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68955

# PERSONAL RECOLLECTIONS

J.D. SERVIS

ALBUQUERQUE, NM

April 1981

These recollections are in the form of pencil notes entered into the margins of a March 1981 draft version of the Ivy series report. These pencil notes are reproduced here.



Paul Bo
3/9/85 for chief
ISCM/DNA

DNA-84-04899

E-16

DRAFT MAR 1981

# IVY SERIES-A REPORT OF DOD PARTICIPATION

Kaman Tempo
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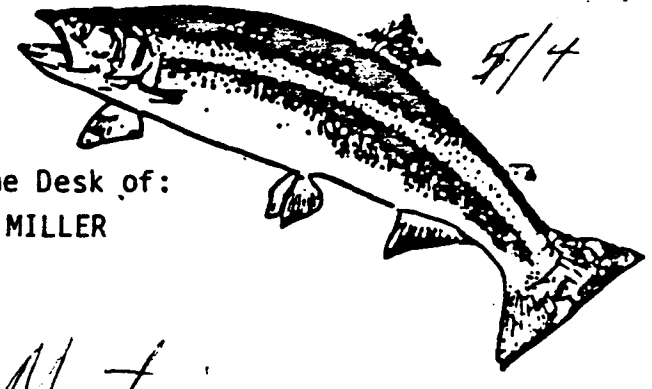

5/4

From the Desk of:
BOB MILLER

Ed Martin -
This contains pencil notes and comments on review by John Sims. Some are noteworthy.
Bob

RECEIVED
MAY 1981
DASIAC

CONTRACT No

Prepared for:
Director
DEFENSE NUCLEAR AGENCY
Washington, D.C. 20305

Radiological safety recognized long Term effects of continuous radiation exposure and followed control procedures similar To health physics practices of Los Alamos and Oak Ridge.

# CHAPTER 2

## RADIOLOGICAL SAFETY PLANNING

We estimated intensities and extent of contamination. Rad safe Unit mission was To support the Technical program and To minimize exposure. Safety planning was not difficult i.e. stay out of contamination.

Operation IVY posed some unique problems to the CJTF 132 staff and the AEC. It was against a background of uncertainty that radiological safety plans were made to protect both IVY participants and inhabitants of nearby islands. The field of radiological safety was relatively new insofar as techniques and applications were concerned: concepts of personnel safety were based on "as little radiation as possible" with no clear understanding of the possible deleterious effects of low-level radiation; little was known about the magnitude and areal extent of radiation produced by a nuclear device; and the experimental program required that certain tasks be performed at specific times in what might be a radiologically contaminated environment. These factors combined to make safety planning of the operation difficult.

erroneous statement

The MIKE shot was expected to produce an explosive yield far surpassing that of any prior test, and the radioactive fallout might pose a far more serious problem both to participants and off-island inhabitants than any previous test. For the first time, a bomb detonated in the atmosphere might significantly contaminate the bottom of the lagoon and restrict its use by fleet ships. The shot would be detonated without benefit of near-shot-time, shot-island weather data because of personnel evacuation

Not True for fusion devices

requirements. Thus, during the 5 hours between evacuation and detonation, unpredicted shifts in forecast favorable winds could increase the fleet fallout hazard.

Two distinct time periods of hazard were recognized: a prompt-effects period, where protection was required against the primary radiation effects occurring at the time of detonation; and a delayed-effects period, where protection was required against descending fallout and at places made radioactive by the prompt radiation or the fallout. Protection against the prompt radiation was effected by the removal of people to safe distances from ground zero, which entailed the complete evacuation of the atoll for the MIKE shot. Protection against the delayed effects (by far the largest area of IVY radsafe planning) included the use of instruments designed to indicate both the presence and intensity of radioactivity at given places, conducting area radiological reconnaissance, maintaining contamination situation maps, posting of hazardous areas, minimizing the spread of contaminated materials into uncontaminated areas, ~~and developing~~ and using decontamination procedures.

RADSAFE PLANNING

The Chief, JTF 132 Technical Operations Branch (J-3), was also the Chief Radsafe Officer. As such, he was responsible for advising the CJTF on the measures necessary to ensure the radiological safety of all test

personnel. The major technical radsafe element of the task force was TU 7 of the Scientific Test Group (TG 132.1). The Chief Radsafe Officer was designated as the commander of this unit. Radiological safety of all military and civilian personnel was specified as a command responsibility (Annex H, Op Order 1-52, IPL 132#4), and radsafe activities were to be performed through normal command channels. Task Unit 7 had support responsibilities that affected the entire task force, while the other three task groups possessed essentially self-contained radsafe units. Each task group commander was responsible for providing the necessary radsafe personnel for his group.

In February 1952, while the task groups were being organized, CJTF 132 published Operation Order 1-52 (IPL 132#4), which specified the radsafe responsibilities:

- The Commander, Joint Task Force 132 was to:
  1. Specify the measures necessary to ensure the radiological safety of task force personnel and furnish technical advisory assistance to task group radsafe officers
  2. Inform the Commander-in-Chief, Pacific (CINCPAC), of potential radiological hazards to those living within a radius of 600 miles (966 km) or personnel flying within a radius of 1,000 miles (1,610 km) of the test site.
- Prior to the onsite operational phase, task group commanders were to:

The station maintained a daily operations schedule for the Radsafe Information Center (RIC) that detailed all missions into contaminated areas, including name of monitor, destination, general type of mission, transportation, and time of departure and arrival. The station was also the clearance point for all working parties before entry into contaminated areas.

Aerial reconnaissance was made each morning of Survey teams monitored all islands and, and when necessary, posted radiation level signs in specified areas so that work teams could plan their activities without exceeding the allowable exposure. Areas with levels of radioactivity higher than 0.100 R/hr were outlined and marked by warning signs. Resurveys were made at frequent intervals to reestablish the 0.100-R/hr line. Entries beyond the 0.100-R/hr line required escort by a monitor.

The Kwajalein Control Group, located at the airstrip, assisted the AEC New York Operations Office (AEC, NYKOPO) in the preliminary phases of establishing a radiation survey system throughout the Marshall Islands. This group procured drinking water samples from Ponape, Kusaie, Majuro, and Kwajalein before and after both shots and forwarded them to the Radiological Field Laboratory for analysis.

Representatives of the Control Group at Kwajalein also supervised the monitoring of samples removed from aircraft of Project 1.3, snap-bag samples of Project 5.4b, and samples for Project 7.3. In addition, they

dose tabulations in this report. Additionally, the section issued, read, and recorded the results of all TG 132.1 personnel dosimeters.

The Radiochemical section operated a mobile radiological field laboratory (AN/MDR-1(XE-31)), designed and furnished by Evans Signal Laboratory. This laboratory analyzed the ~~potential radiation exposures from~~ contamination of air, water, and ~~contaminated~~ objects. Samples were assayed for alpha, beta, and gamma radiation intensity and beta and gamma energy and decay rates. Because the island bases were evacuated for the MIKE shot, the field laboratory was located on the hangar deck of the Rendova. The section regularly assayed the sea water at the swimming beach off Medren and the drinking water aboard ship at Enewetak and other nearby inhabited atolls.

DECONTAMINATION. The Decontamination Group provided the necessary installations and operations ~~to protect personnel who were outside the area of radiological contamination against its effect~~ to control spread of contamination. The group carried out this responsibility by providing personnel decontamination stations, equipment decontamination areas, and entry and exit checkpoints. ~~to ensure that radioactivity was not inadvertently carried to the base islands or the task force ships~~.

SPECIAL MONITORING. One TU 7 monitor was available on call for ~~special~~ laboratory monitoring in connection with radiological problems that might arise during the construction of the MIKE device.

- Interstate Commerce Commission rules (Docket 3666) compliance involving the transportation of radioactive materials (this directive prescribed a maximum permissible exposure of 0.3 R per week on a lifetime basis)



No information has been found that details the organization of TG 132.2 radiological safety. The History of Operation IVY (IPO 132#1, p. 220) indicates that CJTF 132 provided a radsafe officer for TG 132.2, but it is not clear from the group's organization where this individual reported. Specific radsafe responsibilities apparently were extra assignments for personnel who normally performed other tasks. This is supported by three observations. First, CTG 132.2 specified that all task group personnel were to receive basic radsafe indoctrination. Specialized training in monitoring and decontamination was given to a relatively large number of the garrison force, which implies that each company contained a cadre of trained radsafe personnel by the time the operation phase began. Second, a few specific extra assignments pertaining to radiological safety are known, e.g., the 511th TC Port Company operated the personnel decontamination center. Finally, TG 132.2 was tasked with atoll monitoring during early IVY planning when few Army personnel were available on the atoll. It is logical to assume such monitoring was conducted by whomever was qualified, since no formal radsafe group existed, and that this mode of operation continued during the operational phase of testing.

The History of Operation IVY (IPO 132#1) indicates that in September 1951, CJTF 132 sent a letter to CTG 132.2 requesting information on the status of radsafe facilities at Enewetak Island. He was informed that no radiac equipment was available for use by TG 132.2, that no personnel trained in the use of radiac equipment were available in the task group, and that the AEC Resident Engineer had no technical facilities with which to advise CTG 132.2 or to establish radsafe criteria for granting access to the previously contaminated islands of Runit, Eleleron, Enjebi, and Mijikadrek. By late September, the Army was requested to furnish a limited amount of standard radiac equipment to provide CTG 132.2 with the means for fulfilling radsafe requirements during the buildup period. By December, CTG 132.2 was informed that radiac equipment was being procured and would be shipped as it became available. The first shipment, consisting of 12 portable survey meters and 20 low-range dosimeters, was made in late December. Monitors were trained in early 1952 and the radiological status of the atoll was evidently determined before the operational phase, although no record of this survey has been found.

[Batteries were dead. TU-7 provided static of atoll and Technical support.

Task Group 132.3 (Navy)

Annex P to CJTF 132 Op Plan 2-52 (IPL 132#2) directed CTG 132.3 to perform the following assignments:

1. Ensure that appropriate radiac equipment and qualified personnel were aboard each task group unit,

## INDOCTRINATION AND TRAINING

A primary responsibility, established during previous operations, of the scientific radsafe unit was the training of personnel in the concepts and principles of radiation safety. Task Unit 7 of TG 132.1, as the principal technical radsafe organization, conducted a series of seminar discussions relating to the technical operations involved in Operation IVY. Recognized authorities within the task force were invited to address these seminars. The guest discussion leaders presented short lectures and then conducted periods of guided discussion.

The first indoctrination course was conducted in the forward area from 17 to 22 October 1952. The material discussed during these seminars included:

- Concept of Operation IVY
- Radsafe operations and responsibilities
- Radiological instrumentation
- Photodosimetry, dosimetry, and records
- Weather effects on fallout
- Scientific programs
- Weapon effects
- MIKE and KING descriptive material.

Since TG 132.1 was responsible for the radiological safety of the task force during Operation IVY, and because of the possibility that regularly

The only standard directly promulgated by CJTF 132 to all task groups was an MPE of 3.0 R for the entire operation (IPL 132.4.3#1, Annex H). The MPLs used are detailed in the JTF 132 Radiological Safety Report (IPO 132.1TU7#1). All of the radsafe planning documents refer to the 3.0-R MPE; however, the History of Operation IVY (IPO 132#1) and the Radiological Safety Report (IPO 132.1TU7#1) indicate that the MPE was 3.9 R. The date and the reasons for this change have not been determined. The only documentation for the change from 3.0 to 3.9 R was found in the TG 132.4 History (IPO 132#1, p. 30), stating that the dosage was "later raised to 3.9 R." The TG 132.4 History cites a JTF TWX "JTF 132 DTG 100615Z (TGAG#TX-1159)" as the authority for the change. The date of the TWX was the tenth month, presumably of 1952.



At the time, the two limits were probably believed to represent the same degree of safety. The military regulations on radiological safety in effect then were somewhat ambiguous. The military MPE for whole-body exposure was 0.3 R integrated over a period of a week,* but the level recommended for routine operations was 0.05 R (or less) per 24-hour period. If routine exposures exceeded 0.3 R/week, the individual was to be removed from further exposure until his total averaged less than the 0.3 R/week. The 0.3-R/week criterion was the same as the AEC criterion for atomic workers. The 0.3-R per week criterion would result in an exposure of 15.6 R per year, or 3.9 R per quarter year.

* Regulations from NavMed P-1325, "Radiological Safety Regulation," of 1951 are cited here (0.14).

The MPE's do not represent limits within which there can be a complete disregard of exposure. (The exposure to ionizing radiation should be kept to an absolute minimum in all circumstances.)

Radsafe Instrumentation

The majority of the TU 7 area monitoring was done with the AN/PDR-T1B ion chamber (IPO 132.1TU1#615, p. 29). Fifty-five of these instruments were on loan from AFSWP. The instrument electronics had been modified at the Nevada Test Site to eliminate switching transients resulting from changes in scale. A new ion-chamber instrument developed by the Army Signal Corps, IM-71/PD(XE-1), called the "Jasper," was tested and used after humidity leaks were corrected. Twenty-five of these instruments were available to the task force. A letter to CTG 132.4 indicated that "for some instruments" the meter needle would not return to zero when subjected to high temperature. This would not affect the reading above 1 R/hr but could cause some inaccuracies in the lower ranges. ~~Low-level radiation and beta radiation were measured~~ Personnel monitoring was done by with the MX-5 and AN/PDR-T27 Geiger-Mueller instruments. Table 2.3 lists the instruments used by TG 132.3.

In order to protect vessels from contamination by radioactive material in lagoon waters, periodic samples were collected from the lagoon, analyzed in the laboratory van aboard the Rendova, and, in the event contamination was indicated, CTG 132.3 was notified.

Personnel electrostatic dosimeters of at least three different ranges were used: 200 mR (IM/91PD), 10 R (IM/19PD), and 100 R (IM/20PD). No indication of the accuracy of these instruments has been found. (Salt spray caused leakage of instruments To the degree they were considered unreliable!)

Film Badges



Personnel dosimetry was determined from a conbination of film badges and pocket dosimeters. A total of 5000 film badges were utilized and processed during Operation IVY (IPO 132.1TU7#1, p. 30). The intent of the badging program was to supply badges only to those people who might enter contaminated areas or be exposed to fallout.

Badges were issued and processed by the photodosimetry and records section of TU 7 of TG 132.1. The monitor assigned to each recovery or work party obtained film badges and recipient recording forms for the entire party from TG 132.1. The badges were issued daily for each party entering the forward area. Other integrating times may have been used for other groups.

The standard film badge was a DuPont 558 containing one piece of No. 508 emulsion (range 0.015 R to 6 R) and one piece of No. 1290 emulsion (range 5 to 750 R) with a 20-mil-thick (5.08-mm) lead strap, 1/2-inch wide covering about half the length of the packet on both sides. The lead was held on the paper-wrapped packet by an adhesive. The entire packet was

These badges were The same as Those in use at LASL. obtained from LASL.

he films were processed at Medren Island by TU 7. Individual exposure records were kept on 5x8 cards containing the following information:

1. Name
2. Project
3. Home station
4. Date
5. Badge number
6. Exposure
7. Accumulated dose
8. Dosimeter reading.



These cards form the basis of the dose records summarized in the Consolidated List (IPO 132.1TU7#2) used as a standard reference in this report for personnel dosimetry. The file of the 5x8 cards themselves has been microfilmed and this microfilm file has also been used as a reference tool in preparing this report. It is cited as "5x8 card file" (IPO 132.1TU7#3).

Daily reports of the accumulated exposure of monitors, helicopter pilots, and persons whose exposure exceeded 2 R were to be made (IPO 132.1TU7#1, p. 82), but copies of these reports have not been found. These reports were informally provided to the control group each morning so appropriate duty assignments could be made.

and the islands extending southwest from Japan to the archipelago of Mansei Shoto. Following KING, a less extensive survey limited to the Marshalls, the eastern Carolines, and the Marianas was made (IPT#1).

Particulate fallout was collected on sticky "gum" paper at 111 worldwide stations including Honolulu, Guam, Ponape, Truk, and Midway. The concentration of particulate in air was measured at Kwajalein, Guam, Midway, and Honolulu. At these locations air-filtering equipment was turned on when the fallout cloud was known to be in the area. Automatic air-filtering stations, which were instrumented to begin operation when the external gamma exposure reached 0.005 R/hr were located at Kusaie, Ujelang, Bikini, Majuro, and Kwajalein. The radiation level required to start the equipment was not achieved in MIKE and the units were not reset for KING.

The drinking water at Enewetak, Kusaie, Majuro, Ponape, Kwajalein, and Bikini was ~~sampled~~ Tested by TU 7 after the MIKE shot. No hazard was found.

Evacuation

Radsafe plans required an evacuation of all personnel from Enewetak Atoll for the MIKE shot. Early plans for evacuation of the atoll during KING were ultimately revised to evacuate only the islands north of Japtan and maintain the capability to evacuate all personnel from Medren and

detonation at H-hour would carry a radsafe monitor equipped with suitable radiac equipment. The monitor was to be capable of calculating allowable exposures.

- An eligibility list of all individuals who were expected to enter radioactive areas would be submitted to CTG 132.1 two weeks before the tests.
- Film badges were to be supplied to all personnel expected to enter contaminated areas. All persons in aircraft at shot time, or at subsequent times when engaged in operations in or near the radioactive cloud were to wear film badges. Copies of film badge records were to be retained by the task group commander.
- No radioactive material was to be removed from the test site except as authorized in the experimental programs.
- Transportation of radioactive materials to and from the Forward Area would be in accordance with AEC regulations for escorted shipment of such material. Monitoring of radioactive test materials en route would be the responsibility of escorting scientific personnel as directed by CTG 132.1.
- No manned ships were to be permitted inside the lagoon or closer than 25 nmi (46 km) from shot islands at the times of detonation. Ship bearings to avoid immediate

because of the evacuation. Rapid reactivation of emergency facilities on the Enewetak Island airstrip was needed in case of an emergency landing. (The advance planning was justified by an emergency landing of an F-84.) A list of personnel categories considered essential for early reentry to Enewetak included (IPL 132#2, Annex U):

1. Task Group 132.4 personnel to operate aircraft emergency landing area at Enewetak
2. Radsafe monitors
3. Scientific personnel for collection of MIKE data
4. Scientific personnel for KING instrumentation
5. Key Holmes and Narver personnel
6. Loran detachment
7. Documentary photo team
8. Task Group 132.1 command post group
9. Shore-to-ship communications detail
10. Helicopter pilots.

Ed - note change on next page

The first radiological survey was made by TU-7 monitors at H+10 minutes (H+30 minutes for KING) by helicopter from the Rendova. The survey proceeded first to Medren Island and cleared the island for early reentry parties. The helicopter then proceeded north at about 10 knots (18 km/hr). The radioactivity on each island was measured from about a 25-foot (8-meter) altitude using an AN/PDR-T1B detector. The plan called for the helicopter to proceed until it reached an exposure of 3 R/hr. The helicopter,

however, was contaminated by particulates carried by a rain squall and returned to the Rendova for decontamination.

It is unclear from the records examined whether a Navy or an Air Force helicopter was used to conduct the initial survey. It is believed it was a Navy aircraft; however, a quote from WT-614 (IPO 132.1TU7#1, p. 20) states:

> The use of H-19 helicopters proved to be of great aid in radiation survey and recovery. Their use permitted a maximum time within contaminated areas and a minimum time of transportation within contaminated areas.

The H-19 helicopter is an Air Force aircraft. The quote from WT-614 may refer to later surveys and recovery, but this is uncertain.

A private communication with the commander of TU 1, who flew aboard the helicopter at ~~H+10 minutes~~ H+ 2 hours after MIKE for the initial survey, did not completely resolve the question. The former commander was not sure whether the helicopter was an Air Force or a Navy aircraft. He thought, however, it was Navy. His best recollection for IVY supports the belief that at least initial surveys were conducted by Navy helicopters (IPO 132.1#3).

Task Group 132.4 directed TE 132.4.1.1 to furnish two H-19 helicopters to the Rendova to supplement Navy Marine helicopters for atoll reentry flights. The main purpose, however, was to provide transportation for early reentry to Enewetak of an emergency ground crew in the event of any F-84G emergency landings there. The team included a radsafe monitor, four

Personnel were guided by signs and verbal instructions to the personnel decontamination center in the south end of the radsafe building on Medren Island. This center was conveniently located near each of the checkpoints so that "tracking" of contamination was minimized. Upon entering the center, personnel disrobed, discarded protective clothing and items of equipment into the appropriately marked containers, showered, and then passed into the drying room, where they were again monitored. If "clean," they passed into the "clean" change room, retrieved their personal clothing, dressed, and returned to their organizations. If found still contaminated, they were returned to the shower. In several cases, localized "hot" spots were found on body extremities; these were decontaminated by applying a hand brush and more soap.

Various chemical solutions and agents were available to aid in the decontamination, but their use was not necessary.

1. Equipment decontamination. A control checkpoint was established at the boat landing just north of the personnel pier on Medren Island. Departing vehicles had their interior surfaces lined with paper. All landing craft with vehicular or other mobile equipment were instructed to land at the designated boat landing, where the control officer of the checkpoint monitored the equipment. If "clean," the equipment was moved to its destination; if

Table 4.4 (continued)

| Element | Persons Badged | Dose Ranges (rem) 0 | 0.001-0.5 | 0.5-1 | 1-1.5 | 1.5-2 | 2-3 | 3-4 | 4-5 | 5-6 | 6-10 | 10-15 | Over 15 | Over 3.9 | High | Collective Dose (man-rem) | Mean Dose (rem) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Program 6 | 2 | | | 1 | 1 | | | | | | | | | | 1.1 | | |
| Projects 6.1, 6.3, 6.5, 6.7b | 16 | | 2 | 4 | 3 | 5 | 2 | | | | | | | | 2.5 | | |
| Project 6.2 | 2 | | 1 | 1 | | | | | | | | | | | 0.9 | | |
| Project 6.3[b] | 2 | | | 1 | 1 | | | | | | | | | | 1.2 | | |
| Project 6.4a | 1 | | 1 | | | | | | | | | | | | 0.3 | | |
| Project 6.4b | 1 | | 1 | | | | | | | | | | | | 0.1 | | |
| Project 6.9 | 3 | | 1 | 1 | | | 1 | | | | | | | | 2.1 | | |
| Project 6.10 | 25[c] | 17 | 7 | | | | | | | | | | | | 0.2 | | |
| Project 6.11 | 16 | 2 | 14 | | | | | | | | | | | | 0.3 | | |
| Project 6.13 | | | | | | | | | | | | | | | | | |
| Program 7 | 1 | 1 | | | | | | | | | | | | | | | |
| Program 8 | | | | | | | | | | | | | | | | | |
| Projects 8.1-8.4 | 9 | | | 1 | 2 | 1 | 1 | 2 | 2 | | | | | 1 | 3.9 | | |
| Project 8.2[b] | 1 | | | | | | | | | 1 | | | | | 4.1 | | |
| Project 8.3[b] | 2 | | 2 | | | | | | | | | | | | 0.2 | | |
| Program 9 | | | | | | | | | | | | | | | | | |
| Project 9.1 | 1 | | 1 | | | | | | | | | | | | | | |
| Project 9.3 | 2 | 2 | | | | | | | | | | | | | | | |
| Program 11 | 1 | | | | | 1 | | | | | | | | | 1.7 | | |
| Project 11.5 | 6 | | 1 | 3 | 1 | 1 | | | | | | | | | 1.7 | | |
| Task Unit 7 | 46 | 1 | 10 | 10 | 12 | 0 | 7 | 6 | | | | | | | 2.9 | | |
| Task Unit 9 | 25 | 1 | 16 | 1 | 1 | 1 | | | | | | 5 | | | 11.6 | | |

Notes:

[a]Two badge readings missing.

[b]Staff in addition to that shared with Projects 6.1, 6.5, and 6.7b.

[c]One badge damaged.

Ship Recovery

Marine transportation to the northern islands was provided by the boat pools of TG 132.1, augmented by the boat pool of TG 132.3 (Op Pln 2-52, IPL 132#2, Annex R, p. R-1). The TG 132.3 boat pool vessels were all part of TG 132.3's Harbor Control Task Element (132.3.2). Records are not available on the contamination of TG 132.1 ships or the doses of their crews. However, the fleet tug, the USS Lipan (ATF-85), and the five LCUs attached to the Harbor Control Task Element "were contaminated above tolerance levels while they were operating in the contaminated waters or on the contaminated beaches in the northern sections of Enewetak lagoon" (IPO 132.3#2, pp. 5-7). The dosimetry for the crew of the Lipan and the five LCUs is presented in Table 7.1 in Chapter 7.

The KING data recovery activities are summarized in Table 4.5, which shows contamination levels on the islands following KING and the recovery missions planned, in Table 4.6, in which the details of the missions are presented, and in Figure 4.2, which is a map of the atoll showing project instrumentation locations.

Program 1 - Radiochemistry

One way to measure the yield of a nuclear explosion is to analyze the resulting debris radiochemically. Aircraft flying through the shot cloud

only those entering [illegible] were documented

Staffing: Project 2.1b staffing was apparently interrelated with, although somewhat separate from, the rest of the NRL experiments (Projects 2.1a, 2.2, 2.3, 2.4, and 2.6). In the project report seven NRL civilians were cited as being primarily responsible for carrying out the KING experiments. Of the seven, only four appear on the Consolidated List and their dosimetry is shown in Table 4.4.

Project Report: IPO 132.1TU1#626



Project 2.2 - Timing of the Fission Phase

Project 2.3 - Rise of the Fusion Reaction

Project 2.4 - Propagation of the Fusion Reaction

Agency: Naval Research Laboratory (NRL)

Operations: Gamma rays from the MIKE detonation passed 9,000 feet through the helium-filled flume to instruments in Station 202 on Boken Island. Signals from these instruments were then transmitted by wire to recorders in Station 200 nearby (IPO 132#2, pp. B-3 and B-4). For recovery, see under Project 2.6 below.

Radiation Exposure Potential: Same potential as Project 2.1a.

Staffing: See Project 2.6.

Project Reports: IPO 132.1TU1#620, #621, #622, #623, #624, #625.

Project 2.5 - Measurement of Transit Time

Agencies: Sandia Corporation (SC)

Operations: A transmitter in the KING bomb case sent radio signals to receivers in two B-50 aircraft from TG 132.4's Test

Radiation Exposure Potential: The MIKE blast heavily contaminated Boken Island (see Table 4.2 and Appendix C). Enewetak Island was not contaminated during this period, so the single member of the project team headed there should not have faced a radiation exposure.

Staffing: See Project 2.6.

Project Reports: IPO 132.1TU1#620, #621, #622, #623, #624, and #625.



Project 2.1b - Alpha of the KING Fission

Agency: Naval Research Laboratory (NRL)

Operations: Detectors were placed on the north end of Runit Island, about 2,000 feet (600 meters) from the projected KING ground zero, which was on the reef off the end of Runit. The detectors' signals were transmitted through cables to Station 250 farther south on the island. Additional detectors were placed near Station 250, and these transmitted their signals to recorders in Station 250 (IPO 132#2, p. B-2). The high-priority schedule for KING recovery called for a group of three men to helicopter to Runit for recovery of Project 2.1b data (see Mission 3, Table 4.6), but no record is available of when they landed on Runit or how long they stayed.

Radiation Exposure Potential: A survey taken from a helicopter flying over Runit about 50 minutes after the KING shot indicated little contamination, with maximum ground readings estimated at 3.8 R/hr (see Table 4.5 and Appendix C).

two LASL civilians, who worked closely with the project are included in the dosimetry in Table 4.4.

Project Reports: IPO 132.1TU1#620, #621, #622, #623, #624, #625.



Program 3 -- Scientific Photography

This program called for photographic documentation of many aspects of both tests. According to WT-636 (IPO 132.1TU1#636), TU 1 of TG 132.1 assigned eight civilians from an AEC contractor, Edgerton, Germeshausen, and Grier (EG&G), and three Air Force men to work on Program 3 overall (see Table 4.1). The IVY History lists the program leader as a LASL civilian (IPO 132#1, p. 53). Of all these program level personnel, only his dose can be identified on the Consolidated List (IPO 132.1TU7#2), and it was 0.560 rem.

Project 3.1 - Ball of Fire Yield

Agency: Edgerton, Germeshausen, and Grier (EG&G)

Operations: For MIKE a total of 29 cameras were used, 5 on Enjebi, 2 on the USS Estes (AGC-12), and 12 on Medren (IPO 132#2, pp. C-2 and C-3; IPO 132.1TU9#1, p. 16). The high-priority recovery schedule called for three men assigned to this project to helicopter back to Medren from the Rendova 20 minutes after the detonation. At a later time, two men were to helicopter to Enjebi (see Table 4.3, Mission 15). The schedule of less urgent recovery

activities also called for another two-man team to visit Enjebi by helicopter (see Table 4.3, Mission 17). For KING, the cameras were mounted on the Medren phototower and in Station 302 at the foot of the tower.

Radiation Exposure Potential: Enjebi was 2-3/4 nmi from the MIKE ground zero. At 1240 on the day of the MIKE shot, a reading of 50 R/hr was taken from a helicopter 150 feet over the center of the island. Assuming normal radioactive decay, a 10-minute stay would have been allowed 26 hours after the detonation (see Appendix B). Medren Island was not contaminated by either shot. The Estes encountered no early fallout. There was some minor fallout on 3 November on the ship.

3X backgrs

Staffing: Four persons can be identified with Project 3.1 activity, two civilians and two Air Force men, and a summation of their dose is shown in Table 4.4.

Project Report: WT-639 (IPO 132.1TU9#1).

Project 3.2 - Cloud Phenomena

Agency: Edgerton, Germeshausen, and Grier (EG&G)

Operations: Motion and still cameras were operated to record the size, shape, and movement of the shot clouds. For MIKE, project cameras were on Medren, on the USS Curtiss (AV-4) and the Estes, and on two TG 132.4 C-47s. At shot time, the planes were both at 10,000 feet, and one was 85 nmi south of MIKE ground zero and one was 85 nmi east of ground zero (IPO 132#1, IVY, pp. 98-99).

Project 5.1 - Total Dose

Agency: Los Alamos Scientific Laboratory (LASL)

Operations: For MIKE, two lines of film badges were laid out, one from Eluklab to the far end of Bokoluo, and the other from Eluklab to the far end of Enjebi. Three film badges were placed every 100 yards on land. Two of the badges were attached to devices that caused them to drop into shielding receptacles, the first 0.2 second after the explosion and the second 60 seconds after that (IPO 132#2, p. E-1). Retrieval of the film badges for this experiment was accorded secondary priority on the MIKE recovery schedule. A 3-man team was to helicopter to Bokoluo, Bokombako, Kirunu, Louj, Bokinwotme, Eluklab, Dridrilbwij, Bokaidrik, Boken, and Enjebi (Table 4.3, Mission 19). The KING portion of the project consisted of a line of film badge stations about 100 yards apart down the middle of Runit out to approximately 4,000 yards (IPO 132#2, pp. E-1 and E-2). Recovery was scheduled to start at 0900 the day after the KING shot by the same team that was to do the recovery for Projects 4.1, 4.2, 4.4, 5.2, and 8.1 during a projected working period of 4 hours (Table 4.6, Mission 12).

Radiation Exposure Potential: All the islands used for the MIKE portion of this project were contaminated. Assuming normal radioactive decay, limited recovery would have been allowed on each island as follows: Enjebi (26 hours after detonation), Bokoluo and Bokaidrik (36 hours after detonation), Bokombako, Kirunu, and Louj (38 hours after detonation), Boken (50 hours

portion of the project, three stations on Runit were used at distances of 1,200, 1,700 and 2,200 yards from ground zero. Recovery for this project was combined with the recovery for Projects 4.1, 4.2, 4.4, 5.1, and 8.1 the day after KING. It was expected to take about 4 hours (Table 4.6, Mission 12).

Radiation Exposure Potential: A ground reading at Bokombako 3 days after the MIKE shot is not available, but at 4 days the reading was 10 R/hr. At Kirunu, no ground reading is available before 9 November (8 days after MIKE) when it was 2.5 R/hr, which would probably have made it about 10 R/hr on 5 Nov (D+4). At Louj 10 days after the shot it was between 2.2 and 3.3 R/hr (Appendix C). Limited recovery was not allowed on Bokinwotme until 75 hours after the shot (see Table 4.2). At 0726 the day after KING, radiation on Runit varied between 0.001 and 0.100 R/hr (Appendix C).

No ? See comment Append C.

Staffing: The 5x8 cards show that 8 men were involved with Project 5.2. Six were civilians, four of which were from LASL and two from the Radiation Lab of the University of California (Berkeley). Two naval officers, whose duty station was given as LASL, completed the identified project personnel. Dosimetry is shown in Table 4.4.

Project Report: IPO 132.1TU1#634.

(DDE-825), USS Fletcher (DDE-445), USS Radford (DDE-446), USS O'Bannon (DDE-450), and Rendova. The LST used to evacuate the Ujelang natives also carried sticky plates, although it was not part of JTF 132. The high-priority recovery schedule called for a helicopter to carry an unspecified number of personnel to Bokoluo, Enjebi, Elle, Billae, Runit, Ananij, Enewetak, and Medren for retrieval of samples from the fallout stations (Table 4.3, Mission 11). LCMs were to carry personnel to pick up samples from raft stations. The rafts were retrieved on 3 and 4 November (IPO 132#2, p. E-5). It is not clear whether the total of men making up the recovery crews was planned to be six or twelve (see Table 4.3). The O'Bannon began searching for the dan buoys about 0400 the day after the MIKE shot. The last of the buoys was found at 0514 hours on 5 November. Twelve out of the nineteen buoys set out were recovered. Crewmembers apparently took the samples from the shipboard fallout stations.

Radiation Exposure Potential: For land station recovery, see Table 4.3. MIKE contaminated the lagoon's waters. Information, however, is lacking on any contamination suffered by the LCMs, their crews, or the personnel from TU 1 collecting the samples from the raft stations. Fourteen O'Bannon personnel and the ship's deck were accidentally contaminated on 3 November when the crew brought a radioactively contaminated dan buoy aboard. Maxmimum reading on personnel was 1.0 mR/hr on shoes, 0.5 mR/hr on hands. The deck's intensity averaged 0.6 to 0.7 mR/hr. Both the

Radiation Exposure Potential: One hour after the KING shot, a 4-man recovery party was to visit Medren, Runit, and Lojwa to retrieve data for Programs 3.1, 3.2, 3.5, 3.6, 3.8, b.2, and 6.13. Recovery time for these projects was estimated at 2 hours. At 0900 the day after KING, a 3-man team on an LCM was to remove the rafts from the lagoon (Table 4.6, Missions 4 and 14).

Staffing: Only the project officers can be identified as accruing a radiological exposure, presumably in the course of executing tasks associated with the project. His dose was 0.4 rem. Six enlisted men of the Curtiss are credited with aiding in the project but none were apparently badged and just what their assistance was is not clear.

Project Report: IPO 132.1TU1#627.

Project 6.3 - Shockwind, Afterwind, and Sound Velocity

Agencies: Sandia Corporation (SC)
Los Alamos Scientific Laboratory (LASL)

Operations: For MIKE, instruments were placed on Bokaidrik, Boken, Enjebi, Mijikadrek, Bokenelab, Aomon, and Medren. Planned recovery is shown in Table 4.3, Missions 21 and 23. For the KING portion of this project, three stations on Runit and one on Medren were used. Two recovery missions were planned (Table 4.6, Missions 6 and 13).

Radiation Exposure Potential: Recovery missions were low priority and would not have exposed personnel to high background radiation levels.

Operations: To measure sea waves generated by MIKE, instruments were set out at 19 locations: the Enewetak Lagoon near Runit and Enewetak Island, Sea Mounts 265 and 72 north of ground zero, two locations on Bikini Atoll, Kwajalein, Wake, Truk, Guam, Canton Island, Yap, Midway, four locations in Hawaii, and two locations in California. The Horizon recovered the instruments from the two sea mounts.

Radiation Exposure Potential: The Horizon placed instruments on the two sea mounts before the MIKE shot. At shot time the ship was standing by Sea Mount 72. At 0745 the ship was ordered to get underway on a course 045°T at 11.5 knots for 4 hours and then started circling on new station approximately 100 miles north-northeast of ground zero. At 1240 radioactive fallout was detected and the ship was closed up, ventilation secured, and the washdown system started. Upon receipt of a message from the Horizon that fallout was being encountered, the ship was ordered to proceed southward. After 2½ hours steaming at 11.5 knots, the ship reported clear of the fallout area and that the peak radiation intensity encountered was an average of 0.008 R/hr (gamma only) and a maximum of 0.035 R/hr (gamma only). After leaving the areas of highest activity, the masts above the spray from the washdown system were hosed down and the ship's decks were washed down. Then the radiation levels decreased to an average of 0.003 R/hr, with a maximum of 0.020 R/hr. When the ship the returned to Enewetak on 6 November, the radiation intensity had

crew retrieved the mooring buoy 155 miles northwest of Enewetak, 12 crewmen were contaminated by the radioactive buoy. This contamination ranged from 0.0002 to 0.003 R/hr.

Staffing: Five naval scientists, two from NRL, two from NEL, and one from NRDL, all identified in the project report as participating in the forward area, but none appear on the Consolidated List. Dosimetry for the supporting naval units may be found in Table 7.1.

Project Report: IPO 132.1TU1#629.



Project 6.7b - Underwater Pressures Along the Reef

Agency: Sandia Corporation (SC)

Operations: Instruments were placed on 10-foot tripods at a depth of 100 feet in the lagoon off Dridrilbwij, Enjebi, Aomon, and Medren for MIKE. Cables ran from the instrument tripods to recording stations on the four islands. A helicopter-borne team of four was to retrieve data for the MIKE portion of this project as well as for Projects 6.1, 6.3, and 6.5 (Table 4.3, Mission 21). For KING, the instruments in the lagoon off of Medren were reused.

Radiation Exposure Potential: The MIKE recovery was a low-priority one and the KING recovery was at the uncontaminated Medren.

Staffing: See Project 6.1.

Project Report: IPO 132.1TU1#605.

Radiation Exposure Potential: During the MIKE test, four B-29s were used: two for dropping canisters and two for helping guide the F-84G samplers. One B-29 was contaminated to a level of 0.100 R/hr and another to the level of 0.200 R/hr; but it cannot be determined which two of the four they were, although the most likely candidates were the sampler guidance B-29. During the KING test, none of the four B-29s used were contaminated. The Oak Hill was not contaminated.

Staffing: Travel documents (Form 52 WC-20445-A) in the National Archives (RG-374) show a total of 60 men slated to staff Project 6.11. Their distribution is as follows:

| | | |
|---|---|---|
| AFCRC (3160th Electronics Group and 6520th Flight Test Group) | 42 | (16) |
| Contractors | | |
| Glenn L. Martin Co., Baltimore, Maryland | 9 | (0) |
| Bendix Aviation, Burbank, California | 9 | (0) |

The number in parentheses indicates the number badged, most of which were designated as B-29 flight crew. Dosimetry is presented in Table 4.4.

Project Report: IPO 132.1TU1#631.

Project 6.13 - Measurement of Free Air Pressures by Smoke Rocket Photography

Agency: NOL

Operations: Mortars were placed on Runit about 4,600 feet from the KING ground zero. They were arranged to fire smoke rockets in

monitors and decontamination services, film badge development and record keeping, calibration and repair of dosimeters, and similar services to the task force. The nature of some of these activities provided opportunities for radiation exposures.

The task unit was staffed by 5 civilians and 49 military according to WT-636 (see Table 4.1). A group picture taken by a documentary photography on 23 October shows only 41 (21PAK66-5) and the file of 5x8 cards (IPO 132.1TU7#3) gives the names of 46. These named individuals represent all the services and the AEC. Organizations represented were:

Los Alamos Scientific Laboratory (3 military, 3 civilians)
Oak Ridge National Laboratory (1 civilian)
Armed Forces Special Weapons Project-FC (1 military)
Army Chemical Corps (8 military)
Evans Signal Laboratory (2 military, 1 unidentified)
971st OTSU, Army Chemical Corps (1 military)
8452nd AAU, Sandia Base (1 military)
Unnamed unit, Ft. McClellan (1 military)
Naval Air Station, Norfolk (1 military)
CincAirPac, San Diego (1 military)
Cinclant, Norfolk (1 military)
Naval Administrative Unit, Sandia Base (1 military)
Naval Radiological Defense Laboratory, San Francisco (1 military)
13th Naval District (1 military)

higher altitudes than had been done before. This, in turn, required a jet-powered plane to replace the propeller-driven drone B-17s that had been used in GREENHOUSE.

The aircraft selected for cloud sampling was the F-84G. The samplers were to be based at Kwajalein 360 miles (500 km) from Enewetak and had to remain on station for up to 5 hours. This required in-flight refueling from tanker aircraft, as well as the support of other aircraft to provide navigational help for the single-place sampling aircraft.

The air operations became quite complex and the whole IVY exercise was simulated in August 1952 as Operation TEXAN out of Bergstrom AFB, Texas. This operation even included the dropping of a dummy KING bomb into the Gulf of Mexico.

The potential size of the MIKE detonation also required the complete evacuation of the task force from Enewetak Atoll. The preparations for this are discussed below.

MIKE Evacuation

The expected magnitude of the MIKE blast and the possibility of considerable fallout led to a decision to evacuate prior to shot time all task force personnel on Enewetak Atoll and all the natives from Ujelang

Task Unit-1 was deployed and operated from the control ready room of the RENDOVA.

Control
Laboratory
Decontamination
Administration

-- Task Group 132.1 personnel including: early reentry teams, radiation monitors, and staff of the radiological laboratory.

USNS Shanks

-- The bulk of the TG 132.1 scientific and technical staff and a substantial Holmes and Narver contingent.



USNS Collins

-- Remainder of the joint task force headquarters staff.

-- Headquarters detachment of TG 132.2.

-- Task Group 132.2 Boat Pool.

-- Task Group 132.2 Detection Unit.

-- Part of the contingent from the Coast Guard Loran station.

-- 18th Military Police Counter Intelligence Detachment.

-- Counter Intelligence Corps Detachment.

-- Task Element 132.4.1.1.

-- 1502-1 Air Detachment of the Military Air Transport Command.

-- 1960-1 Airways and Air Communications Service Detachment.

-- Task Group 132.1 personnel, including Holmes and Narver employees to render messing and housekeeping support.

only the greatest one for each island (IPO 132.3#5, Rendova; IPO 132.1TU1#617, pp. 109-110).



Over Enewetak and Medren, the survey team detected no radiation, but they found Runit contaminated. About 40 minutes after the detonation, while in the vicinity of Billae Island, the helicopter was contaminated by muddy rainout and the survey terminated. At 0821, upon its return to the Rendova, the helicopter showed residual contamination of 2 R/hr (IPO ~~132~~.1TU7#1, p. 37).

direction of cloud and

~~Apparently~~ On the basis of the ~~quick~~ radiation survey of Enewetak and Medren islands, an 8-man reentry party TE 132.4.1.1 was flown ashore in an Air Force H-19 helicopter about 40 minutes after the shot to reopen the Enewetak airstrip on a limited basis. Once reopened, about 2 hours after the detonation, the airstrip could be used for emergency landings by planes taking part in postshot activities (IPO 132#1, p. 279). At the same time, a Holmes and Narver group was helicoptered to Medren to look for damage and to check refrigerators, powerhouses, and the water plant (IPO 132#1, p. 279).

Efforts to survey the radiological condition of the atoll and the damage to facilities continued. At about 0915, the Scientific Deputy to CTG 132.1 and a scientific party helicoptered from the Rendova, apparently intending to go around the atoll counterclockwise. At Runit, they were forced to turn back by "excessive, active fallout" (IPO 132#1, p. 279).

accompanied by a Rad Safe Engineer

survey of the atoll and the Scientific Deputy's attempt at a combination damage and radiological survey at 0915 probably were made in ~~Navy~~ Marine helicopters (IPO 132.1#3). Just when the Marine helicopters assigned to TG 132.3 went is not recorded, nor is the role of the Air Force H-19 helicopters evacuated on the Rendova. Given the great need for helicopter support, neither could have been on the sidelines for long. One source specifically mentions that the H-19s were of great aid in radiation survey and recovery (IPO 132.1TU7#1, p. 26).

Two Navy helicopters used in initial survey flights became contaminated and spread contamination to the Rendova. One of these helicopters collected contamination to a level of 0.5 R/hr and the other to a level of 1 R/hr. Maximum intensity in the interior of the Rendova was 0.035 R/hr on the deck directly below when the second helicopter was parked. Although no member of the carrier unit of which the Rendova was a part received a radiation dose greater than 2.185 rem, the helicopter crews as a group received the highest radiation exposures in the carrier unit (see Table 7.1).

On the night of 1 November, the commander of the joint task force had set 0900, 2 November, as the tentative time for general reentry. At 0800 on 2 November, the CTG 132.2 and the task group's radiological safety officer helicoptered ashore from the Collins. Task force ships reentered the lagoon at about 0954 and by 1110 elements of TG 132.2 and the Holmes and Narver contingent from Enewetak Island started ashore by boat. The

airfield was open on a limited basis by 1200, although it is not clear what the status of the field had been after its initial reactivation the day before by TE 132.4.1.1. Nor is it clear where those men spent the night. By 1230 the island's power and telephone systems were in operation again. By 1600 all the facilities on the island had been essentially reactivated (IPO 132.2#1, p. IX-1). By four days postshot all units of TG 132.1 were ashore (IPO 132.1#2, MIKE Inst).

Reentry and data recovery near the shot island was ~~apparently~~ done two and three days following the shot when the areas had sufficiently cooled so that some minutes could be spent at an instrument station before possible overexposure (IPO 132#1, p. 286). A particular data recovery mission at Boken is discussed in some detail in Chapter 4 under Program 2.

Blast damage on Enewetak Island was limited to the B-29 hangar which was distorted slightly so that its doors would not close (IPO 132#1, p. 281). Apparently, it was still usable.

Given the lack of fallout on Enewetak Island, personnel returning there probably suffered no radiological risk by so doing.

Personnel from TG 132.1 were on Medren by about 1045 on 2 November. Since blast damage on Medren was superficial, and no fallout was recorded, it ~~can be assumed that~~ reentry went smoothly, although it may have gone a bit more slowly than on Enewetak. Some TG 132.1 personnel remained in the

ships for several days primarily because all the support facilities had not been reactivated (IPO 132.1#2, MIKE Inst). ~~Here, again, there is no evidence of radiological risk to personnel who returned to Medren.~~

Although Enewetak and Medren were free of fallout, and water samples had revealed no contamination in the southern part of the lagoon, the picture was exactly the reverse farther north. Thus, all traffic north of Medren had to be cleared through the radsafe control point in Building 57 on Medren (IPO 132#1, p. 281). Two days after the burst, final work for KING on Runit was possible for personnel based on Medren, and a hot lunch was served there from a Holmes and Narver chuckwagon. However, no one stayed there overnight (IPO 132.1#2, KING Inst).

Lightly contaminated

Fallout on Task Force Ships

At the time MIKE was detonated, the Horizon was standing by wave instruments at Seamount 72 approximately 72 miles (133 km) north of ground zero. At 0745 the ship was ordered to get underway for a new position approximately 100 miles (185 km) north-northeast of ground zero. At 1240, after reaching the new position the crew detected fallout. The ship was closed up, and the washdown system started. The commander of the joint task force ordered the ship southward, and after about 2½ hours of steaming at 11.5 knots (21 km/hr), the ship reported it was clear of the fallout.

The peak radiation the ship encountered averaged 0.008 R/hr (gamma only), with a maximum of 0.035 R/hr (gamma only). The masts above the spray from the washdown system were the area of greatest radioactivity. After these were hosed down and the decks washed down, the radiation levels decreased to an average of 0.003 R/hr with a maximum of 0.02 R/hr. On 6 November, when the ship returned to Enewetak, the radiation intensity had decreased to an average of 0.0004 R/hr, with a maximum of 0.003 R/hr (IPO 132.32#3).

Minute fallout particles remained suspended for several days

The USS Radford (DDE-446) and the USS Fletcher (DDE-445) reported radioactive fallout while at sea off of Enewetak Atoll between midnight and 1200 on 3 November. The fallout was most noticeable during and immediately after rain squalls and averaged 0.001 R/hr, with an occasional maximum approaching 0.003 to 0.004 R/hr (IPO 132.3#1). Regulations required that a ship have a level below 0.0006 R/hr if it was to be given final radiological clearance, so on 5 November TG 132.3's radsafe staff checked all ships and pointed out areas needing further decontamination. By 8 November all ships had radiation readings below the required level.

Conclusion of MIKE

The night of 3 November, the Commander of the Joint Task Force sent a final radiological safety advisory to the Commander of the Pacific Fleet stating that fallout from MIKE posed no health hazard to surface or air

that 30 of these men served in the Headquarters element TG 132.1 (IPO 132#1, p. 81) and the remaining served in the task units and projects making up TG 132.1. Identifiable Army personnel participation was in TU 1, Projects 2.1, 5.4b, 6.1, and 9.2; TU 7 (Radsafe); and TU 9 (Photography). In the Consolidated List, six men were identified simply as TG 132.1 and have been entered thus in Table 6.1. The remaining Army personnel identified in this group are discussed below under their home organizations and their dosimetry is listed this way in Table 6.1.

Army Chemical Center, Chemical and Radiological Laboratories, Edgewood Arsenal, Maryland. Twelve men (three civilians, two Air Force officers, and seven Army enlisted men) are cited in the Project 5.4b report as participating in Enewetak field operations. Eleven appear on the Consolidated List with exposures. In addition, eight military from this organization served in TU 7 and were badged. Activities of both groups apparently brought them into contact with radioactive material and their doses are among the highest recorded in IVY. Dosimetry is shown in Table 6.1.

Monitors & decontamination

Army Chemical Corps, Office of the Chief, Washington, D.C.. One officer from this office served in TU 7 and was badged.

Rad Safe Engr.

Evans Signal Laboratory, Ft. Monmouth, New Jersey. Two civilians were badged as part of Project 9.2 and may have been remotely located at Bikini during the test period. Their badges showed no exposure. Two

other civilians and one military from this organization served in Lab TU 7. Dosimetry for the identified ESL personnel is shown in Table 6.1.

Ft. McClellan, Alabama. One officer from an unknown unit at this location was in TU 7. — Army Chemical Corps School

Ft. Sill, Oklahoma. One military from an unknown organization from Ft. Sill was badged and received an exposure of 2,510 rem. He was possibly with TU 7. Rad Safe Engr. monitor - Artillery School

971st OTSU, Ft. Monmouth, New Jersey. One military from this organization was in TU 7. Laboratory



8452nd AAU, Sandia Base, New Mexico. One military was in TU 7. — Spec Wpns Scient Rad Safe Engr.

In addition, Army personnel participated whose duty stations were non-Army organizations. These include the Naval Research Laboratory (2 men), the Air Force 1523rd Motion Picture Sq (2 men), and the Los Alamos Scientific Laboratory (11 men). Dosimetry for these men is entered under non-Army organizations in Table 6.1.

TASK GROUP 132.2 (ARMY)

This task group was the Army support group and was composed of several units that were on garrison duty at Enewetak and several other units that augmented the garrison forces.

There were 46 Army personnel identified only as "TG 132.2" in the Consolidated List. The dosimetry of these men is presented first in Table 6.1, followed by the dosimetry of the men that can be associated with the several TG 132.2 units.

4th Transportation Co. (Truck). Three officers and 125 men stationed in Enewetak through IVY. Only a single individual badged. See Table 6.1.

18th Military Police Criminal Investigation Detachment. One officer and two men on Enewetak were badged. See Table 6.1.

125th MP Provost Marshall Detachment. Two officers and five men on Enewetak, none of whom were badged.

511th Transportation Co. (Port). Five officers and 155 men exclusively on Enewetak. Eleven were badged and may have been used as radsafe monitors as exposures are higher than normal duties would imply. See Table 6.1.

TU-7 borrowed TG 132.2 2 months for [illegible] mission.

Naval Administrative Unit, Sandia Base, New Mexico. This organization appears to be a unit that administered the naval personnel who were on duty assignments at LASL and AFSWP, Field Command. Three individuals appeared on the Consolidated List and two can be identified as participating in Project 6.1.

Naval Air Station, Norfolk, Virginia. One naval officer was badged from NAS and participated in TU 7 (Radiological Safety). Rad Safe Engr. who evacuated Ujelang.

Naval Electronic Laboratory, San Diego, California. Three individuals participated in Projects 6.4b and 6.7c. Only one individual was badged.

Naval Ordnance Laboratory, White Oak Maryland. Six people are recorded as participating in Program 6 (Blast Measurements). Three individuals were badged.

Naval Radiological Defense Laboratory, San Francisco, California. Ten individuals (two Navy, one civilian, and one unidentified) participated in Project 5.4a with BuShips.

Naval Research Laboratory, Washington, D.C. NRL was the largest laboratory organization participating in IVY. Ninety-four people are recorded as participating in Projects 2.1a, 5.4a, 6.4b, 6.7a, and 8.5. Only 50 people (8 Navy, 1 Air Force, 1 Army, and 40 civilians) were badged.

Navy Department, Washington, D.C. One individual had a reading of 1.000-1.500 R with no identifiable activity. TU-7 visitor

Office of Naval Research, Washington, D.C. and Branch Office, Pasadena, California. Six people were scheduled to participate in Projects 11.2, 11.3, and TU 7. One Navy individual was badged with no identifiable project participation. (Rad Safe Engr. monitor)

Public Works Officer, 13th Naval District, Seattle, Washington. One Navy individual was badged. He was in TU 7. (Rad Safe Engr. monitor)

Public Works, USN Special Weapons Unit, Sandia Base. Two men from this unit were badged. One worked with Project 5.4a.

Staff Cinc Lant, FH Naval Base, Norfolk, Virginia. One naval officer was badged with this unit. He served in TU 7. (Rad Safe Engr. monitor)

Staff COM AIR PAC, San Diego, California. One naval officer was badged with this group. He participated in TU 7, and reentry on Project 2.1a with NRL. (Rad Safe Engr monitor)

Other Navy Elements with Undefined Functions:

FPO 824 c/o PM, San Francisco - USN. Five individuals (two Navy, three unknown) were badged with this group.

Simpac Fleet. One civilian received a zero reading.

TASK GROUP 132.2 (ARMY SUPPORT)

Navy Detachment. This group, remaining at Enewetak between GREENHOUSE and IVY, provided small boat support for the garrison force at Enewetak. This unit provided interisland and intra-atoll sea-lift service for Enewetak in cooperation with the small boat service provided by the Holmes and Narver boat pool. This unit called for an operational strength of one officer and twenty-four enlisted men. One naval officer was badged.

As a precaution TU-7 badged one member if contamination was doubtful.

TASK GROUP 132.3 (NAVY SUPPORT)

The personnel dosimetry from the Consolidated List is presented in Table 7.1 for the naval units of TG 132.3. The units were organized into elements whose functions are discussed in Chapter 1. The information in Table 7.1 is presented in order of these elements. The organizational elements are shown in Table 7.2 along with the ship characteristics.

Task Element 132.30 (Weapons Element)

The seaplane tender USS Curtiss (AV-4) served in two roles during Operation IVY. As TU 132.34.0 of the Convoy and Escort Element 132.34, the Curtiss transported components of the shot devices from the United

Helicopter Transport Squadron 362 with two HRS-2, Fleet Composite Squadron 3 (VC-3) detachment with six F4U-5N Corsair propeller fighter aircraft, and Fleet Aircraft Service Squadron 7 (FASRON-7) detachment with four TBM-3R, single engine carrier transport aircraft.

On 15 September 1958 the Rendova sailed from San Diego with its assigned air group aircraft plus sixteen F-84Gs to be used by TG 132.4 (Air Force) for cloud sampling, and four C-47 to be used in interatoll airlift. Also loaded in the Rendova for the operation were two U.S. Army Signal Corps trailers to be used by TG 132.1 in radsafe operations. The C-47 were offloaded at Pearl Harbor 21-23 September, and the F-84 were transported to Kwajalein, 30 September-1 October. The Rendova arrived at Enewetak on 2 October.



Commander TG 132.3 transfered with his staff to the Rendova on 4 October. Tasks assigned to TU 132.3.0 were generally carried out as planned. Table 7.22 provides a summary of the Rendova's preshot, shot time and postshot activities for MIKE detonated on 1 November, and KING detonated on 16 November. The table, Scientific Project Support, identifies the specific scientific projects supported by the Rendova.

The maximum permissible exposure specified for Operation IVY was 3.0 R (measured gamma only), based upon a 3-month operational period (IPL 132.3#1, p. J-III-1). No crewmember of the Carrier Unit received a recorded radiation dose in excess of 2.815 rem. To carry out the

# SECTION 9

## SUMMARY OF U.S. MARINE CORPS PARTICIPATION IN IVY

Marine Corps organizations were represented in the Scientific Task Group (TG 132.1) and in the Naval Task Group (TG 132.3). In TG 132.1, four marines worked in TU 7 (Radsafe) as monitors and in decontamination work. In TG 132.3, 67 Marines were part of the ships company of the USS Curtiss (AV-4) of TU 132.30.0 of the Weapons Element, but none appear on the Consolidated List (IPO 132.1TU7#2). The USS Estes (AGC-12), TU 132.31.0 of the Transport Element, had five Marines as a part of its ships company, none of whom appear on the Consolidated List.

HMR-362, a marine helicopter unit that provided support for the scientific program, was based on the USS Rendova (CVE-114), the Carrier Unit (TU 132.3.0) of the task force. This unit had 14 officers and men, of which 10 were badged.

A 93-man contingent of Marines was at the Naval Base on Kwajalein during the IVY testing period, but none of these appear on the Consolidated List, implying no badging and no expected exposure.

Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. ORNL provided at least one person to JTF 132 and he worked in TU 7. Scientific advisor Horizon manager

Sandia Corporation, Albuquerque, New Mexico. This AEC captive organization staffed Projects 2.5, 6.1, 6.3, 6.5, 6.7b, and the Arming and Firing Task Unit. Sandia total at the PPC was 67 (IPO 132.1TU1#636), of which 19 were badged.

OTHER GOVERNMENT AGENCIES

Federal Civil Defense Agency (FCDA). A representative of this agency was badged at IVY. He was ~~possibly~~ an observer.

U.S. Coast and Geodetic Survey (USCGS) participated in the pre-MIKE geological surveys of the atoll (Program 11). No representatives were badged.

U.S. Coast Guard. One officer and eight men were located at Enewetak and ran a Loran station there. They were considered a part of TG 132.2 and were evacuated for the MIKE shot with TG 132.2. None were badged.

Other Government Officials (VIP). One member of Congress was badged at IVY as was also a member of the President's Cabinet. Senator Gruening

CONTRACTORS

Allied Research Associates (ARA), Boston Massachusetts. Plans called for three employees of this firm to assist the Air Force in the conduct of Project 6.10. Only one was badged.

American Car and Foundry Industries (ACF). This firm fabricated and assembled the mechanical portions of the MIKE device. ACF provided 46 people to TU 4, the Weapon Assembly Task Unit. None of these were apparently badged. They were ~~probably~~ evacuated from Eluklab and taken to Kwajalein after the assembly process was completed.

Bendix Aviation, Burbank, California. This firm was to provide eight engineers to support the telemetry system for Project 6.11. None were badged and they ~~probab~~ly did not get farther than Kwajalein.

Boeing Company. This Air Force contractor was to have a representative to aid in the effects aircraft experiment. No Boeing people were badged.

Cambridge Corporation, Boulder, Colorado. This A.D. Little subsidiary was an AEC contractor that provided the handling services for the super-cold liquefied gases required for the MIKE device. This was done as TU 3, and 83 men were involved. None were badged, indicating that this group did not return to Enewetak after MIKE.

# CHAPTER 11

## SUMMARY OF PERSONNEL EXPOSURES

Generally speaking, the only task force personnel exposed to nuclear radiation during the IVY test series were involved in operations such as radioactive cloud sampling and data recovery where exposures were expected to occur. There appears to have been no widespread exposure of support personnel. As a consequence, the personnel who were exposed were prepared. They knew what to expect and they were protected in the sense that their times of exposure were monitored and a record was kept of their cumulative dose.

Very few men exceeded the task force's maximum permissible exposure of 3.9 rem. Those that did significantly exceed these were involved in two incidents.

The first (and the one resulting in the highest doses recorded) inolved the crew of an SA-16 search and rescue amphibian aircraft who were responding to an emergency situation. A sampler aircraft and pilot went down in the ocean following the MIKE shot. The search and rescue aircraft took the shortest path to the downed aircraft and in so doing knowingly passed through a fallout zone. As a result, the 7-man crew received doses of 10 to 17.8 rem.

The second incident that created another group of easily observed overexposures in the dosimetry records was the 12-man crew of a C-54 photo plane; the crewmembers received doses between 8.6 and 11/6 rem. This plane was on a mission to take aerial pictures of the MIKE crater and was caught in fallout.

In both incidents the corrective measures possible were taken, i.e., early ending of the mission and prompt return to base for decontamination, flying through available rainshowers to aid in decontamination on the return flight.

The exposure records of the task force as a whole seem to accurately reflect the operations that took place; i.e., men who were exposed were badged and the badges appear to reflect the exposure potential of what is known about the activity. Possible exceptions to this are the crewmembers of the USS Arikara, who were slightly contaminated during the recovery of a buoy following MIKE but whose badges registered a zero exposure. Perhaps the contamination was so low (0.5 mR) and the decontamination so prompt that the badges did not respond.

The summary statistics in Tables 11.1 and 11.2 present the exposures by Service and by task force component. Averages (arithmetic means) have been derived from the records in order to make a simple presentation. Two points, however, should be noted.

Table 11.1. Summary of IVY personnel exposure by Service.

| | Number of Men | Mean Dose (rem) |
|---|---|---|
| Army and Army Organization Civilians | | |
| Task Group 132.1 | 50 | 1.08 |
| Task Group 132.2 | 106 | 0.34 |
| Other Army | 9 | 0.16 |
| Total Army | 165 | 0.55 |
| Navy and Navy Laboratory Civilians | | |
| Hq JTF 132 | 1 | 0.75 |
| Task Group 132.1 | 79 | 0.74 |
| Task Group 132.3 | 724 | 0.19 |
| Other Navy | 15 | 0.23 |
| Total Navy | 819 | 0.24 |
| Air Force and Air Force Laboratory Civilians | | |
| Hq JTF 132 | 1 | 0.25 |
| Task Group 132.1 | 55 | 1.85 |
| Task Group 132.4 | 693 | 0.56 |
| Total Air Force | 759 | 0.64 |
| Marine Corps | | |
| Task Group 132.1 | 4 | 1.62 |
| Task Group 132.3 | 10 | 1.05 |
| Total Marine Corps | 14 | 1.21 |
| Joint Department of Defense | 1 | 1.7 |

TU-7 monitors spent more time in contamination Than project personnel. Biggest concern was beta burns on unprotected hands.

of this interval is overestimated by assuming that an exposure of 0.25 rem characterizes the interval. This may have raised the average derived somewhat but as the values are low anyway (tenths of rem), recalculation using the individual values is unwarranted.

No one received significant radiological exposure.

Long Term effects of cigarrette smoking, suns ultra-violet, coral infections, alcohol outweigh long Term effects of short period radiation exposure

IVY was an excellent Training program for The several service rad-safe engineers and Technicians. It proved that military services could conduct controlled operations in radiological contamination.

John Servis
Col USA (RET)
Commander, TU-7 132.1

## APPENDIX C

## RADIATION DATA FOR IVY

This radiation data was prepared several months after the completion of IVY. It is a summary of data from situation maps and monitor readings. It is somewhat academic in its extrapolation to H+1 hour readings and reentry times.

The data quoted here ~~was~~ were not used for control purposes.



Control was maintained by daily radiological reconnaisance by helicopter. These surveys indicated light, moderate, or heavy contamination.

Entry to moderate contamination required monitor escort.

Entry to heavy contamination was limited to emergency situation.

By laboratory test, water concentrations of contamination could be estimated by the amount of suspended sediment