

AD-A078 543

CALIFORNIA UNIV LOS ANGELES
OPERATION PLUMBBOB, NEVADA TEST SITE, MAY-OCTOBER 1957. PROJECT--ETC(U)
SEP 57 B CASSEN , H C GASS

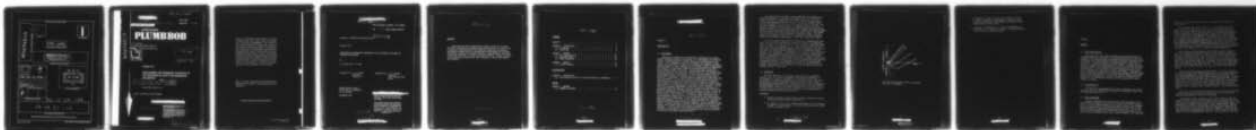
F/G 18/4

UNCLASSIFIED

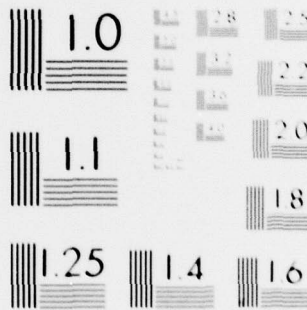
AEC-ITR-1492

NL

1 OF 1
AD
A078543



END
DATE
FILMED
1-80
DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

PHOTOGRAPH THIS SHEET

ADA 078543

DTIC ACCESSION NUMBER



LEVEL



INVENTORY

ITR-1492

DOCUMENT IDENTIFICATION

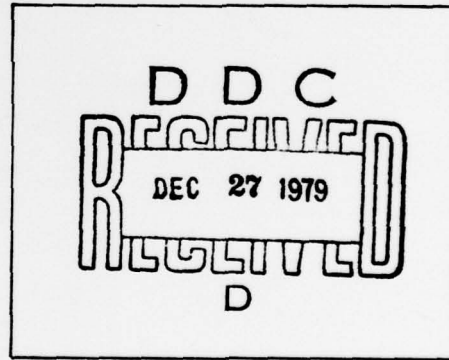
DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

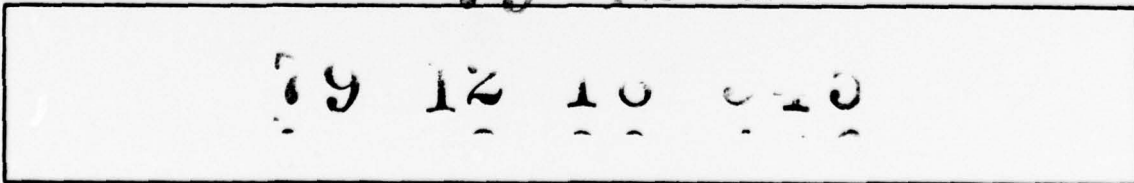
ACCESSION FOR	
NTIS	GRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
Per Hrc. on file	
BY	
DISTRIBUTION /	
AVAILABILITY CODES	
DIST	AVAIL AND/OR SPECIAL
A	

DISTRIBUTION STAMP



DATE ACCESSIONED

79 12 18 345



DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

(No WT issued)

~~CONFIDENTIAL~~

ITR-1492

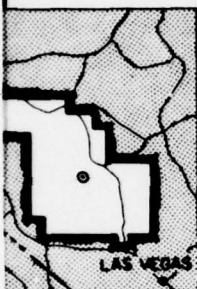
Copy No. 165 A

PRELIMINARY REPORT

UNCLASSIFIED

ADA078543

OPERATION PLUMBBOB



NEVADA TEST SITE
MAY-OCTOBER 1957

TECHNICAL LIBRARY
SEP 3 1958
of the
ARMED FORCES
SPECIAL WEAPONS PROJECT
a/24379

Project 37.4

MEASUREMENT AND PERMANENT RECORDING OF FAST NEUTRONS BY EFFECTS ON GERMANIUM DOSIMETERS

Classification (Cancelled) (Changed to- **UNCLASSIFIED**)
By Authority of TID 1381 (SUPPL) 31 Dec 71
By Phil Johnson Date 15 Feb 72

Issuance Date: August 27, 1958

CIVIL EFFECTS TEST GROUP



~~FORMERLY RESTRICTED DATA~~

UNCLASSIFIED

~~CONFIDENTIAL~~

Subject to Paragraph 100a in foreign dissemination.
Section 149b, Atomic Energy Act of 1954.

This material contains information affecting the national defense of the United States within the meaning of the espionage laws Title 18, U. S. C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

Statement A
Approved for public release;
Distribution unlimited.

This is a preliminary report based on all data available at the close of this project's participation in Operation PLUMBBOB. The contents of this report are subject to change upon completion of evaluation for the final report. This preliminary report will be superseded by the publication of the final (WT) report. Conclusions and recommendations drawn herein, if any, are therefore tentative. The work is reported at this early time to provide early test results to those concerned with the effects of nuclear weapons and to provide for an interchange of information between projects for the preparation of final reports.

When no longer required, this document may be destroyed in accordance with applicable security regulations.

DO NOT RETURN THIS DOCUMENT

CONFIDENTIAL

This document consists of 18 pages

No. 165 of 225 copies, Series A

UNCLASSIFIED

Operation PLUMBBOB Preliminary Report

Project 37.4

MEASUREMENT AND PERMANENT RECORDING OF FAST NEUTRONS BY EFFECTS ON
GERMANIUM DOSIMETERS

By

B. Cassen and H. C. Gass

Approved by: K. H. Larson
Director
Program 37

Approved by: R. L. Corsbie
Director
Civil Effects Test
Group

Atomic Energy Project
University of California
at Los Angeles

September 1957

~~FORMERLY RESTRICTED DATA~~

Handle as Restricted Data in foreign dissemination. Section 144b, Atomic Energy Act of 1954.

This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

UNCLASSIFIED

1-2

CONFIDENTIAL

UNCLASSIFIED

ABSTRACT

Laboratory and field experiments relative to the use of semi-conductor fast-neutron dosimeters which were pursued on a small scale in Operation Upshot-Knothole and Operation Teapot were continued. Considerable improvements in methodology and procedures of dosimeter preparation leading to increased accuracy, reproducibility and sensitivity were obtained in interim laboratory studies. Results obtained during Operation Plumbbob that take advantage of these improvements are reported.

UNCLASSIFIED

 ORIGINAL

UNCLASSIFIED

CONTENTS

ABSTRACT	3
CHAPTER 1 INTRODUCTION	7
1.1 Background	7
1.2 Objectives	8
CHAPTER 2 METHODS	11
2.1 Shot Participation	11
2.2 Instrumentation	11
2.3 Field Procedures	11
CHAPTER 3 RESULTS	14
3.1 Interim Summary	14

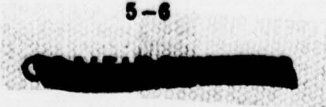
ILLUSTRATIONS

CHAPTER 1 INTRODUCTION	
1.1 Dose-response Curves for Various Purities of Germanium . .	9

TABLES

CHAPTER 3 RESULTS	
3.1 Summary of Results	15

UNCLASSIFIED



~~CONFIDENTIAL~~

UNCLASSIFIED

Chapter 1

INTRODUCTION

1.1 BACKGROUND

Discovery of changes in the electrical conductivity of single-crystal germanium produced by exposure to a fast-neutron flux was the result of investigations by Lark-Horowitz and collaborators at Oak Ridge.¹ First attempts to use this phenomenon for dosimetric applications were made by the authors in a preliminary study² at Operation Upshot-Knothole in 1953. Between 1953 and 1955, extensive improvement was obtained in small-scale research and development at the UCLA Atomic Energy Project (UCLA-AEP). Participation was undertaken in Operation Teapot,³ and relatively excellent results were obtained with one purchased batch of germanium. At the same time results were obtained with material from other sources of supply which were very difficult to interpret. Variable surface conductivity conditions were also encountered. It was then realized that material could not be satisfactorily specified for purchase and that probably subspectroscopic amounts of impurities could radically change the response characteristics of the single-crystal germanium to fast neutrons. During 1956, the Biophysics Department of the UCLA School of Medicine, in cooperation with the UCLA-AEP, received a grant from the Air Force to study the preparation of single-crystal germanium so that it could be grown to have reproducible and specifiable properties with respect to its response to fast neutrons. A zone-melt ingot purification and crystal-growing furnace was set up, and many melts were made under a wide variety of conditions.⁴ It was found that any type of previously observed response, e.g., that of the General Electric Co. (GE) and Hughes batches found during Operation Teapot,³ could be reproduced by control of minute amounts of certain additives such as metallic indium. Several such crystal ingots were grown in preparation for Operation Plumbbob. It has not yet been determined whether or not the prepared dosimeters are optimum for field measurements, but they are believed to be better than those previously used.

UNCLASSIFIED

~~CONFIDENTIAL~~
~~FOR OFFICIAL USE ONLY~~

The basic findings of this interim effort on the preparation of germanium suitable for dosimetry are shown in Fig. 1.1. The dose-response curve of the material most highly purified by zone melt is represented diagrammatically by curve A. It had the highest slope and the crossover point (a) fell in the range of 100 to 150 rep. The relative behavior of other batches is shown by curves B, C and D. Material prepared by GE³ followed a response such as D, with a crossover point (d) in the region of 18,000 rep. However, the initial slope in the negative direction, indicated by the dotted line F, was higher than the slope of A above its respective crossover point. For this reason the GE material seemed to give indications of some of the internal shelter doses on shot Apple I in the dose range of 25 rep.³

Up to the present time, numerous unsuccessful attempts have been made to add controlled amounts of indium to a material of characteristic response A in order to shift its starting point beyond the crossover (a) shown on the abscissa of Fig. 1.1. Different parts of the same ingot have been shown to acquire different responses, and much of the ingot was usually unusable because of the resultant low resistivity of the dosimeters. Preliminary tests indicated that a practical procedure for application to the problems of Operation Plumbbob entailed a preexposure of dosimeters made of type A material to about 2000 to 5000 rep., e.g., by placing a batch at a selected distance from a shot earlier than the shots on which the dosimeters would be used for measurement purposes. The procedure would produce the "bump-over" desired, with the associated disadvantage that the dosimeters would require recalibration at the UCIA-AEP to establish their initial resistances prior to field use.

1.2 OBJECTIVES

The main objective of the present operation was to determine whether or not the interim improvements and increased knowledge of the behavior of germanium dosimeters, as described in Sec. 1.1, could be utilized to obtain increased accuracy and sensitivity of fast-neutron dosage measurements made in the region of a nuclear detonation. A supplementary objective was to determine whether or not the higher initial negative slope of the type D material (Fig. 1.1) could be used to obtain greater sensitivity for measurement of fast-neutron penetration of personnel shelters close to GZ.

REFERENCES

1. Nucleon Irradiated Semiconductors, Reading Conference, Purdue University Special Report, July, 1950.
2. B. Cassen, H. Gass and J. Nuding, Measurement of Fast Neutrons by Effects on Semiconductors, Operation Upshot-Knothole Report WT-803, September, 1953.

8 UNCLASSIFIED

~~CONFIDENTIAL~~

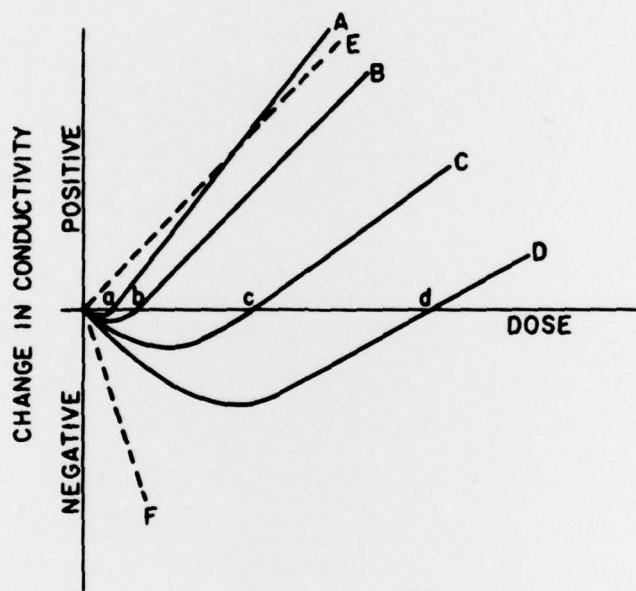


Fig. 1.1—Dose-response curves for various purities of germanium.

3. B. Cassen, H. Gass, T. Crough, W. A. Smith, Jr., and J. Moyer, Measurement and Permanent Recording of Fast Neutrons by Effects on Semiconductors, Operation Teapot Report WT-1170, March, 1957.
4. B. Cassen, V. Burkig and W. A. Selle, Development of a Germanium Crystal Dosimeter, School of Aviation Medicine, USAF, Report No. 57-90, May, 1957.

Chapter 2

METHODS

2.1 SHOT PARTICIPATION

After discussion with other dosimetric groups participating in Operation Plumbbob it was agreed that maximum information on the performance of the single-crystal germanium fast-neutron dosimeters could be obtained with minimum effort and expense through cooperative participation. Germanium dosimeter stations similar to those used at Operation Teapot¹ were placed adjacent to neutron and gamma-dosimetry stations surveyed and established by Projects 39.1 and 39.5 (ITR-1500 and ITR-1504). In this manner, resultant measurements could be directly compared with those made by other techniques. Participation of this nature was undertaken on shots Stokes, Doppler, Franklin Prime, Smoky, Fizeau and Laplace. On shot Smoky certain types of germanium fast-neutron dosimeters were placed in shelters in cooperation with Project 39.1 and returned to Project 37.4 for reading after their postshot recovery.

2.2 INSTRUMENTATION

The laboratory instrumentation and field methodology and instrumentation were not significantly different from Operation Teapot¹ and the references given in it.

2.3 FIELD PROCEDURES

Germanium dosimeters were prepared for field experiments by inserting four dosimeters into an 8-in. length of 52S aluminum tubing with a 0.375-in. outside diameter and a 0.049-in. wall. The aluminum tube was swaged closed at one end, and after it was filled, the open end was closed with glass-fiber-reinforced scotch tape. Two of the filled tubes were wrapped in aluminum foil and placed within a 12-in. long thin-wall aluminum tube of 1-in. outside diameter. Both ends were

sealed with rubber stoppers to prevent infiltration of radioactive contaminants.

The stoppered units were fastened to standard angle-iron fence posts, 1.25 in. by 1.25 in. by 6 ft., which were driven into the ground so that the apex of the angle faced the direction of the oncoming shock front. The post was slanted so that the major dimension of the dosimeter unit was approximately perpendicular to the radial line from the point of detonation. The tubular units were fastened to the stake in its protected included angle and were held in position with standard fiber-glass-reinforced tape. The stakes and tubes were then completely covered with heavy-duty aluminum foil to act as a heat-flash shield. Previous operations had shown that even at stations set up near the base of towers this type of flash shield successfully prevented severe burning of the stakes and attached materials.

These units were located along the surveyed lines of Projects 39.1 and 39.5 near stations established by those projects as well as those of Projects 39.9 and 37.5. Slant distances were computed from information supplied by the former two groups. Two to four of the stoppered units were used at each of the close-in stations and one or two at the more distant stations. On higher yield shots stations were generally located at 600, 700, 800, 900, 1000, 1100, 1200, 1250, 1300, 1400, 1500, 1750 and 2000 yards from GZ. On smaller yield shots the distances were usually 500, 600, 700, 800, 900, 1000, 1250 and 1500 yards.

Postshot recoveries were customarily made on D+2 day, since the resistance changes in the dosimeters produced by fast-neutron exposure are relatively permanent. This allows a later recovery after the areas have become more accessible from a Rad-Safe standpoint. In some cases recoveries were made much later without apparent effect on the dosimeters. If on recovery any tubes showed radioactive contamination beyond acceptable limits, the rubber stoppers were removed and discarded with the outside tube at the recovery site, and the non-contaminated inner containers were transported back to the Mercury laboratory.

After each shot recovered dosimeters were recorded and sorted into special holders in which they were transported to the UCLA-AEP for cold-bath measurements of resistivity changes.

Preliminary results obtained on shot Stokes indicated that the amount of indium in most of the dosimeters was not constant nor sufficient enough to yield linear responses in the lower dosage range. This suggested that instead of depending on exact indium-content control, the dosimeters should be preirradiated by exposure to about 2000 rep on a shot prior to the one which they would document. Therefore on shot Doppler 250 dosimeters were placed in a steel pipe at a distance chosen to receive approximately 2000 rep. These dosimeters were then

sent back to the UCLA-AEP for establishment of a new preshot resistance value. The chosen predose proved to be optimum, and 99 percent of the instruments showed a slight increase in conductivity, indicating that they had been dosed just beyond their crossover points as explained in Sec. 1.1. These dosimeters were used on shot Franklin Prime, and a new batch was preirradiated by Franklin Prime for use on later tests.

REFERENCES

1. B. Cassen, H. Gass, T. Crough, W. A. Smith, Jr., and J. Moyer, Measurement and Permanent Recording of Fast Neutrons by Effects on Semiconductors, Operation Teapot Report WT-1170, March, 1957.

UNCLASSIFIED

Chapter 3

RESULTS

3.1 INTERIM SUMMARY

The results of laboratory measurement of exposed dosimeters showed that the expected improvement in accuracy and sensitivity was not obtained. This was traced back to laboratory errors in pre-measurement. The results, however, have about the same quality as those obtained during Teapot.¹ Table 3.1 is a summary of some of the measurements obtained. They and additional measurements, which are harder to definitely interpret at the present time, such as shelter measurements on shot Smoky, will be exhaustively analyzed in the final report.

The units of ΔC in Table 3.1 are micromhos per inch as used previously in WT-1170. In WT-1170 the symbol $\Delta \sigma$ was used instead of ΔC . They are equivalent.

REFERENCES:

1. B. Cassen, H. Gass, T. Crough, W. A. Smith, Jr., and J. Moyer, Measurement and Permanent Recording of Fast Neutrons by Effects on Semiconductors, Operation Teapot Report WT-1170, March, 1957.

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

Table 3.1 - SUMMARY OF RESULTS

Shot	Slant Distance in Feet	No. of Dosi-meters	Average ΔC	Shot	Slant Distance in Feet	No. of Dosi-meters	Average ΔC	
Stokes	2343	10	14,345	Franklin Prime	1677	6	13,900	
		7	14,481			3	15,605	
	2581	15	12,405			11	14,151	
	2848	13	7,157			6	13,100	
	3044	9	3,891			4	8,208	
	3354	10	641			10	7,962	
Doppler						2229	8	7,770
							4	4,069
	2121	16	16,308			4	4,215	
	2343	10	8,662			5	4,818	
		11	10,138			4	4,545	
		15	10,622			4	3,993	
	2581	4	6,232			4	3,007	
		16	7,360			4	3,213	
						4	3,338	
	2704	21	6,570			4	3,274	
	2848	17	3,955			7	2,568	
	3044	7	2,570			4	2,588	
	4	2,948		3	2,137			
	8	1,494		4	1,877			
	4	1,519		4	1,276			
Laplace	1677	8	5,162		3093	3	1,184	
	1950	7	3,204			4	846	
	2226	7	1,662	Fizeau	1869	10	9,496	
					2173	3	8,709	
					2735	4	5,979	
					3039	8	2,250	
						9	2,165	
					3633	10	360	

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

DISTRIBUTION

Military Distribution Category 5-40

- ARMY ACTIVITIES**
- 1 Asst. Dep. Chief of Staff for Military Operations, D/A, Washington 25, D.C. ATTN: Asst. Executive (R&SW)
- 2 Chief of Research and Development, D/A, Washington 25, D.C. ATTN: Atomic Division
- 3 Chief of Ordnance, D/A, Washington 25, D.C. ATTN: ORDTX-AR
- 4 Chief Signal Officer, D/A, P&O Division, Washington 25, D.C. ATTN: SIGRD-B
- 5 The Surgeon General, D/A, Washington 25, D.C. ATTN: MEDNE
- 6-7 Chief Chemical Officer, D/A, Washington 25, D.C.
- 8 The Quartermaster General, D/A, Washington 25, D.C. ATTN: Research and Development
- 9-11 Chief of Engineers, D/A, Washington 25, D.C. ATTN: ENGRB
- 12 Chief of Transportation, Military Planning and Intelligence Div., Washington 25, D.C.
- 13-15 Commanding General, Headquarters, U. S. Continental Army Command, Ft. Monroe, Va.
- 16 President, Board #1, Headquarters, Continental Army Command, Ft. Sill, Okla.
- 17 President, Board #2, Headquarters, Continental Army Command, Ft. Encz, Ky.
- 18 President, Board #3, Headquarters, Continental Army Command, Ft. Benning, Ga.
- 19 President, Board #4, Headquarters, Continental Army Command, Ft. Bliss, Tex.
- 20 Commanding General, U.S. Army Caribbean, Ft. Amador, C.Z. ATTN: Cml. Off.
- 21-22 Commanding General, U.S. Army Europe, APO 403, New York, N.Y. ATTN: OPOT Div., Combat Dev. Br.
- 23-24 Commanding General, U.S. Army Pacific, APO 958, San Francisco, Calif. ATTN: Cml. Off.
- 25-26 Commandant, Command and General Staff College, Ft. Leavenworth, Kan. ATTN: ALLS(AS)
- 27 Commandant, The Artillery and Missile School, Ft. Sill, Okla.
- 28 Secretary, The U.S. Army Air Defense School, Ft. Bliss, Texas. ATTN: Maj. Ergun V. Roth, Dept. of Tactics and Combined Arms
- 29 Commanding General, Army Medical Service School, Brooks Army Medical Center, Ft. Sam Houston, Tex.
- 30 Director, Special Weapons Development Office, Headquarters, CONARC, Ft. Bliss, Tex. ATTN: Capt. T. E. Skinner
- 31 Commandant, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington 25, D. C.
- 32 Superintendent, U.S. Military Academy, West Point, N. Y. ATTN: Prof. of Ordnance
- 33 Commandant, Chemical Corps School, Chemical Corps Training Command, Ft. McClellan, Ala.
- 34-35 Commanding General, U.S. Army Chemical Corps, Research and Development Command, Washington, D.C.
- 36-37 Commanding General, Aberdeen Proving Grounds, Md. ATTN: Director, Ballistics Research Laboratory
- 38 Commanding General, The Engineer Center, Ft. Belvoir, Va. ATTN: Asst. Commandant, Engineer School
- 39 Commanding Officer, Engineer Research and Development Laboratory, Ft. Belvoir, Va. ATTN: Chief, Technical Intelligence Branch
- 40 Commanding Officer, Picatinny Arsenal, Dover, N.J. ATTN: ORDBB-TK
- 41 Commanding Officer, Frankford Arsenal, Philadelphia 37, Pa. ATTN: Col. Teves Kundel
- 42-43 Commanding Officer, Chemical Warfare Laboratories, Army Chemical Center, Md. ATTN: Tech. Library
- 44 Commanding Officer, Transportation R&D Station, Ft. Eustis, Va.
- 45 Director, Technical Documents Center, Evans Signal Laboratory, Belmar, N.J.
- 46 Director, Waterways Experiment Station, PO Box 631, Vicksburg, Miss. ATTN: Library
- 47 Operations Research Office, Johns Hopkins University, 6935 Arlington Rd., Bethesda 14, Md.
- 48-49 Commanding General, Quartermaster Research and Development Command, Quartermaster Research and Development Center, Natick, Mass. ATTN: CBR Liaison Officer
- 50 Commandant, U.S. Army Aviation School, Fort Rucker, Ala.
- 51 President, U.S. Army Aviation Board, CONARC, Fort Rucker, Ala.
- 52 Commanding Officer, Diamond Ordnance Fuze Laboratories, Washington 25, D.C., ATTN: Coordinator, Atomic Weapons Effects Tests
- 53 Commanding General, Quartermaster Research and Engineering Command U.S. Army, Natick, Mass.
- 54-58 Technical Information Service Extension, Oak Ridge, Tenn.
- NAVY ACTIVITIES**
- 59-60 Chief of Naval Operations, D/N, Washington 25, D. C. ATTN: OP-36
- 61 Chief of Naval Operations, D/N, Washington 25, D.C. ATTN: OP-03EG
- 62 Chief, Bureau of Medicine and Surgery, D/N, Washington 25, D.C. ATTN: Special Weapons Defense Div.
- 63 Chief, Bureau of Ordnance, D/N, Washington 25, D.C.
- 64-65 Chief, Bureau of Ships, D/N, Washington 25, D.C. ATTN: Code 348
- 66 Chief, Bureau of Yards and Docks, D/N, Washington 25, D.C. ATTN: D-440
- 67 Chief, Bureau of Supplies and Accounts, D/N, Washington 25, D.C.
- 68-69 Chief, Bureau of Aeronautics, D/N, Washington 25, D.C.
- 70 Chief of Naval Research, Department of the Navy Washington 25, D.C. ATTN: Code 811
- 71 Commander-in-Chief, U.S. Atlantic Fleet, U.S. Naval Base, Norfolk 11, Va.
- 72-75 Commandant, U.S. Marine Corps, Washington 25, D.C. ATTN: Code A03H
- 76 President, U.S. Naval War College, Newport, R.I.
- 77 Superintendent, U.S. Naval Postgraduate School, Monterey, Calif.
- 78 Commander, Joint Task Force Seven, Arlington Hall Station, Arlington 12, Va., ATTN: TS and RD
- 79 Commanding Officer, U.S. Naval Schools Command, U.S. Naval Station, Treasure Island, San Francisco, Calif.
- 80 Commanding Officer, U.S. Fleet Training Center, Naval Base, Norfolk 11, Va. ATTN: Special Weapons School
- 81-82 Special Weapons Unit, Pacific, U.S. Naval Air Station, North Island, San Diego 35, Calif.
- 83 Commanding Officer, Air Development Squadron 5, VX-5, China Lake, Calif.
- 84 Commanding Officer, U.S. Naval Damage Control Training Center, Naval Base, Philadelphia, Pa. ATTN: ABC Defense Course
- 85 Commander, U.S. Naval Ordnance Laboratory, Silver Spring 19, Md. ATTN: EH
- 86 Commander, U.S. Naval Ordnance Laboratory, Silver Spring 19, Md. ATTN: F
- 87 Commander, U.S. Naval Ordnance Test Station, Inyokern, China Lake, Calif.
- 88 Commanding Officer, U.S. Naval Medical Research Inst., National Naval Medical Center, Bethesda 14, Md.
- 89 Director, U.S. Naval Research Laboratory, Washington 25, D.C. ATTN: Mrs. Katherine H. Case

UNCLASSIFIED

UNCLASSIFIED CONFIDENTIAL

- 90 Director, The Material Laboratory, New York Naval Shipyard, Brooklyn, N. Y.
- 91 Commanding Officer and Director, U.S. Navy Electronics Laboratory, San Diego 52, Calif. ATTN: Code 4223
- 92-95 Commanding Officer, U.S. Naval Radiological Defense Laboratory, San Francisco, Calif. ATTN: Technical Information Division
- 96 Commander, U.S. Naval Air Development Center, Johnsville, Pa.
- 97 Commander-in-Chief Pacific, Pearl Harbor, TH
- 98 Commander, Norfolk Naval Shipyard, Portsmouth 8, Va. ATTN: Code 270
- 99 Officer-in-Charge, U.S. Naval Civil Engineering Research & Evaluation Lab., Construction Battalion Center, Port Hueneme, Calif. ATTN: Atomic Energy Div.
- 100-104 Technical Information Service Extension, Oak Ridge, Tenn. (Surplus)

- 134 Commander, Lowry AFB, Denver, Colo. ATTN: Department of Special Weapons Training
- 135 Commander, 1009th Special Weapons Squadron, Headquarters, USAF, Washington 25, D.C.
- 136-137 The RAND Corporation, 1700 Main Street, Santa Monica, Calif. ATTN: Nuclear Energy Division
- 138 Commander, Second Air Force, Barksdale AFB, La. ATTN: Operations Analysis Office
- 139 Commander, Eighth Air Force, Westover AFB, Mass. ATTN: Operations Analysis Office
- 140 Commander, Fifteenth Air Force, March AFB, Calif. ATTN: Operations Analysis Office
- 141 Commander, Western Development Div. (ARDC), PO Box 262, Inglewood, Calif. ATTN: WDBIT, R. G. Weits
- 142-146 Technical Information Service Extension, Oak Ridge, Tenn. (Surplus)

AIR FORCE ACTIVITIES

- 105 Asst. for Atomic Energy Headquarters, USAF, Washington 25, D.C. ATTN: DCS/O
- 106 Director of Operations, Headquarters, USAF, Washington 25, D.C. ATTN: Operations Analysis
- 107 Director of Plans, Headquarters, USAF, Washington 25, D.C. ATTN: War Plans Div.
- 108 Director of Research and Development, DCS/D, Headquarters, USAF, Washington 25, D.C. ATTN: Combat Components Div.
- 109-110 Director of Intelligence, Headquarters, USAF, Washington 25, D.C. ATTN: AFOIN-IBS
- 111 The Surgeon General, Headquarters, USAF, Washington 25, D.C. ATTN: Bio. Def. Br., Pre. Med. Div.
- 112 Asst. Chief of Staff, Intelligence, Headquarters, U.S. Air Forces-Europe, APO 633, New York, N.Y. ATTN: Directorate of Air Targets
- 113 Commander, 497th Reconnaissance Technical Squadron (Augmented), APO 633, New York, N.Y.
- 114 Commander-in-Chief, Pacific Air Forces, APO 953, San Francisco, Calif. ATTN: PFCIE-AP, Base Recovery
- 115 Commander-in-Chief, Strategic Air Command, Offutt AFB, Omaha, Nebraska. ATTN: OAMS
- 116 Commander, Tactical Air Command, Langley AFB, Va. ATTN: Documents Security Branch
- 117 Commander, Air Defense Command, Bnt AFB, Colo.
- 118-119 Research Directorate, Headquarters, Air Force Special Weapons Center, Kirtland AFB, New Mexico. ATTN: Blast Effects Res.
- 120 Director of Installations, DCS/O, Headquarters, USAF, Washington 25, D.C. ATTN: AFOIS-E
- 121 Commander, Air Research and Development Command, Andrews AFB, Washington 25, D.C. ATTN: EDEN
- 122 Commander, Air Proving Ground Command, Eglin AFB, Fla. ATTN: Adj./Tech. Report Branch
- 123-124 Director, Air University Library, Maxwell AFB, Ala.
- 125-126 Commandant, Air Force School of Aviation Medicine, Randolph AFB, Tex.
- 127-128 Commander, Wright Air Development Center, Wright-Patterson AFB, Dayton, Ohio. ATTN: WCOBI
- 129-130 Commander, Air Force Cambridge Research Center, 10 Hanscom Field, Bedford, Mass. ATTN: CRQST-2
- 131-133 Commander, Air Force Special Weapons Command, Kirtland AFB, N. Mex. ATTN: Tech. Infor. Office

OTHER DEPARTMENT OF DEFENSE ACTIVITIES

- 147 Asst. Secretary of Defense, Research and Engineering, D/D, Washington 25, D.C. ATTN: Tech. Library
- 148 U.S. Documents Officer, Office of the U.S. National Military Representative, SHAPE, APO 55, New York, N.Y.
- 149 Director, Weapons Systems Evaluation Group, OSD, Rm 2E1006, Pentagon, Washington 25, D.C.
- 150 Chairman, Armed Services Explosives Safety Board, D/D, Building T-7, Gravelly Point, Washington 25, D.C.
- 151 Commandant, Armed Forces Staff College, Norfolk 11, Va. ATTN: Secretary
- 152 Commander, Field Command, Armed Forces Special Weapons Project, PO Box 5100, Albuquerque, N. Mex.
- 153 Commander, Field Command, Armed Forces Special Weapons Project, PO Box 5100, Albuquerque, N. Mex. ATTN: Technical Training Group
- 154-155 Commander, Field Command, Armed Forces Special Weapons Project, P.O. Box 5100, Albuquerque, N. Mex. ATTN: Deputy Chief of Staff, Weapons Effects Test
- 156-166 Chief, Armed Forces Special Weapons Project, Washington 25, D.C. ATTN: Documents Library Branch
- 167-171 Technical Information Service Extension, Oak Ridge, Tenn. (Surplus)

ATOMIC ENERGY COMMISSION ACTIVITIES

- 172-174 U.S. Atomic Energy Commission, Classified Technical Library, Washington 25, D.C. ATTN: Mrs. J. M. O'Leary (For DMA)
- 175-178 U.S. Atomic Energy Commission, Technical Reports Library, Washington 25, D.C. ATTN: Mrs. J. M. O'Leary (For R. L. Corbie, CETO)
- 179-180 Los Alamos Scientific Laboratory, Report Library, PO Box 1663, Los Alamos, N. Mex. ATTN: Helen Redman
- 181-185 Sandia Corporation, Classified Document Division, Sandia Base, Albuquerque, N. Mex. ATTN: H. J. Smyth, Jr.
- 186-188 University of California Radiation Laboratory, PO Box 808, Livermore, Calif. ATTN: Clovis G. Craig
- 189 Weapon Data Section, Technical Information Service Extension, Oak Ridge, Tenn.
- 190-225 Technical Information Service Extension, Oak Ridge, Tenn. (Surplus)

UNCLASSIFIED

CONFIDENTIAL FORMERLY RESTRICTED DATA