WALTER REED ARMY INSTITUTE OF RESEARCH
Walter Reed Army Medical Center
Washington 12, D.C.

UNCLASSIFIED

RCC6.950210.002

AFSWP-893

WRAIR-1S-55

November 1955

# RECOVERY OF RADIOACTIVE IODINE AND STRONTIUM FROM HUMAN URINE—OPERATION TEAPOT (S)

James B. Hartgering
Ariel G. Schrodt
Edward C. Knoblock
Alvin G. Burstein
Richard D. McIver
James E. Roberts

Department of Biophysics



Project: 6-59-08-014, Biological and Medical Aspects of Ionizing Radiation
Subtask No. 16: World-wide Contamination (Interim Report)

DNA #832

[redacted]

[redacted]

UNCLASSIFIED

[illegible]

Reports Control Symbol: CSPRD-1

~~SECRET - RESTRICTED DATA - ATOMIC ENERGY ACT OF 1954~~

UNCLASSIFIED

DATE ON INHALATION OF $RaSO_4$ BY HUMANS (G)

| Days After Exposure | Body Burden | Rn/Total | Total Excretion* | Excretion As % of Body Burden |
|---|---|---|---|---|
| 3 | 0.338 μg | 0.27 | $206 \times 10^{-10}$ g Ra | 6.1% |
| 13 | 0.252 | 0.12 | $43.9 \times 10^{-10}$ | 1.74% |
| 35+ | 0.282 | 0.18 | $32.5 \times 10^{-10}$ | 1.15% |
| 35** | 0.200 | 0.25 | $32.5 \times 10^{-10}$ | 1.62% |
| 102 | 0.097 | 0.31 | $7.8 \times 10^{-10}$ | 0.8% |
| 235 | 0.042 | 0.52 | $2.2 \times 10^{-10}$ | 0.52% |
| 622 | 0.023 | 0.69 | $0.2 \times 10^{-10}$ | 0.087% |
| 1012 | 0.017 | 0.66 | $0.13 \times 10^{-10}$ | 0.077% |

*Based on 35 g dry weight of feces and 1250 cc urine per day.

+Based on Rn-gamma ray activity.

**Based on body burden at 3 days minus intervening excretion.

TABLE OF CONTENTS

| Chapter | | Page |
|---|---|---|
| TEAPOT SERIES FACT SHEET | | 1 |
| PREFACE | | 12 |
| LIST OF ILLUSTRATIONS | | 20 |
| LIST OF TABLES | | 21 |
| LIST OF ABBREVIATIONS AND ACRONYMS | | 24 |
| 1 | INTRODUCTION TO OPERATION TEAPOT | 25 |
| 1.1 | International and Domestic Conditions Influencing Operation TEAPOT | 26 |
| 1.2 | The Nevada Test Site | 29 |
| 1.3 | Summary of Operation TEAPOT Events | 34 |
| 1.4 | Department of Defense Participants and Activities | 35 |
| 2 | RESPONSIBILITIES OF THE ADMINISTRATIVE ORGANIZATIONS DURING OPERATION TEAPOT | 36 |
| 2.1 | The Joint Test Organization | 37 |
| 2.1.1 | Test Manager's Organization | 40 |
| 2.1.2 | The Test Director's Organization | 46 |
| 2.2 | The Organization of Exercise Desert Rock VI | 48 |
| 3 | EXERCISE DESERT ROCK VI PROGRAMS AT OPERATION TEAPOT | 54 |
| 3.1 | Troop Orientation and Indoctrination Program at Exercise Desert Rock VI | 58 |
| 3.2 | Troop Test Program at Exercise Desert Rock VI | 63 |
| 3.3 | Technical Service Program at Exercise Desert Rock VI | 69 |
| 4 | DEPARTMENT OF DEFENSE PARTICIPATION IN JOINT TEST ORGANIZATION PROGRAMS AT OPERATION TEAPOT | 78 |
| 4.1 | Military Effects Group Programs | 81 |
| 4.1.1 | Program 1: Blast Pressure Measurements | 82 |
| 4.1.2 | Program 2: Nuclear Radiation Effects | 88 |
| 4.1.3 | Program 3: Effects on Equipment Structures | 98 |
| 4.1.4 | Program 5: Aircraft Structures | 103 |
| 4.1.5 | Program 6: Electromagnetic Effects and Tests of Service Equipment | 106 |
| 4.1.6 | Program 8: Thermal Radiation Effects | 109 |

After the aircraft landed, project personnel held standard gamma survey meters near the contaminated surfaces to determine their radiation intensities. Several types of meters were used and their readings were compared. After the initial surface contamination studies, Project 2.8a personnel evaluated the decay of radioactivity on the aircraft in two ways. Aircraft were resurveyed periodically over the next two days to assess the rate of decay, and project participants attached film to contaminated areas of the aircraft with masking tape to assess the accumulation of radiation exposure. The film was removed for analysis within 24 hours after the detonation.

The last phase of Project 2.8a was a study of project personnel involved in making the film surveys described above. Some participants placed film over the hands and fingers of their gloves while they performed the radiation survey work. The film was then removed, developed, and evaluated to assess accumulated dose to ground-crews working on contaminated aircraft. Another technique was to have the project personnel rub the base of their hands over the surface of an aircraft with known contamination. An autoradiograph of the hand was then made by placing the hand on a large x-ray film packet for a period of time and then developing the film to observe the image created. In this way, changes in the contamination patterns of aircraft and relative amounts of contamination transferred to the hand could be measured. While conducting these studies, none of the survey team exceeded the AFSWC maximum permissible exposure of 3.9 roentgens for ground crew personnel (80).

Project 2.8b, Manned Penetration of Atomic Clouds, was a study to measure the radiation dose rate and dose received by air crews flying near and into the nuclear cloud. As indicated above, the same aircraft may have been used as for Project 2.8a. Specific information was sought by the Air Force on radiation dose rates inside the cloud, the total dose received during

25

passage through the cloud, and the dose received on the return flight. In addition, it is likely that lead vests were also tested for their effectiveness in shielding the crew against radiation. Seven aircraft penetrations were made through the nuclear clouds of five detonations, which ranged in yield from eight to 30 kilotons. Project personnel instrumented F-84s, B-36s, B-57s, and T-33s to measure gamma radiation dose rates. All instrumentation was prepared and checked for proper operation on the day before each shot. Typically, two automatic recording dose-rate meters were used in each aircraft. One was mounted in the nose compartment, and the other in the rear of the cockpit. A non-recording meter for use by the pilot was also installed in each aircraft. In addition to the dose-rate meters, a number of film devices were used. National Bureau of Standards film packets were placed in the cockpit and nose of each aircraft near the recording dose rate meter to determine accumulated radiation dose at the recorders during the mission.

The pilot of each aircraft was accompanied by a technical observer in all aircraft but the F-84, which had a maximum crew of one. Pilots and technical observers wore film badges issued by the Radiation Safety Division of the AFSWC 4926th Test Squadron. The pilot and technical observer also carried a number of small pieces of Dupont dental x-ray film. One special film pack was designed to measure internal body radiation dosage. This film packet consisted of nine small disks of film enclosed in a watertight capsule attached to a string. The capsule containing the film was swallowed by the technical observer and the pilot prior to take-off and retrieved after the flight was completed. A similar capsule containing film was attached to the outside of the pilot's flight suit near his stomach. The pilot and the technical observer wore lead vests to reduce radiation exposure to the body (46; 112; 284; 306).



37

Typically, the aircraft left Indian Springs AFB before shot-time, climbed to an altitude of about 40,000 feet, and flew to a position about 48 kilometers east of the ground zero to observe the detonation and the subsequent development of the nuclear cloud. The aircraft then flew by the cloud to estimate the time required to fly through the most dense section of the cloud. The aircraft then flew through the cloud. The technical observer, who had a stopwatch, recorded the time of entry into and exit from the visible cloud. In addition, an automatic dose-rate recording meter was also used to measure time in the cloud. After emerging from the cloud, the aircraft returned immediately to Indian Springs AFB, and the crew and instruments were removed from the aircraft. Crew members left the aircraft by climbing onto a forklift, which lowered them to the ground. They were then decontaminated. A description of these procedures is found in section 5.3 of this volume (46; 80; 306).

For these missions, the Test Manager authorized a special exemption to the radiation exposure limit for four Project 2.8b Air Force officers. Each officer was authorized to receive a total of 15 roentgens whole-body gamma radiation during participation in the project (285).

### 4.1.3 Program 3: Effects on Equipment and Structures

The purpose of Program 3 was to document blast and shock effects of nuclear detonations on vehicles and buildings. The nine projects conducted under Program 3 during TEAPOT were considerably reduced from the extensive testing conducted during UPSHOT-KNOTHOLE, and focused on assessing the destructive characteristics of the precursor zone of the blast wave. The program included tests on vehicles placed near ground zero and on a variety of concrete and steel structures, including under-ground shelters. The data from these projects were used to assess the damage potential of nuclear detonations on large, fixed targets and rigid structures.



31