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Report to the Scientific Director

RADIOLOGICAL SAFETY

By

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ABSTRACT

This report contains a description of the mission, organization, and activities of Task Unit 7, Task Group 7.1, Joint Task Force SEVEN, during Operation Redwing. Task Unit 7 was charged with the responsibility of providing radiological-safety support for the Scientific Task Group, TG 7.1. The various chapters are devoted to a discussion of the activities engaged in by the Task Unit and the organization necessary to provide adequate radiological-safety support for a weapons-test operation of the magnitude of Operation Redwing. Radiological-survey results of the atolls following firing of the various devices are presented. Special problems arising during the operation are discussed.

ACKNOWLEDGMENTS

Task Unit 7 (TU-7) wishes to acknowledge the cooperation and support of the following organizations. Their combined efforts were largely responsible for the success of the radiological-safety operations during Operation Redwing.

Health Division, Los Alamos Scientific Laboratory (LASL)
J-Division, LASL
Supply and Property Department, LASL
Albuquerque Operations Office, Atomic Energy Commission (AEC)
Holmes and Narver, Inc. (H&N), Los Angeles, Calif.
Office of the Chief Chemical Officer, Washington, D. C.
U. S. Army First Radiological Safety Support Unit, Chemical Corps Training Command, Ft. McClellan, Ala. (the First RSSU)

In addition, the following individuals are to be credited with making significant contributions that materially assisted TU-7 during all phases of the operation:

Thomas L. Shipman, Health Division, LASL
Duncan Curry, Jr., J-Division, LASL
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Leo G. Chelius, Health Division, LASL
Dean D. Meyer, Health Division, LASL
Simon Shlaer, Health Division, LASL
Major Charles L. Weaver, U. S. Army

[redacted]

Chapter 1

ORGANIZATION

1.1 TU-7 Mission

The mission of TU-7, Task Group (TG) 7.1, was as follows:

a. Perform all ground- and aerial-monitoring services associated with the scientific mission of TG 7.1 except those in conjunction with aircraft and airborne collection of scientific data.

b. Assume responsibility for TG 7.5 radiological safety during the operational phase of Redwing.

c. Provide laboratory and technical assistance in nonmedical radiological safety problems to all task groups.

d. Provide all legal dosimetry services for Joint Task Force SEVEN.

1.2 TU-7 Organization

The operational concepts, calling for firing capabilities at both Bikini and Eniwetok atolls, necessitated a Task Unit organization that provided two separate and independent radiological-safety organizations. Accordingly, separate organizations were established at Bikini and Eniwetok with over-all control being maintained by the Commander of TU-7 (CTU-7). The organizations at each atoll were similar, varying only in the number of personnel assigned to the various sections. Each organization contained the following sections, as shown in the organization chart in Fig. 1.1.

a. Dosimetry and Records Section for maintaining legal dosimetry records.

b. Plotting and Briefing Section for conducting all aerial surveys and briefing all personnel going into radex areas.

c. Monitor Section for providing all monitoring services and manning check points.

[redacted]

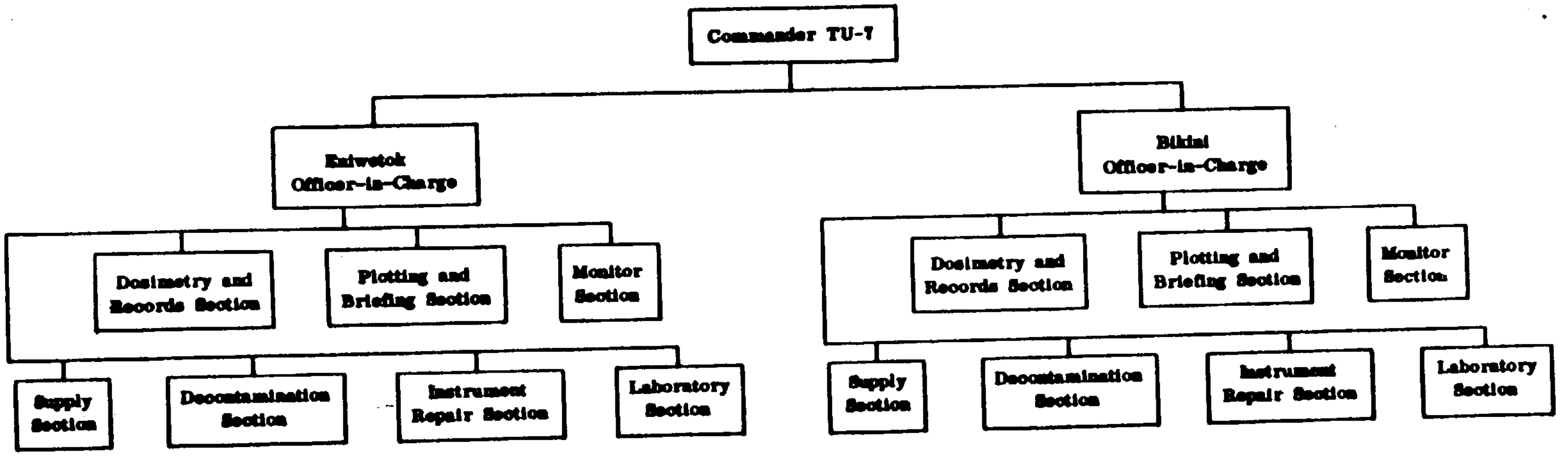

Fig. 1.1—Organization chart, TU-7, TG 7.1.

d. Supply Section for providing rad-safe supplies and laundry services (facilities furnished by TG 7.5).

e. Decontamination Section for operating facilities for personnel and equipment decontamination.

f. Instrument Repair Section for maintaining rad-safe instruments.

g. Laboratory Section for determining the amount of radioactivity in soil and water samples.

The Task Unit headquarters consisted of CTU-7, a photodosimetry officer, a supply supervisor, and an administrative clerk. All photodosimetry work was controlled directly by CTU-7 through the photodosimetry officer, thus relieving the atoll commanders of responsibility for the legal dosimetry records. This arrangement was necessary because of the requirement to maintain, in many cases, duplicate dosimetry records at Bikini and Eniwetok, since many of the technical personnel participated in missions at both atolls.

Under normal operating conditions the Eniwetok organization strength was 65; that at Bikini, 50. All supply problems were handled through J-4, located at Eniwetok. The master files of photodosimetry records were maintained at Eniwetok and the film badges issued to members of TG 7.2, TG 7.3, and TG 7.4 were processed by the Eniwetok Dosimetry and Records Section.

Radiological safety support for TG 7.5 was provided by H&N rad-safe personnel, who were incorporated into TU-7 during the operational period. Generally, the group comprised approximately 10 people.

1.3 Procurement of Personnel

Personnel for manning TU-7 were procured from the Army, Navy, and Air Force. The majority (102 officers and enlisted men) came from the Army, as the entire complement of the U. S. Army First Radiological Safety Support Unit (the First RSSU), Ft. McClellan, Alabama, was made available to TG 7.1. Included in this total are two officers (nuclear effects engineers) requisitioned directly from the Chemical Corps. Eight officers and enlisted men and thirty civilian trainees were provided by the Navy. The civilians, employees of the Navy at various shipyards throughout the United States, were used primarily to operate control points and decontamination centers. Four Navy enlisted hospital corpsmen provided all radiochemistry services, normally the counting of water and soil samples. Navy officers were placed throughout the Task Unit as required. Air Force officers and enlisted men worked in the Plotting and Briefing Sections and in the Monitoring Sections. Air Force personnel performed all necessary monitoring functions concerned with the loading of sample-return aircraft.

1.4 Training of Personnel

Training of the Task Unit personnel and project monitors was carried on at several places. Most of it was given at Ft. McClellan, Alabama, with the First RSSU providing the training staff. However, many members of this staff had first to be trained in their jobs. This was done through a unit-training program at Ft. McClellan. In addition, a project monitors' course, conducted by members of the First RSSU, LASL, and UCRL, was held at Ft. McClellan during January 1956. Approximately 100 project personnel attended the course, which lasted four and one-half days.

Training of selected photodosimetry, monitoring, and radiochemistry personnel was conducted at LASL by a number of groups within H-Division. The Navy hospital corpsmen spent approximately eight weeks in its various laboratories. Instrument-repair personnel were specially trained at the Navy facility at Treasure Island, San Francisco, arrangements being made through the Naval Radiological Defense Laboratory (NRDL). Also, all Navy civilians used by the Task Units were given four weeks of instruction at NRDL prior to departure for the Pacific Proving Grounds.

Monitors' training courses were conducted at Parry and Enyu islands as required. Holmes and Narver personnel were trained as monitors by the H&N organization on Parry Island.

Chapter 2

ENIWETOK OPERATIONS

2.1 Facilities and Services

In support of the operations at Eniwetok Atoll, check points controlling entry and exit from contaminated areas were established under the direction of the Plotting and Briefing Section of the Rad-Safe Center as required. Main check points utilized at all times were located at the air dispatcher's office and at the boat landing. As the situation demanded, other check points were established at the personnel pier and on islands in the atoll other than Parry. All persons entering or returning from a radex area were processed through these check points. An area was considered a full radex area if the contamination exceeded 100 mr/hr and full protective clothing was required for entry into it. Limited radex areas were established as necessary where the contamination was in excess of 10 mr/hr but less than 100 mr/hr. In these areas the clothing requirements were dictated by the situation and the job to be performed.

2.1.1–Personnel-decontamination facilities were removed from the Rad-Safe Building and established on the beach across the road from the Rad-Safe Center, since the facilities in the Rad-Safe Building had been found to be completely inadequate during Operation Castle. The facilities consisted of clean and "hot" change areas and showers. A total of 1560 parties, with 1 to 50 men in each, were processed through the Eniwetok check points from 5 May to 20 July 1956. Of this group, approximately 1600 individuals were processed through the personnel-decontamination station. Laundry services necessary to maintain the protective clothing were provided by H&N under the direction of the Supply Section of the Rad-Safe Center. Two complete laundry units consisting of washers and driers were used for contaminated clothing only.

2.1.2–The equipment-decontamination station on Parry Island processed a total of 225 vehicles, ranging from jeeps to large mobile cranes. In addition, numerous pieces of small equipment were cleaned up for the various projects and for H&N. Normal procedure called for all heavy equipment returning from shot islands to be monitored on removal from boats at the boat landing and directed to the decontamination station if necessary. Versene and citric acid were the common decontaminating agents employed, and a steam generator was used to provide hot solutions for the necessary washing. When equipment was not needed immediately, the vehicles were held in a "hot" parking lot for varying lengths of time before decontamination in order to reduce contamination levels by radioactive decay of the contaminants.

2.1.3—The Plotting and Briefing Section was responsible for the conduct of all radiological surveys on the atoll, the majority of which were made by helicopter. Normal operations included a pre-entry survey with CTG 7.1 at H+1 to H+3 hr, a detailed survey of the entire atoll at H+4 to H+8 hr, and detailed surveys on the mornings of D+1 and D+2 days. Additional surveys were made as required. The basic instrument used in the aerial surveys was a special ionization chamber built by Jordan Electronics, Inc., to the desired specifications. Some AN/PDR-39 survey meters converted to read 500 r/hr were also used. When necessary, data were radioed back to the Rad-Safe Center from the survey helicopter. Plotting and briefing stations were maintained in the Rad-Safe Center and the J-3 office. Ground surveys of islands in the atoll were conducted when required.

2.1.4—Monitors for recovery parties were provided by TU-7 when necessary. The demand was quite small. Normally, no more than two or three were furnished after any one shot. In general, projects provided their own monitors as members of the recovery parties. Monitors were responsible to party leaders, who were expected to accept a monitor's advice and plan their operations accordingly.

2.1.5—Laboratory facilities for radiochemistry work at Eniwetok Atoll were obtained from the Army Signal Corps. One radiochemistry trailer, AN/MDQ-1, was parked near the Rad-Safe Building and used for all sample preparation and counting. The work load of the Laboratory Section at Eniwetok was quite small. Approximately 100 samples of lagoon water were processed after the [redacted] devices were fired. In addition, several tritium urine analyses were performed. Because of alpha contamination after the [redacted] shots, a certain amount of alpha-counting was necessary. Rain-water samples were collected and counted periodically for gross beta-gamma activity or total alpha activity. Chemical analysis was not required.

2.2 Shots and Survey Results

During the entire Eniwetok operational phase, the contamination from any one shot did not materially interfere with preparations for the next. In certain cases, crude decontamination measures were necessary in order to reduce the contamination level to a point where a normal day's labor could be performed without excessive dosage resulting. Generally, road-scraping and bulldozing operations were all that was necessary. Table 2.1 gives the firing schedule for Eniwetok Atoll.

TABLE 2.1—FIRING SCHEDULE, ENIWETOK ATOLL

Device	Date (M.I.)	Local Time
[redacted]	5 May 56	0625:29
[redacted]	28 May 56	0756
[redacted]	31 May 56	0615:29
[redacted]	6 June 56	1255:30
[redacted]	12 June 56	0626
[redacted]	14 June 56	1126
[redacted]	16 June 56	1313:53
[redacted]	22 June 56	0956
[redacted]	3 July 56	0606
[redacted]	9 July 56	0606
[redacted]	22 July 56	0616

[redacted] produced significant amounts of contamination on all islands north [redacted]it. Survey results four hours after shot time are shown in Fig. 2.1. Because of contamination, the camps on Rojoa and Teiteiripucchi were permanently closed after this shot. The camp on the south end of Runit, however, was not significantly contaminated and it was re-occupied. Decontamination around the air dispatcher's office on Biijiri and along the roads within the Aomon-Rojoa complex was accomplished by using road scrapers and bulldozers. This materially reduced the dosage that personnel received in transit to working sites. In addition, the areas around the tower sites on Runit, Eberiru, and Aomon were decontaminated by scraping and filling, which permitted work to continue there in a normal manner without exposing personnel to radiation doses in excess of the maximum permissible exposures.

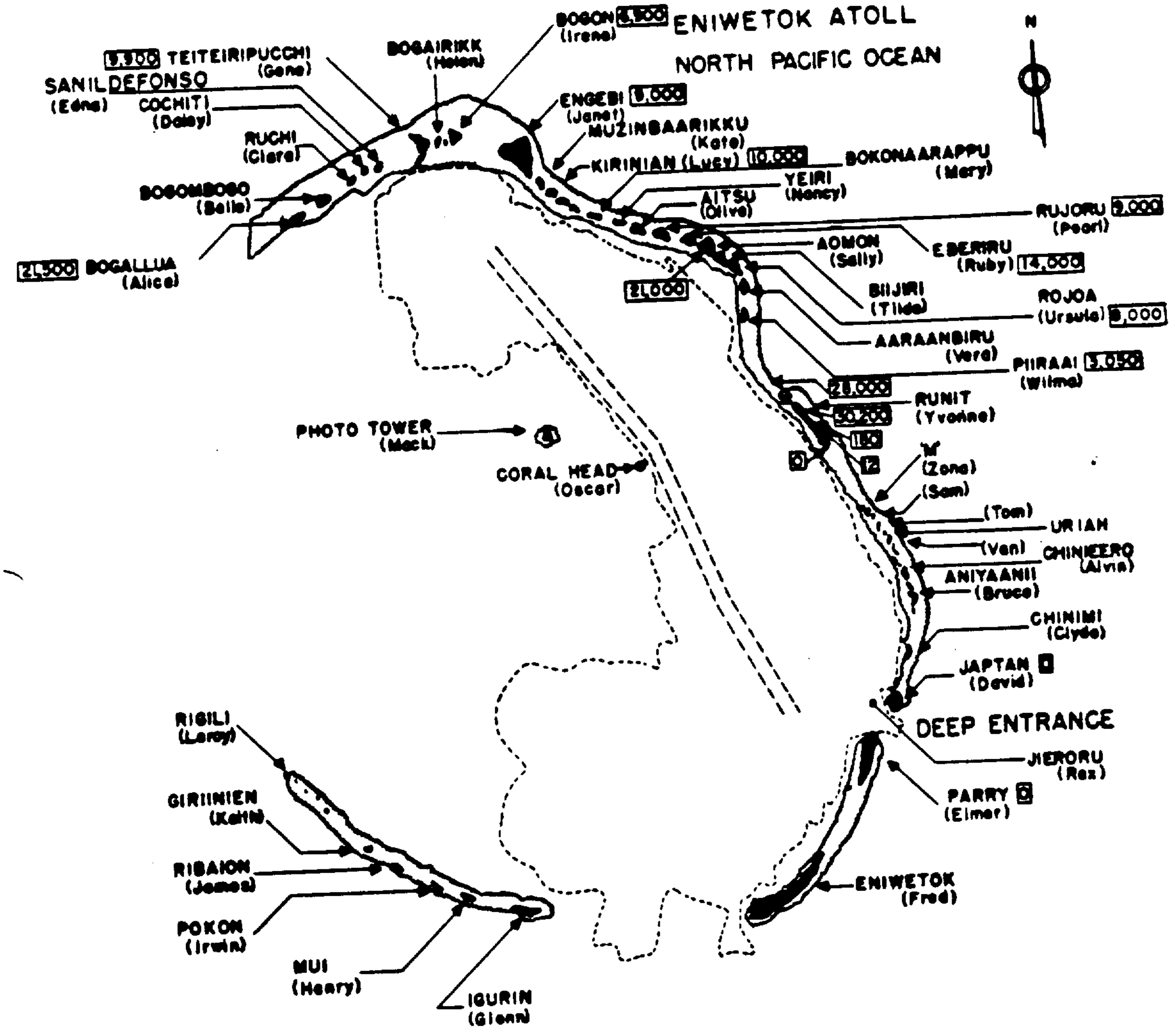

Fig. 2.1 [redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot site was north end of Runit.

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2.2.2—The [redacted] device, fired on Aomon, produced contamination only in the shot area on the island. Significant amounts of alpha (plutonium) contamination were found. Figure 2.2 shows the H+4 hr survey results. Because of this plutonium contamination, added precautions were taken in processing all persons returning from recovery operations. The tower site [redacted] on Aomon was not materially affected, however.

2.2.3—The [redacted] fired on Runit in the vicinity of the airstrip, produced heavy contamination only on the shot island. Survey results at H+4 hr are shown in Fig. 2.3. Islands north of Runit in the atoll were but slightly contaminated and no interference with preparations for other shots resulted. Bulldozing operations were carried out on Runit in the [redacted] tower area in order to reduce exposures to an acceptable level for personnel requiring access to this area.

2.2.4—[redacted] produced extremely heavy contamination on the Teiteiripucchi-Bogon complex. Survey results are shown in Fig. 2.4. Certain recovery missions requiring entry on the south end of Teiteiripucchi were held up for approximately two days. Entry into the bunker on Bogon by helicopter was not materially affected.

2.2.5—Heavy contamination [redacted] fired on central Runit, was limited primarily to the shot island. However, the photo tower on Mack was highly contaminated from the fall-out. The contamination on Mack was reduced to some extent by local rain showers; in general, this contamination complicated preparations for other shots, since it made full protective clothing mandatory for any operations in the tower. Survey results at H+4 hr are shown in Fig. 2.5.

2.2.6—The [redacted] device was fired on Aomon and resulted only in heavy local contamination. Tower sites for the [redacted] device on Eberiru and the [redacted] device on Rujoru were not materially affected. Survey results are shown in Fig. 2.6. Significant alpha (plutonium) contamination resulted from the shot, requiring the establishment of a special check point and personnel-decontamination facilities on the south end of Aomon in order to facilitate recovery operations. During these operations extreme precautions were necessary, and certain of the operations required the use of supplied-air breathing apparatus by welders, as for example, when cutting torches were used on pipe sections.

2.2.7—The [redacted] air-dropped and detonated at 700 ft over central Runit, produced no significant contamination. The pre-entry survey showed that no detailed survey was required and that recovery operations could proceed without difficulty.

2.2.8—[redacted] fired on Rujoru, produced heavy local contamination on the shot island. Contamination on the adjacent island of Eberiru

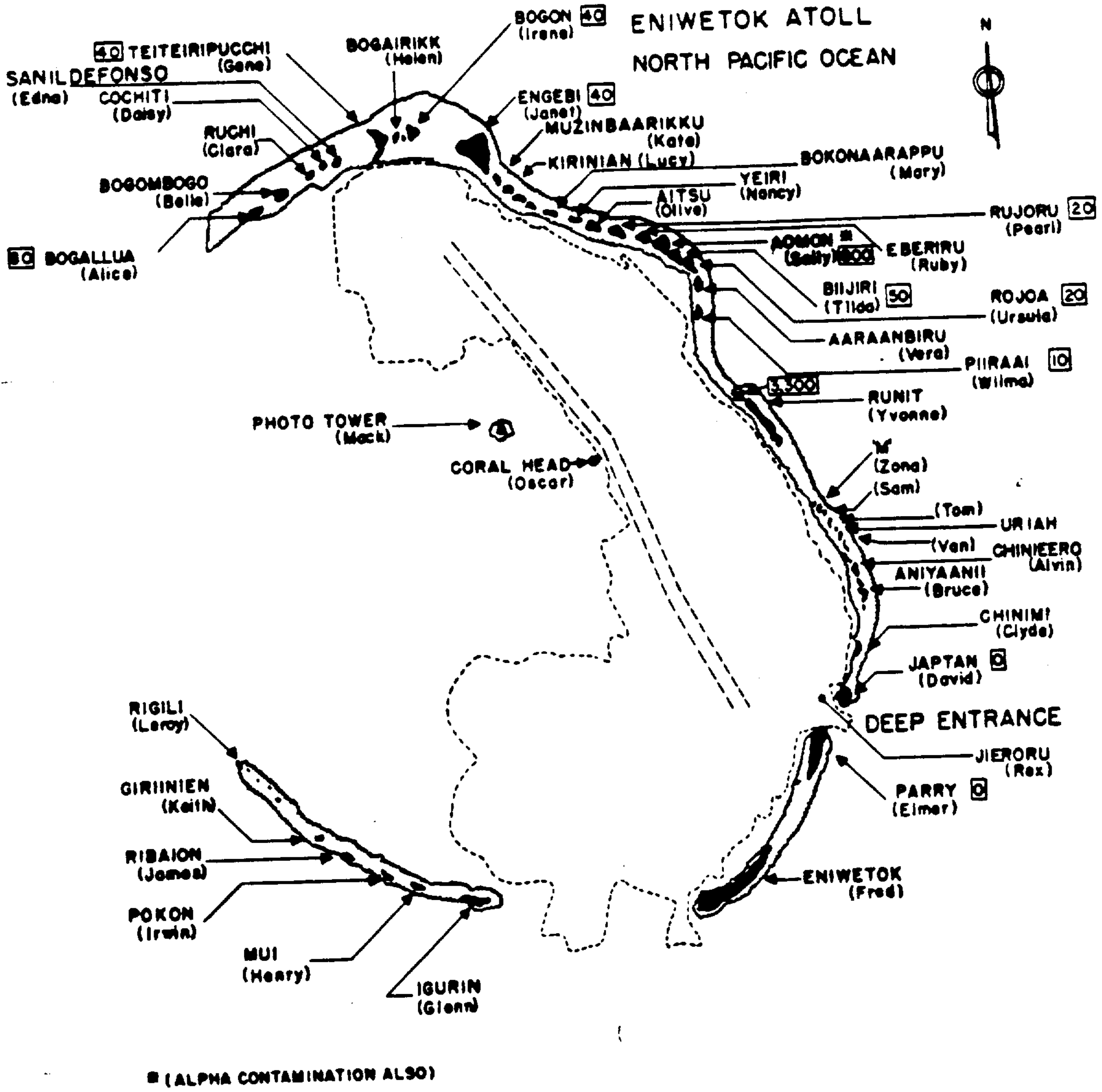
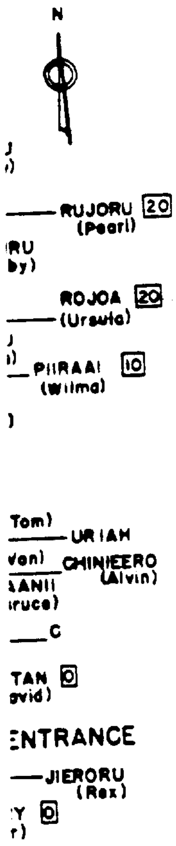


Fig. 2.2 [redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Aomon.



H+4 hr, in

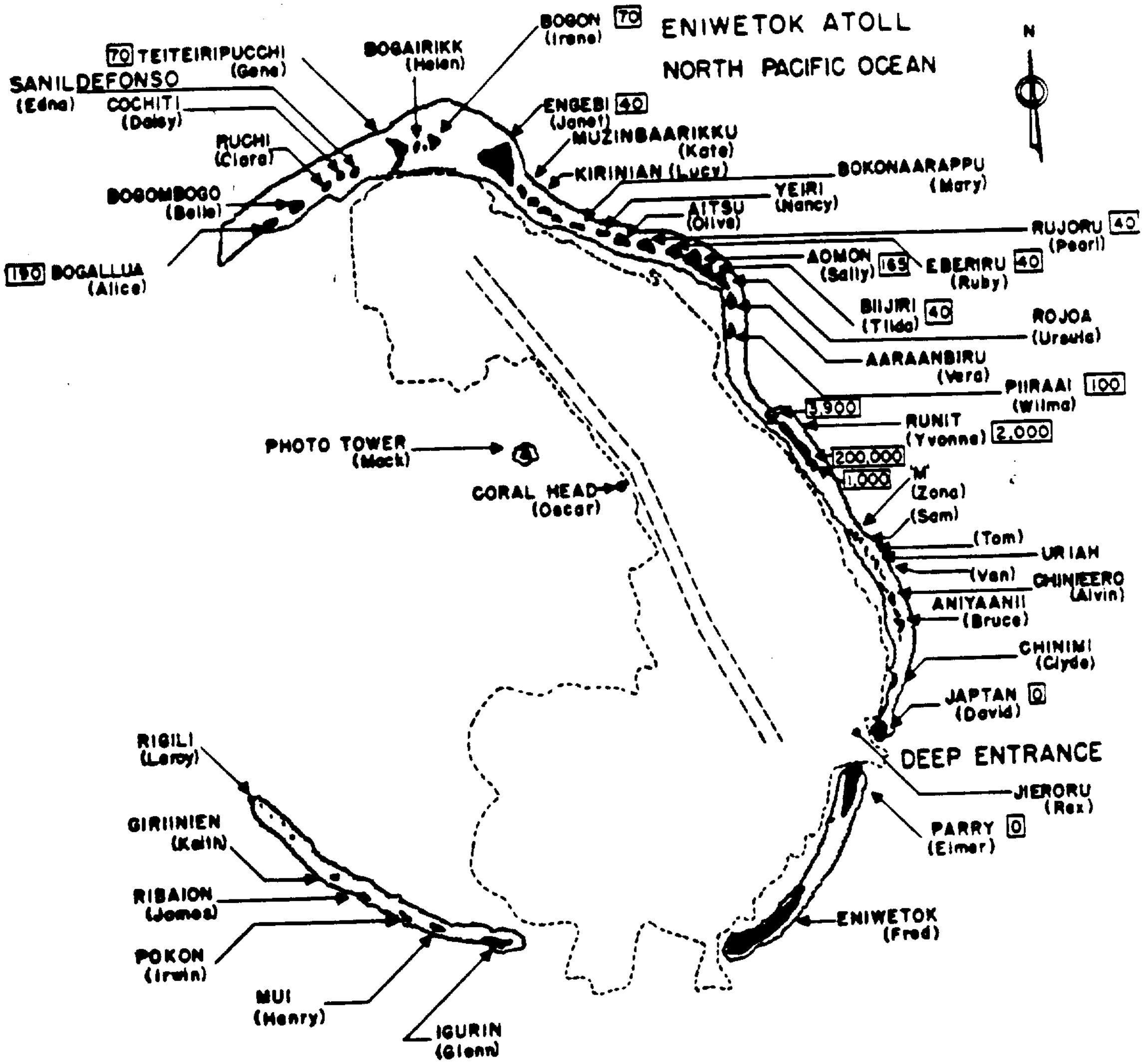


Fig. 2.3 [redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot site was south end of Runit.

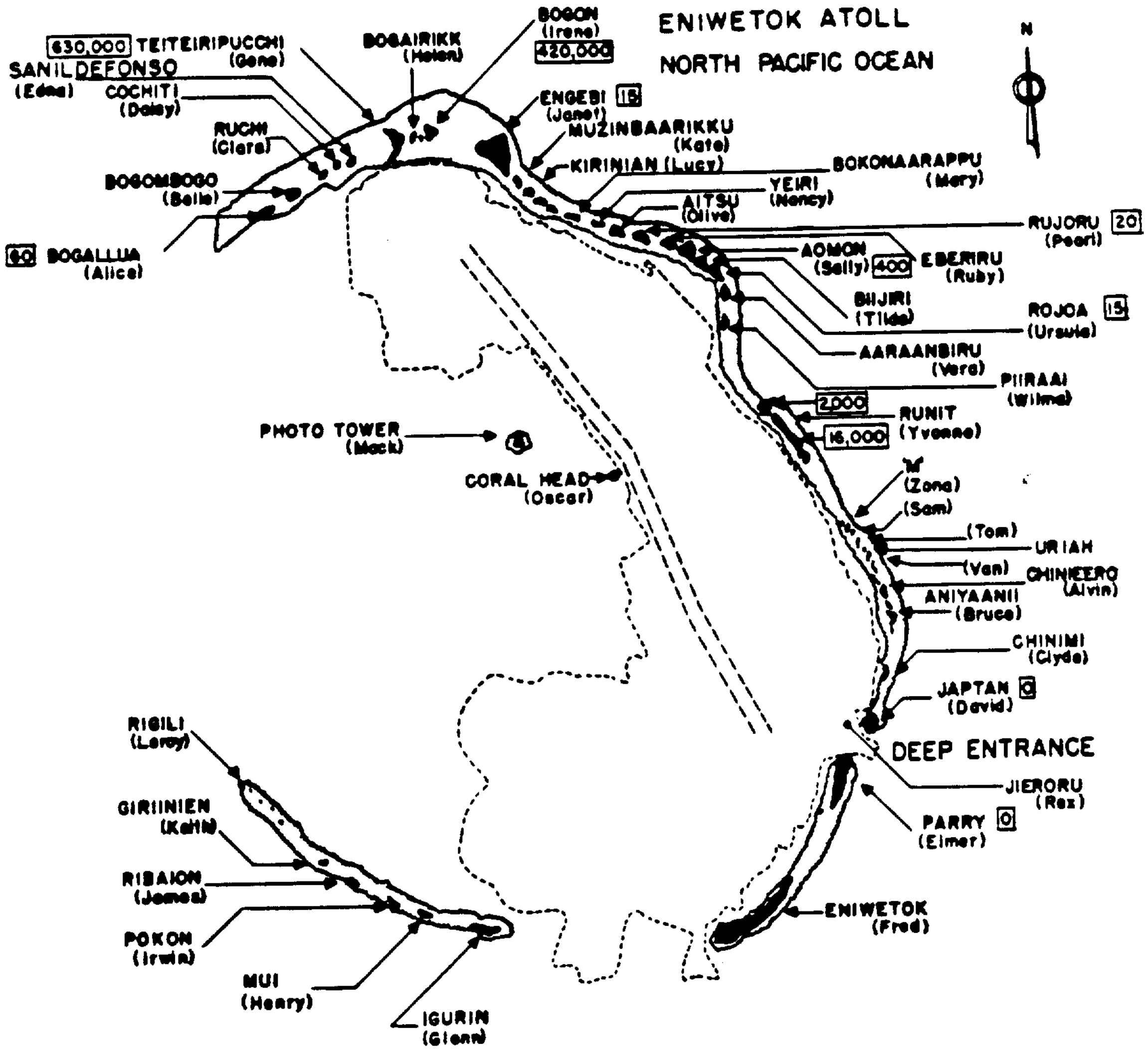
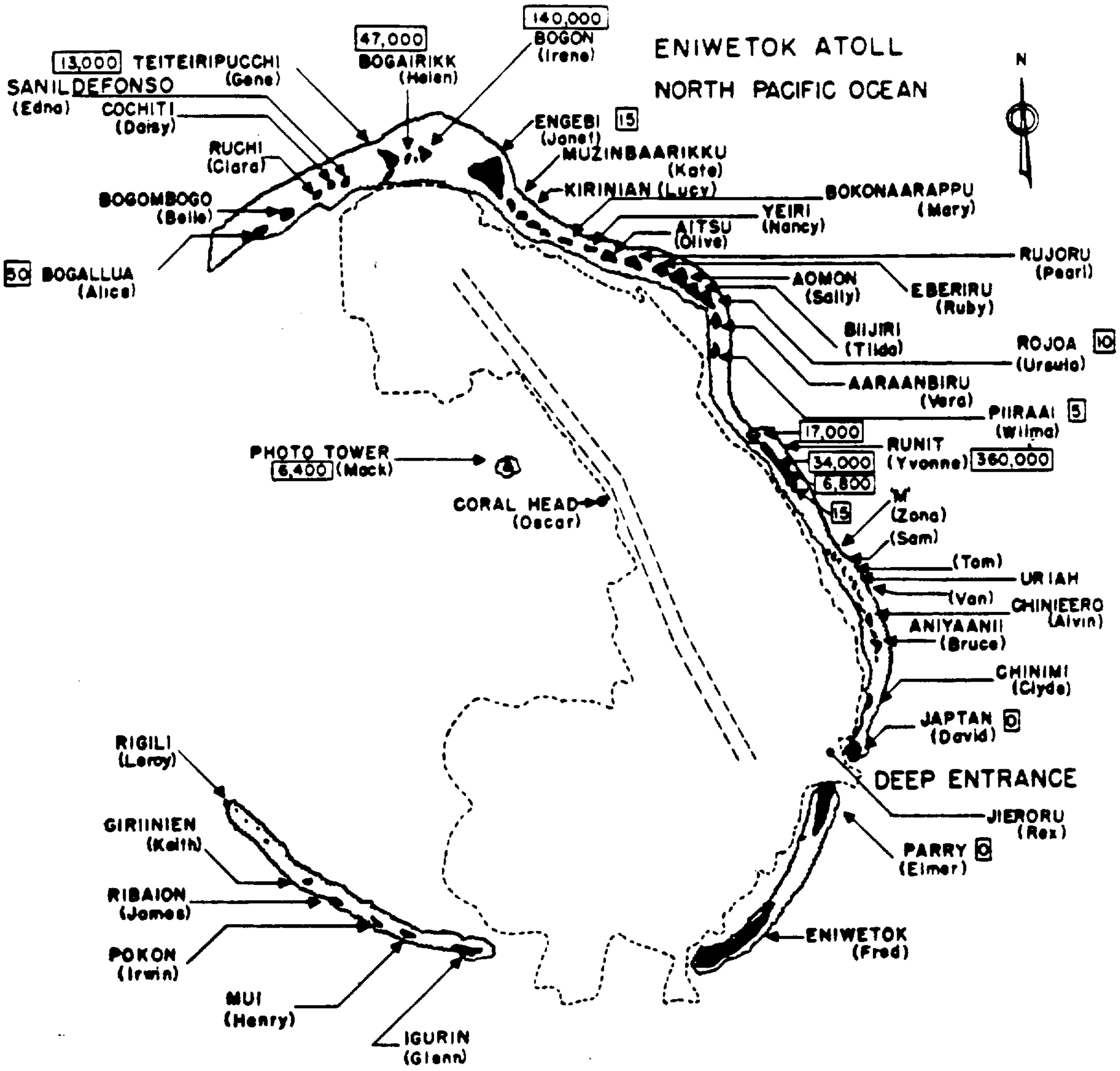


Fig. 2.4 [redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Bogon.



ı milli-

[redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot site was central Runit.

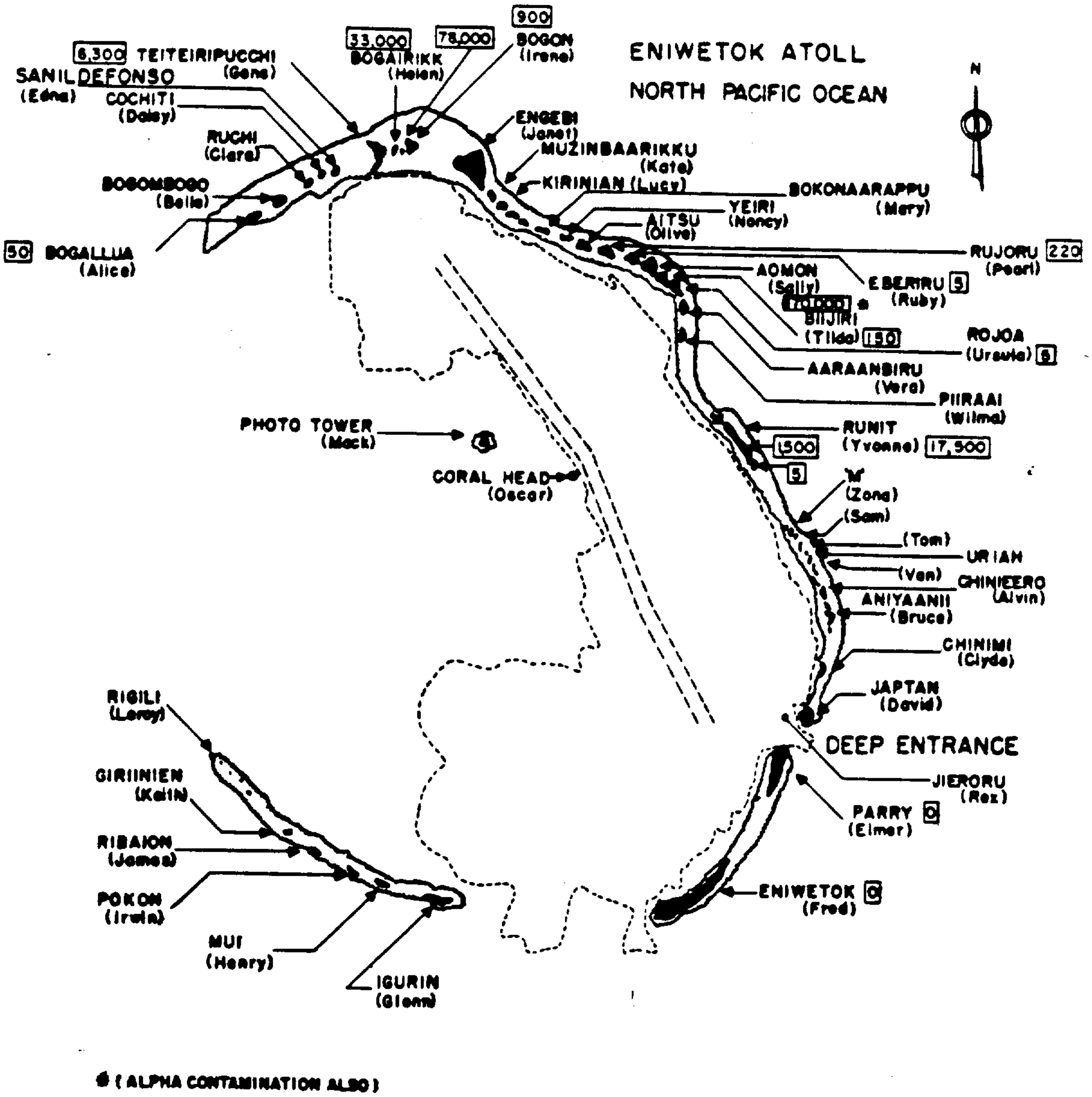


Fig. 2.6—[redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Aomon.

I+4 hr,

was of no consequence and did not interfere with preparation for the firing of [redacted] Survey results at H+4 hr are shown in Fig. 2.7.

2.2.9—Extremely heavy local contamination resulted from the firing of [redacted] on Eberiru. In addition, significant amounts of contamination were deposited on the northern islands of the atoll. Survey results are shown in Fig. 2.8. Certain recovery operations on Eberiru and adjacent islands were delayed for several days as a result of the contamination.

2.2.10—In order to fire the [redacted] in the Mike crater off Teiteiripucchi, a considerable amount of earth-moving was required. This was necessary because of the need for an unobstructed line-of-sight from the bunker on Bogon to the shot barge in the crater. When th[redacted] was fired on Bogon, it dug a rather large crater and threw up considerable debris that had to be moved to meet the line-of-sight requirements. Since contamination levels in the Teiteiripucchi-Bogon complex were of the order of 4 to 5 r/hr at the time the construction work was required, extra precautions were necessary to ensure against overexposure of equipment operators. Accordingly, a cab shielded by 1/2 to 1 in. of lead was built onto one of the bulldozers. This bulldozer was used in most of the work of moving the contaminated sand and operators were changed frequently. The highest dosage received by any one operator was approximately 700 mr after about six hours of operation of this bulldozer.

Firing of the [redacted] device produced exceptionally heavy contamination throughout the upper islands of the atoll. The H+4 hr survey results are shown in Fig. 2.9. Water in the north end of the lagoon was highly contaminated for a considerable distance from the shot island, and as the silt and debris were moved out by the lagoon currents, the contamination spread widely. Two days after the shot was fired, the swimming beach at Japtan had to be closed, since the water-contamination level had exceeded the established tolerance of 50,000 disintegrations per minute per liter. Three days after firing, the beaches on Eniwetok and Parry islands were also closed. The beach on Parry Island was closed for two days; the other two, for approximately seven.

2.2.11—Decision to fire [redacted] in the Mike crater off Teiteiripucchi was based in part on the contamination levels resulting from the [redacted] Information regarding this contamination was obtained through special radiological surveys by helicopter and T-boat of the crater area and adjacent islands. The contamination of these areas did not, however, interfere with preparations for firin[redacted] and although its detonation produced heavy contamination in the northern islands of the atoll (see Fig. 2.10), the radiation levels did not materially interfere with recovery operations. Water contamination from radioactive silt and debris was heavy along the north and west reefs.

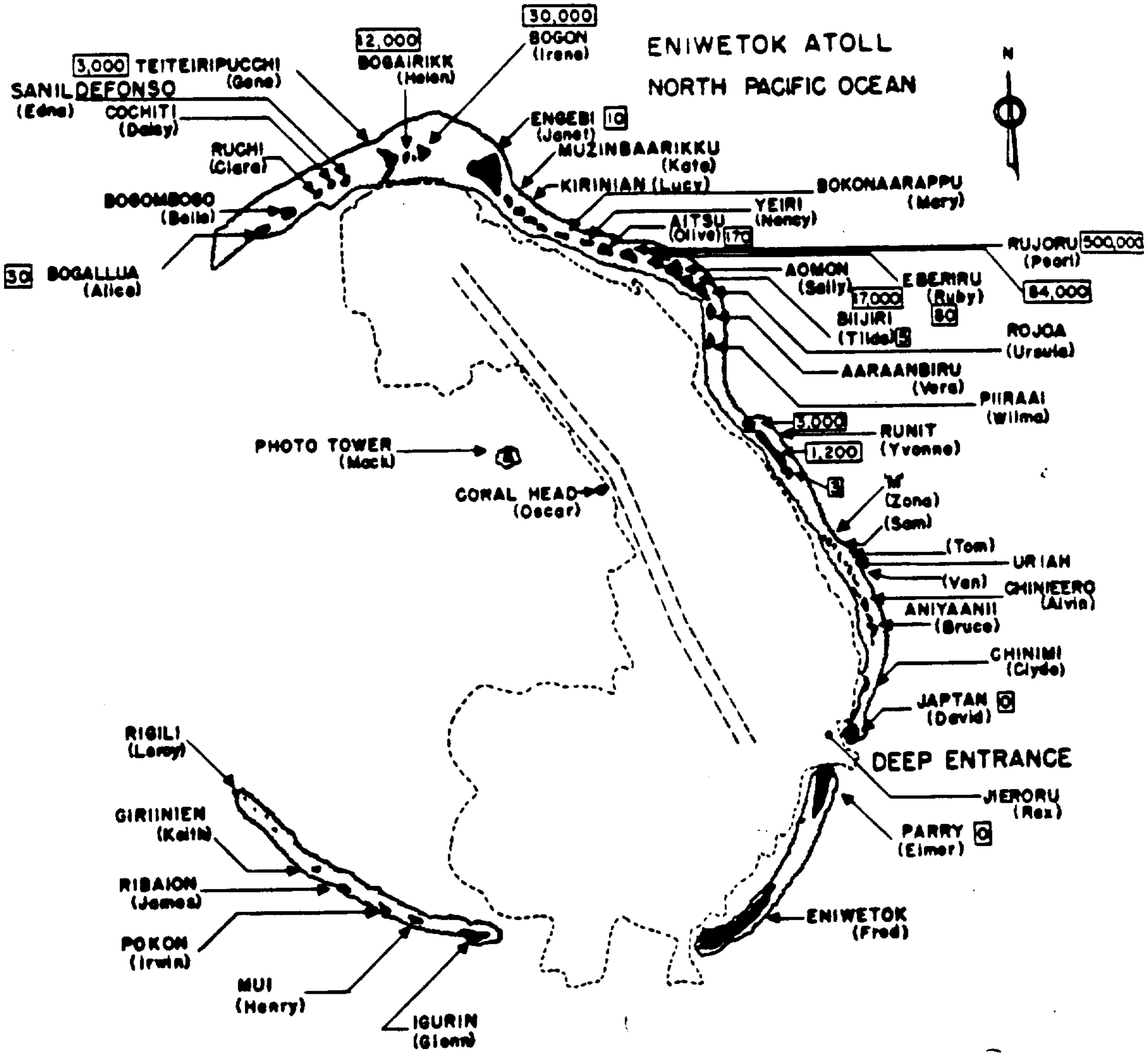


Fig. 2.7 [redacted] intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Rujoru.

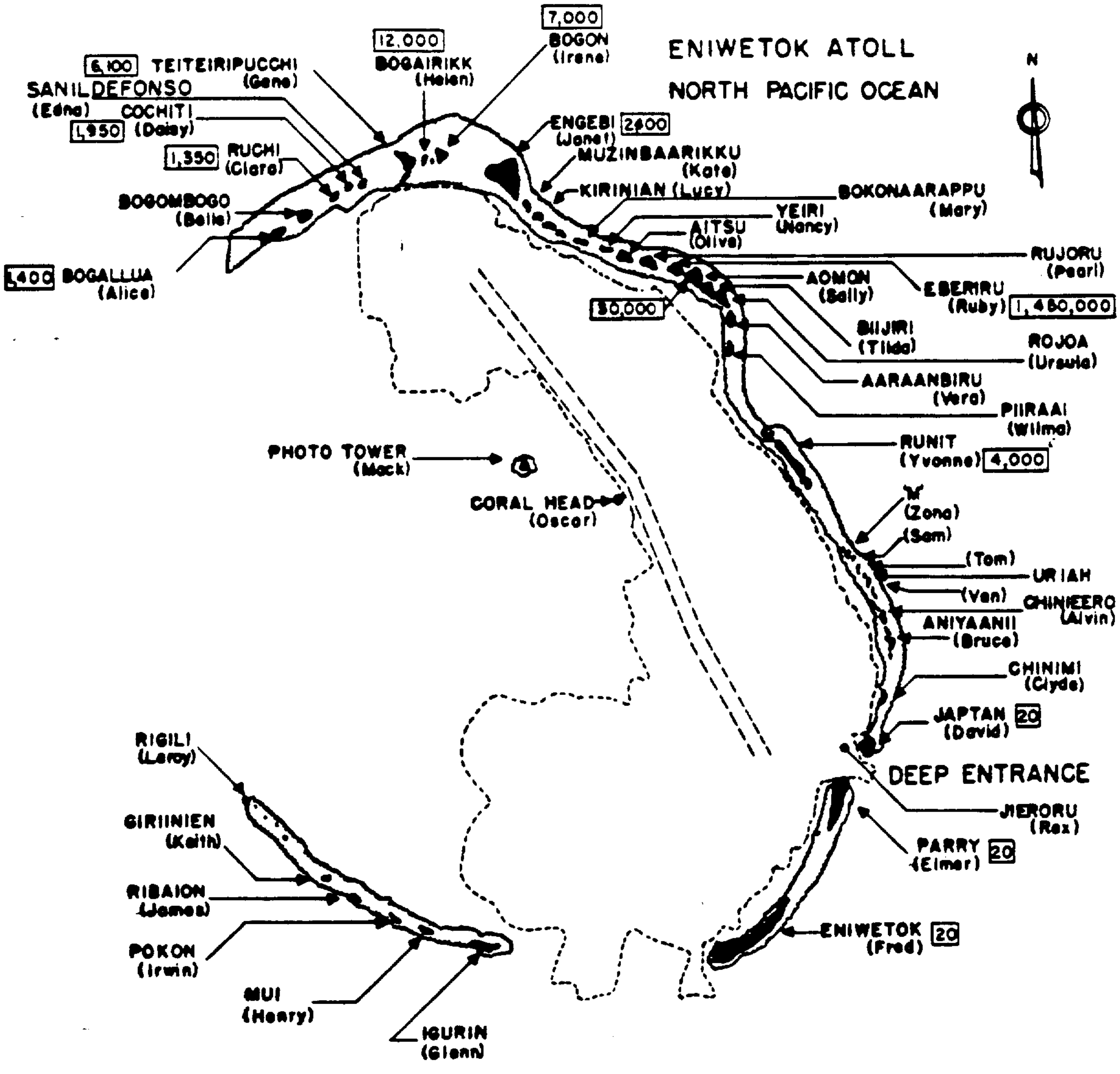


Fig. 2.8 [redacted] intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot island was Eberiru.

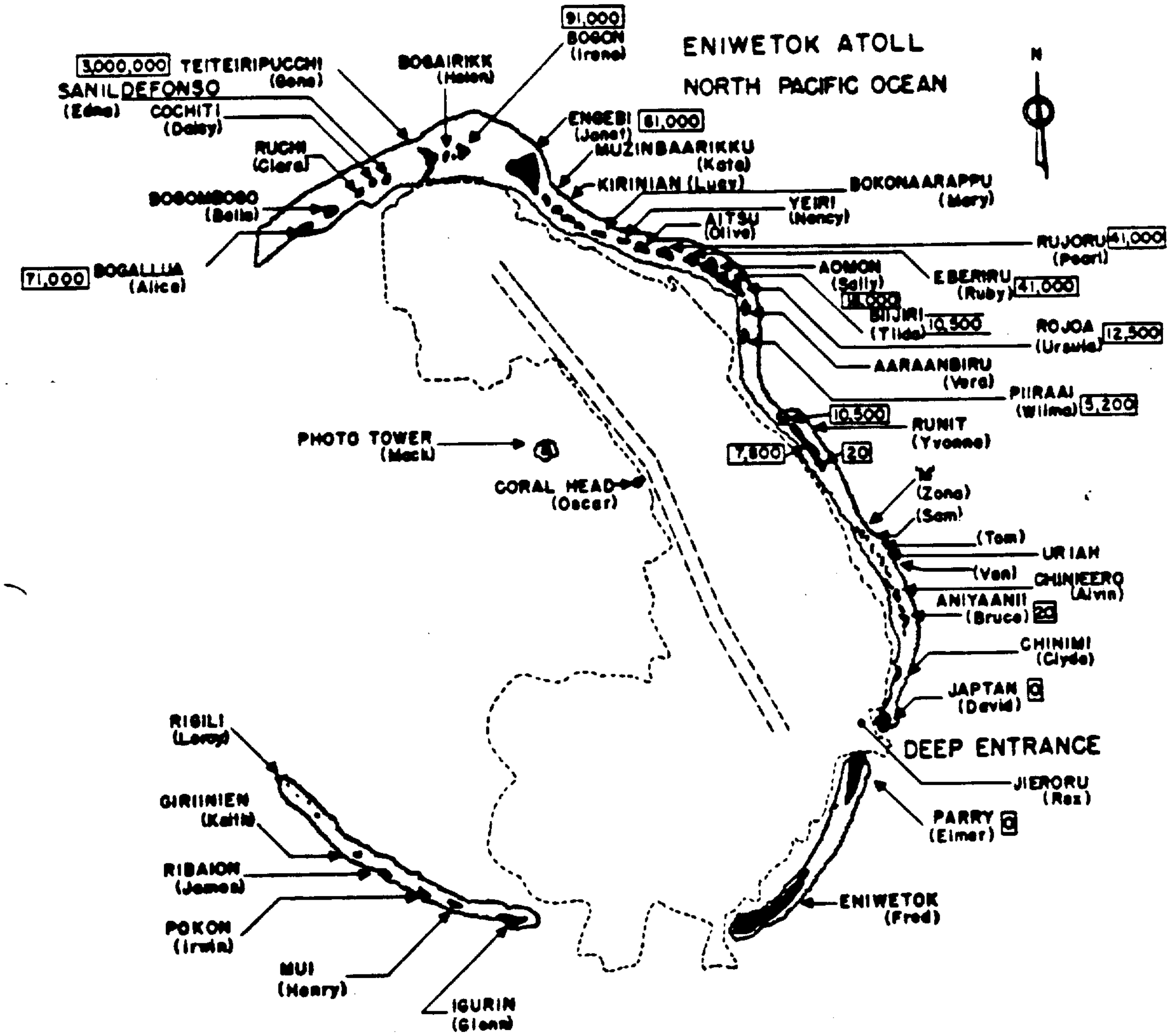


Fig. 2.[redacted] radiation intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot site was Mike crater.

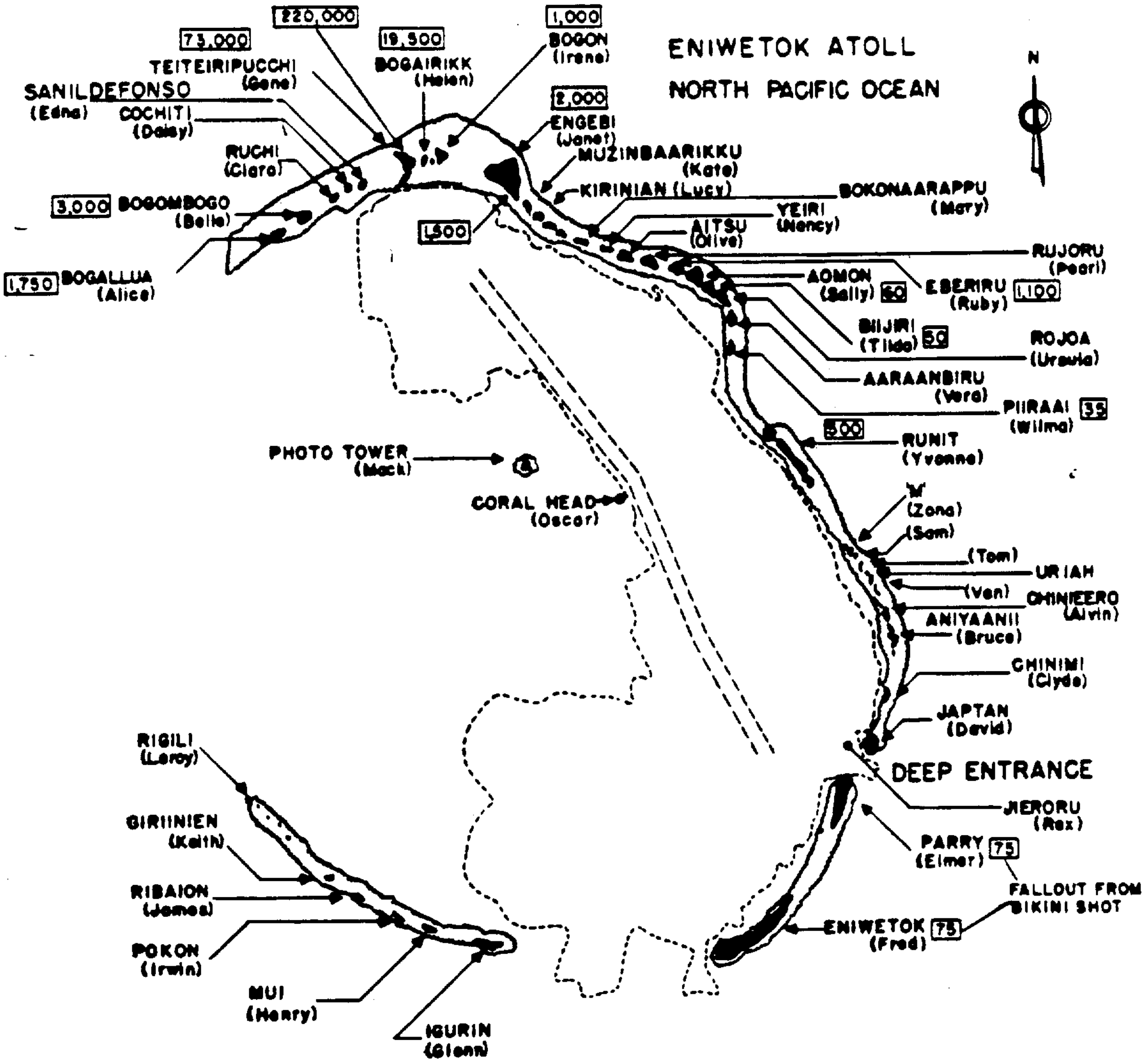


Fig. 2.10 [redacted] intensities on Eniwetok Atoll at H+4 hr, in milliroentgens per hour. Shot site was Mike crater.

2.3 On-Site Fall-out

Fall-out on Eniwetok and Parry islands was observed only once from devices fired at Eniwetok Atoll. Approximately two hours after detonation of [redacted] on Eberiru Island, an increase in background was noted on Parry Island. The fall-out, which was light, continued for approximately one hour. Peak intensity, reached at the end of the fall-out, was 22 mr/hr. Rain showers later in the day effectively removed most of the contamination.

The only significant fall-out observed on Eniwetok and Parry islands during the operation resulted from the [redacted] device fired on Bikini Atoll. The fall-out on Eniwetok commenced approximately nine hours after the device was fired. Two peak intensities in air concentration were observed, as shown in Fig. 2.11. The increase in the background was quite rapid, with a peak of 100 to 120 mr/hr throughout Parry Island. During the fall-out period, which lasted approximately 17 hr, several rain showers occurred; rain samples assayed showed counts in excess of 5,000,000 disintegrations per minute per liter.

The gamma background level fell off quite rapidly once the fall-out ceased. It is to be noted in Fig. 2.11 that the background decay was much more rapid than that expected from the normal exponential decay until H+48 hr and later.

Clean-up operations after the fall-out were conducted around living and recreation areas. As a result of the rain showers, hot spots were found around each building where rain runoff collected. These hot spots, along with other contamination on the surface, were most effectively reduced by using bulldozers, road scrapers, and hand-grading operations to turn the sand. The decontamination efforts were successful in reducing the level to such that no one exceeded the 300 mr/week tolerance level.

Most serious effect of the fall-out was delay of the roll-up operations. Initially, personnel from H&N whose dosage records indicated that they were near the limits of 3.9 r were flown out to Bikini to remove them from the contaminated area. Generally, people in this category were urgently required for roll-up. Accordingly, the maximum permissible exposure for the operation was raised to 7 r. This allowed roll-up to proceed without further delay.

On the average, the dosage received by any one individual on Eniwetok or Parry islands as a result of the fall-out varied from 2 to 3.5 r, depending on the length of stay of the individual and the type of work in which he was engaged. In general, those working in jobs requiring them to remain outdoors during working hours were at the upper end of the dosage spread.

During the actual fall-out period, personnel were requested to remain indoors as much as possible and to take full advantage of shower facilities. Of interest is the fact that no evidence of gross personnel contamination was observed as a result of this fall-out.

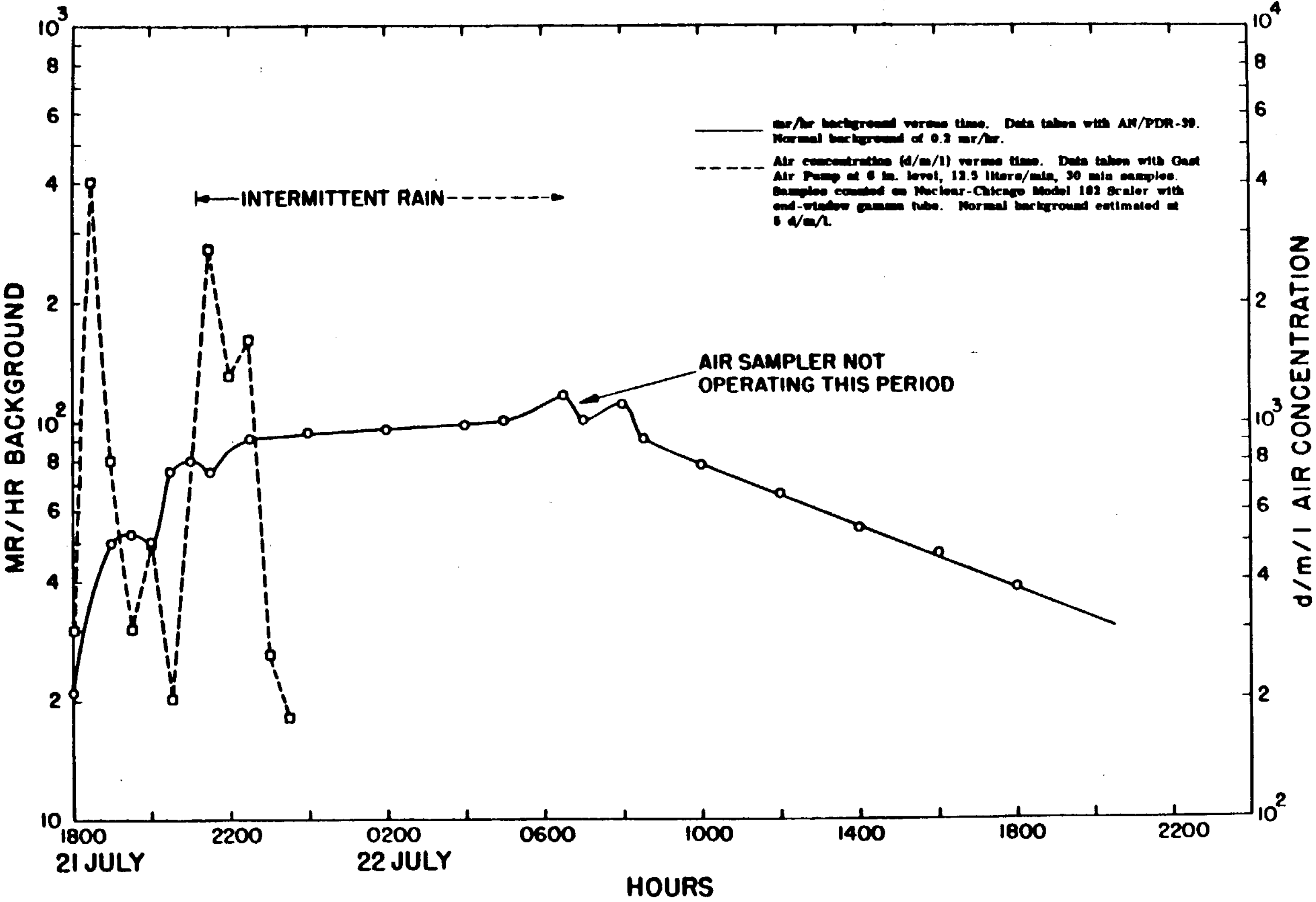


Fig. 2.11—Data on [redacted] fall-out at Rad-Safe Building on Parry Island, Eniwetok Atoll, from 1800 hr, 21 July to 2400 hr, 22 July 1956. Shot was fired at Bikini Atoll.

2.4 Unusual Incidents

Only one incident occurred on Eniwetok Atoll that presented a serious hazard from a radiological standpoint. This hazard arose from a plutonium spill that occurred in a trailer belonging to Project 2.51. A plutonium foil, prepared by LASL, split open at the crimping on the edge. When this foil was picked up for inspection, an estimated 100 mg of oxidized plutonium escaped through the split in the seal. Project personnel continued to use the trailer after the accident, and as a result, the alpha contamination was spread to other trailers, personnel, and living quarters.

Monitoring of personnel disclosed that 10 persons had been contaminated. Twenty-four-hour urine specimens were taken from the 10 after they had been decontaminated and all showed measurable amounts of plutonium. However, the amounts they received were well below tolerance limits.

As a result of the spread of the plutonium one barracks room and four tents required decontamination. In addition, bedding and personal clothing were confiscated and disposed of. A thorough survey revealed that, fortunately, none of the plutonium was carried to the mess hall.

Trailers contaminated by the spill were eventually decontaminated, but serious equipment losses resulted. The trailer in which the spill occurred was completely stripped of equipment, the majority of which had to be discarded. All plutonium-contaminated items were poured in concrete, then taken well out to sea for burial.

Chapter 3

BIKINI OPERATIONS

3.1 Facilities and Services

Operations similar to those at Eniwetok were carried out at Bikini. Control points were established as required, primary points being the boat landing and the helicopter pad. In addition, for afloat operations, check points and radiological-safety centers were established on the USNS Ainsworth, the USS Curtiss, the USS Badoeng Strait, the USS Estes, and the USS Catamount. These rad-safe centers included plotting and briefing areas, clothing and equipment issue points, and personnel-decontamination stations. Radex areas were established as required in a manner similar to that discussed for Eniwetok.

3.1.1—Personnel-decontamination facilities, which were a duplicate of those on Eniwetok, were established on Enyu Island adjacent to the Rad-Safe Building. Approximately 3400 people were processed. Laundry services necessary to maintain the protective clothing were provided by H&N personnel using the laundry facilities that were installed on the rad-safe barge. This barge provided complete personnel-decontamination facilities as well as laundry facilities and was to be used only in the event that operations were to be conducted entirely from shipboard. Only the laundry facilities were ever used.

3.1.2—The equipment-decontamination station on Bikini processed approximately 100 vehicles during the operation. In addition, several helicopters were decontaminated for the Marines. Army Chemical Corps decontamination trucks were used for all equipment-decontamination operations as no steam generator was available at Bikini.

3.1.3—As at Eniwetok, the Plotting and Briefing Section was responsible for all surveys. These surveys were conducted by helicopter. A pre-entry survey was flown at H+2 to H+4 hr, with a detailed one following at approximately H+6 hr. Other detailed surveys of the entire atoll were flown on succeeding days after each shot as required. The instrumentation for each was the same as that used at Eniwetok. Communications from helicoptor to ground were provided by EG&G but proved to be unsatisfactory. Eventually, the data were sent back via the flight-operations radio net when necessary.

Evacuation of the atoll before each shot required that the pre-entry survey originate from afloat. Normally the helicopter selected for the mission departed from the USS Badoeng Strait and made its first stop at the USS Curtiss to pick up the rad-safe personnel. The helicopter then stopped on Enyu to pick up CTG 7.1, and the mission was carried out. Once the island of Enyu was declared clear by CTG 7.1, personnel returned to the island and all operations were conducted from ashore.

3.1.4–Monitors for recovery parties were provided as required. As at Eniwetok, the demand was quite small. Generally speaking, projects provided their own monitors and required no monitoring assistance from TU-7.

3.1.5–The radiochemistry trailer, obtained from the Army Signal Corps, was deck-loaded on the USNS Ainsworth. All radiochemistry work was carried out in this trailer. The Laboratory Section handled approximately 400 water samples, which were taken from the water supplies of the various ships and from the swimming beach on Enyu. No chemical analysis was required; gross beta-gamma activity was determined.

3.2 Shots and Survey Results

Very little interference with preparations for firing the various devices was caused by excessive contamination. In certain cases the spotting of the shot barge was delayed for a day or so as radiation levels were excessive in those areas in which the surveyors had to work. Generally speaking, however, no delay was encountered as a result of the contamination. Table 3.1 lists shots, shot dates, and times for Bikini Atoll.

TABLE 3.1–FIRING SCHEDULE, BIKINI ATOLL

Device	Date (M.I.)	Local Time
[redacted]	21 May 56	0550:38
[redacted]	28 May 56	0556
[redacted]	12 June 56	0626
[redacted]	26 June 56	0606
[redacted]	11 July 56	0556
[redacted]	21 July 56	0546

3.2.1-[redacted]detonated in air over Namu, produced no contamination at Bikini Atoll. The pre-entry survey, flown at approximately H+2 hr, showed the entire atoll clear and radiation levels at background.

3.2.2-[redacted]fired on the ground on Eninman, produced heavy contamination throughout the entire atoll, with the exception of Enyu Island. Survey results at H+4 hr are shown in Fig. 3.1. The fact that Enyu was not contaminated was most fortunate as it allowed operations to proceed from the camp ashore in a normal manner.

3.2.3-[redacted]fired on a barge off Yurochi, produced heavy contamination on the northern islands of the atoll. In Fig. 3.2 are shown survey results at H+4 hr. No delay in recovery operations or preparation for the next shot was experienced.

3.2.4-[redacted]as also fired on a barge off Yurochi. H+4 hr survey results are shown in Fig. 3.3. Contamination levels were much lower than expected and recovery operations were carried out as scheduled.

3.2.5-[redacted]was fired on a barge off Yurochi. As with [redacted]ontamination levels were quite low and did not interfere with recovery operations. Survey results are shown in Fig. 3.4.

3.2.6-[redacted]was fired on a barge anchored on the reef west of Yurochi. Contamination was heavy on the northern islands of the atoll. In contrast to the other barge shots, contamination was also experienced on the atoll's southwestern islands. See Fig. 3.5 for H+4 hr survey results. The heavy contamination delayed some of the recovery operations and also the roll-up operations. Fall-out from the firing of this device contaminated Eniwetok Atoll.

3.3 On-Site Fall-out

Very little fall-out was experienced on Enyu Island. On three occasions fall-out was observed and the background was increased somewhat. Fall-out from [redacted] started approximately 28 hr after detonation and continued for approximately 12 hr. This fall-out was very light, with a peak intensity of 12 mr/hr gamma radiation. Fall-out from [redacted] occurred approximately 18 hr after detonation, with peak gamma intensities of 22 mr/hr. Very slight fall-out from [redacted]pproximately 18 hr after firing increased the background by approximately 4 mr/hr. Heavy rains occurred during the fall-out periods following the firing of the [redacted]nd exceptionally high activity was observed in the rainwater.

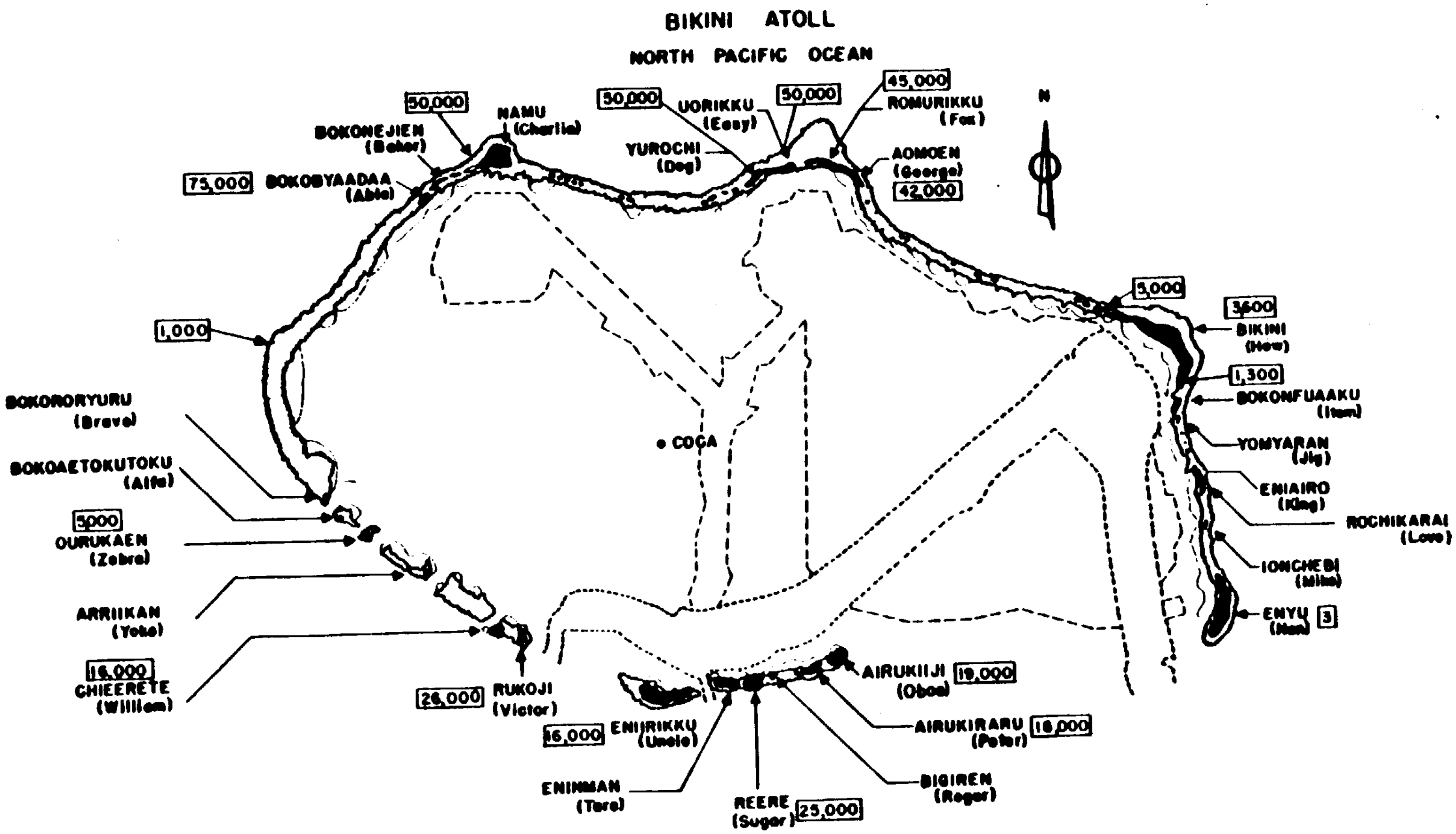


Fig. [redacted] radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot island was Eninman.

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Fig. 3.1–[redacted] intensities on Bik toll at H+4 hr, in milliroentgens per hour. Shot island was Eninman.

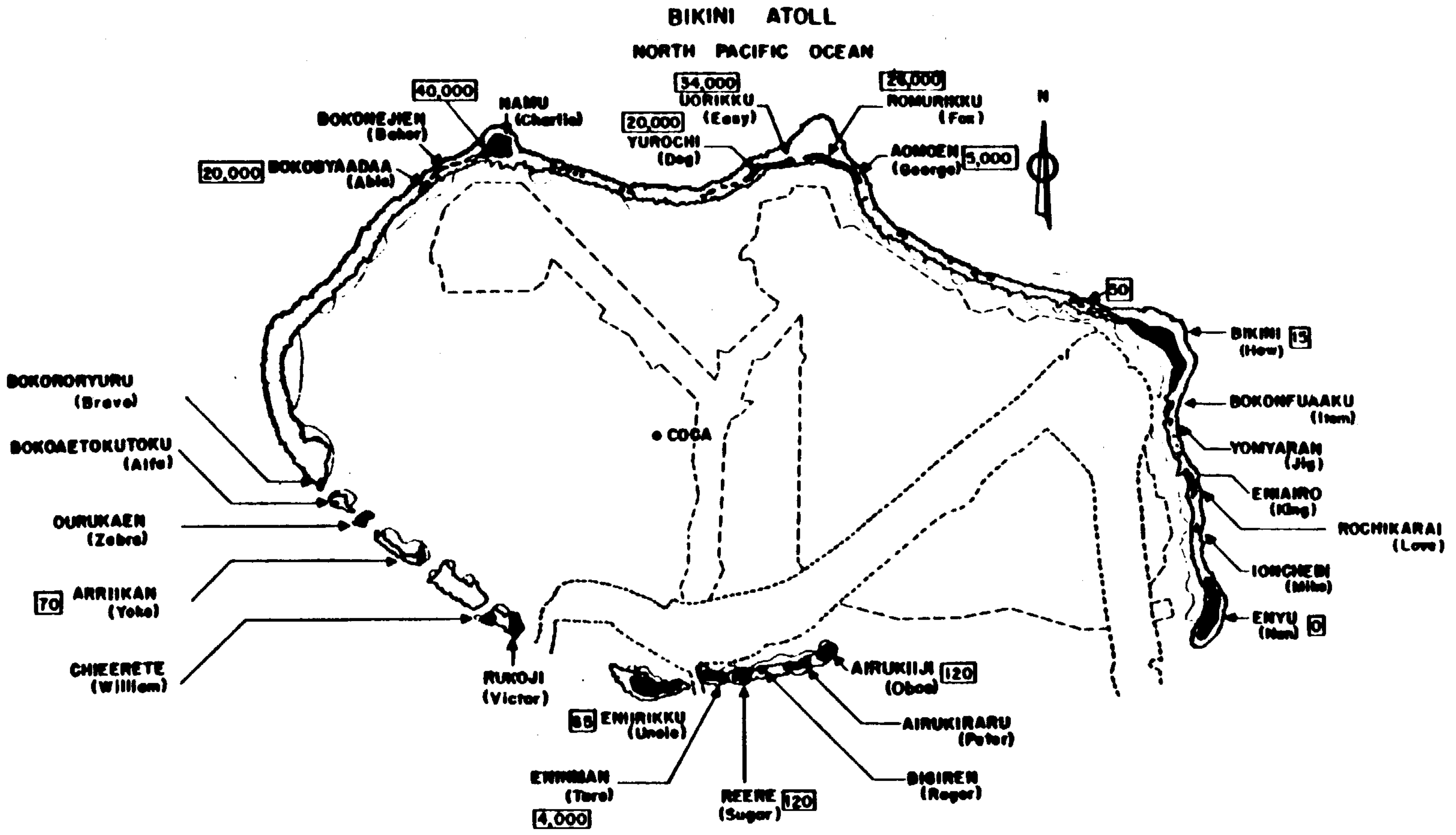

Fig. 3.2–[redacted] intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was barge off Yurochi.

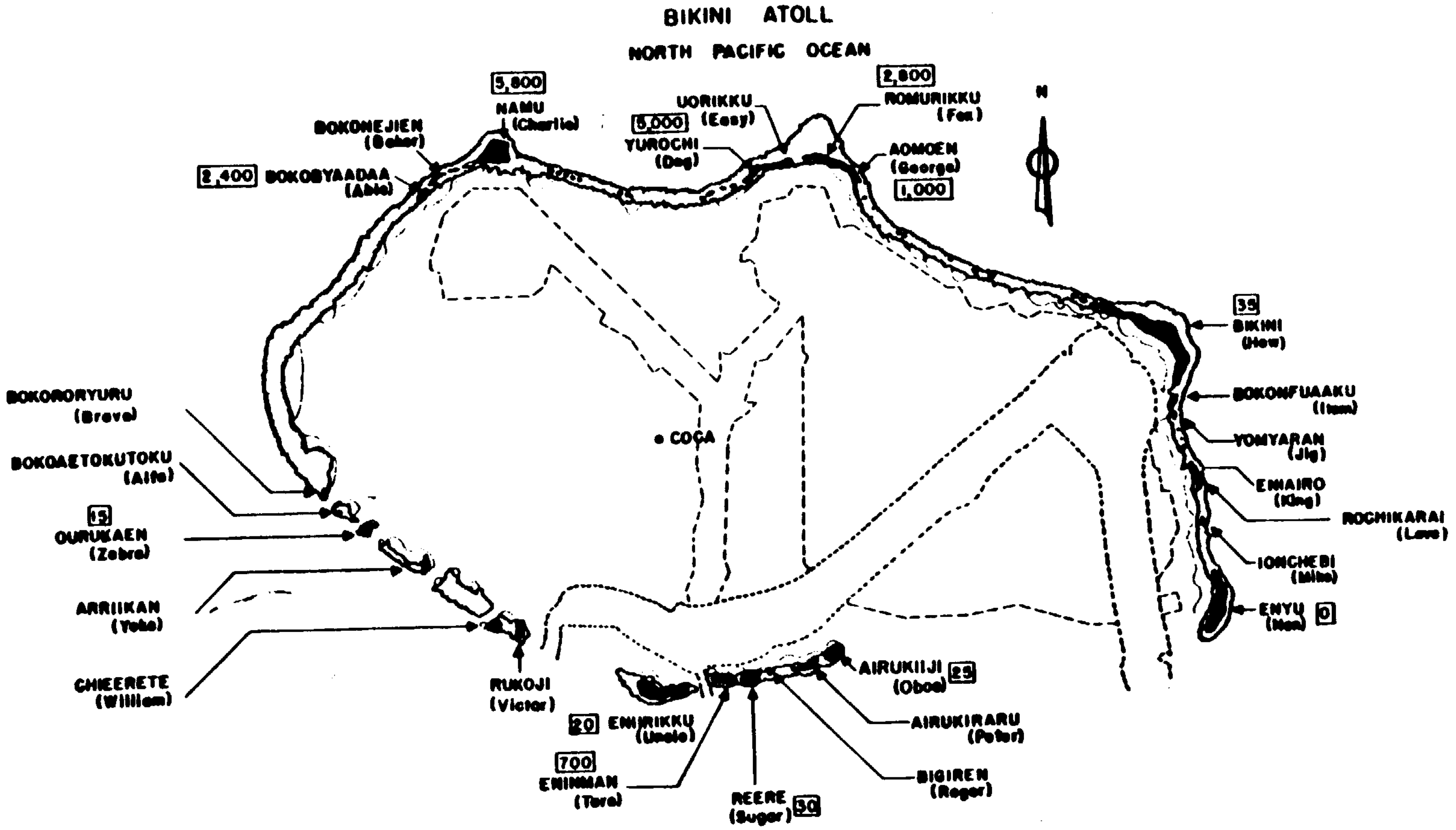

Fig. 3.3—[redacted] Intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was barge off Yurochi.

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Fig. 3.3—[redacted] intensities on Bik toll at H+4 hr, in milliroentgens per hour. Shot s was barge off Yurochi.

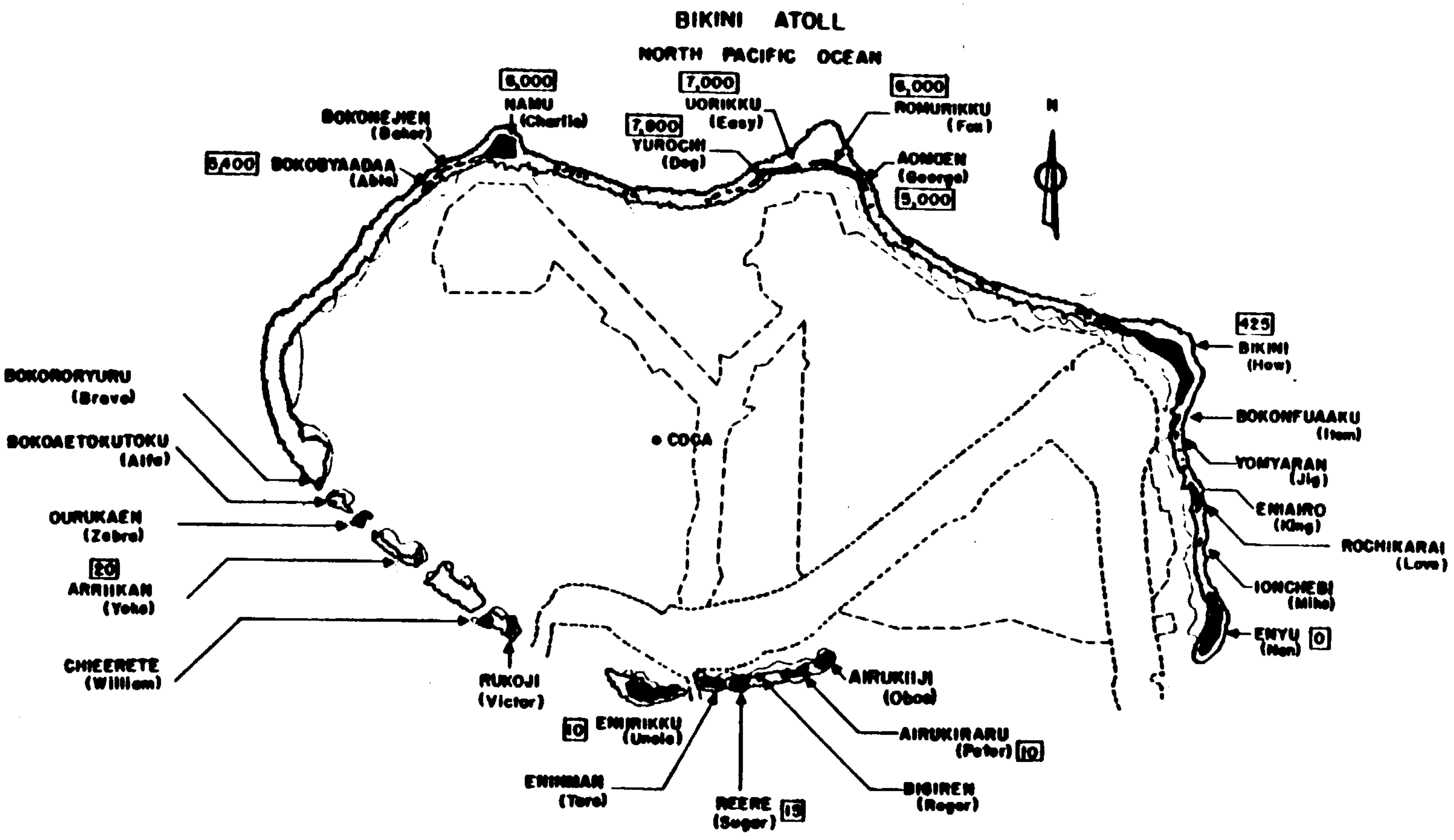

Fig. 3.4—[redacted] intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was barge off Yurochi.

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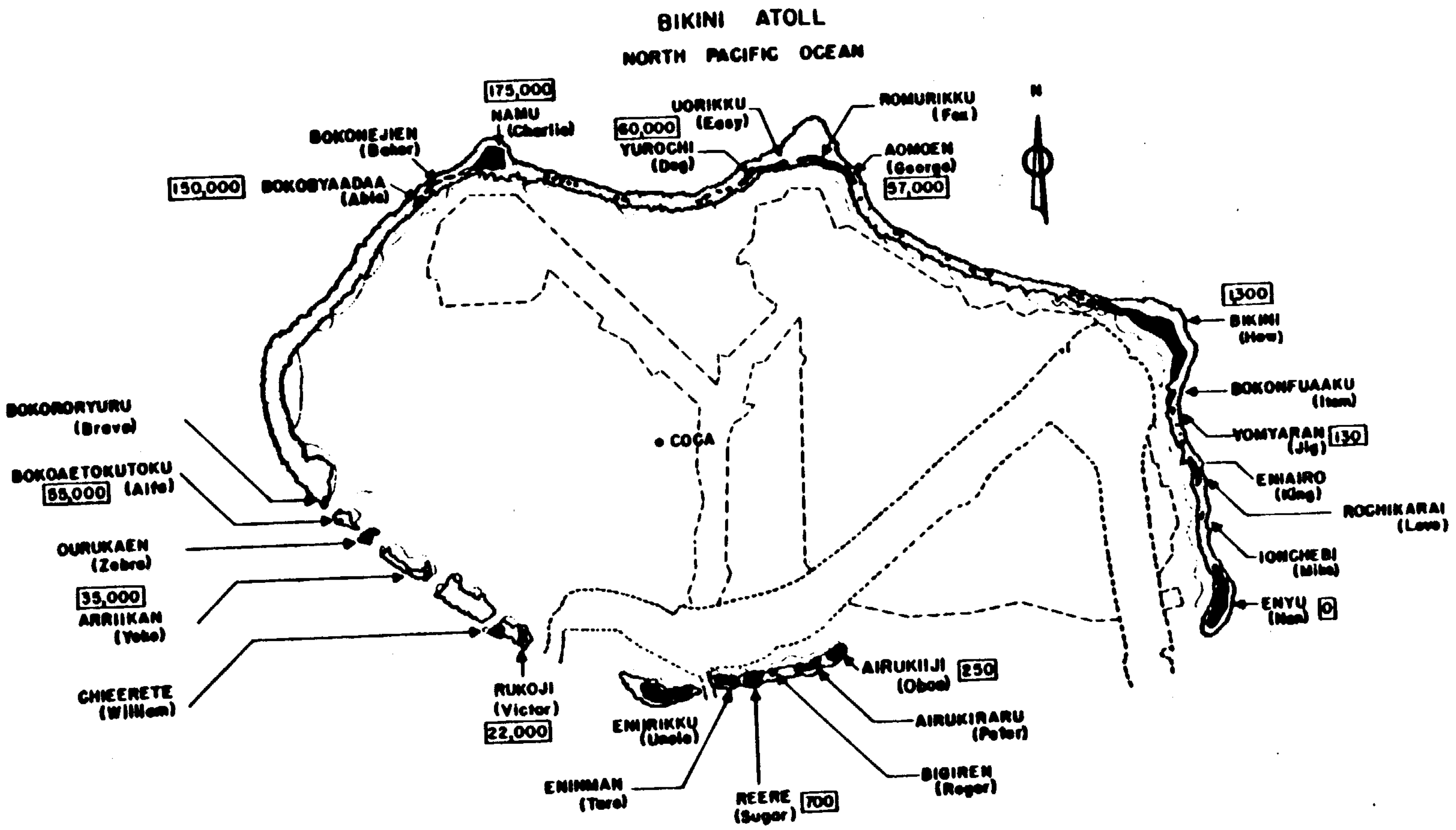

Fig. 3.5 [redacted] radiation intensities on Bikini Atoll at H+4 hr, in milliroentgens per hour. Shot site was barge on reef west of Yurochi.

Fig. 3.5—[redacted]intensities kini Atoll at H+4 hr, in milliroentgens per hour. ot site was barge on reef west of chi.

3.4 Unusual Incidents

Once the firing of the barge shots commenced at Bikini contamination of the lagoon water was observed. After the firing [redacted] the swimming beach on Enyu was closed for the duration of the operation. The beach had previously been closed because of the water contamination originating from the [redacted] shots. It was observed on the various rad-safe surveys that the water adjacent to the beaches of the northern islands of the atoll was generally much more contaminated than the islands. Several days were usually required for the silt and debris to move out through normal water circulation. Usual result of this water contamination was delay in mooring houseboats and the next shot barge.

Chapter 4

LEGAL DOSIMETRY

4.1 Dosimetry Devices

Experience during Operation Castle in 1954 indicated that there was definite need for providing legal dosimetry services to all personnel in Joint Task Force SEVEN. Accordingly, the film-badge program for Operation Redwing was designed to provide adequate dosage information on every man entering the Pacific Proving Grounds. A so-called permanent badge was issued to everyone in the Task Force for wear at all times. In addition, a "mission" badge was issued to those persons who were required to enter contaminated areas. Dosimetry records were then kept on both types of badges for each individual. Pocket dosimeters, Bendix model 611, 0 to 5 r range, were also used with the mission badges as a means of obtaining quick information as to dosage received by an individual while in a contaminated area.

4.1.1—The permanent-badge program was designed to provide a dosage-indicating device to all personnel in the Task Force. Issue of the first permanent badges was made on 15 April 1956, with exchange scheduled each six weeks. As the operation progressed, it was found that badges worn in excess of four weeks were badly watermarked, showed evidence of severe light leaks, and were generally quite difficult to read. As a result, the exchange period for TG 7.1 and TG 7.5 was shortened to three weeks and the period for all others was shortened to four. During the operation 40,000 permanent badges were issued, processed, and recorded. Records were maintained on approximately 15,000 individuals.

4.1.2—The mission-badge program was designed to provide a rapid determiniation of the dosage an individual had received while participating in recovery or construction missions in radex areas. Only persons entering a radex area were provided with mission badges. No deficiencies were noted with these badges, as the usual period of wear was approximately 12 hr. Approximately 45,000 mission badges were processed.

4.1.3—The Bendix Model 611 pocket dosimeter, 0 to 5 r range, was chosen for use at the Pacific Proving Grounds after an extensive testing program. This dosimeter was found to be the most satisfactory of the several tried as its response in the high temperature and humidity was the most dependable. Two thousand were purchased. In general, the dosimeters were quite satisfactory in giving rapid information as to the dosage received by an individual. Many inaccuracies, however, were noted in the dosimeter readings, and therefore this information was primarily used only as a guide to how quickly the mission film badge should be processed. If indicated by the dosimeter reading, the mission badge would be processed immediately upon turn-in. All dosimeters were proof-tested at LASL to a pressure equivalent to 50,000 ft MSL, and each was tested for electrical leakage. In general, the proof-testing program was quite satisfactory. The average reject rate was approximately 15 per cent.

4.1.4—To simplify the issuance of mission badges, all personnel in TG 7.1 and TG 7.5, and others where necessary, were issued "charge-a-plates" similar to those used in commercial charge-account operations. Use of these plates eliminated filling out forms by hand, thus speeding up the issuance of badges tremendously.

4.1.5—Following disclosure of the deficiencies in the permanent film badge, a vigorous experimental program was undertaken in an effort to develop a film packet and badge holder that would not be susceptible to watermarking and light leaks. Various methods of packaging the film packet, such as using a polyvinyl plastic in place of the cellulose acetate, were tried. In addition, the film packets were dipped in ceresin wax prior to sealing in the cellulose acetate holder. Also, the standard film badge, complete with acetate holder, was coated with various materials. The results of the experimental program indicated that the film packets that were dipped in ceresin wax before sealing in the cellulose acetate holder were most satisfactory. The experimental program with these particular badges is continuing at the Eniwetok Proving Ground.

4.2 Film Processing and Record Posting

All film processing and record posting was done manually. As a result, as many as 40 individuals were assigned to the Dosimetry and Records Section. The manual reading and posting operations were tedious and time-consuming, and also subject to many errors. A continuing re-check was required to ensure the greatest accuracy possible, but this was not always successful. The master-record file for all personnel in Joint Task Force SEVEN was maintained at Eniwetok Atoll. At Bikini Atoll a records file of only those personnel present at the atoll was maintained. This split filing system necessitated a daily exchange of dosage information, primarily from Bikini to Eniwetok, in order to maintain the master file. This information was exchanged via the radio-teletype circuits.

All film processing at Eniwetok Atoll was carried out at the Rad-Safe Building on Parry Island. At Bikini, dual processing equipment was maintained as the possibility of afloat operations, similar to Operation Castle, was always present. A photodosimetry processing trailer, obtained from the Army's Evans Signal Laboratory, was maintained aboard the USNS Ainsworth at all times. Fortunately, no real need arose for its use. Although the photodosimetry facility in the Rad-Safe Building on Enyu was always available, the building suffered damage during the [redacted] shots and extensive repair to the darkroom was required.

4.3 Technical Overexposures

Prior to the fall-out at Eniwetok resulting from the [redacted] shot, approximately 50 individuals of the entire Task Force had received technical overexposures in excess of 3.9 r. The dosage received from fall-out at Eniwetok increased this number significantly, with approximately 600 persons exceeding the 3.9 r limit.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

5.1.1—The project-monitor program was successful and significantly reduced the personnel strength requirements of TU-7.

5.1.2—The permanent- and mission-film-badge programs were successful in providing the necessary dosage information for all personnel in the Task Force. The total number of personnel engaged in legal dosimetry work should be reduced. Difficulties encountered with the permanent film badge can be remedied.

5.1.3—The Task Unit organization was adequate and satisfactorily met ll requirements.

Recommendations

5.2.1—The project-monitor program should be continued in future opera-

.2.2—A development program aimed at improving the permanent-film-ackage and providing a certain amount of automation of the film-ng and recording procedures should be established.