APPLICATION TO NMRI COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS

REF: SECNAVINST 3900.39A

NAV1.954607.005

I. PRINCIPAL INVESTIGATOR: Weathersby, P.K. LCDR, MSC, USN

ASSOCIATE INVESTIGATORS: Homer, L.D., Flynn, E.T., CAPT, MC, USN
Meyer, P. (Livermore Laboratories)

II. TITLE OF RESEARCH PROJECT: Tracer Gas Kinetic Studies for Decompression Table Design.

III. LOCATION WHERE STUDY WILL BE PERFORMED. Lawrence Livermore Laboratory, Livermore, California

IV. A. The Livermore Committee will review the application before the experiments are begun. That committee has approved the FY81 proposal for human experiments.

B. N.A.

V. APPROXIMATE DATES OF RESEARCH: FROM: 7/81 TO: 9/82

VI. DESCRIPTION OF RESEARCH:

The project involves breathing a mixture of 20% oxygen and 80% Nitrogen for a period of up to 120 minutes. The gas will also contain up to 0.5 mCi per liter of nitrogen-13, krypton-85, and/or argon-37. For the period of radioactive gas breathing and for the up to 60 minutes follow the subjects will be sitting in front of a radiation detection device (a positron gamma camera). The radioactive nitrogen is prepared on-site by bombardment of pure nitrogen with gamma rays and other tagged gases are either prepared on-site or purchased.

Normal male volunteers from NMRI will be used. Up to to ten subjects will be studied, some subjects may be studied twice. No medications will be used and no pain will experienced. Only very minor discomfort will be felt from the requirement of breathing through a mouthpiece and remaining immobile for 120 minutes. Some of the subjects will also be asked to have a single x-ray exposure for anatomic reference to the gas study.

VII. a. What are the risks that may or may not be encountered by subjects?

The only risks inherent in the procedure are those arising from the special gas breathed. Chemical risks arise from the possibility of creating noxious gases in the radioactive nitrogen preparation. These could include ozone and nitrogen dioxide. The major risk is radiological, that is, the unavoidable exposure of subjects to ionizing radiation. The total dose of radiation from the studies is estimated to not exceed 0.5 rad to the lungs and 0.01 rad to the body (2). This dose can be compared to the 0.18 rad/year of natural background exposure of the total population; 0.026 rad for a single chest x-ray; 5.0 rad/year, the current federal satutory limit for occupational exposure; and 4000 rads in clinical radiation therapy (1).

b. What are the safeguards against these risks?

The procedures to be used will attempt to minimize the chance of any chemical risks and to prevent any radiation exposure above the amount stated above. The radioactive nitrogen will be prepared using techniques developed by P. Meyer. Only very pure nitrogen will be exposed to the gamma-ray source (LINAC electron beam with heavy metal target). After activation, samples of the gas will be taken and immediately analyzeed for ozone, nitrogen dioxide and N-13 activity. Only when these analyses are completed will the nitrogen-oxygen mixture be breathed by the subject. Expired gases will be directly vented outside the lab building to prevent any other exposure. Subject doses will be calculated by standard methods (2) since the major exposure is too localized and transient to be directly measured.

Procedures will follow those established last year. In those experiments the measured ozone and nitrogen dioxide were well below specification in every case. External dosimetry of test subjects showed no detectable radiation dose occurred (less than 0.01 rad). Final internal dosimetry calculations showed lung doses in the subjects of 0.30 to 0.45 rad, compared to the chosen limits of 0.50 rad.

c. What benefit will science or the subject potentially realize?

No direct benefits will be realized by the subjects. Indirect benefits may be realized by U.S. Navy divers, a group that is expected to provide the majority of subjects. The project is designed to provide data on the rate of nitrogen uptake and elimination in the human body. Decompression sickness among divers is thought to be caused by an inability to remove the excess nitrogen from a diver's body after breathing high pressure air. Prevention of decompression sickness is approached by adherence to decompression tables that are calculated to match the rate of nitrogen removal with the rate of diver return to normal pressure. The study proposed will attempt to provide the data necessary for NMRI to provide the safer decompression tables required by 1982.

The procedures are well established at the Livermore laboratory and are well accepted nationally in the field of experimental physiology. The equipment and expertise are too specialized for any accepted clinical standard.

VIII. The NMRI Informed Consent is attached as well as reference (2) and the previous version of the Livermore Informed Consent.

REFERENCES

1. The effects on population of exposure to low levels of ionizing radiation. National Academy Science, National Research Council, Washington, D.C.

2. Lawrence Livermore Laboratory Memo to Paul Meyer from C.B. Ozaki, 23 MAY 80, "Estimation of total absorbed doses from inhalation of 13-N, 15-O, 37-Ar, and 85-Kr".