this combined Canada/United States saturation dive.

The information gathered and experience gained from this dive will be very beneficial to the Canadian Forces. Results will be used to address operational problems related to submersible lockout in Toronto. This new facility, to be completed in 1977, will accommodate experimental dives to depths in excess of 5,000 feet.

A diver lockout submersible, SDL-1, was acquired by the Canadian Forces in 1972. (see *FP*, Spring 1973). Because of the absence of an adequate surface support platform for the submersible, however, lockout diving operations have been limited to 150 feet. The submersible has been used in the non-lockout mode to its maximum depth of 2,000 feet and has successfully participated in helicopter and aircraft recovery operations to depths of 600 feet. The Canadian Forces recently acquired an Italian ship for conversion to a submersible and surface diving support ship. This vessel should be operational by the fall of 1977. The Canadian Forces will then have a capability to respond to national and international commitments involving continental shelf diving operations.

This successful dive will greatly assist Canadian Forces implementation of their diving plans. In addition, this combined exercise continues the close working arrangement between Canadian and U.S. Navy divers that has proven to be beneficial to both countries.



Canadian diver with underwater puzzle during IEP saturation dive.

New CO for NAVEODFAC

During a change of command ceremony on June 30, 1976, CDR Jerome R. Heck, USN, was relieved by CDR William S. Cadow, Jr., USN, as the Commanding Officer of the Naval Explosive Ordnance Disposal Facility (NAVEODFAC), Indian Head, Maryland. Guest speaker at the ceremony was RADM Edward W. Carter, III, USN.

CDR Cadow has served aboard the ships USS BEXAR (APA-237), where he was Boat Group Commander; USS GREAT SITKIN (AE-17), where he was EOD Officer, Ordnance Officer, Cargo Officer, and Weapons Officer; and USS WAINWRIGHT (DLG-28), where he was Ships Weapons Coordinator. CDR Cadow is a graduate of the Underwater Swimmer's School, Key West, Florida, and the Basic EOD Course at NAVSCOLEOD, Indian Head. He served as Operations Officer at EOD Unit One, and subsequently established EOD Unit One, Detachment Alfa in Long Beach, California. At the latter post, he was Officer-in-Charge with additional duty as COMINEPAC EOD Staff Officer. CDR Cadow also served as Officer-in-Charge of the newly established EOD Mobile Unit, Pacific before becoming Commanding Officer of EOD Unit One. He then reported to the Office of the Chief of Naval Operations, where he served as Head, EOD Section and as Alternate Navy Member of the Department of Defense EOD Program Board. Before arriving at Indian Head in June 1976, CDR Cadow was stationed in Crane, Indiana, where he served as Ordnance Officer at the Naval Ammunition Depot and then as Executive Officer at the Naval Weapons Support Center.

On his detachment from NAVEODFAC, CDR Heck was assigned to the Naval Weapons Station, Earle at Colts Neck, New Jersey, where he has assumed the duties of Executive Officer.

CAPT R.B. Moss : SUPSALV '76-

CAPT Robert B. Moss, USNR, became the Director of Ocean Engineering (Supervisor of Salvage) on May 28, 1976, relieving CAPT J.H. Boyd, Jr., USN. Faceplate *had the pleasure of talking with CAPT Moss about his new duty as "SUPSALV."*

"I feel fortunate in taking over a group that is on a good course and making good speed." The group about which CAPT Moss is speaking is the Naval Sea Systems Command Office of Ocean Engineering (Supervisor of Salvage) for 5 years. (See page 4.) more than the approximate 2 months he has been SUPSALV; because before taking over his new duty, CAPT Moss served as the Deputy Director of Ocean Engineering (Supervisor of Salvage) for 5 years. *(See page 4.)*

"Personnel is the single most important element of our business." Continuing on this topic, CAPT Moss emphasized the value of the SUPSALV-sponsored E.D. Summer Salvage Course. "I hope this program will gain the interest and active participation of the upcoming Engineering Duty Officers, for this involvement is essential to the continued health and stability of the diving and salvage community." He commented that acquiring the basic skills is just a first step. "The successful application of this highly specialized knowledge is quite another and requires, among other elements, experience."

The time consumed in training and experience gathering is one of the primary strong points of a program CAPT Moss played a key role in forming, the Reserve Harbor Clearance Unit Program. "The RHCU Program was created to keep a ready reserve of trained divers/salvors on hand for an immediate and highly capable response force. SUPSALV is the technical sponsor for this program, and I intend to continue working with this group to improve the quality of their equipment and their training."

Stressing the need for direct communication with personnel, CAPT Moss discussed plans for an active campaign to open and maintain clear channels of communication with all fleet and shore-based activities. "One method I intend to use is a series of visits for face-to-face discussions with various commands."In addition, CAPT Moss has already initiated a survey throughout the fleet and has urged a continuous written interaction between these activities and with SUPSALV (see Soundings, page 4).

Commenting on the current maintenance funds squeeze, CAPT Moss noted "the increased importance of developing the time and money saving techniques of underwater ship husbandry. I plan to pick up the emphasis that CAPT Boyd had put on this program and continue it with a high degree of interest."

Regarding surface supported diving hardware, CAPT Moss commented, "I realize that all fleet needs cannot be met, but I intend to make every effort to improve the quantity and quality of equipment going out to the fleet." He discussed the efforts of his predecessors in this area, which he feels are now bearing fruit (for example, the Mk 12 surface supported diving system and the Mk 1 Bandmask). He did point out that "there will be increased effort and attention placed on surface supported air diving hardware as opposed to the more rarely used and complex deep diving systems."

CAPT Moss discussed current plans for a major realignment of the Emergency Ship Salvage Material System, which will provide logistic support for Ship Salvage and Oil Pollution Material. "These plans take into account updated fleet demands as well as the need for an improved economic efficiency. Basically, there will be a consolidation of storage sites, with plans to allocate full time manning of the remaining sites with contractor personnel."

"Obtaining sufficient funds is never a simple matter." CAPT Moss stressed the need for all throughout the fleet who are concerned with budget matters to be extremely articulate in describing diving and salvage requirements to funding authorities to ensure that the program is not lost in the larger realm of Navy-wide programs. "There has been significant progress in this area in the past few years, as seen in the hardware being readied for fleet use. I hope to continue this process with enough success to realize the introduction of additional equipment."

In addition to these programs and areas of interest, CAPT Moss expressed a special concern for the operational side of Ocean Engineering."To further add to SUPSALV's response capabilities, the continued development and late summer testing of the Large Object Salvage System (LOSS) will be actively pursued. Also scheduled is participation with the National Aeronautics and Space Administration (NASA) in the design of equipment for recovery and the actual recovery of the Space Shuttle hardware. Planning has already begun, and I am looking forward to the opportunity of working with NASA on this project."

UDT-21 Sinks Ship

PH1 Bob Woods
Atlantic Fleet Audio Visual Command

Navy frogmen recently sank the hulk of a liberty ship in the Gulf of Mexico for Alabama's off-shore Artificial Reef Program. Members of the Navy's Underwater Demolition Team Twenty-One (UDT-2l), homebased at the Atlantic Fleet Amphibious Base, Little Creek, Virginia, were tasked to sink the W.F. ANDERSON after receiving permission from Alabama's Division of Marine Resources.

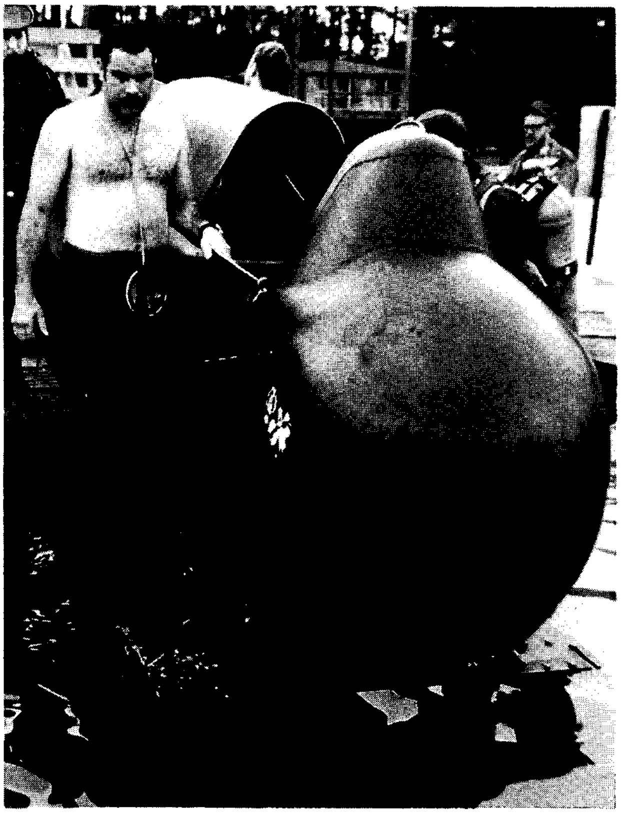
Four liberty ship hulks had already been sunk approximately 15 miles off shore from Dauphin Island, located at the entrance to Mobile Bay; and the state of Alabama planned to sink a fifth hulk to complete an artificial reef. After learning of the plans for a fifth sinking, UDT-21 members contacted the Division of Marine Resources at Dauphin Island and asked if they could sink the ship. This would not only assist Alabama, but also would provide the team with a realistic training exercise.

To make the exercise more realistic, it was set up as though a terrorist group in the Caribbean area planned to disrupt port facilities along the Gulf Coast. Simulated intelligence reports stated that the terrorists had obtained an old liberty ship, the W.F. ANDERSON, and they planned to sink the ship at the entrance to Mobile Bay to successfully block the harbor.

UDT-21 was directed to conduct an operation to prevent the W.F. ANDERSON from entering the Bay. Since an underwater attack was the only way the ship could be stopped without disclosing the United States' knowledge of the terrorist activities, the team would use combat swimmers and a swimmer delivery vehicle (SDV). The SDV is a small wet submersible that carries swimmers to and from military objectives (see *FP*, Spring 1975).

To further enhance the situation, the combat swimmers were kept in total isolation at Little Creek until they boarded an Air Force C-130 Hercules aircraft

Top: Charges are detonated on hull. Bottom: EMI Auger (foreground) and ET2 Blemmer steady SDV during launching.



for Conservation

Top: Hulk of ANDERSON sinks beneath surface. Bottom: Limpet mines are loaded aboard ANDERSON.

at the Naval Air Station, Norfolk, Virginia. After boarding the aircraft and flying to the drop point, the fully equipped combat swimmers parachuted at midnight into the Gulf of Mexico offshore Dauphin Island.

The swimmers were recovered by two 65-foot fast patrol boats and taken back to Dauphin Island for further briefings. Unfortunately, the sinking had to be delayed because of poor weather conditions and a shipyard strike in Mobile, where the liberty ship was being readied.

The rescheduling allowed some team members to check and investigate the hulk of the W.F. ANDERSON to evaluate where to place the explosives and to determine the amount required. Since the hull of the liberty ship was heavily encrusted with barnacles from years of being inactive in the "moth-ball" fleet, the team decided that it would be better to place the explosive charges inside the hull instead of outside.

On the morning of March 12, the W.F. ANDERSON was towed by a civilian tug past historic Fort Gaines and Fort Morgan, Civil War strongholds that guard the entrance to Mobile Bay. The vessels then proceeded to the open sea where the old ship would be sunk by UDT-21.

With the demolition experts and SDV crewmen aboard, the two fast patrol boats towed the SDV and rendezvoused with the liberty ship at the location prescribed by Alabama State officials. The SDV simulated an attack on the liberty ship while the swimmers boarded the hulk to place the charges. On signal, the patrol boats then picked up the divers from the ship and proceeded to a safe distance to witness the explosion.

Fifteen minutes after the personnel departed the W.F. ANDERSON, a tremendous explosion occurred that was heard and felt back on the mainland. The old ship, which for many years carried cargo over the world's sea lanes, now continues in service as part of Alabama's Artificial Reef Program.

F. Sayle attaches EEG electrode to C. Carlson during dive.

Saturation Excursion Diving at Univ. of PA

C. J. Lambertsen, M.D.
Institute of Environmental Medicine
University of Pennsylvania

Several federal agencies (Navy, National Institutes of Health, the National Aeronautics and Space Administration), the offshore diving industry, the oil industry, the gas and chemicals industry, and the ocean equipment industry jointly sponsored a deep dive study program of the University of Pennsylvania's Institute for Environmental Medicine during the summer of 1975.* In this study, the fourth in a series of "Predictive Studies," the Institute's chamber experiments exposed professional divers to rapid increases of pressure equal to 400–800–1,200, and 1,600 feet of sea water.

The primary purpose of the program, named "Predictive Studies IV," involved detailed quantitative investigation of physiological derangements produced by rapid compression to high pressures. Plans therefore included compression rates intentionally selected to induce prominent neurophysiological effects. Methods were devised to provide repetitive measurement, which allowed tracking the development and rates of adaptation to the influences of compression.

Another major purpose of the study was to determine the effectiveness of practical underwater work in excursions between 1,200- and 1,600-foot pressure equivalents.

A third purpose, required for the success of the overall program, was an investigation of the expected shortening of the decompression requirements in transient excursions from deep saturation levels as compared with decompression in excursions of equal degree and duration from the surface.

The plan for saturation-excursion exposures included two separate "dive" phases. The first was largely designed to evaluate the decompression concepts devised for deep excursions. Basically, the two phases were as follows:

> Phase I: Initial "excursions" to 400–800–1,200 feet, with return from the 1,200-foot level to saturation at 800 feet. Repetitive 800- to 1,200-foot excursions.
>
> Phase II: Initial excursion to 400–800–1,200 feet, with subsequent repetitive excursions from 1,200 to 1,600 feet.

Each phase included four trained participants, pressurized two at a time, with one diver at rest and one excercising.

The scope of specific investigations in Predictive Studies IV included mental, sensory (visual, auditory, and vestibular), electrophysiological, neuromuscular, cardiovascular, respiratory/pulmonary, metabolic, temperature, renal, hematological, and endocrine functions. The measurements required for the approximately 30 related projects were combined and integrated into 17- and 12-minute "modules" of active and passive monitoring.

The physiological and underwater work studies were conducted at the Institute's environmental laboratories. These laboratories surround an integrated system of diving, altitude, temperature, toxicology, and hyperbaric therapy chambers. These environmental chambers have received engineering analysis and certification by the Naval Facilities Engineering Command as part of the University's interest in making the system available for Naval use.

The pattern of compression rates used is shown in Table 1. This included a 22-hour hold from the time of reaching 1,200 feet to the time of beginning excursion to 1,600 feet. Repeated excursions from 1,200 to 1,600 feet in 20 minutes were performed for the physiological and underwater work studies. These rates were selected to intentionally bring out symptoms and objective effects of pressurization. However, prompt adaptation relieved or obscured effects detectable in the first day.

Table I

COMPRESSION RATE PROFILES

DEPTH	PHASE I COMPRESSION RATE (ft/min)	PHASE I COMPRESSION DURATION (min)	PHASE II COMPRESSION RATE (ft/min)	PHASE II COMPRESSION DURATION (min)
0-400	20	20	32	12.5
400-600	10	20	16	12.5
600-800	5	40	8	25
			2 HOUR HOLD	
800-1000	20	10	20	10
1000-1100	10	10	10	10
1100-1200	5	20	5	20
			22 HOUR HOLD	
			EXCURSIONS INITIAL / LATER	EXCURSIONS INITIAL / LATER
1200-1400	—	—	(20) / 40	(10) / 5
1400-1500	—	—	(10) / 20	(10) / 5
1500-1600	—	—	(5) / 10	(20) / 10

The rapid rates of compression initially selected were tolerated better than expected and rates were increased in later stages. Joint discomfort occurred in only one diver, once, in the hip, while exercising on the ergometer at approximately 800 feet. No detectable sensory, cardiovascular, neuromuscular, metabolic, or temperature regulation disturbances developed. Mental function tended to follow the general symptomatic state of the participant. Symptoms of pressurization effects were tolerable throughout excursions in both phases except during initial compression to 1,200 feet. At that stage, some participants developed prominent discomfort with nausea, general weakness, and vomiting. Hand tremor, noted previously, did occur, but not to a degree that limited technical performance. Electroencephalographic changes of the types previously noted also occurred, but were not sufficient to limit the exposure plan. The participants adapted progressively within a few hours after reaching 1,200 feet. By the next day they were able to perform the intricate tasks of inserting needle electrodes and catheters and applying other monitoring devices without evident difficulty. Compression from 1,200 to 1,600 feet followed without notable symptoms.

When it had been established that severe physiological derangement did not occur on the initial 1,200- to 1,600-foot excursions, subsequent excursions were used to study practical underwater working performance. Work involved the programmed dismantling of components of an oil wellhead, which was mounted in the water-filled chamber. After compressing two divers in 20 minutes from a 1,200-foot saturation depth to 1,600 feet, each diver in turn entered the water to perform his task, tended by his partner. In Phase II, each subject worked under water at a 1,200-foot saturation depth and on excursion to 1,600 feet. Work performance at these depths was comparable to that in water at atmospheric ambient pressure, although a tendency to excitation occurred in each diver on the excursion compression.

Most past attempts to study rapid compression were unable to prevent a marked rise in the chamber's gas temperature. For this reason, gross ambient temperature rise has remained as a possible factor contributing to the neurological effects of compression. The Institute's chambers, equipped with both high capacity and fine temperature control systems, prevented a temperature rise generally of more than ±2°F during the most rapid compressions. This allowed compression itself to be investigated. The program intentionally did not include exposure to low gas or water temperature, since such exposure would have prevented the examination of the effects of hydrostatic compression itself.

For its decompression investigations, the Institute used the recent findings of the Navy Experimental Diving Unit, which indicate that tolerable supersaturation should be greater at high exposure pressures than at low pressures. Planned decompression, checked and adjusted in Phase I, allowed the 400-foot, 20-minute excursion (1,200 to 1,600 feet), with 55 minutes actual time at 1,600 feet, to be accomplished with a 90-minute decompression back to the 1,200-foot saturation depth. While bends did occur in this preliminary investigation, the initial concept was clearly validated by the nearly tenfold shortening of overall decompression time.

The sequence of changing pressurization rates, periods of adaptation, saturation at intermediate pressure, and deep excursion from saturation has proven exceptionally useful both for investigative and for practical purposes. The compression rates tolerated and recovered from by the participants allowed reaching 1,200 feet in approximately half the time used previously. These rates also allowed participants to reach 1,600 feet in approximately 26 hours, which is several days sooner than in previous exposures. Participants deliberately exposed to prominent pressure-induced symptoms at 1,200 feet recovered enough within 1 hour to continue working. Divers who were compressed from 1,200 to 1,600 feet in 20 minutes on the following day were able to perform normally throughout the excursion.

A great deal of credit for the success of the Predictive Studies IV Program belongs to the six industrial diver-participants, which included Craig R. Carlson, Ocean Systems, Inc.; Louis W. Jenkins, Sub Sea International, Inc.; Gerard B. McHale, International Underwater Contractors, Inc.; Michael R. Phillips, Ocean Systems, Inc.; Frank H. Sayle, Oceaneering International, Inc.; and William A. Schwab, Saturation Systems, Inc.

*
Industrial Sponsors included:
Offshore Diving Industry: International Underwater Contractors, Inc.; Martech, Inc.; Oceaneering International, Inc.; Ocean Systems, Inc.; Santa Fe Diving, Inc.; Saturation Systems, Inc.; and Sub Sea International, Inc.
Oil Industry: Continental Oil Co.; Placid Oil Co.
Gas and Chemicals Industry: Air Products and Chemicals, Inc.
Equipment Industry: McEvoy Oilfield Equipment Co.
Ocean Systems, Inc., managed the detailed coordination of industrial sponsorship and liaison with the Institute Program.

GUADALCANAL aground.

EDENTON anchored to right of GUADALCANAL.

EDENTON Successful in Med. Salvops

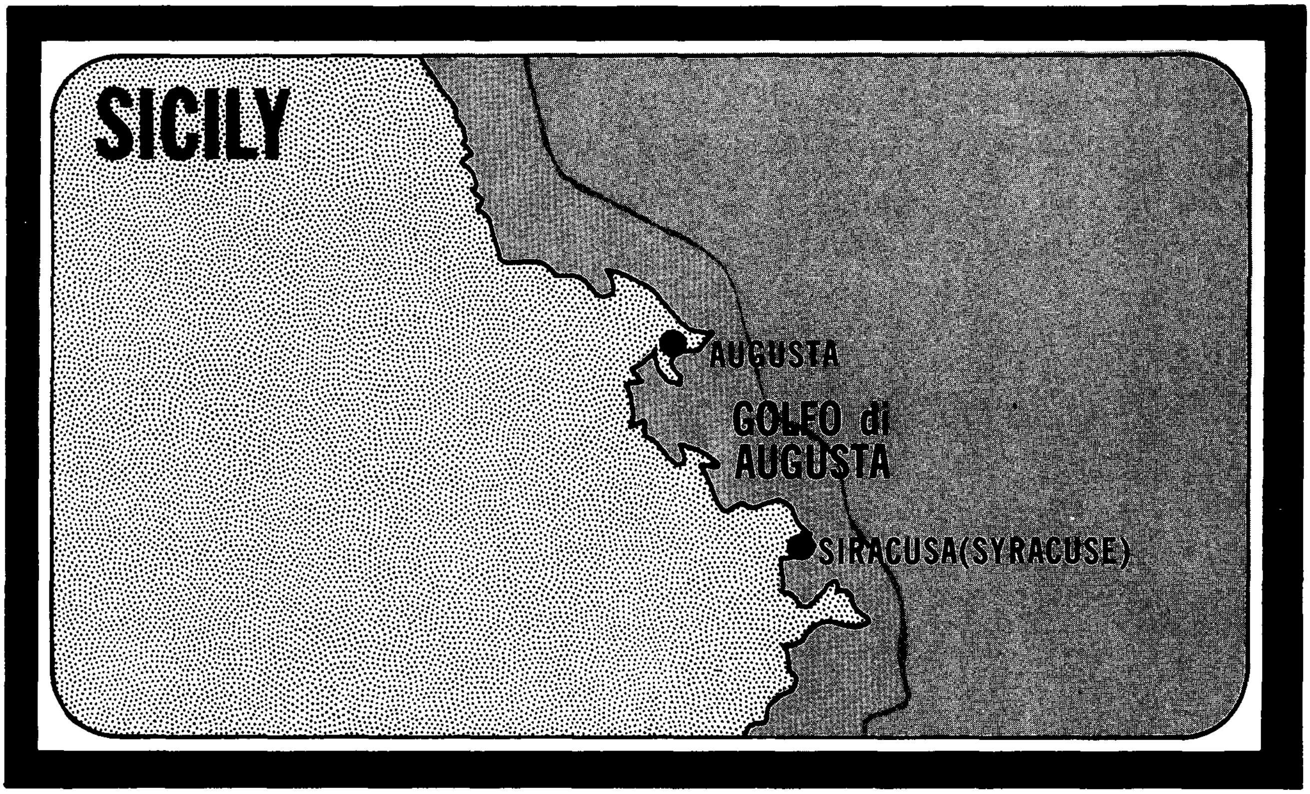
LTJG J.R. Buttermore
USS EDENTON (ATS-1)

While at anchor in Augusta Bay, Sicily, on January 27, 1976, USS GUADALCANAL (LPH-7) encountered extremely heavy winds. Numerous other ships, including commercial supertankers, were battered about by the adverse weather and were dragging their anchors within the sheltered harbor. While getting underway and trying to avoid drifting merchant ships, GUADALCANAL went aground just off the northern breakwater of the harbor. Harbor tugs were called in for assistance, but GUADALCANAL remained hard aground.

USS EDENTON (ATS-1), currently deployed to the Mediterranean and at that time located off Naples, Italy, was tasked by Commander Service Force SIXTH Fleet to assist the stranded ship. EDENTON detached a fly-away diving team and got underway immediately for Augusta Bay.

The diving team boarded GUADALCANAL that afternoon and conducted an initial diving survey to ascertain the amount of damage and degree of grounding. The ship was found to be aground from frame 42 forward to frame 96 aft on a soft coral bottom. The screws, rudders, and shafts were clear of the bottom with no apparent damage. A large rock, located on the starboard side at frame 63, had caused a large dent in the ship's hull; and, in fact, the ship appeared to be lodged on the rock. An inspection of all interior spaces was conducted to locate any protrusions into the ship's hull. None were found, and the ship's watertight integrity remained intact. The ship's draft was 19 feet 6 inches forward and 27 feet 6 inches aft. Also, a slight "hogging" condition was noted. The ship was listing 4° to port in a fixed position with no danger of shifting and going harder aground. Two harbor tugs were "made up" to GUADALCANAL to ensure its fixed position.

EDENTON arrived on the scene at first light on January 29 and anchored near the stranded ship. EDENTON salvors boarded GUADALCANAL to discuss the initial findings. The "ground reaction" was computed to be 1,810 tons and the "tons per inch immersion" was 100.4. With the vast amount of cargo, ballast, and fuel on board, the salvage plan was formulated to refloat the ship by conducting a systematic offload of weight in the amount equal to the calculated ground reaction. The topside weight would be offloaded first to ensure maximum ship stability. This procedure would continue progressively downward until the ship was refloated. The offloading sequence was devised to produce a 0° list approximately when the calculated ground reaction figure of 1,810 tons was reached. The offload was scheduled to be completed at exactly the computed high tide the next afternoon. The sequence of offloading was as follows:



Fore and aft peak tank	510 tons
(to eliminate the hogging condition)	
Ship's boats	24 tons
Helos	160 tons
Marine equipment	268 tons
Marine personnel	220 tons
Yellow gear	30 tons
Anchors	22 tons
	1234 tons
Water	570 tons
	1804 tons
Fuel	25 tons
	1829 tons

All arrangements were made and offloading commenced at 1200Z, 29 January and continued throughout the day and night with draft readings being taken every 2 hours to monitor the change in displacement.

EDENTON's workboat conducted a leadline survey of the area aft of GUADALCANAL to verify the charted depth in preparation for the ungrounding. EDENTON then moved in astern of GUADALCANAL and passed (floated) its 2¼-inch tow wire to the fantail of the stranded ship and secured it to the after towing pad. While nearing completion of offloading, EDENTON took a mild strain on it's tow wire to prepare for a maximum pull at high tide. The direction of pull was the exact reciprocal of the course GUADALCANAL was on when grounding occurred. An Italian salvage ship, PROTEO, was also on-scene and was made up to GUADALCANAL's port quarter to assure that the ship's stern would not go further aground upon refloating. Four harbor tugs were made up to the bow, two pushing and two pulling, to perform the same function forward as PROTEO did aft.

All ships began their previously coordinated actions together, and within minutes the GUADALCANAL was free of the bottom and under tow by EDENTON. PROTEO cast off her tow line and steered clear. The harbor tugs on the bow remained in place to aid in steering the ship. Upon reaching the desired deep water, EDENTON "tripped out" her tow line and stood by as the harbor tugs guided GUADALCANAL to the deep-water NATO pier.

EDENTON then anchored nearby and detached its diving team to conduct a complete underwater hull survey. The survey was completed on January 31, and a report was made to the Commanding Officer of GUADALCANAL. The entire operation was completed without incident or accident exactly as planned. The success of this operation can be attributed mainly to the cooperation, coordination, and professionalism of the various personnel brought together in the short 3-day refloating, ungrounding, and return to duty of an important fleet asset.

Argus Island Demolition

LT William Hall, CEC, USN
Office of the Supervisor of Diving

The Argus Island tower was successfully demolished by fleet units of the U.S. Navy on May 13, 1976. The accomplishments in the completion of this project are the result of 9 months of careful planning and preparatory training done by COMSERVRON EIGHT in cooperation with the Supervisor of Salvage. The Argus Island demolition was different in four areas from past clearance operations managed by SUPSALV. First, this was a major *fleet* operation with very limited contractor support (provided by SUPSALV).

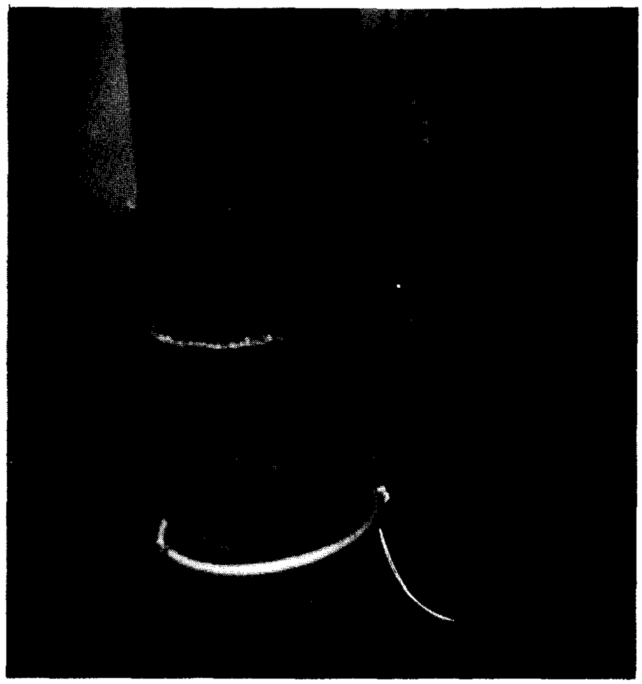
Second, the diving operations were conducted by U.S. Navy divers using major components of the Emergency Air Diving Fly Away System. Further, it is significant to note that diving operations were conducted at a diving depth of 200 feet of seawater (fsw) using air as the breathing medium. Third, shaped charge explosives were used to clean, peel, and cut the tower legs and structural support bracing. Fourth, the SUPSALV 50-ton Propellant Embedment Anchor was used for the first time in a salvage operation by fleet units.

The Argus Island tower site is located approximately 35 nautical miles southwest of Bermuda. The water depth at the tower site is 192 fsw. The main tower structure consisted of four major bearing legs extending from a depth of 192 fsw, founded on pile cap driver approximately 60 feet into a hard coral bottom, and a rectangular platform house approximately 65 feet above mean sea level. There were nine primary horizontal bracing levels in the structure. These levels were braced by tubular K-frame diagonals between each level. The apexes of these K-frame supports were horizontally braced with simple diagonals. After the 12 K-frame braces at the base of the tower were cut, the basic plan for demolition of the tower required 20 explosive shaped-charges to be placed strategically on the main bearing legs at depths varying from 170 to 190 fsw. These charges would be detonated in three sequential steps to completely sever the structure near the sea floor. Concurrent with the third and final shaped-charge detonation, two salvage ships in harness with two beach gear purchases per ship would exert the necessary force to topple the tower in place. Achieving a minimum clearance depth of 90 fsw would successfully conclude the operation.

On April 28, 1976, USS HOIST (ARS-40) and USS ESCAPE (ARS-6) arrived on scene to commence demolition operations. HOIST was designated as the diving operation platform; ESCAPE was designated as deployment platform for the 50-ton Propellant Embedment Anchors. Weather and sea conditions made diving operations impractical during the period of April 28 to May 1. During this time, HOIST hove to while ESCAPE proceeded with Propellant Embedment Anchor operation.

The 50-ton Propellant Embedment Anchor was developed by the Civil Engineering Laboratory (CEL) in Port Hueneme, California, for SUPSALV. The Propellant Embedment Anchoring System consists of a structural steel launch vehicle and a projectile fluke that is fired into the sea floor.

The CEL engineers have designed a variety of projectile flukes to be used



Photos show sequence of: Leg untouched; divers attaching cleaning charge; and (after leg has been cleaned and peeling charge has been attached and detonated) leg shown with peeled section of outer casing before final peeling shot is set up.

in various types of sea floor. For the Argus Island operation, a fluke designed for coral bottoms was chosen. The anchor wall is attached to a padeye on the projectile fluke with a high strength shackle. For this operation 1-5/8-inch wire rope pendants approximately 600 feet long were shackled to the fluke padeye using 25-ton bell shackles to serve as anchor legs.

Since the Propellant Embedment Anchoring System was not designed specifically to be deployed from an ARS type ship, there were two major problem areas to be overcome before the system could be successfully and safely deployed with ESCAPE. First, the weight of the anchor system when fully prepared for firing weighed approximately 8.5 tons. Second, the depth of water at the site was approximately 200 fsw.

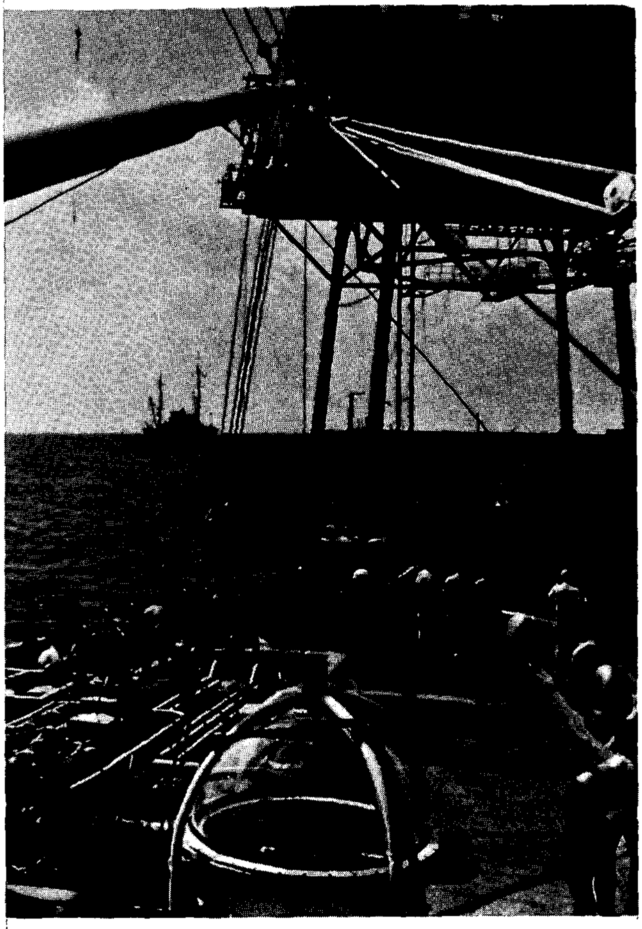
The first problem was handled by testing the stern boom (8-ton capacity) to 16 tons static and 12 tons/dynamic loading at pierside in Mayport, Florida. This allowed confidence in the rig's capability to handle the anchor system and gave the crew some experience in handling heavy loads with the boom rig. The second problem was solved by fairleading the bull rope through a 2-inch sheave fastened to the H-bitts and lead over the starboard quarter roller. The bull rope was then shackled to the anchor launch vehicle. Next, the stern boom was used to lift the anchor system from the fantail over the starboard quarter and into the water until the strain was taken by the bull rope. The boom hook was then disconnected and the anchor system was lowered to the sea floor using the ship's towing engine. Once properly positioned on the sea floor, the anchor system was fired electrically from the fantail of ESCAPE.

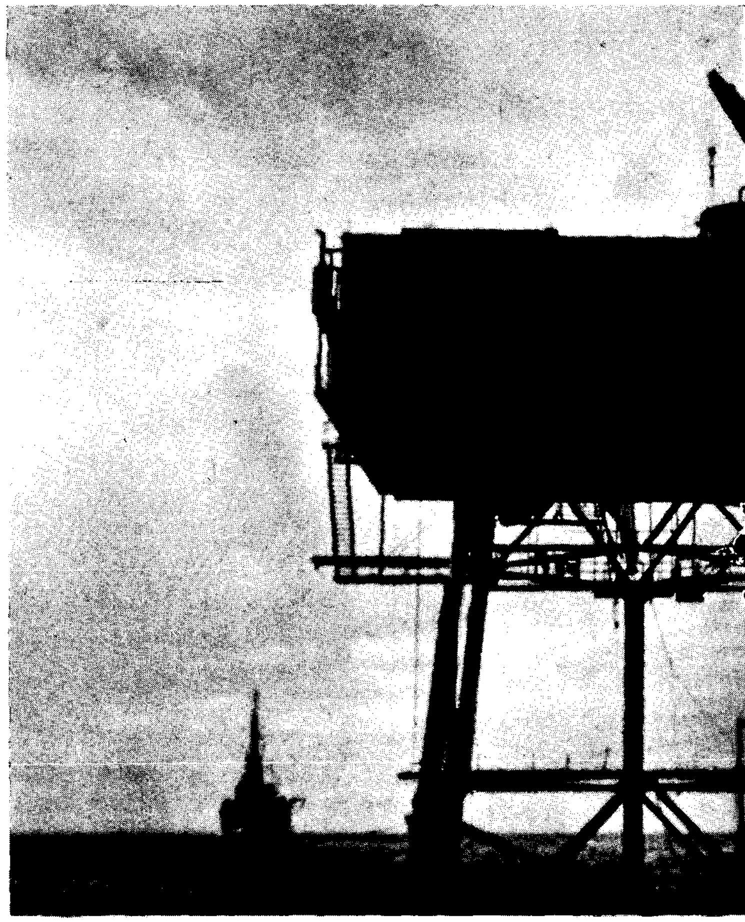
A total of six anchors was required for ship mooring and toppling mooring as shown on page 21. ESCAPE actually made seven shots, because on the second shot the shackle (a 25-ton screw pin shackle) that connected the wire pendant to the projectile fluke failed. A misfire caused by a leaking O-ring seal in the safety and arming device was the only other unplanned incident to occur during the anchor deployment, which was conducted over a 4-day period.

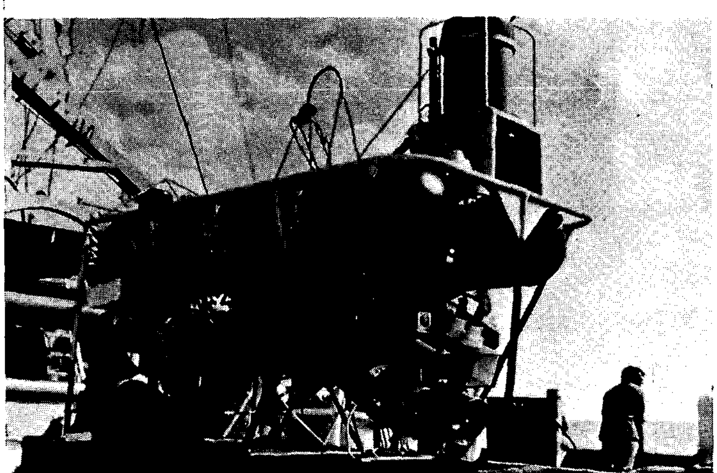
On April 30, HOIST moved into the east tower moor and prepared to start diving operations. Since sea swells were running as high as 8 feet, diving operations were delayed until May 1. While waiting for sea swells to diminish, HOIST and ESCAPE divers were set to work preparing the fly away diving components for diving operation. The various components of the Emergency Air Diving Fly Away System used on the operation included a low pressure air compressor system, a diver's open bell, and a Mk 1 Diver's System.

The low pressure air compressor system consists of two diesel-driven Quincy compressors rated at 97 scfm at 250 psig. The system also includes a diving console and filter capable of supporting two divers, a standby diver, and the open bell. This bell's construction is unique among previous open bells. The basic steel structure encloses a 53-inch-diameter acrylic dome and

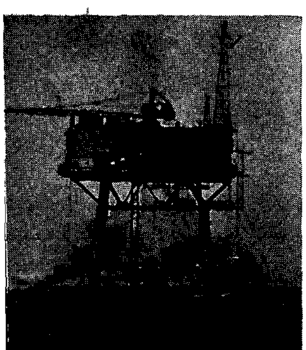
(continued on page 20)

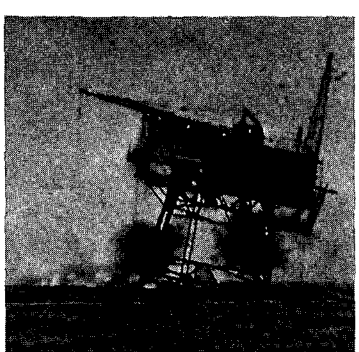


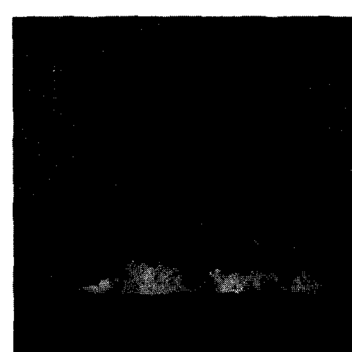




Upper left photo shows open diving bell in foreground during operations on Argus Island Tower (behind ship). Left photo shows close view of DEEP DRONE. Sequence of photos below show detonation of charges on the tower and the collapse of the tower.







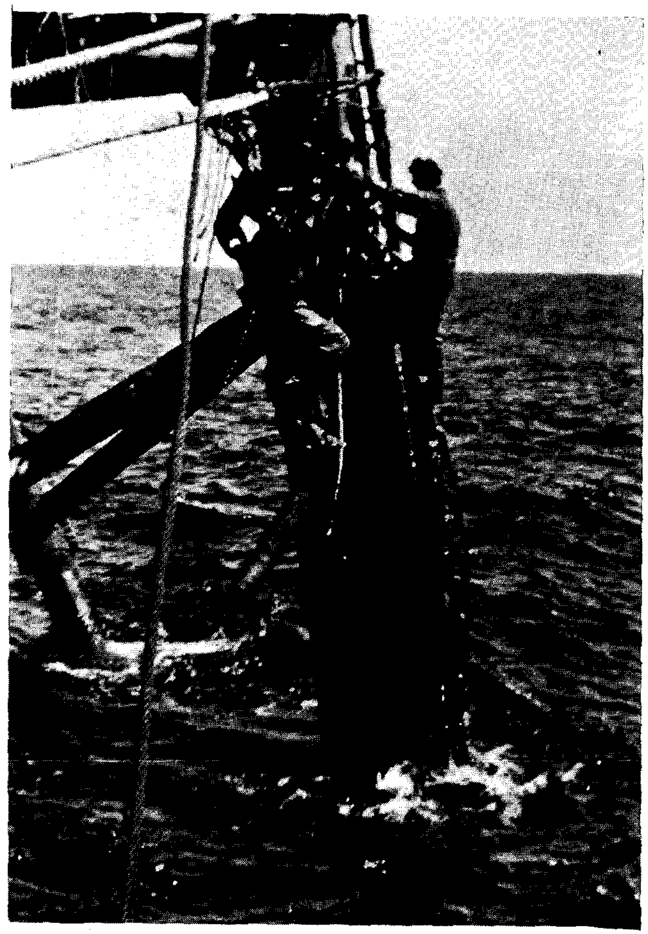
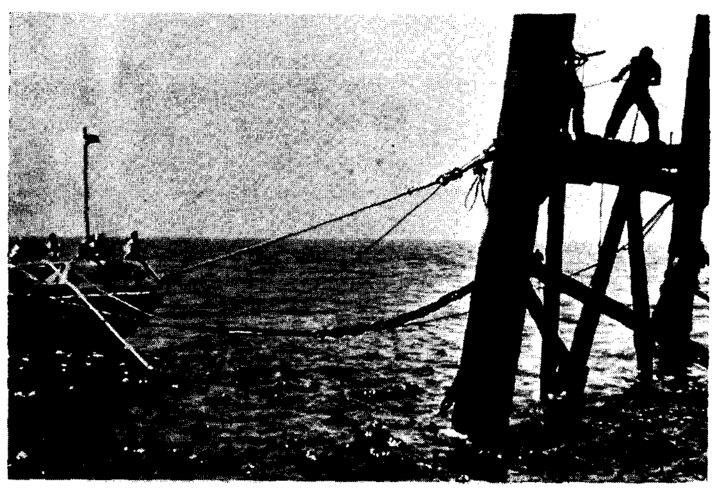
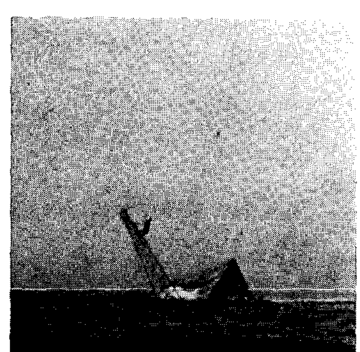
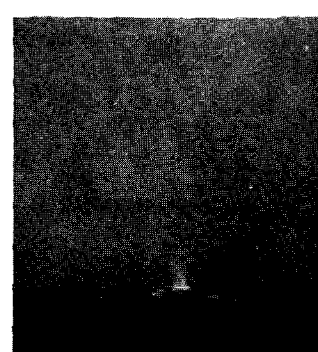


Photo above shows tower with USS HOIST and USS ESCAPE on either side. Upper right photo shows crew rigging a chain bridle on a tower leg. Photo at right shows another view of tower preparation, with stern of ESCAPE nearby.







(continued from page 17)
the demand BIBS installed inside the bell provides an additional safety factor. This bell is suitable for both deep air diving and mixed gas diving. The Mk 1 Diver's System is the new standard lightweight diving outfit as described in the article "Mk 1 DIVER'S SYSTEM: The New Lightweight Diving Outfit", *FP*, Spring 1976.

Decompression dives were conducted from 160 to 195 fsw using the Mk 1 Diver's System with the support of the NAVSEA open bell. During part of the operation it was necessary for divers to decompress on the tower due to sea swell conditions. The maximum air decompression table used was 200 feet for 30 minutes. There were only two treatment cases performed for decompression sickness (pain only symptoms) during this operation out of a total number of 45 dives completed.

SUPSALV's new operational remote cable controlled vehicle (DEEP DRONE) was used on scene to monitor diving operations, inspect specific tower areas after explosive shots, and to document the underwater sequence of the operation. DEEP DRONE has numerous capabilities. These include a depth capability of 2,000 fsw, a still camera (70 mm), a TV camera (closed-circuit), searching sonar (360°), two horizontal thrusters, one vertical thruster, and a maximum forward speed of 3 knots. The vehicle's weight is 1,250 pounds. The entire system can be flown by any commercial air freighter or in the normal cargo area of a wide body jet. Personnel from Alcoa Marine Corp. were on site to operate DEEP DRONE during the operation.

The shaped-charge explosive cutting was done by HOIST and ESCAPE divers. Jet Research, Inc., personnel, who fabricated the shaped-charge explosive package, were also on scene to provide technical assistance. The sequence of cutting the main legs included three basic steps. The first was to place and fire cleaning charges on subject legs. The second step was to inspect the cleaned areas, then place and fire a peeling charge on the legs. The final step was to inspect the peeled legs, then place and fire a cutting charge on the legs coordinated with the toppling pull from HOIST and ESCAPE. The K-frame and diagonal braces were cut outright by a single cutting charge on each brace without use of the cleaning charge.

With the exception of the delays due to weather, the operation proceeded according to plan until the first attempt at toppling on May 9. After HOIST and ESCAPE were in harness and exerting the proper horizontal pull to achieve toppling, the four cutting charges were fired. However, the tower did not topple, and after 20 minutes of pulling the attempt was halted. DEEP DRONE and scuba divers were deployed to determine the status of the cutting charges. It was discovered that three of the four cutting charges detonated and produced partial cuts; the cutting charge on the northeast tower leg did not detonate. It was decided to place new cutting charges on the south legs of the tower and proceed with another toppling attempt on May 12. This attempt was also unsuccessful. During this second attempt, ESCAPE parted her bull rope approximately 3 to 4 minutes after charge detonation.

For the third attempt to topple, an alternate plan for cutting the legs was used. Two 20-pound haversacks filled with military explosive (C-4) were lowered inside each of the hollow bearing legs to a point approximately 6 to 8 feet above the previous cuts. In this plan, the northern legs were to be shot a few seconds before the southern legs to ensure tower movement in a northerly direction. As part of this plan, ESCAPE attached 600 feet of 10-inch nylon hawser to her remaining length of bull rope.

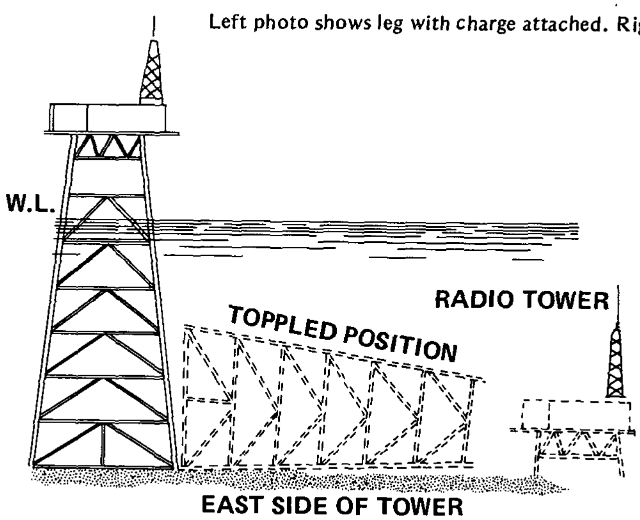
On May 13, the final and successful attempt to topple the Argus Island tower was made. The tower slid beneath the water surface at 10:45 a.m. local time.

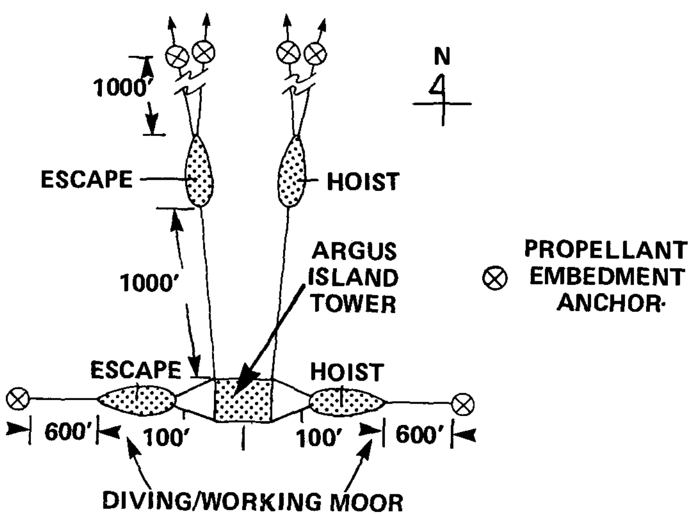
The remaining part of the operation was to ensure that the depth of clearance was no less than 90 fsw. Upon impact with the water, the platform house sheared and separated from the tower legs, coming to rest on the sea floor in an upright position. The house itself was at a deeper depth than the depth of clearance desired; however, the radio antenna on the roof of the house had to be removed by divers using shaped-charge explosives.

The successful completion of the Argus Island demolition points out several significant facts. Deep air diving is a valuable and efficient way of accomplishing short duration dive requirements at the deeper depths. This mode of diving is a real asset and should be used to its maximum limits. Explosive cutting techniques were proven to be quite successful in this application and should be considered for future operations. The Propellant Embedment Anchor System was extremely effective in the application with beach gear for mooring in areas where the sea floor was not suitable for standard drag burial anchors. The conjunctive use of the Embedment Anchors and standard beach gear represents an attractive alternative to standard beach gear anchor legs. (In addition, the explosive Embedment anchor used with the new hydraulic pullers, presented at the 1976 Working Diver Symposium, represents an even greater advance in the state-of-the-art of salvage equipment.)

A list of the diving personnel involved in this operation is shown on page 21. All the personnel involved in the planning, training, and execution of the Argus Island demolition earned a Navy "WELL DONE!" Detailed accounts of diving operations and salvage equipment operations will be provided by fleet participants in the Fall issue of *Faceplate*.

Left photo shows leg with charge attached. Right photo shows leg after detonation.





Salvage Officer:

LT Ken Edgar

Senior Master Diver:

BMCM Sothers

ESCAPE Divers:

LTJG R.A. Hinderer
ENS P. Stanton
HT3 M.A. Arnett
TMSM J.L. Counts
ENC J.W. Hayes (MDV)
MM1 K.W. Hearth
SK3 R.B. Hernandez
HT1 J.R. Hill
MM1 S.L. Smith
HT3 J.L. Taylor
HM1 S.E. Tripp
EN3 D.H. Wolff, Jr.
MN2 G.R. Zawacki

HOIST Divers:

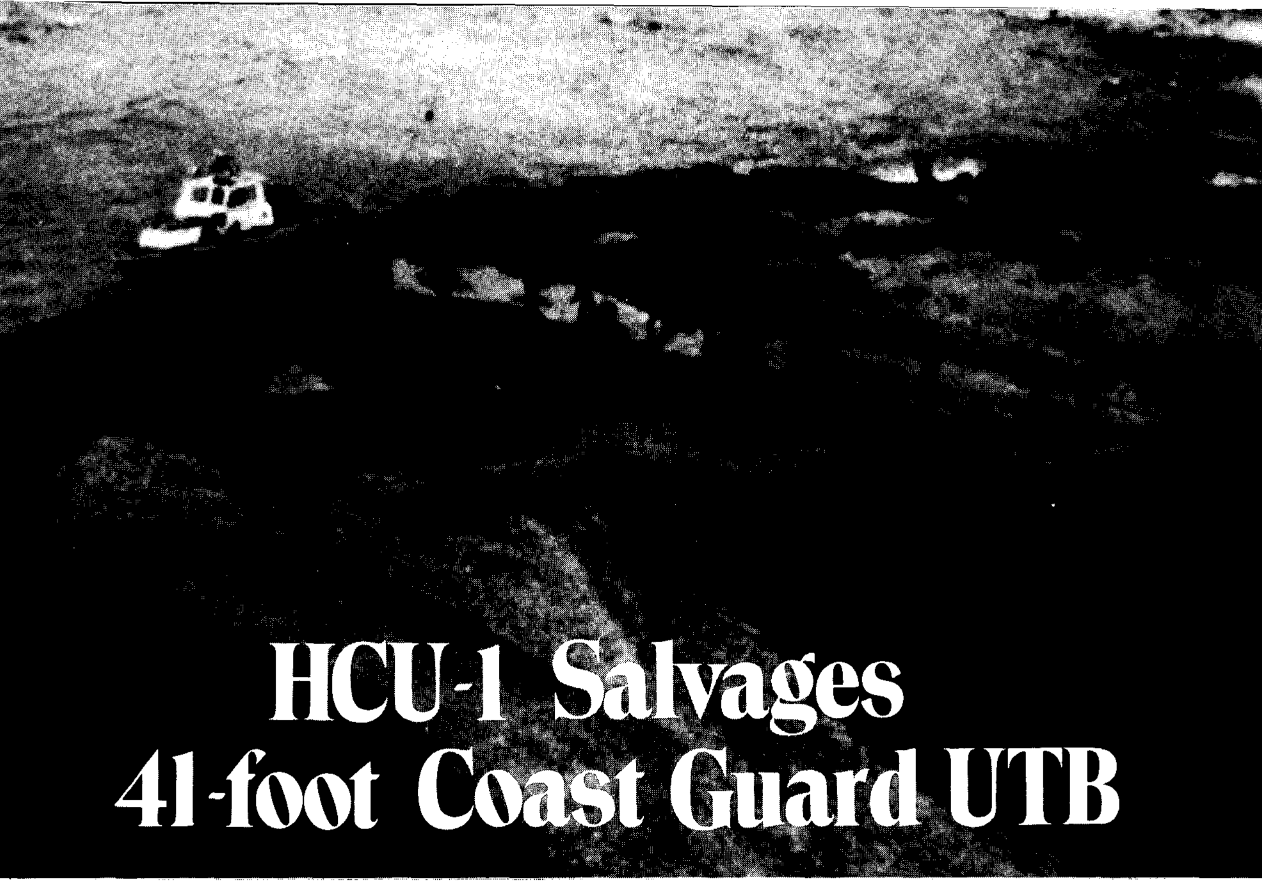
CWO2 G.P. Yatsko
LTJG D.L. Stone
ENS J.D. Evans
ENS S.E. Grove
ENC J.L. Starcher (MDV)
BMC F.P. Magaraci
HT1 B.M. Smith
BM1 J.E. Tucker
EN2 S.J. Hagenhoff
BM2 P.M. Wolfe
EN3 B.D. Wilkins
EN3 C.L. Crowder
HM2 D.D. Johnson

Combat Camera Group Divers:

PHC R.(N.M.N.) Johnson
PH1 D.J. Graver

EOD Diver:

HTCS J.G. Spencer



HCU-1 Salvages 41-foot Coast Guard UTB

UTB aground on Sand Island.

LCDR P. W. Wolfgang
Harbor Clearance Unit ONE

A Korean fishing vessel went aground during a severe storm while attempting to enter the Honolulu, Hawaii, Harbor on the evening of November 23, 1975. A 41-foot Coast Guard craft was dispatched immediately by the Joint Rescue Coordinating Center (JRCC) Honolulu to provide assistance to the grounded fishing vessel. Sea and surf conditions were extremely high, and, while providing assistance, the 41-foot UTB was forced aground on Sand Island.

The Commanding Officer of Harbor Clearance Unit ONE (HCU-1) received a call early the following morning from JRCC Honolulu advising of the incident and indicating that a request for salvage assistance would probably follow. Because of this probability, the HCU-1 pulling barge was rigged for both pulling and lifting efforts.

HCU-1's Commanding Officer and Executive Officer arrived at the scene of the grounded UTB to confer with the CO of the Honolulu Coast Guard Base and to make an initial appraisal of the situation. It was found that the UTB was broached against a man-made breakwater (land fill) and was "working" in heavy surf. The gross weight of the boat was approximately 20 tons, and it was situated such that it was estimated to be as much as 10 tons aground. The only damage reported was to the skegs and screws, with no apparent rupture to the hull. The boat crew and other Coast Guard personnel had kedged several small boat anchors to seaward with steadying lines to the UTB to prevent further grounding. Because of the continued high seas and winds, the reef around the UTB was being washed with heavy surf, and it was not possible to perform a thorough survey of the reef to seaward of the grounded craft.

Initial salvage planning was based on the assumption that removing the craft back out across the reef would be most logical, once the existing seas abated. Accordingly, preparations were continued to ready the pulling barge for a pull to seaward. In view of the high seas existing between Honolulu Harbor and Pearl Harbor (where HCU-1 is located), a YTB was requested from Port Services, Naval Station, Pearl Harbor, to tow the barge to the salvage site. HCU-1's LCM-8 proceeded ahead of the tug and barge; and, after making several "dry runs" to determine set and drift, a reference buoy was established at the beach gear anchor drop point.

Once the barge arrived and was made up in tow, the LCM-8 towed it down the selected approach course to the grounded UTB. As the barge passed the reference buoy planted by the LCM-8 crew, the beach gear anchor was let go. The LCM-8 continued towing the barge toward the UTB until all beach gear wire was streamed. The bitter end of the wire had been pre-secured in the beach gear holding stopper.

The anchor was set as the wire was stretched out. Almost simultaneously, the LCM-8 was cast off and the barge "fetched up" on the beach gear leg. The barge rode inside the surf line on the very edge of the reef approximately 150 yards from the UTB. After it was determined that the barge was riding satisfactorily on the bear gear leg, two divers (dressed in full wet suits, swim vests, and "boon dockers") swam the bitter end of a 5,000-foot graduated double braided salvage messenger through the surf to the UTB. The swimmers reported numerous coral heads and an extremely rough bottom contour existing between the UTB and the edge of the reef. Based on this information, a decision was made not to attempt retraction of the UTB until the weather had abated enough to allow a detailed survey of the reef. This would ensure that a proper path for retraction of the UTB could be selected. The steadying line from the barge to the UTB was tensioned slightly to help stabilize the UTB for the night. Seas were again building up and were beginning to break over the deck of the barge. Because of this, the salvops were secured to await daylight and improved weather. The HCU-1 crew was removed from the barge by LCM-8 (after several exciting moments), and all personnel returned to base with the exception of the Coast Guard crew keeping watch on the UTB.

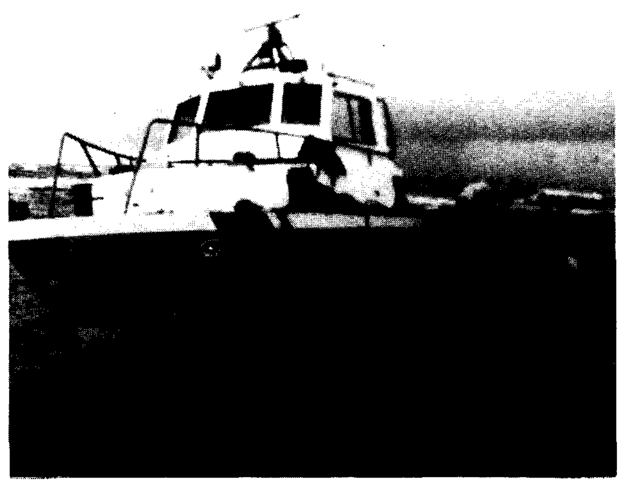
Early the next morning, the CO and XO arrived back at the salvage site (by land) to find that the boat had shifted 180° and was broached opposite side to the reef. The tide was low at the time, allowing a more accurate survey to be made. This new survey indicated little likelihood that the craft could be retracted to seaward. Once the seas abated there would not be enough water over the reef to float the UTB; and, in view of the extremely rough bottom, it did not appear possible to drag the craft over the reef to seaward without doing extensive damage to the hull.

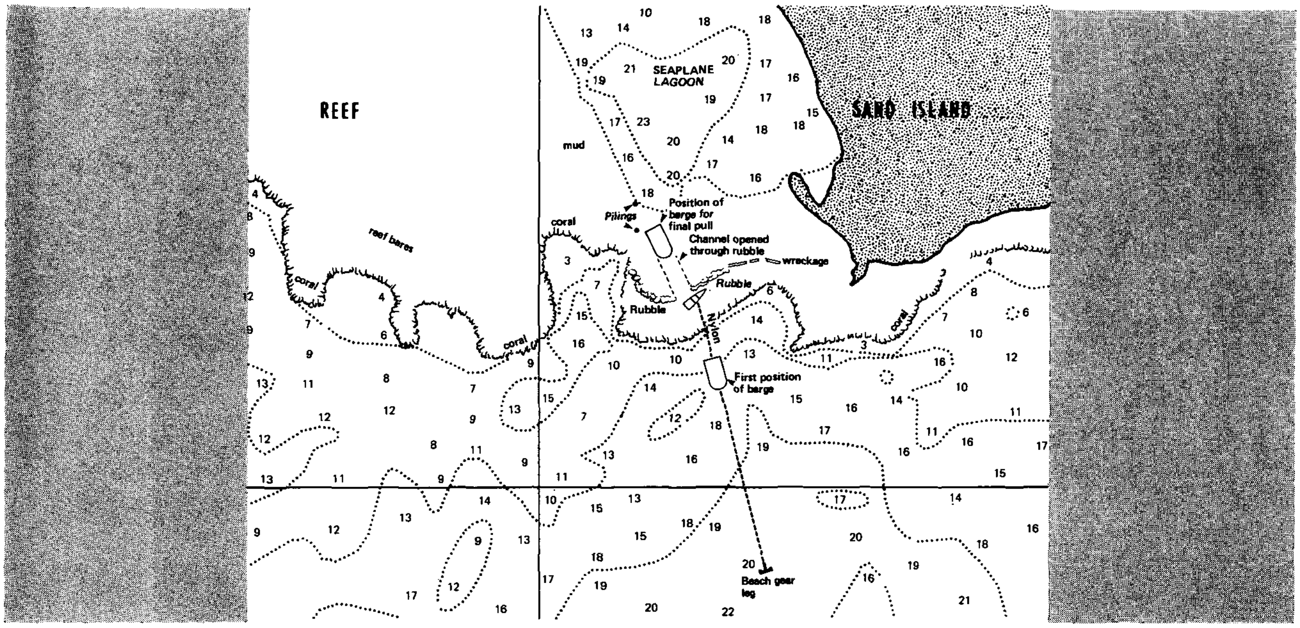
The land fill that the craft was resting on was composed of old scrap metal, bottles, pieces of pipe, and other pieces of unrecognizable trash. This had been dumped to provide a breakwater for the seaplane landing lagoon on the inward side of the reef. Over the years, the sea environment had amalgamated the debris, giving it the appearance of a solid reef. Closer inspection, however, disclosed that the material was not fused and could be broken apart. Inward of the fill the bottom was composed of sand and rubble that could be moved with shovels. Approximately 30 yards from the boat was "good" water deep enough to float the UTB and, better yet, deep enough to float the barge. It seemed feasible to channel through this composition breakwater and then through the rubble using picks, shovels, and jack hammers. By utilizing the barge for lifting/pulling on the lagoon side, it appeared that the UTB could be pulled across the top of the reef to deep protected water with the least chance of bottom damage to the craft. Also, this work could be carried out in spite of continuing heavy seas since conditions were good on the inside of the breakwater.

The decision was made to relocate the pulling barge to the lagoon and pull the UTB as planned. The only problem at this point was in trying to unmoor the barge in the high surf after getting a crew on board. The immediate problem of crew transfer was solved by the Coast Guard helicopter supporting the operation. The helicopter quickly lifted the HCU-1 personnel to the site and lowered them to the barge. It was at this time that the extent of the damage from the seas breaking over the barge was realized. The gear was in a state of disarray, with some of it lost. However, a major problem that could not be immediately solved was rerigging the tow in the heavy surf and driving wind and rain. Efforts were aborted after several attempts to pass the messenger by LCM-8. Because of the weather, the helicopter could not do more than retrieve the personnel on the barge. Thus, the personnel were lifted back to shore and operations were secured until a break came in the weather. A review of the situation indicated that the method of channeling and pulling to the lagoon side was still the best available. Planning was finalized for this effort based on relocating the barge at the first opportunity.

The next morning, November 26, the helicopter transported the crew onto the barge and then carried a messenger out to the LCM-8 waiting off the barge's bow. Once the towline was secured on the LCM-8, the barge was towed to seaward. When the barge was well under

Closer view of stranded UTB.





way, the beach gear leg was tripped out. After approximately 2 hours, the barge had been towed around through Honolulu Harbor to the lagoon side of the land fill and was beached with the "A" frame facing the UTB on the other side.

During the transit of the barge, a large working party of both Coast Guard and HCU-1 personnel started clearing the channel through the breakwater. Picks, shovels, sledges, and pneumatic jack hammers were being employed "with a will." The UTB was resting its full length against the high point of the reef, and this section of the fill was removed from 6 feet aft of the UTB to a point under its shoulder (expected pivot point). A channel approximately 3 feet deep and 12 feet wide was cleared from the stern of the UTB to the bow of the barge.

During the channeling operations, a bridle was rigged between the stern tow bitts and port skeg of the UTB. This was to be the main lifting/pulling point. A fairlead block was then positioned outboard of the boat on the edge of the reef at low water. Next, a 5-inch nylon line was passed from the barge through the fairlead block and back to the bow of the UTB on the seaward side. This created a double pull rig that would pivot the UTB and position its stern in the man-made channel when both the starboard bow and port stern rigs were pulled simultaneously.

Since the high tide was only 1 hour away, the crew quickly rigged a 1-1/4-inch wire rope from the stern bridle of the UTB up to a fairlead block on the "A" frame and down to a fairlead and beach gear tackles on deck of the barge. Both the nylon and wire rope were taken to a Clyde Winch on the barge and the pull commenced. The next large swell to strike the UTB lifted it slightly, and the combined lift and pivoting action of the pull caused the UTB to rotate its stern into the cleared channel in perfect fashion.

The nylon to the bow of the UTB was quickly cast off. The bridle to the port side of the stern of the boat was removed, and a new bridle consisting of four passes of 5/8-inch wire was passed around the stern towing bitts and through each strut forward of the rudders. The four passes of wire were grasped at the middle of each side of the stern of the UTB and pulled abaft and stern. All of these were then shackled into the eye of the 1-1/4-inch heaving wire from the "A" frame on the barge. With the upward angle of the "A" frame exerting a strong lifting and pulling force, the boat was slowly dragged through the cleared channel to a point just under the "A" frame. The stern of the boat was still supported by the lift wire to ensure control, and the boat was partially floating. The LCM-8 had been made up on the lagoon end of the barge in a power rig. The barge was backed off the beach, and the boat and barge were moored to a pair of pilings in the seaplane lagoon. These efforts were completed at 12:45 a.m. on November 27 (Thanksgiving morning).

The UTB was eased back into the water, rigged for tow alongside the LCM-8, and then delivered to the Coast Guard at the Honolulu Base at 2:20 a.m. Later contact with the Honolulu Coast Guard Base personnel indicated that a probable savings of approximately $500,000 had resulted from the efforts of the salvage personnel.

MK 12 UPDATE

The Mk 12 Surface Supported Diving System (SSDS) has been developed to provide a modern replacement for the Mk V hard hat diving equipment. The basic criteria involved in the creation and development of this new diving system include diver safety, mobility, and comfort.

The Mk 12 SSDS has been designed from the beginning with the following features in mind:

General:

- State of the art materials and production techniques.
- Complete interchangeability of parts.
- Reduced overall system weight.
- Increased diver safety.

Helmet and Recirculator:

- Reduced helmet and venturi noise.
- Increased field of vision.
- Positive buoyancy control.
- Increased life support mission time.

Protective Suit:

- Provision of dry diver envelope.
- Improved diver weight distribution.
- Reduced possibility of diver blowup.
- Improved diver mobility.
- Improved diver comfort within the above constraints.

The Mk 12 SSDS consists of a helmet assembly, a recirculator assembly, a dress assembly, and support equipment. The helmet, of fiberglass construction, may be used with either air or mixed gas as the breathing medium. The recirculator, using baralyme as a CO_2 scrubbing agent, is a modular add-on component of the mixed gas mode. The diving dress includes a dry suit, an outer chafing garment, a jocking harness, and lightweight diving boots. Two- and 4-pound lead weights, to a maximum of 40 pounds, fit into the thigh and shin pockets of the outer garment. A waist-located weight belt is provided for use when the diver is working in a current or turbulent water. Support equipments consist of a system test set, a system repair kit, a diving station flow meter, and an improved communication/strength cable.

In the air mode, gas is supplied from the surface umbilical through a non-return valve and tubing to the helmet supply valve. It then goes to the air supply diffuser and into the helmet, flushing CO_2 away from the diver's mouth area, and then out the exhaust valve. The exhaust valve can be adjusted to provide a helmet ΔP of 0.3 psi to 2.5 psi at an average flow of 4 actual cubic feet of air per minute (acfm).

In the mixed gas mode, the breathing medium from the surface umbilical enters the recirculator manifold and is directed through a venturi into the helmet mixed gas ducting. The gas flows down across the faceplate and flushes CO_2 away from the diver's face and into the recirculator return ducting located at the lower sides of the helmet interior. The mixture leaves the helmet by the return adapter, is "scrubbed" through a baralyme bed, and then is sucked back into the venturi stream. This scrubber system is designed to recirculate 90 percent of the gas mixture flowing through the helmet. Only 10 percent exhausts through the exhaust valve, while maintaining helmet CO_2 levels below 2.0 percent surface equivalent.

Two thermal protection diving suits are available with the air mode. For shallow, warm water conditions, a wet suit can be interfaced with the Mk 12 helmet fitted with an ambient exhaust valve and a neoprene neck dam. However, for colder and deeper applications, a Mk 12 helmet fitted with a variable exhaust valve and interfaced with a complete dry suit will provide better thermal protection.

In the mixed gas mode, a dry suit will be the standard configuration. However, it is planned to investigate the possibility of interfacing the Mk 12 helmet with the standard hot water suits used by the U.S. Navy.

The first prototype Mk 12 SSDS underwent technical evaluation (TECHEVAL) in the summer of 1973, during which time numerous problem areas were identified that required correction. By December 1975, new components—principally supply and exhaust valves, the basic helmet shell configuration, and the dry suit, outer garment, and harness arrangement—were redesigned or adapted to correct system defects. During the same period, new electrical connectors were identified and a system test set and a shipping and stowage container set were developed. Finally, a new Navy diving hose (MIL-H-2815E) was introduced, which will become the standard breathing umbilical for the Mk 12 system. In mid-1975, it was determined that the next TECHEVAL would be done in two phases, the air mode in the period of January to March 1976 (discussed below), and the mixed gas mode early in 1977.

The air mode test and evaluation plan is detailed in *"TECHEVAL Test Plan, Mark 12, Surface Supported Diving System, T/S 283"* (December 1975), prepared by the Navy Experimental Diving Unit (NEDU), Panama City, Florida.

OPERATIONAL FINDINGS:

System Characteristics: A summary of the test results compared to system evaluation criteria for both operational and technical characteristics is provided in Table 1. Physical characteristics are compared in Table 2. Test data to derive these tables came from all of the test dive series.

Unmanned Test Series: In this series helmet flow, ΔP, CO_2 level, and noise level were measured at depths from the surface to 300 feet of seawater (fsw) using NEDU's Ocean Simulation Facility (OSF). All design parameters were met with the exception that mid-frequency noise level exceeded the desired limit at depths below 100 fsw. This subject is further addressed in the DEFICIENCIES section.

Tool Test Series: Underwater tool testing was conducted using the hydraulic impact wrench, grinder, and cutter. In addition, underwater welding and cutting were demonstrated. All tasks were completed satisfactorily. Actual welding/cutting time was 2 hours and 51 minutes, with no apparent effect upon the diving system from electrolytic action. The welding shield allowed good vision under water and was simple to use. When using certain tools, e.g., grinder, it was found that the diver required additional weight to remain planted on the bottom and to overcome the rotational forces of the grinder.

Maximum Limits Test Series: This manned dive series was a group of progressively deeper dives (50, 100, 150, and 200 fsw) and was performed under controlled conditions in NEDU's Ocean Simulation Facility.

Reliability Test Series: These manned dives were a sustained diving effort conducted from the Naval Coastal Systems Laboratory's Stage II, located 2 miles out in the Gulf of Mexico off Panama City Beach, Florida, in 60 fsw. Two new fly-away compressors were used to provide low pressure air to the fly-away diving console. In a 2-week period, 95 dives were conducted in the wet suit (swimming) configuration using the ambient helmet exhaust valve, and 96 dives were conducted in the dry suit (plodding) configuration using the adjustable helmet exhaust valve. All dives were satisfactorily completed.

Training: During TECHEVAL, two separate 2-week training periods were conducted for TECHEVAL divers from NEDU (Tool and Maximum Limit) and fleet divers (Reliability). Representatives from the Naval School of Diving and Salvage (NSDS), Washington, D.C., participated as members of each group. This 2-week period proved adequate to cross-train Mk V divers to the Mk 12 system.

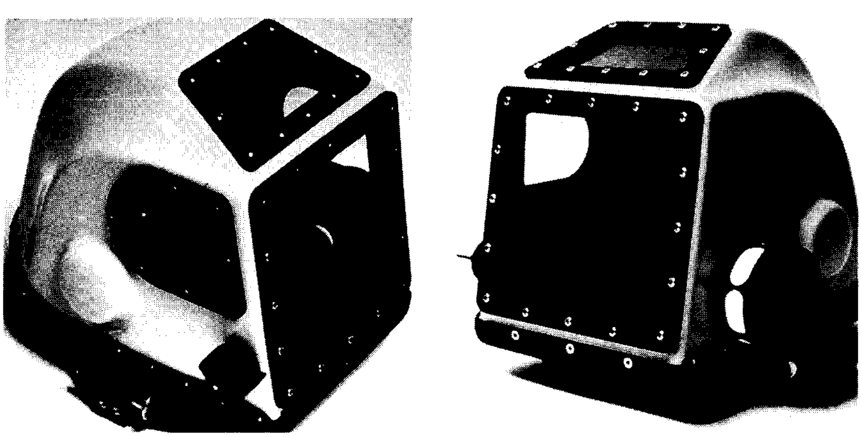
DEFICIENCIES:

Helmet:

Noise Level: The single major discrepancy of the Mk 12 SSDS helmet is the excessive noise level at depths greater than 100 fsw, as previously noted. A new helmet liner material and an improved air supply diffuser will probably reduce the helmet noise level to acceptable limits. These components are presently being tested. On the other hand, considering the maximum length of the dive profile (5 hours), the Mk 12 helmet is almost within the desired sound levels now, since the basic noise level standard of 90 dbA is established for an 8-hour period.

Breech Ring Latch Mechanism: On several occasions the breech ring latch was difficult to release. In the latch area, tolerances have been eased, and the problem is now corrected.

Metal Finish: The black chrome coating used on all external metal surfaces deteriorated in high wear areas, i.e., supply and exhaust valve handles. A new metal finishing technique called Impreglon™ is being



Photos above show two different views of the MK 12 helmet.

investigated. Initial tests of Impreglon™ coated metals have shown exceptional resistance to salt water and dissimilar metal corrosion while providing a tough anti-friction surface.

Air, Electrical, and Mixed Gas Adapters: The compression O-ring seals used in these adapters leaked when not adequately tightened down, and they were responsible for some "down" time during TECHEVAL. These adapters have been redesigned to barrel O-ring seals, which will eliminate this problem.

Dress:

Harness Latch Mechanism: The harness latch mechanism became unfastened underwater in two instances during TECHEVAL dives. A positive securing device is presently being tested.

Dry Suit Sizing: The dry suits used during TECHEVAL were not sized for the U.S. Navy diver population. This required a one size down grading for all of the dry suits, i.e., medium became small, large became medium, etc. In a very few instances, it was determined that an extra, extra large suit size was required. This will be a subject for further review.

Boot Sizing: Two types of boot (off-the-shelf) were evaluated during TECHEVAL. In general, the boots were too narrow and sized too small. This problem will be corrected in future orders.

Support Equipment:

Communication Cable/Life Line Covering: On several occasions the polyurethane jacket covering the cable was severely cut by barnacles and the neoprene coating of the breathing umbilical was scraped but not badly damaged. This is the first recorded instance of damage to this coating in 4 years of Mk 12 diving. Careful reevaluation as to the suitability of this cable is required. It is likely that a substitute cable will be required.

CONCLUSION:

The Mk 12 SSDS air mode has completed TECHEVAL in a satisfactory manner and is ready in all aspects for operational evaluation (OPEVAL). Procurement of the Mk 12 SSDS air mode should proceed as scheduled.

The Mk 12 SSDS is a major step forward for the U.S. Navy compared to the Mk V system. The Mk 12 is lighter, has better visibility, is safer, is designed to meet the current physiological standards, and uses modern materials and fabrication techniques.

TABLE 1

Operational Characteristics	Mk 12 Developmental Objectives	TECHEVAL Results
Normal Working Dive Limit (NWDL)	200 fsw[1]	200 fsw
Maximum Dive Limit	250 fsw	200 fsw[2]
Total Time of Dive Limit	5 hours	5 hours
Lower Temperature Limit	29° F	27.8° F[3]
Higher Temperature Limit	120° F	120° F[3]
Sea State	4	4
Maximum Water Current	2 kts.	1.5 kts.[4]
Noise Level	<90 dbA/8 hr	<90 dbA/8 hr
CO_2 Ventilation, Surface Equivalent	Max. 2%	1.9%
Flow Capability at All Depths	6 acfm	6 acfm

NOTES:

1. SOR 46-54 states NWDL as 200 feet of seawater (fsw); the Diving Manual states NWDL is 190 fsw. This latter value is the acceptable normal working dive limit.
2. Manned dives to 250 fsw were planned on two separate occasions. However, they were not accomplished due to the non-availability of the test facility. The system was tested during the unmanned tests to 300 fsw successfully.
3. Unmanned testing. Manned diving was limited in the lower temperature ranges to 35° F due to a cooling equipment malfunction and in the upper temperature range to 93° F by order of the NEDU Senior Medical Officer.
4. Limited by sea conditions prevalent during the test period.

TABLE 2
PHYSICAL CHARACTERISTICS

Buoyancy:

Required: The system when manned is to be neutrally buoyant with minimum weight addition under normal operating conditions. Diver buoyancy control, both positive and negative, is required.

Actual: The Mk 12 SSDS (air mode) has proved to be neutrally buoyant with weight variations determined by diver preference. All TECHEVAL divers were able to demonstrate buoyancy control, both positive and negative. Some divers developed skills to provide very fine vertical positioning (hovering).

Weight:

Required: Dry weight of the system should be minimized. A system dry weight of less than 115 pounds in the operational air mode is desirable.

Actual: The Mk 12 SSDS (air mode) dry weight is 100 pounds, including normal diver weights of 40 pounds. This weight is approximately ½ the Mk V (air mode) dry weight of 195 pounds.

Envelope Dimensions:

Required: The diver, when fully dressed, will be able to pass through submarine and dive system hatches or climb, unassisted, through a cylindrical trunk 30 inches deep and 24 inches in diameter.

Actual: This has been successfully demonstrated in the air mode.

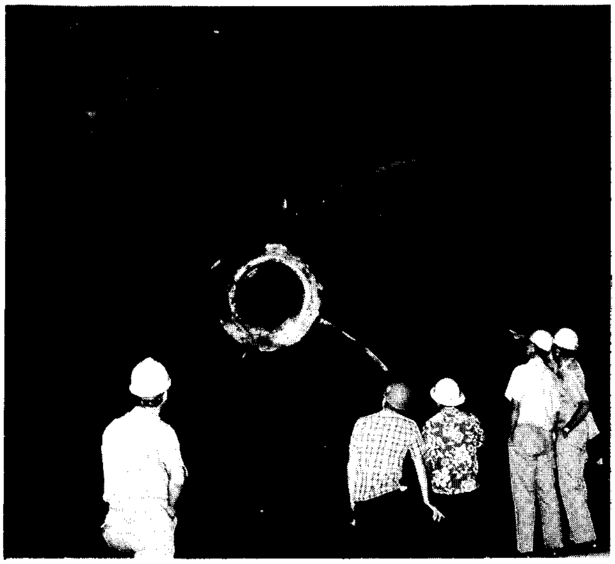
USS NEW ORLEANS Repair

While underway in the Pacific, 1,500 miles from Pearl Harbor, Hawaii, USS NEW ORLEANS (LPH-11) lost one blade of a single propeller. NEW ORLEANS immediately slowed to a speed of 9 knots (and then to 4 knots) and headed for the Pearl Harbor Naval Shipyard. The estimated cross section of the bronze propeller was 5 feet by a maximum of 8 inches thickness. A replacement propeller was not available at Pearl within a reasonable timeframe; thus, a decision was made to remove the opposite blade to permit the ship to continue its interrupted transit to San Diego, California.

An old, badly damaged propeller (which was somewhat smaller than NEW ORLEANS' propeller) was available at Pearl, and it was decided to experiment cutting this under water while awaiting NEW ORLEANS. Various types of steel and ceramic rod, O_2, and air, various pressures (currents up to 500 amp), and various techniques of holding this smaller propeller were tried under water by several divers. Progress was very slow. Using the maximum current available, the rate was approximately 1 inch of cut at one edge per hour.

At this point, a careful review was made of other options. It was determined that the screw could be removed without moving the tail shaft or rudder. Also, it was estimated that the blade could be cut in 1½ shifts on the surface. The revised estimate for underwater cutting was 4 or 5 days—and perhaps longer. Other techniques of cutting were also considered, including available types of saws and drills.

Upon the arrival of NEW ORLEANS, a careful inspection was made by shipyard divers, including the use of underwater damage assessment television system (UDATS) video tape and a visual inspection by the shipyard diving officers. This investigation disclosed that the blade had a classic fatigue failure. There was no visible damage to any other blades or to the rudder. Also, as nearly as could be determined with the rope guard intact, there was no damage to the stern tube bearing.



Closeup of damaged propeller.

A decision was made at this time by the diving officer to remove the propeller with the ship waterborne, inspect and cut the opposite blade, and reinstall a modified propeller. Work commenced early in the morning to rig and prepare the ship for the removal of the propeller. By mid-day, it was apparent that the preparatory work would be completed in order to blow the propeller loose early the next morning. Arrangements were then made with the explosive ordnance disposal (EOD) personnel for their support in the operation.

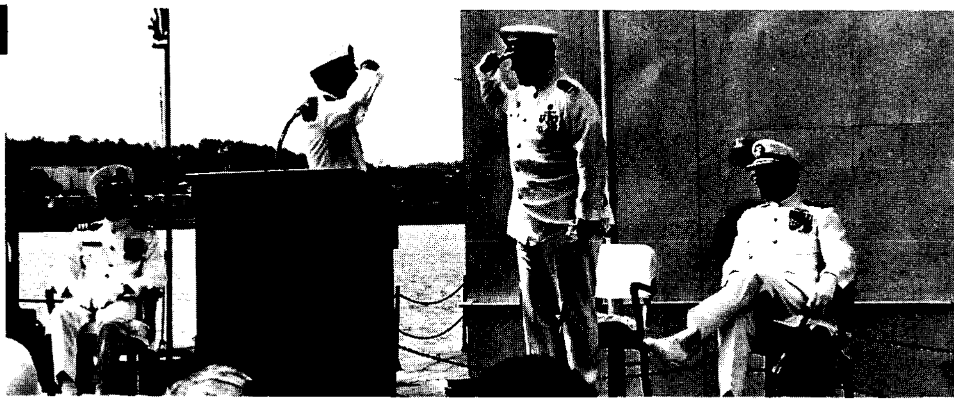
The first charge of primacord blew the propeller back approximately 1 inch. Two subsequent charges moved it another ½ inch. Hydraulic jacks were then used to move it off the tail shaft after the nut was removed.

The rigging job was complicated because of the size of the propeller (approximately 24 tons) and because it was forward of the rudder, where it could not be reached with a balance beam. Thus, it had to be suspended by chainfalls, rigged out to one side, and finally picked up by a portal crane. Fortunately, the ship had permanent padeyes installed. Nevertheless, the removal of the nut and the propeller required the remainder of the day. The propeller was finally up on the dock late in the night of the second day of operations.

Reinstallation began early the next morning. Shaft runout readings and bearing clearances were taken, which disclosed abnormal conditions. The other blade had been removed by that time, and the propeller was ready to be reinstalled. The new propeller was on the shaft, aligned, and pulled up in place by the end of the third day. The nut and dunce cap were replaced the next day, and NEW ORLEANS was ready for sea.

Subsequent tests at sea indicated that there were no vibration problems, and the ship was able to sail to San Diego at a speed of 9 knots. A message from the Commanding Officer of NEW ORLEANS praised the "expertise and professionalism" of the Pearl Harbor Naval Shipyard personnel. "The ingenuity and timeliness shown in accomplishing the unique and laborious task were without equal. All involved performed in a highly professional manner . . . ."

NSDS Gets New CO



During a special ceremony on May 28, 1976, CDR Anthony C. Esau, USN, was relieved by CDR Frank B. Richards, USN, as Commanding Officer of the Naval School, Diving and Salvage (NSDS), Washington, D.C. Principal speaker was RADM T.L. Malone, Director of the Deep Submergence Systems Division. In his remarks, he mentioned several historical highlights in past and present U.S. Navy diving, current fleet capabilities and how NSDS plays a vital role in supplying the fleet with trained diving personnel. He also noted that NSDS was a "one-of-a-kind facility" in that it is the only training command authorized to train and qualify deep sea diving and salvage personnel for the entire U.S. Navy, U.S. Armed Forces, and selected allied nations.

CDR Richards comes to his new post from the Naval Ordnance Test Unit, Patrick Air Force Base, Florida, where he was Head of the SSBN Test Operations Branch. After CDR Richard's commissioning in 1960, he served as Communication Watch Officer, Commander Submarine Force Atlantic Fleet, and as Operations Officer for USS KITTIWAKE (ASR-13). After graduation from Deep Sea Diving School in 1964, he served as 1st LT and Diving Officer aboard USS TRINGA (ASR-16), as Executive Officer aboard USS KITTIWAKE (ASR-13), and as Operations, Navigator, and Diving Officer aboard USS ORION (AS-18). After 27 months as Commanding Officer of USS PETREL (ASR-14), he reported to USS HOLLAND (AS-32) as Operations, Navigator, and Diving Officer.

CDR Esau has served as Commanding Officer of NSDS since October 1972 (see *FP*, Spring 1973). He will now report to USS ORTOLAN (ASR-22), where he will take on the duties of Commanding Officer.

F-14A Recovered Off Ensenada

A U.S. Navy F-14A aircraft crashed into Mexican waters approximately 10 nautical miles offshore Ensenada, Mexico, on March 24, 1976. The aircraft (BUNO 15946) had been conducting training maneuvers with other aircraft when a fire occurred in the port engine causing loss of flight control. Both crewmen ejected safely and were recovered by helicopter.

An accompanying aircraft took navigational fixes using TACAN from N.A.S. Miramar and INS (inertial navigation). This marked the pilot and flight officer's position as well as the approximate area of aircraft water entry. Water depths at these locations were indicated as being from 500-600 fathoms.

The Office of the Supervisor of Salvage (SUPSALV), U.S. Navy, was contacted for assistance to locate and recover the wreckage for accident prevention analysis. On March 25, 1976, SUPSALV tasked its prime search and recovery contractor, Seaward, Inc., to provide a search team, assets, and management. Mr. R.E. Kutzleb of Seaward, Inc., traveled to San Diego, California that evening to rendezvous with Mr. J. D. Totten, who had been designated as the on-scene SUPSALV Representative.

The M/V MAXINE D., an offshore supply vessel under contract to the U.S. Navy, was made available as the search platform. Mobilization of the search team and assets commenced on March 26. A delay was experienced after arrival at the search area when the sonar cable became jammed in the lowering sheave roller and was badly cut. This was corrected and the search continued through April 1, when the sonar and weight assembly was brought up hard into the lowering sheave, causing a failure of both davits on which the assembly was suspended. MAXINE D. returned to port (San Diego) for repairs, and the search team and equipment were loaded aboard USNS DESTEIGUER (T-AGOR 12) to continue the search.

DESTEIGUER got under way early April 22, 1976, and the search re-commenced that evening. The search continued (except for one brief return to port) until April 9. At this time DESTEIGUER was ordered to San Diego to transfer the search team and equipment to USS GRAPPLE (ARS-7) because of other higher priority commitments.

USS GRAPPLE arrived in San Diego late evening on April 10, and was underway to the search area on April 12. (During the in port period, Mr. J.D. Totten was relieved by Mr. T.B. Salmon as SUPSALVREP.)

The area search was again commenced and continued for 3 days, when a severe storm caused a 3-day cessation of the search effort. Mr. Joel Teague arrived on scene on April 21, replacing Mr. Salmon as the SUPSALVREP.

On April 24, a significant sonar contact was acquired, which, upon careful re-investigation, was considered to be the wreckage of the missing F-14A aircraft. This location was geographically recorded, and two Deep Ocean Transponders (D.O.T.'s) were placed in the debris field to acoustically mark the location for submersible verification. GRAPPLE then returned to San Diego, where all equipment and personnel were offloaded.

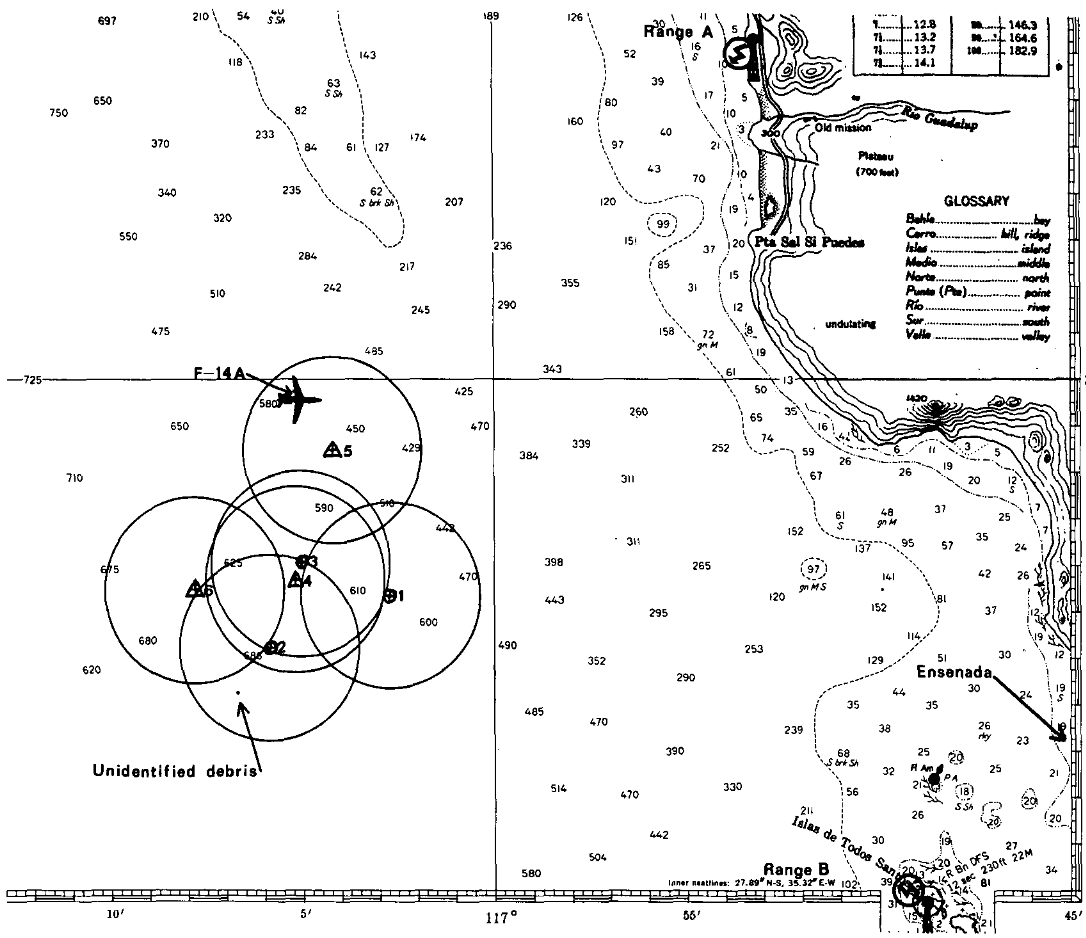
A Project Manager (Mr. J.W. McDonald) and Navigational Technician (Mr. W.J. Gibson) of Seaward, Inc., transferred over to the M/V MAXINE D. that night with the SUPSALVREP to provide surface positioning for the DSV SEA CLIFF. The deep submergence vehicle (DSV) SEA CLIFF is a 3-man research submersible that is capable of operating to depths of 6,500 feet. SEA CLIFF is homebased at SUBDEVGRU-1, San Diego.

MAXINE D. arrived at the search area on April 27, but the weather was too rough for the SEA CLIFF to operate and diving operations were postponed a day. The DSV SEA CLIFF was then launched, and it confirmed the F-14A wreckage visually and photographically, recovering some small wreckage in the process. SEA CLIFF then returned to San Diego that evening to process the photographs.

The navigation equipment and personnel were retained until April 30 to ensure that the site could be re-visited by normal surface navigation. Final demobilization of research team personnel and equipment then commenced.

SUMMARY REMARKS

Search techniques included a thorough briefing with the chase aircraft pilot, LTJG R.M. Norman of VF-1, and a search pattern that included an overlapping sonar sweep of approximately 30 percent. Search line records were inspected at random intervals to ensure that



selected objects were sighted on adjoining and connecting passes.

The search area was relatively flat to the west with a very soft mud bottom. To the eastward, steep cliffs with rocky slopes were present (in one case rising 1,200 feet vertically from the sea floor). Searching in these areas was dangerous to the towed equipment, and so wherever available, the ship's fathometer was run ahead of the sonar path to portray vertical obstacles.

In order to ensure the least bending radius for the sonar cable, a 22-inch "Skookum" block was rigged over the stern of each search vessel (except USNS DESTEIGUER). A special diesel-powered portable winch was also used to store and handle the sonar cable. The winch performed admirably in all cases.

A variety of support services was provided to the search team. These included the following search platforms: M/V MAXINE D., a 165-foot offshore supply vessel with a 100-ton crane; USNS DESTEIGUER, an oceanographic research vessel; and USS GRAPPLE (ARS-7), a heavy salvage ship from the U.S. Navy Pacific Surface Force. Rigging and heavy lift services were supplied by both the Naval Undersea Center (NUC) and the U.S. Naval Base, San Diego. Navigational Shore Sites were provided by the Mexican government and Mexican Navy. Additionally, liaison and logistic support was made available to the search team from the staff of the Submarine Development Group One. Visual confirmation of the debris was provided by the deep submergence vehicle SEA CLIFF.

Any search task, if it is to be successful, should be carefully planned and methodically executed. In water depths of over 300 feet, search equipment and supporting assets such as ships, winches, etc., *must* be selected with great care and then dedicated to the task until completion.

In this most recent F-14A task, single ship dedication was not possible and, therefore, accepted as something to be "lived with." The lesson learned, however, was that valuable search time was lost during each shift of personnel and equipment. Also, in trying to minimize this "lost time," equipment damage as well as search personnel fatigue was occasionally incurred.

A second lesson learned was that just any ship of convenience may not be acceptable as a search platform. Ample deck space, a clear view of the equipment, and quick responsive ship speed are important criteria that cannot be overlooked.

High Pressure Research Project at NMRI

Ms. Mary M. Matzen
Naval Medical Research Institute

The goal of the hyperbaric research program at the Naval Medical Research Institute (NMRI), Bethesda, Maryland, is to meet future diving operational requirements of the U.S. Navy with maximum safety and effectiveness. To accomplish this goal, NMRI researchers, through animal and human studies, are working toward a better understanding of the problems arising from diving. They are searching for ways to resolve these problems.

The hyperbaric research capability of NMRI will be greatly expanded when the new Hyperbaric Research Facility (HRF) is completed. The HRF is located adjoining NMRI; it will house one man-rated chamber complex and 21 large animal chambers. (A description of HRF, then known as EHEL, appeared in *FP*, Spring, 1975.)

The breathing medium is the source of life to a diver. But it is also the source of many of his physiological problems because his body interacts with the breathing gases under hyperbaric pressure. Many facets of the NMRI hyperbaric research program probe for the underlying mechanisms of these body-gas interactions.

The inert gases the diver breathes have their own unique disadvantages. For example, nitrogen causes narcosis, increased breathing resistance, and longer decompressions. Helium causes rapid loss of body heat, "Donald Duck" speech, and altered excitability of the nervous system. The life-supporting oxygen essential to all breathing mixtures is toxic when excessive amounts are breathed under pressure.

The inert gases used as diluents for oxygen are taken up by the body tissues under pressure. As the pressure is reduced, they must be eliminated from these tissues—but in a form that does not inflict acute or chronic injury. To avoid such injury, rational decompression schedules are vital. And, such decompression schedules must be based on a quantitative understanding of inert-gas transport in the human body, which does not yet exist. Hyperbaric researchers at NMRI are working to define the biophysics of inert-gas transport and elimination and to develop decompression principles that first will be tested in laboratory animals. This work should lead to the formulation of optimal decompression schedules for manned saturation and subsaturation dives.

An investigation of the mechanisms of bubble growth in decompression sickness and the dissolution of bubbles with recompression therapy goes hand-in-hand with the investigation of inert-gas transport and elimination. Objective criteria to diagnose and predict decompression sickness are being developed, as well as methods to assess the adequacy of decompression and to detect tissue damage.

Researchers at NMRI are also searching for an understanding of the basic mechanisms that cause narcosis. Through animal studies they are attempting to determine the site of action of narcotic gases and to understand the alterations in membranes that narcotic and environmental factors (such as cold, high concentrations of inspired carbon dioxide, compression rates, and the like) as they relate to altered cognitive function and to neuromuscular performance of underwater tasks. They will look for ways to counteract the effects of inert-gas narcosis to increase diver safety and effectiveness.

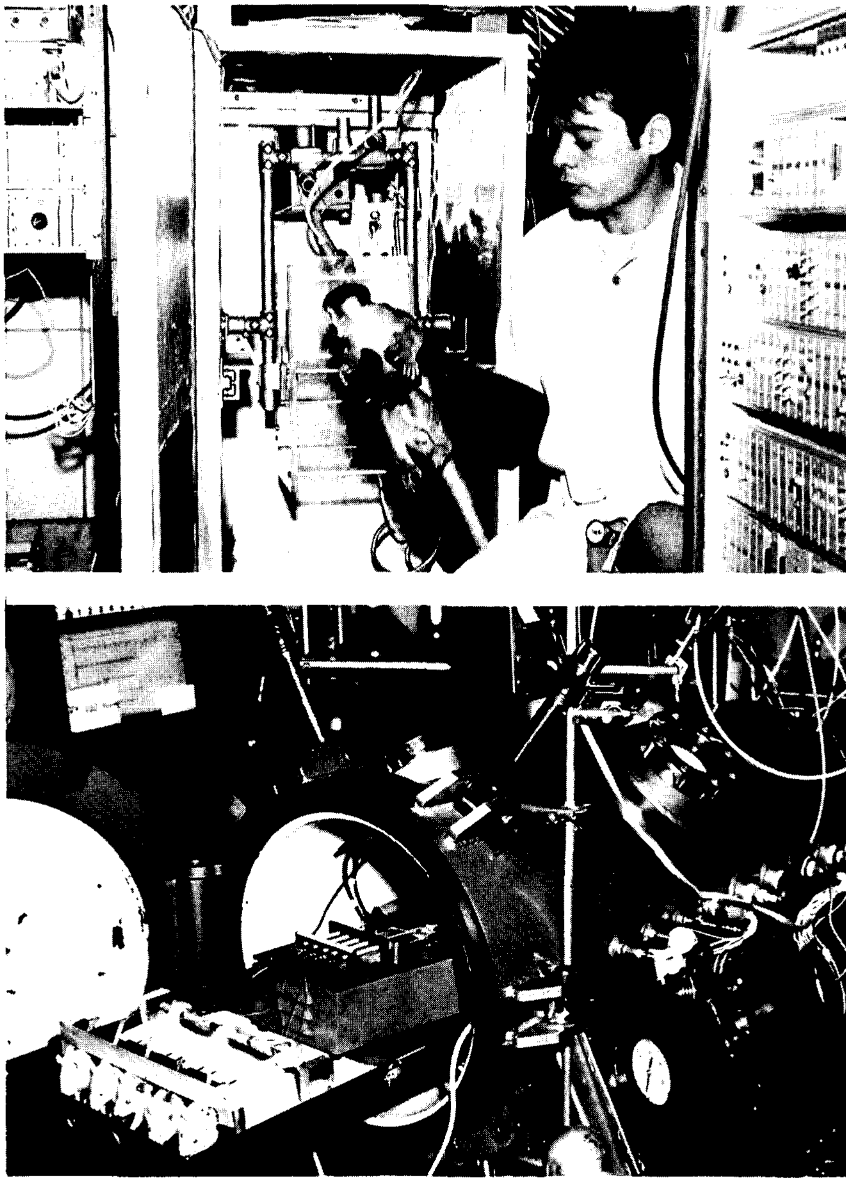
The toxic effects of oxygen are related to its partial pressure in the breathing medium. However, elevated partial pressures of oxygen are widely used to speed up decompression and to treat decompression sickness, air embolism, and other clinical problems such as gangrene and carbon monoxide poisoning. Also, there are limits of safe oxygen partial pressures to which divers can be exposed for both short- and long-term exposures. Determining safe limits of oxygen partial pressures is further complicated by the variation in oxygen tolerance between individuals or in one individual from day to day, between wet and dry environments, and between work and rest exposures.

It is known that the use of elevated pressures of oxygen can cause toxic effects in the enzyme, cellular, and organ systems of man and animal. Investigators at NMRI are studying the syndrome of oxygen toxicity in intact animals.

NMRI is also investigating the nature of the underwater environment as a continuing hazard to the respiratory and circulatory systems. Researchers will evaluate the effects of immersion, pressure breathing, external impedance to breathing, and gas density as they relate to the mechanical work of breathing, the chemical cost of respiration, and the efficiency of respiratory muscle.

Research on respiratory control will attempt to determine the "normal" respiratory state for divers as well as the safe tolerance limits for carbon dioxide retention. The interactions of narcotic gases with increased gas density and high oxygen tensions will be determined.

Cardiovascular function is affected by hydrostatic pressure, the nature of the inert gas in the environment, and high partial pressures of oxygen. An ultimate NMRI research goal is to determine a depth limit for the circulatory system. This will be accomplished initially through animal studies, as the effects of increased pressure and various gas mixtures on the physiological components of the circulatory system are assessed at graded hyperbaric pressures.



Photos show animals being put in various hyperbaric experiments.

The study of underwater performance and performance physiology is crucial to the Navy's diving operational goals.

Diver performance will be assessed on existing and yet-to-be-developed tasks that can be monitored to provide data on the physiological cost of work and the impact of equipment on both the diver and his performance.

Exercise physiology methods will be used to assess diver work capability and tolerance for work in dry and wet hyperbaric conditions. These detailed studies will provide data on the metabolic, respiratory, and circulatory responses to calibrated levels of exercise.

Cold is particularly penetrating in the diving environment. It limits diver efficiency and effectiveness, increases operating time, and at times is life-threatening. Research at NMRI on thermal stress will focus on the study of skin and respiratory heat exchange of divers in high-pressure, helium-oxygen environments. It will also focus on divers breathing compressed air or a helium-oxygen mixture in cold water. The goal is to devise equations that can predict heat loss and body temperature for any combination of ambient pressure and temperature. The goal also includes defining the tolerable range of deviation from normal skin and body temperatures under hyperbaric conditions.

The relationship between body heat loss, temperature, and performance will be investigated and defined. The various levels of body heat loss will be correlated to changes in performance on underwater tasks that require manual dexterity, a sense of touch, strength, and cognitive function. The effects of cold, underwater exercise, and breathing various gas mixtures will be investigated as they affect cardiovascular, endocrinologic, respiratory, and exercise responses in humans.

Symptoms of what has been termed the "high pressure nervous syndrome" (HPNS) have been reported in every deep chamber dive. These symptoms appear as electronencephalographic irregularities, tremor, loss of vigilance, altered postural equilibrium, fatigue, and microsleep. Researchers at NMRI are investigating the effects of temperature and rate of compression on HPNS. They are trying to determine whether a diver can learn to adapt to this condition, and if he can, to what degree. The use of additive gases, such as higher percentages of nitrogen, are under investigation as a way to reduce these symptoms. The basic mechanisms of HPNS are being studied to obtain further information about the onset, the nature, and the treatment of HPNS.

Another important area of research under way at NMRI is the investigation of the effects of deep submergence on infection and on an organism's response to it. Microbiologists believe that the common infectious disease agents of humans may become more virulent under high pressures and that treatments effective at surface pressure may become less effective in hyperbaric environments. These researchers are also concerned about the possibility of a mutation effect on bacteria, which may be caused by gases or chemicals that become concentrated in closed environments. Other related microbiological studies in small animals will lead to increased understanding of the long-term effects of high pressures on humans.

There is often need to give medication to a diver under high pressure because of accidents, decompression sickness, minor illnesses, pain or discomfort. Yet drugs that are considered safe and effective at surface pressure can have an altered effect on biological systems in the high-pressure environment. The NMRI program includes a general pharmacologic study to survey the activity and toxicity of common therapeutic drugs such as aspirin, caffeine, antihistamines. It also includes anesthetic drugs, antibiotics, and the like, under hyperbaric conditions.

The effects of hyperbaric exposures on human nutritional requirements and the way food is used by the body are also under investigation at NMRI. This information will be related to the response or susceptibility of a diver to the physiological problems and stresses associated with the high pressure environment.

Although man has been diving for centuries, little is known about the long-term and short-term effects on humans of chronic exposures to high pressures and to the gases used in diving systems. NMRI researchers, as they define the effect of hyperbaric exposures on the various body functions and systems, will also be seeking ways in which mammalian systems adapt or acclimatize to the high-pressure environment. The NMRI diving research goal is to enable U.S. Navy divers to adjust to their abnormal environment so they can meet the future diving operational requirements with maximum safety and effectiveness.

Diver on work sled ergometer is being monitored during a cold stress study.

The Old Master ...

I've recently been reading "Navy Diving: Who's Doing It and Under What Conditions," a Naval Medical Research Institute Report of December 1975. The authors have reached some very interesting conclusions.

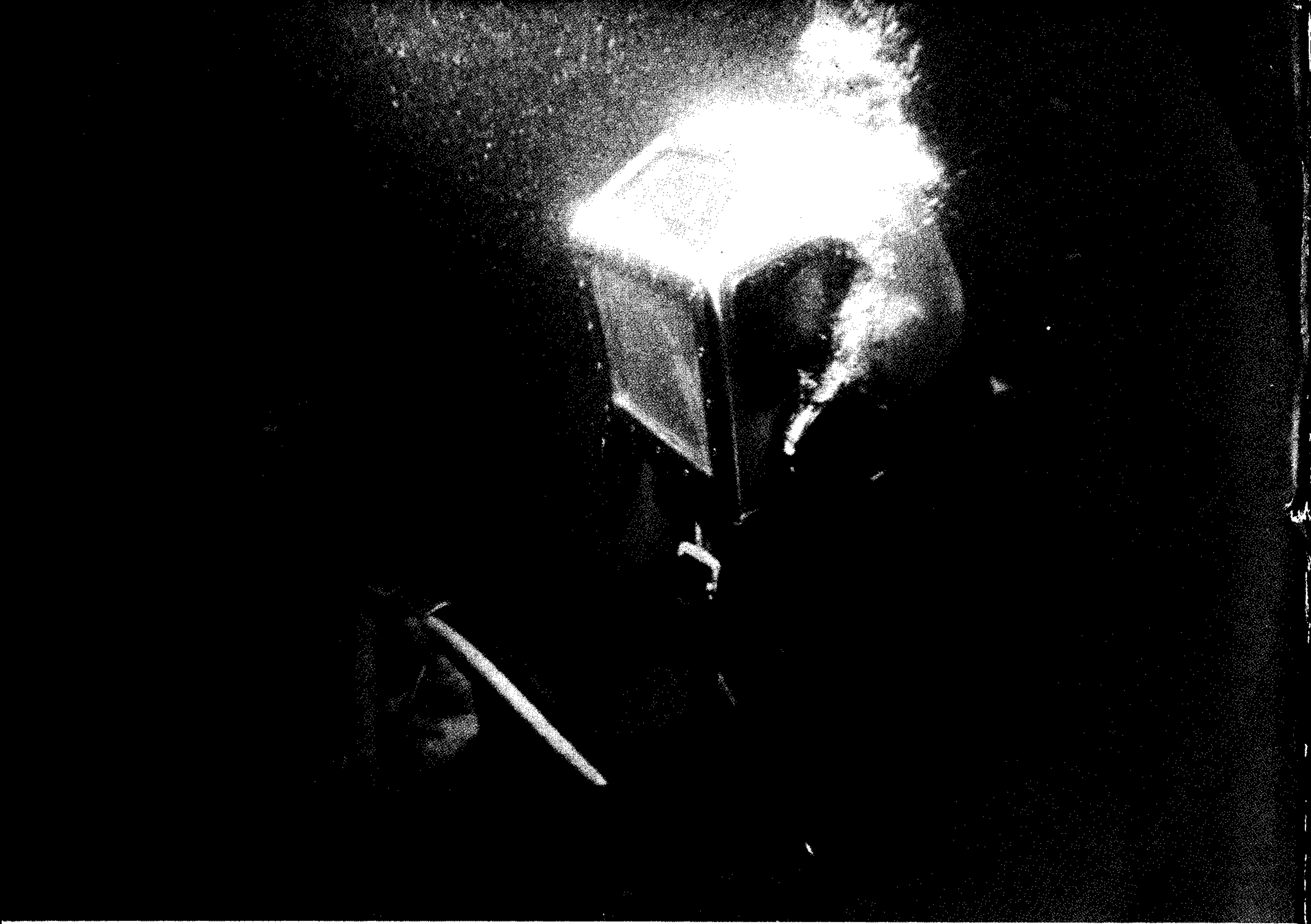
This report and its conclusions are based on the information gained by the submission of OPNAV Form 9940/1. This is the form that combines the old diving log and the accident/injury form. I'd like to remind each and every one of you to take extra care in filling out completely a proper 9940/1 for each dive you make. The information you provide on each form is assembled together with all other 9940/1 forms that are sent to the Naval Safety Center in Norfolk, Virginia. This assembled group of statistics is then used by a variety of people.

In Washington, diving statistics are used to get funds from Congress for the operation and maintenance of diving ships and equipment and for the development and issue of new diving equipment. The Chief of Naval Operations uses these diving statistics to justify the total number of divers in the Navy, as well as to cut and create new diving billets. In addition, detailers use these figures to plan for tour rotation of Navy divers. The Bureau of Medicine and Surgery and the Navy Experimental Diving Unit use these diving statistics to spot faults in decompression/treatment tables and to find mistakes in operating and emergency procedures for diving equipment. Further, these statistics are used by the Safety Center to ensure that Navy diving is still the safest "game in town." And, finally, the fleet staffs use this information to decide which units will get new diving gear and which will get old diving gear.

So if you look at the overall picture, you'll see that the ol' 9940/1 form isn't so insignificant! Remember, all those people who use those diving statistics to support the fleet are depending on you—the NAVY diver. The correct address to send your 9940/1's to is as follows:

Commander, Naval Safety Center
Attn: Code 22
U.S. Naval Station
Norfolk, VA 23511

Your next 9940/1 might be the one that identifies a fault in a piece of diving gear or a mistake in the tables!



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