[redacted]

AG CENTRAL FILES

FILE # 920

VOLU[redacted]

MONTH JA[redacted]ARY Dec

SUBJECT: WEAPONS EFFECTS, GENERAL.

[redacted]

C[redacted]RTIFICATE

I certify that I have had access to the attached file on the days indicated below, and that no papers or other material were removed from the file while in my possession.

NOTE: This is to be certified by each person using this file.

SIGNATURE	DATE OUT	DATE RETURNED

WASHINGTON 25, D.C.

REPLY TO ATTN OF AFRDR-NU

25 JUL 1962

SUBJECT FY 64 Nuclear Weapon Effects Research Program

920

12605

TO Chief
Defense Atomic Support Agency
Washington 25, D.C.

1. Reference is made to HQ USAF letter, subject as above, dated 5 June 1962.

2. Request the attached proposal be included in the FY 64 NWER program in the Biomedical area. The work contemplated will be more specifically detailed subsequent to the present nuclear test series.

FOR THE CHIEF OF STAFF

Leonard A Eddy

LEONARD A. EDDY
Colonel, USAF
Directorate of Research
LCS/Research & Technology

1 Atch
DD 613c, Project No 780C-5830,
Oculo-Visual Damage from
Thermal Radiation

Copy
Ltr
&
NEXT 5 pp

RESEARCH PROPOSAL FOR SUBTASK IN
NUCLEAR WEAPONS EFFECTS RESEARCH

920

Item 1. Weapons Effects Board Number and Title: Number ;
Title: "(U) Oculo-Visual Damage from Thermal Radiation"

Item 2. DASA CMAS Code: A10c

Item 3. Directing Agency: School of Aerospace Medicine (AMD), AFSC

Item 4. Contractor and/or Government Laboratory:

To be determined.

Item 5. Contract Number: To be determined.

Item 6. Estimated Funding:

	(Thousands $)
FY 64	150
FY 65	150
FY 66	150
FY 67	150

Item 7. Estimated Completion Date: 1967

Item 8. Requirement and/or Justification: This research is in direct support of ARO's 38C01, 38C03, 38C04 and 38C05. The continuity of vision is an absolute requirement for the execution of the military missions. Because of anatomical characteristics of the eye, it is vulnerable to the devastating effects of thermal and thermonuclear radiations. Therefore, research must be accomplished to obtain threshold data for ocular tissue damage for the entire spectrum of thermal and ionizing radiations. Also, the histochemical tissue changes must be studied to understand underlying mechanisms. Such information is essential to the intelligent therapeutic management of persons so exposed. Since prevention of tissue damage is the ultimate goal of this research, a part of the effort is directed to the development of eye-attenuating, variable density filters for use in windows, canopies, goggles, and optical instruments.

Item 9. Brief of Proposal and Objective:

A. Brief: The objective of this task is to conduct in-house and

contractual research programs that will provide a basis for the therapy and prevention of ocular radiation damage. These will include:

1. Clinical and histopathological investigation of cellular tissue effects of radiation exposure.

2. Accumulation of threshold data for ocular damage for thermal radiations.

3. Evaluation of functional visual decrements, transient and permanent, resulting from thermal radiations.

4. Establishing ocular constants for appropriate laboratory animals so that data is extrapolatable to the human situation.

5. Developing a workable filter system suitable to provide eye protection under changing conditions of thermal irradiance.

B. Approach: Histopathologic staining techniques, clinical biomicroscopy, and other clinical laboratory techniques will be used to study clinical pathologic changes resulting from radiation exposure.

Two thermal devices (photocoagulator and heliostat) are currently being used to produce retinal thermal damage. The primary purpose of these studies is to evaluate the occurrence and character of retinal burns with the varying parameters of dosage, image size, irradiance (rate of heat delivery) spectral nature of source, and lesion site for various ocular tissues. Also, the photocoagulator has been modified to serve as a source for the production of transient visual decrement (flashblindness). This phenomenon is being evaluated with respect to (1) duration of exposure, (2) pupil size, (3) state of retinal pre-adaptation and field luminence.

In order to relate anatomic and physiologic characteristics of human and animal subjects, it is necessary that appropriate ocular constants be established which include: (1) refractive status, (2) principal planes and points, and (3) transmissivity and absorbence of ocular tissues.

One method of affording eye protection from retinal burn and/or flashblindness is that of application of photoreactive materials which act as self-attenuating filters. While many chemical compounds exhibit phototropic properties, only a few

groups are suitable for this purpose. One such group is the spiropyran family and related compounds. Application of this type material has demonstrated that the hazard of flashblindness can be reduced or eliminated. Further evaluation of these materials is necessary to completely define the maximum potential of these materials. Methods for standardizing and comparisons of material groups are currently being developed to serve as a basis for selection, development, and evaluation of any photoreactive material.

C. Related Subtasks: This study is a continuation in the laboratory of a retinal burn field study begun many years ago and culminating in Operation Hardtack. The results of these other studies are still being evaluated and the data will be compared ultimately with these laboratory data.

D. Other Information: None

E. Background History and Progress: This task is a combination of the oculo-visual work of interest to DASA and formerly listed under task titles 5830-67021 and 5830-67029. In the past, work has consisted of independent studies by National Cash Register Company (monitored by personnel in the Ophthalmology Branch, School of Aerospace Medicine) in which prime emphasis has been to explore the feasibility of using photochromic dyes for protective filter devices against flashblindness in nuclear explosions. In-house studies previously have been directed toward the delineation of retinal burn thresholds for thermal irradiation and to determine transmission of light through ocular media. These separate efforts have culminated in some instances in evaluation at Weapon Effects Tests at both the Pacific and the Nevada Test Sites.

Ocular tissues are sensitive to radiation; the lens and retina being more sensitive than other ocular tissues. Thermal radiation may cause temporary loss of visual function, flashblindness, or if sufficient energy is present will cause chorioretinal burn with permanent damage. Thermal radiation as used here include: near ultraviolet, visible and near infrared radiations as would emanate from a nuclear detonation. The site of damage from thermal radiation is the retina and choroid primarily because absorption of the energy and production of heat occurs at this site.

One basic problem is that of determining threshold retinal thermal dosage to produce a permanent chorioretinal burn lesion.

initial work has included the construction of a heliostat laboratory, which uses the radiant energy of the sun as a source, and high irradiances can be produced. Instrumentation design and construction of equipment has been accomplished, as well as testing of equipment. Production of retinal burns in rabbits has been started.

In-house research is being accomplished, including acquisition data on ocular constants such as refractive status and principal planes of animal eyes, transmissivity characteristics of animal eyes, and other animal studies which are designed to show functional versus gross damage. Acuity evaluation in the rhesus monkey is a well established laboratory procedure. Flashblindness studies have been carried out using a modified photocoagulator and considerable useful data regarding the physiological responses involved has been obtained.

Contracts with the National Cash Register Company are currently providing the United States Air Force with a photochemical device (self-attenuating variable density filter) to provide protection against flashblindness. The National Cash Register Company has developed a series of photochemical dyes that can be triggered by certain light wavelengths. Initial study of over 200 photoreactive compounds has been accomplished, and seventeen new photoreactive compounds were synthesized, many of which exhibit absorption in the blue region of the visible spectrum. Preparation of materials capable of absorption in the shorter wavelength range represents a significant adva e in the neutral density filter program.

Experimental filters that are complementary and exhibit absorption almost throughout the entire visible spectrum have been fabricated.

It has been determined that the position of the photostationary state is directly proportional to the concentration of the solution, and the rate of color formation is directly proportional to the intensity of the irradiating light.

F. Future Plans:

1. To study changes in ocular media from acute and chronic subthreshold dosages of radiation.

2. To study in greater detail functional decrements resulting from threshold and subthreshold radiation exposure.

3. Continued evaluation to establish more definitive threshold criteria.

4. Evaluation of various spectral bands with regard to ocular damage. In particular, suitable energy sources such as optical masers will be evaluated for this purpose.

G. References:

Glutathione Protection in X-Irradiated Eyes. A. A. Swanson, H. W. Rose, and J. I. Taube. Archives of Ophth. 57:832, 1957.

Glutathione Protection in X-Irradiated Eyes. A. A. Swanson, H. W. Rose, and J. I. Taube. Fed. Proc. 16:126, 1957.

Effects of High Intensity X-Irradiation on the Retina. S. P. Kent and A. A. Swanson. Rad. Res. 6:111, 1957.

Effects on Eyes from Exposure to Very High Altitude Bursts. (Title not classified.) J. E. Pickering, R. G. Allen, et al. ITR 1633, 23 January 1959.

Development of Photoreactive Materials for Eye-Protective Devices. Richard E. Fox. The National Cash Register Company, SAM Report 61-67, April 1961.

Visual Aspects of Radiation Exposure. J. F. Culver. Military Medicine, Vol. 126, No. 9, Sept 1961.

Early Ocular Effects of High-Energy Proton and Alpha Radiation. J. F. Culver and N. L. Newton. (In Press)

Protective Glasses Against Atomic Flash. J. F. Culver and A. V. Alder. Paper presented to AGARD, NATO Meeting, Lisbon, Portugal, Apr 61. (To be published in proceedings of that meeting.)