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UNITED STATES GENERAL ACCOUNTING OFFICE  
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MANPOWER AND WELFARE DIVISION

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The Honorable Paul G. Rogers  
House of Representatives



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Dear Mr. Rogers:

This is in response to your request concerning hyperbaric (high-pressure) facilities used by the Department of the Navy in its deep submergence research programs. You requested us to provide information on

- the Navy's justification for building a new hyperbaric facility at Bethesda, Maryland, while a similar facility is being built at Panama City, Florida;
- the number, depth capability, and use of the hyperbaric facilities available in the District of Columbia, Maryland, and Virginia; and
- the Navy's proposed use of the hyperbaric facility at Panama City.

As previously discussed with you, we limited our work to (1) reviewing data on the Navy's undersea research programs and the planning documents for the facilities at Bethesda and Panama City and (2) interviewing Department of Defense and Navy officials regarding the missions and functions of the Bethesda and Panama City facilities and the relationships between them.

The Navy uses hyperbaric chambers to simulate undersea conditions. The safety, health, and effectiveness of personnel required to live and work in the sea are insured by using these chambers to (1) develop equipment capable of withstanding the high pressures and other hazards of the ocean depths and (2) determine the physiological and psychophysiological effects of undersea environments on man.

A June 1966 report of the President's Panel on Oceanography entitled "Effective Use of the Sea" stated that the general level of research for using man at depths in the ocean was inadequate. The report pointed out that the Navy had primary responsibility for developing the capability for human activity at

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ocean depths. According to a Navy official, this report was instrumental in the Navy's increasing its hyperbaric research efforts.

#### THE BETHESDA FACILITY

The Navy is building a 95,000-square-foot research facility at Bethesda called the Environmental Health Effects Laboratory. It will accommodate the Naval Medical Research Institute's Environmental Biosciences and Behavioral Sciences Departments and the Navy Toxicology Unit.

The Laboratory will perform basic and applied research and development. The effects of stresses imposed by underseas environments on animals will be emphasized. Planned research includes such biomedical areas as oxygen toxicity, breathing resistance, gas narcosis, tissue bubble formation, decompression schedules, and pharmacology.

All three hyperbaric chambers currently operational at Bethesda are restricted in depth capability. One animal chamber has a maximum depth capability of 1,000 feet, another smaller chamber is limited to 670 feet, and a clinical chamber for humans is limited to 225 feet. According to Navy officials, these chambers are inadequate because:

- They are not equipped for long-term deep dives.
- The two larger chambers and related equipment are 29 years old and are inadequate for deep submergence research beyond 1,000 feet.
- Wet 1/ or low temperature dives are not possible.
- The long time it takes to compress and decompress them hampers research.

The officials also cited inadequate laboratory space for animal preparation and equipment storage.

The Laboratory's estimated cost is about \$13.4 million. It is expected to house 12 hyperbaric chambers--4 with a 2,200-foot depth capability and 8 with a 3,300-foot depth capability.

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1/ A wet dive is a dive in a chamber flooded with water.

In November 1974 approximately 73 personnel were involved in hyperbaric research at Bethesda. A Navy official said the number of deep submergence biomedical research projects will be increased to insure that the additional hyperbaric chambers are used. To fully operate the Laboratory, the following 12 additional personnel will be required:

- 2 diving medical technicians.
- 2 ship fitter-machinists (must also be qualified as chamber operators).
- 3 electronics technicians (must also be qualified as chamber operators).
- 2 investigators (1 neurophysiologist and 1 respiratory physiologist-computer science specialist).
- 2 general lab technicians (must also be qualified as chamber operators).
- 1 lab histologist.

An official at Bethesda said that diving medical technicians are the only category presently in short supply.

Enclosure I contains information obtained from a Navy official regarding the number, depth capability, and use of hyperbaric facilities, in the District of Columbia, Maryland, and Virginia.

#### THE PANAMA CITY FACILITY

The hyperbaric facility being built at Panama City, called the Ocean Simulation Facility, will cost an estimated \$14 million and will consist of six chambers with 2,200-foot depth capabilities. The facility will create, develop, and test manned diving systems. Manned equipment systems and techniques will be tested in a simulated ocean environment to insure that they are effective, practical, and safe. The research will emphasize the man-machine interface and will be directed at developing undersea warfare capability, including mine, torpedo, and acoustic countermeasures; inshore submarine, sneak craft, and swimmer countermeasures; and swimmer-diver equipment and techniques.

As planned in 1966, the facility was to be used and staffed by the Naval Coastal Systems Laboratory in Panama City. However,

the Navy recognized early in 1972 that the staff at this Laboratory would not be sufficient to fully use both facilities. Therefore, the Navy decided to staff the Ocean Simulation Facility by relocating the Experimental Diving Unit from the Navy Yard at Washington, D.C., to Panama City in November 1974. The Navy said this relocation was desirable because the diving unit's chambers were 31 years old and inadequate for dives of more than 1,000 feet. The diving unit staff consists of 95 personnel, including a psychologist, medical officers, engineers, technicians, and experienced Navy divers.

The diving unit performs in-house diving and diving systems development, testing, and certification of systems, including biomedical and physiological testing, work in gas mixtures, and decompression. The Navy has stated that the Ocean Simulation Facility would remain available for Naval Coastal Systems Laboratory programs as well as for activities of the diving unit.

According to the Navy, the Ocean Simulation Facility will provide (1) a reference center for diving physiology and medical information and (2) consulting services to the Navy and the civilian community on decompression tables, diving diseases, and treatment of decompression sickness. In addition, the medical department intends to perform studies in a number of areas, including

- breathing resistance studies on underwater breathing apparatus on immersed man,
- cardiorespiratory responses to immersed exercise, and
- the application of physiology research methods to underwater breathing apparatus evaluation.

Enclosure II contains information obtained from a Navy official on the planned use (from Nov. 18, 1974, through June 1, 1976) of the six hyperbaric chambers at the Panama City facility.

#### FEASIBILITY OF CONSOLIDATING THE FACILITIES

According to Navy officials, the Bethesda and Panama City facilities cannot feasibly be consolidated because:

1. The researchers at Bethesda are involved in many biomedical research areas, only some of which require hyperbaric chambers. Transferring researchers involved in hyperbaric research would adversely affect their other research.

2. The Bethesda location offers researchers opportunities for interchange with the National Institutes of Health, universities, and the Bethesda Naval Hospital and access to excellent libraries. Researchers we interviewed considered such intangible assets vital to their research. On the other hand, work at Panama City will focus on testing and evaluating systems and techniques, not on basic biomedical research.
3. Neither facility could handle the workload of both laboratories. A Bethesda official said the present chambers were used an average of 30 hours a week. The logbooks showed that these chambers were used 4,891 hours between January 1, 1973, and November 11, 1974. This total did not include nonscheduled dives, setup time, and postdive time.
4. Five Bethesda chambers will be used in toxicology studies, making them unsuitable for the manned equipment systems to be tested at Panama City.
5. Certain facilities, such as additional chambers and animal laboratory and housing space, would have to be constructed at Panama City to accommodate the Bethesda programs.

The Chesapeake Division of the Naval Facilities Engineering Command estimated that it would cost about \$29 million in facility expansion to give Panama City the capability of performing the research scheduled for Bethesda. In addition, Navy officials estimated an additional \$1 million per year in operating costs to carry out the research program at Panama City.

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We discussed the matters in this report with Navy officials, who agreed with the accuracy of the facts presented. We do not plan to distribute this report further unless you agree or publicly announce its contents.

Sincerely yours,



Gregory J. Ahart  
Director

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HYPERBARIC FACILITIES IN  
THE DISTRICT OF COLUMBIA,  
MARYLAND, AND VIRGINIA

	<u>Use</u>	<u>Number</u>	<u>Hyperbaric chambers</u> Maximum depth capability ( <u>feet</u> )
District of Columbia (note a):			
U.S. Naval Oceanographic Office	Recompression and decompression	1	280
U.S. Naval School of Diving and Salvage	Diver training and testing; recompression and decompression and medical treatment	2	200
Maryland:			
Westinghouse Ocean Research and Engineering Center, Annapolis	Diving research, diver training; recompression and decompression	3	1,500
Center for the Study of Trauma, University Hospital, University of Maryland School of Medicine, Baltimore	Medical treatment and research	2	224 and 168
	Diving research	1	1,000
U.S. Naval Explosive Ordnance Disposal Facility, Indian Head	Recompression and decompression	1	450
Naval School, Explosive Ordnance Disposal, U.S. Naval Ordnance Station, Indian Head	Diver training and testing	1	180

		<u>Hyperbaric chambers</u>	
		<u>Number</u>	<u>Maximum depth capability (feet)</u>
	<u>Use</u>		
U.S. Naval Ordnance Laboratory Test Facility, Solomons	Diver training and testing; recompression and decompression	1	224
U.S. Naval Medical Research Institute, National Naval Medical Center, Bethesda	Medical treatment and research Animal research	1 2	225 670 and 1,000
Virginia:			
U.S. Army 77th Engineer Company, Fort Belvoir	Recompression and decompression and transfer	1	224
Marine Hull Division Diving Section, U.S. Army Transportation School, Fort Eustis	Diver training; recompression and decompression	1	450
Water Immersion Simulator, Langely Research Center, National Aeronautics and Space Administration, Hampton	Recompression and decompression	1	450
Harbor Clearance Unit Two, U.S. Naval Amphibious Base, Norfolk	Diver training and testing; recompression and decompression	2	165
Underwater Demolition Team Twenty-One, Naval Special Warfare Group, U.S. Naval Amphibious Base, Norfolk	Diver training; recompression and decompression	2	224

ENCLOSURE I

		<u>Hyperbaric chambers</u>	
		<u>Number</u>	<u>Maximum depth capability (feet)</u>
	<u>Use</u>		
Medical College of Virginia, Richmond	Medical treatment	1	33

a/ Does not include six chambers of the Experimental Diving Unit at the Washington Navy Yard. The chambers will be disassembled and the support systems will be moved to Panama City.



PLANNED USE OF HYPERBARIC CHAMBERS  
AT OCEAN SIMULATION FACILITY, PANAMA CITY, FLORIDA,  
FROM NOVEMBER 18, 1974, THROUGH JUNE 1, 1976

Activity scheduled

## 1974:

Starting Nov. 18	Moving, setup, and repairs; training program, classroom and on-the-job training
Dec. 2 to 6	Certification review, certi- fication dive, walk through, precertification dive opera- tion
Dec. 9 to 13	Certification dive
Dec. 16 to 29	Corrections, certification dive, if required
Dec. 16 to Mar. 1975	Compressor and hardware check- out of MK XIV system (type of breathing system)
Dec. 24 to Jan. 2, 1975	Holiday leave period

## 1975:

Jan. 2 and 3	Final pre-dive check
Jan. 6 to 10	10-ft. checkout dive in manned chambers--A, B, C, D, E, and wet chamber <u>a/</u>
Jan. 8	Dedication
Jan. 13 to 17	30-ft. dive, chambers A, B, and C
Jan. 20 to 24	30-ft. dive, chambers C, D, and E
Jan. 27 to Feb. 7	Upkeep, dive workup for 100/300-ft. saturation dive (dive over 6 hours' dura- tion)

Activity scheduled

Feb. 10 to 17	100/300-ft. saturation dive, chambers A, B, C, and wet
Feb. 18 to Mar. 3	Upkeep
Mar. 3 to 18	300-ft. saturation excursion dive (variation in diving depths), chambers A, B, and C
Mar. 10 to Apr. 7	Installation of MK XIV equipment in chambers D and E
Mar. 18 to Apr. 1	Upkeep
Apr. 1 to 15	300-ft. saturation dive with excursions
Apr. 13 to June 10	Breathing machine tests on MK XIV equipment in chambers C, D, and E at 200 ft., 400 ft., and 800 ft., respectively
Apr. 15 to 29	Upkeep and workup
Apr. 29 to May 13	300-ft. saturation excursion dive
May 13 to June 2	Upkeep and workup
June 2 to 17	300-ft. saturation excursion dive
June 17 to July 8	Upkeep and workup
July 8 to 22	300-ft. saturation excursion dive
July 22 to Aug. 5	Upkeep and workup
Aug. 5 to 19	200-ft. saturation excursion dive with MK XIV equipment
Aug. 19 to Sept. 2	400-ft. saturation excursion dive with MK XIV equipment
Sept. 16 to Oct. 1	Upkeep

Activity scheduled

Oct. 7 to 21	800-ft. saturation excursion dive with MK XIV equipment
Oct. 21 to Nov. 11	Upkeep
Nov. 11 to Dec. 11	1,000-ft. saturation excursion dive with MK XIV equipment
Dec. 11 to Jan. 6, 1976	Upkeep and holiday routine
1976:	
Jan. 6 to Feb. 9	1,400-ft. saturation excursion dive
Feb. 9 to Mar. 2	Upkeep
Mar. 2 to 30	1,800-ft. saturation excursion dive
Mar. 30 to May 4	Upkeep and workup
May 4 to June 1	2,000-ft. saturation excursion dive

a/ The six chambers are referred to by the Navy as A, B, C, D, E, and a wet chamber.