[illegible] as the principal breathing medium.

2. Planning Estimates:	FY74	FY75	FY76	FY77	FY78	FY79
a. Man Years (Total)	4.4	5.0	5.0	5.0	5.0	5.0
1. Military	2.3	2.3	2.3	2.3	2.3	2.3
Professional	0.9	1.0	1.0	1.0	1.0	1.0
Supporting	1.4	1.3	1.3	1.3	1.3	1.3
2. Civilian	2.1	2.7	2.7	2.7	2.7	2.7
Professional	0.6	0.9	0.9	0.9	0.9	0.9
Supporting	1.5	1.8	1.8	1.8	1.8	1.8
b. Funds (Total)	95	125.0	127.0	128.0	129.5	131.0
1. BUMED Research	75	125.0	127.0	128.0	129.5	131.0
Personal Services	27.0	27.0	29.0	30.0	31.5	33.0
Material	22.0	25.0(1)	25.0	25.0	25.0	25.0
Other	0	13.5	0	0	0	0
2. Contributing	20.0	0	0	0	0	0

c. Contracts: None

d. Facilities: None

e. Equipment: Gas Mixing system to reduce cost of buying bulk quantities of pre-mixed gases - 30K; water system for potable water and emergency fire system - 2K; masks and suits - 2.5K TOTAL 34.5K

f. Continuing Costs: Overhead Distribution 25K

(1) Material to include: Bulk nitrogen and helium for divers breathing gas; food; sodasorb; purafil; videotape; audiotape and various miscellaneous items.

3. Objectives: The stated objectives of this study are: (1) to explore the adaptability and physiological responses of man during long exposures to partial pressures of nitrogen at shallow and intermediate depths; (2) to determine the range of partial pressures of oxygen suitable for use in a nitrogen-oxygen breathing gas mixture during saturation diving; (3) to explore the use of various breathing gas mixtures in excursion dives from a saturated nitrogen-oxygen base.

Physiological and biochemical monitoring of germane parameters will result in a concise medical evaluation of man in the sequence [illegible] on-[illegible] evaluation of adaptation to breathing elevated partial pressures of nitrogen for extended periods will offer additional insight into the problem area of inert gas narcosis. Further observations pertinent to the phenomena of isobaric gas exchange in man, and the sequential use of multiple inert gases in diving will be made. A systematic evaluation of the tolerance and adaptation of man to the elevated partial pressures of oxygen and nitrogen present in compressed air at simulated depths below 60 feet of sea water can be made after animal experimentation indicates that no significant oxygen toxicity is likely to develop at specific depths. This program has been underway under a work unit recently terminated and will continue under this work unit.

4. Technical Approach: The use of NITROX (nitrogen-oxygen) breathing mixtures, including compressed air, has been an established diving technique during short exposures for many years at relatively shallow depths of usually less than 200 feet of sea water. Multiple day exposures to compressed air have been successfully completed at simulated, and actual depths of 60 feet, and saturation exposures have also been conducted at a simulated depth of 100 feet, employing nitrogen and 0.2 atmospheres of oxygen (NORMOXIC). Helium-oxygen mixtures have been employed for saturation and short term exposures at depths of up to two thousand feet.

The stresses imposed by brief exposures to nitrogen at depths of less than 200 feet suggest that long term saturation exposures should be possible. The safety of a fourteen day exposure of man to normoxic nitrox mixtures at 100 feet has been established at several laboratories. Under this work unit, the physiologic responses and adaptation of three subjects will be measured during saturation exposures in a dry chamber at depths starting at 100 feet, and progressing downward in increments of about one atmosphere until careful monitoring suggests that the safe limits of human exposure have been reached.

When it has been demonstrated that subjects can safely and effectively function while saturated under these conditions, simulated excursion dives employing helium-oxygen breathing mixtures or nitrogen-oxygen breathing mixtures will be made from the saturation depth. The oxygen content during these normoxic saturation dives will be maintained between 0.2 and 0.3 atmospheres during the saturation phase and will range from 0.2 to 1.2 atmospheres during the excursions. This is within known safety limits and should avoid any oxygen toxicity.

Compressed air is a nitrogen-oxygen mixture of special interest because of its ready availability and low cost. Previous studies at this Laboratory have demonstrated that human subjects can breathe for several weeks at 50 and 60 feet of sea water pressure, and tolerate excursions to a depth of 250 feet, as well as up to 5 feet. This series of shallow habitat air dives (SHAD) evaluating the effect of breathing elevated partial pressures of oxygen in the presence of much higher partial pressure of nitrogen, will be continued.

Experimental animal (rat) dives will precede human exposures. The animals will be carefully evaluated for morbidity, including evidence of oxygen toxicity, particularly in the respiratory system. [illegible] exposures [illegible] the exposure time [illegible] for the animals, and excursions will not exceed a simulated pressure of 300 feet of sea water.

Each dive will be carried out in a dry hyperbaric chamber located in Building 141, Naval Submarine Medical Research Laboratory under the immediate supervision of ENC (MDV) James E. Jordan, USN (Ret.) or his designated alternate. The chamber atmosphere will be managed to optimum comfort through maintenance of a comfortable temperature and humidity, as well as continuous carbon dioxide removal. Continuous monitoring of the chamber parameters will be maintained. A volume tank, supplied by two air compressors, supplies compressed air for air diving and emergency breathing purposes. Nitrogen and helium gases conforming to U.S. Navy standards will be purchases from commercial sources either premixed with oxygen or to be mixed with oxygen, under the supervision of Mr. Jordan, or his designated alternate. Mask breathing of appropriate gases will be immediately available to meet medical contingencies. Decompression procedures will be based on the standard perfusion limited model of Haldane, using limiting values proven safe in recent experiments at this Laboratory, and other laboratories with proven scientific reputations in diving.

To effect an accurate evaluation of the chamber environment and to assure the immediate medical safety of the inhabitants, numerous tests will be administered and biomedical evaluations completed daily pre, post, and during the various saturation dives. Pre-/post each dive the volunteer inhabitants will be a participant in the diver Longitudinal Health Survey (long bone surveys on a pre-basis only). During the dive, medical examinations will be done in the pressurized environment by a diving medical officer at intervals consistent with the requirement for inhabitant safety. Various mental arithmetic, tracking, discrimination and auditory tests will be administered frequently throughtout the dive. Visual evoked responses, EEG, visual acuity, lateral and vertical phoria, depth perception, field of view, and night vision sensitivity will be measured to assess the inhabitants for possible subtle, acute and/or chronic effects of oxygen. Pulmonary function will be measured as appropriate with a wedge spirometer. Moderate workloads (200-250 watts) will be effected daily through bicycle ergometry to assist in maintenance of physical fitness and to assess exercise tolerance. Scalar/vector EKG's and breath by breath gas analysis will be done daily. Blood samples will be collected daily for hematological assessment, and chemistry/biochemistry monitoring. Blood gas analysis and blood pH determinations will also be conducted periodically during these experiments. Twenty-four hour urine specimens will be monitored for physical and biochemical variations. A doppler bubble detector will be used to monitor all decompression and periods of exposure to breathing mixtures containing helium. The judicious utilization of these evaluations should permit effective inhabitant monitoring during the dive and a thorough evaluation of the dive upon completion.

5. Investigational Drugs: N/A

6. Use of Human Volunteers: Yes. Use of human volunteers in this study will be in accordance with SECNAV INS[illegible] 00.39. A proposed human [illegible] will be submitted [illegible] for approval prior to conducting the proposed experiments. Volunteer subjects will be personnel trained in an appropriate course of instruction as a diving corpsman, first or second class diver or they will have completed the course of instruction in Hyperbaric Nursing at the Submarine Base, Groton, Conn. Subjects will hold current diving or hyperbaric chamber qualifications.

7. Future Plans: FY75:

a. Complete 15 day NITROX dive with 3 subjects spending five days at each of 3 depths - 100 feet, 132 feet and 165 feet.

b. Complete 14 day 100 foot NITROX dive with HELIOX excursions.

c. Complete the third dive in the shallow habitat air dive (SHAD) series (depth and time to be established after suitable animal experimentation).

8. Publications:

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