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HAROLD L. BRODE

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OPERATION CROSSROADS

1946



United States Atmospheric Nuclear Weapons Tests
Nuclear Test Personnel Review

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BAKER Emerges From Bikini Lagoon Amid Target Fleet

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Crossroads was the first peacetime nuclear weapons test series. It was conducted at Bikini Atoll in 1946.

Report emphasis is on the radiological safety of the personnel. Available records on personnel exposure are summarized.

FACT SHEET

Operation CROSSROADS was an atmospheric nuclear weapon test series conducted in the summer of 1946. The series consisted of two detonations, each with a yield of 23 KT:

- ABLE -- detonated at an altitude of 520 feet (158 meters) on 1 July
- BAKER -- detonated 90 feet (27 meters) underwater on 25 July.

It was the first nuclear test held in the Marshall Islands.

The series was to study the effects of nuclear weapons on ships, equipment, and material. A fleet of more than 90 vessels was assembled in Bikini Lagoon as a target. This target fleet consisted of older U.S. capital ships, three captured German and Japanese ships, surplus U.S. cruisers, destroyers and submarines, and a large number of auxiliary and amphibious vessels. Military equipment was arrayed on some of the ships as well as amphibious craft that were beached on Bikini Island. Technical experiments were also conducted to study nuclear weapon explosion phenomena. Some experiments included the use of live animals.

The support fleet of more than 150 ships provided quarters, experimental stations, and workshops for most of the 42,000 men (more than 37,000 of whom were Navy personnel) of Joint Task Force 1 (JTF 1), the organization that conducted the tests. Additional personnel were located on nearby atolls such as Enewetak and Kwajalein. The islands of the Bikini Atoll were used primarily as recreation and instrumentation sites.

Before the first test, all personnel were evacuated from the target fleet and Bikini Atoll. These men were placed on units of the support fleet, which sortied from Bikini Lagoon and took safe positions at least 10 nmi (18.5 km) east of the atoll.

In the ABLE test, the weapon was dropped from a B-29 and burst over the target fleet. In BAKER, the weapon was suspended beneath an auxiliary craft anchored in the midst of the target fleet.

ABLE operations went smoothly except that the test weapon was dropped between 1,500 and 2,000 feet (457 and 610 meters) off target. The radioactivity created by the burst had only a transient effect, and within a day nearly all the surviving target ships had been safely reboarded. The ship inspections, instrument recoveries, and remooring necessary for the BAKER test proceeded on schedule. Five ships were sunk as a result of the test.

The crews of the target ships that had been remanned following ABLE were evacuated before BAKER to the support fleet east of the atoll. BAKER sank

eight ships and damaged more ships than ABLE. The detonation caused most of the target fleet to be bathed in radioactive water spray and radioactive debris from the lagoon bottom. With the exception of 12 target vessels anchored in the array and the landing craft beached on Bikini Island, the target fleet remained too radiologically contaminated for several weeks for more than brief on-board activities.

The inability to complete inspections on much of the target fleet threatened the success of the operation after BAKER. A program of target vessel decontamination was begun in earnest about 1 August. This involved washing the ships' exteriors using work crews drawn from the target ships' companies under radiological supervision of monitors equipped with radiation detection and measurement devices. Initially, decontamination was slow as the safe time aboard some of the target ships was measured only in minutes. As time progressed, the support fleet itself had become contaminated by low-level radioactivity in marine growth on the ships' hulls and seawater piping systems.

By 10 August, a decision was made to stop work in Bikini and tow the surviving target fleet to Kwajalein Atoll where the work could be done in uncontaminated water. The move was accomplished during the remainder of August and September. A major task at Kwajalein was to offload ammunition stored aboard the target ships. This work continued into the fall of 1946. Personnel continued to work on target ships at Kwajalein into 1947.

Eight of the major ships and two submarines were towed back to the United States and Hawaii for radiological inspection. Twelve target ships were so lightly contaminated that they were remanned and sailed back to the United States by their crews. The remaining target ships were destroyed by sinking off Bikini Atoll, off Kwajalein Atoll, or near the Hawaiian Islands during 1946-1948.

The support ships were decontaminated as necessary and received a radiological clearance before they could return to the fleet. This decontamination and clearance process required a great deal of experimentation and learning at Navy shipyards in the United States, primarily at San Francisco.

Finally, a formal resurvey of Bikini Atoll was conducted in the summer of 1947 to study long-term effects of the CROSSROADS tests.

All CROSSROADS operations were undertaken under radiological supervision intended to keep personnel from being exposed to more than 0.1 roentgen (R) per day. At the time, this was considered to be an amount of radiation that could be tolerated for long periods without any harmful effects on health.

Radiological supervision included predicting areas of possible danger, providing trained personnel equipped with radiation survey instruments to act as guides during operations involving potential exposure, and elaboration of rules and regulations governing conduct in these operations. Personnel were removed for one or more days from areas and activities of possible exposure if their badges showed more than 0.1 R/day exposure.

About 15 percent of the JTF 1 personnel was issued at least one of the 18,875 film-badge dosimeters during CROSSROADS. Approximately 6,596 personnel were on islands or ships that had no potential for radiation exposure. Personnel anticipated to be at greatest radiological risk were badged, and a percentage of each group working in less contaminated areas was badged. The maximum accumulated exposure recorded was 3.72 R, received by a radiation safety monitor.

Lacking complete radiation exposure data, reconstructions have been made of personnel exposures for unbadged crewmembers of the ships involved. These calculations have considered the several sources of radiation at work in Bikini, such as the low-level contamination in the lagoon water, living aboard support ships, and boarding the contaminated target ships. The calculations relied upon radiation measurements recorded by radiation safety personnel in 1946. This data was used in a computer model that includes such factors as the radiation-shielding properties of ships' hulls and realistic patterns of daily personnel activity on weather decks and below. The actual movements of each ship were then used to reconstruct a dose for the crew. Calculated exposures range from 0 to 2.5 rem (gamma) for support ships. Exposures for target ship crews that reboarded their ships after BAKER were higher than those for support ship crews. A summary of film badge readings (in roentgens) for July and August, when the largest number of personnel was involved, is listed below:

Actual Film Badge Readings:
(R gamma)

	Total	0	0.001-0.1	0.101-1.0	1.001-10.0
July	3,767	2,843	689	232	3
%	100	75	18	6	<0.1
August	6,664	3,947	2,139	570	8
%	100	59	32	9	0.1

PREFACE

Between 1945 and 1962, the U.S. Atomic Energy Commission (AEC) conducted 235 atmospheric nuclear weapon tests at sites in the United States and in the Pacific and Atlantic oceans. In all, about 205,000 Department of Defense (DOD) participants, both military and civilian, were present at the tests. Of these, approximately 142,000 participated in the Pacific test series and approximately another 4,000 in the single Atlantic test series.

In 1977, 15 years after the last aboveground nuclear weapon test, the Centers for Disease Control (CDC) of the U.S. Department of Health and Human Services noted more leukemia cases than would normally be expected among about 3,200 soldiers who had been present at shot SMOKY, a test of the 1957 PLUMBBOB series. Since that initial report by the CDC, the Veterans Administration (VA) has received a number of claims for medical benefits from former military personnel who believe their health may have been affected by their participation in the weapon testing program.

In late 1977, the DOD began a study that provided data to both the CDC and the VA on potential exposures to ionizing radiation among the military and civilian personnel who participated in the atmospheric testing 15 to 32 years earlier. In early 1978, the DOD also organized a Nuclear Test Personnel Review (NTPR) to:

- Identify DOD personnel who had taken part in the atmospheric nuclear weapon tests
- Determine the extent of the participants' exposure to ionizing radiation
- Provide public disclosure of information concerning participation by DOD personnel in the atmospheric nuclear weapon tests.

This report on Operation CROSSROADS is one of a series of volumes that are the product of the NTPR. The DOD Defense Nuclear Agency (DNA), whose Director is the executive agent of the NTPR program, prepared the reports, which are based on military and technical documents reporting various aspects of each of the tests. Reports of the NTPR provide a public record of the activities and associated radiation exposures of DOD personnel for interested former participants and for use in public health research and Federal policy studies.

Information from which this report was compiled was primarily extracted from planning and after-action reports of Joint Task Force 1 (JTF 1) and its subordinate organizations. Documents that accurately placed personnel at the test sites were desired so that their degree of exposure to the ionizing radiation resulting from the tests could be assessed. The search for this information was undertaken in archives and libraries of the Federal Government, in special collections supported by the Federal Government, and, where reasonable, by discussion or review with participants.

For CROSSROADS, the most important archival source is the National Archive and Record Center, Modern Military Branch, Washington, D.C. The Naval Archives at the Washington Navy Yard also were helpful, as was the collection of documents in the AFWL Technical Library at Kirtland Air Force Base, Albuquerque, New Mexico, and the Stafford L. Warren Papers at the University of California, Los Angeles. Other archives searched were the Department of Energy (DOE) archives at Germantown, Maryland, its Nevada Operations Office (DOE/NV) archives at Las Vegas, and archives of the Test Division of the Los Alamos National Laboratory.

JTF 1 exposure records and an additional file of exposure-related documents that had been microfilmed by the Reynolds Electrical and Engineering Company, Inc., support contractor for DOE/NV, were also useful.

Primary documentation of personnel movement in areas of potential radiation exposure is limited. This has been compensated for, where possible, with inferences drawn from secondary sources and the exposure records themselves.

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CHAPTER 1
OVERVIEW

INTRODUCTION

After the atomic bomb attacks on Japan had abruptly ended World War II, many military leaders felt that military science was at a crossroads. The officer who commanded the first postwar nuclear test series commented that "warfare, perhaps civilization itself, had been brought to a turning point by this revolutionary weapon" (Reference C.12.1, Cap. Plate XI). With this in mind, he therefore had the nuclear test operation designated CROSSROADS. Operation CROSSROADS was at that time the largest U.S. peacetime military operation ever conducted. It involved 42,000 personnel, 251 ships, and 156 aircraft.

This series consisted of two detonations at Bikini Atoll in the Marshall Islands during the summer of 1946. These were:

- ABLE (1 July 1946, 0900) -- an airdrop detonated at an altitude of 520 feet (158 meters)
- BAKER (25 July 1946, 0835) -- an underwater shot 90 feet (27 meters) below the surface

An additional deep underwater detonation, Test CHARLIE, was planned but was not conducted.

This report documents the participation of War and Navy Department* personnel who were active in the test series. Its purpose is to bring together available information about the atmospheric nuclear tests series pertinent to the exposure of both uniformed and civilian personnel to radiation. The report lists the organizations represented and describes their activities. It discusses the potential radiation exposure of personnel. Finally, it presents the exposures of participating personnel recorded by film badges and scientifically based estimates of radiation doses for participating units.

The weapons used in the CROSSROADS tests were of the same design as the one that had been dropped on Nagasaki, Japan. Each had a yield of 23 KT (the equivalent of 23,000 tons of TNT). This weapon type had been developed by the U.S. Army's Manhattan Engineer District during the war, primarily at the District's laboratory at Los Alamos, New Mexico, with research support from laboratories at the University of Chicago and Oak Ridge, Tennessee, and material production from Hanford, Washington. Under the terms of the Atomic Energy Act of 1946, the Manhattan Engineer District was dissolved at the end

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* In 1947 the War Department was dissolved. Jurisdiction over the ground components of the Army became the function of the newly created Department of the Army, and the new Department of the Air Force was established to direct the former Army Air Forces. These two new departments and the Department of the Navy formed the new Department of Defense.

of 1946, and its contracts, facilities, and management responsibilities were transferred to the newly established Atomic Energy Commission (AEC).

The primary purpose of CROSSROADS was to determine the effects of atomic bombs upon naval vessels. The effects of nuclear weapons on ships was of considerable interest to the U.S. defense establishment. As early as August 1945, the Chairman of the Senate's Special Committee on Atomic Energy proposed that the effectiveness of atomic bombs be demonstrated on captured Japanese ships. In September, the Army Air Forces commanding general put the question of such a test before the Joint Chiefs of Staff (JCS) (Reference A.1, p. 10).

The Navy's response to this proposal was that such a test also should include a few modern U.S. naval units in the target array (Reference A.1, p. 10). In effect, this broadened the test from a mere demonstration of the power of nuclear detonations to a scientific test whose results could be used in designs of naval vessels and naval tactics. In November the JCS established a subcommittee to prepare a detailed proposal. The subcommittee completed its work in 6 weeks.

Secondary purposes of CROSSROADS were to afford training for Army Air Forces personnel in attack techniques using atomic bombs against ships, and to determine atomic bomb effects upon military equipment and installations. Such information was not available from the Trinity test or the Hiroshima and Nagasaki bombings (Reference C.9.189, p. XIII).

On 10 December 1945, the President announced that the United States would further explore the capabilities of atomic energy in the form of scientific atomic bomb tests under JCS jurisdiction. The JCS proposed a joint task force to be composed of Army and Navy personnel and civilian scientists, and on 10 January 1946 the President approved the formation of this task force. On 11 January the JCS created Joint Task Force One (JTF 1) and approved a naval officer who had commanded large Army-Navy operations in the Pacific during the war and who also had been Chief of the Navy's Bureau of Ordnance to serve as Commander JTF 1 (CJTF 1).

CROSSROADS, as proposed, was to have consisted of three nuclear events. In approving the plans, the President approved the detonation of three nuclear weapons, one-third of the U.S. stockpile at the time -- surely a measure of the importance given the operation (Reference A.7).

Among the major problems confronting CJTF 1 after his appointment was the selection of a test site. Several locations were considered in the Atlantic and Pacific oceans and in the Caribbean Sea. The requirements were:

- A protected anchorage (at least 6 nmi [11 km] wide) to hold the target and support fleet
- A site that was nearly uninhabited
- A location at least 300 statute miles (about 483 km) from a city
- Freedom from severe cold and violent storms

- Predictable winds directionally uniform at all altitudes from sea level to 60,000 feet (18 km)
- Predictable water currents of great lateral and vertical dispersion; fast currents avoiding important fishing areas, ocean shipping lanes, and inhabited shores
- Control by the United States.

The location that best satisfied these requirements was Bikini Atoll. Bikini's location in the Central Pacific is shown in Figure 1 and a map of the atoll itself in Figure 2. The final choice of Bikini was announced on 24 January 1946 by the JCS after a slight delay because the fishing industry feared the tests might kill millions of fish, especially tuna and whales. To evaluate any dangers, the Department of Interior's Fish and Wildlife Service conducted surveys. Those surveys concluded that Bikini was not a critical area for tuna fish or other fish of commercial importance and was far from migratory whale routes (Reference A.1, pp. 19 and 20).

CJTF 1 requested that the Bikini native population be evacuated from the atoll by 15 March 1946. Rongerik Atoll was selected as the future home for the Bikinians and on 26 February a group of Navy Construction Battalion personnel (Seabees) began construction of cisterns, water catchments, and 26 house frames there. These frames (Figure 3) were temporarily covered with canvas, but this was replaced by thatch from the pandanus, or screw pine, tree. The thatch was brought to Rongerik by the Bikinians. The cisterns were initially filled with 25,000 gallons (94,785 liters) of water brought from Kwajalein.

Bikini was evacuated on 7 March. Figure 4 shows the Bikinians collecting their belongings, and Figure 5 shows the loading of the LST that transported them. The 167 Bikinians arrived at Rongerik the next day (Figure 6). In an effort to improve the lives of the Bikinians who were unhappy with Rongerik, meetings were held in 1946 and 1947 between the Chief and members of his council and military authorities to find a more suitable island. On 3 November 1948, the Bikinians and their possessions were resettled on the island of Kili, in the southern Marshall Islands, 400 nmi (741 km) southeast of Bikini and 27 nmi (50 km) southeast of Jaluit Atoll (Reference A.8, pp. 507-551).

On 23 March, after preparations for the operation were well underway, the President changed the date of the first test from 15 May to 1 July; the second test was scheduled for 25 July. This allowed certain members of Congress to observe Operation CROSSROADS. On 7 September 1946, the President announced that Test CHARLIE, the third scheduled and a deep underwater test, was indefinitely postponed (Reference C.9.206, p. V-(D)-5). Engineering problems in constructing a bathysphere capable of withstanding the tremendous pressures involved precluded the scheduling of Test CHARLIE before Spring of 1947 (Reference C.9.206, p. V-(A)-5).

REPORT ORGANIZATION

Subsequent sections of this overview chapter discuss the form of weapon effects test programs, with emphasis on potential radiation exposure of participating Navy and War Department personnel. The chapter concludes with a description of JTF 1 and indicates how elements within JTF 1 functioned.

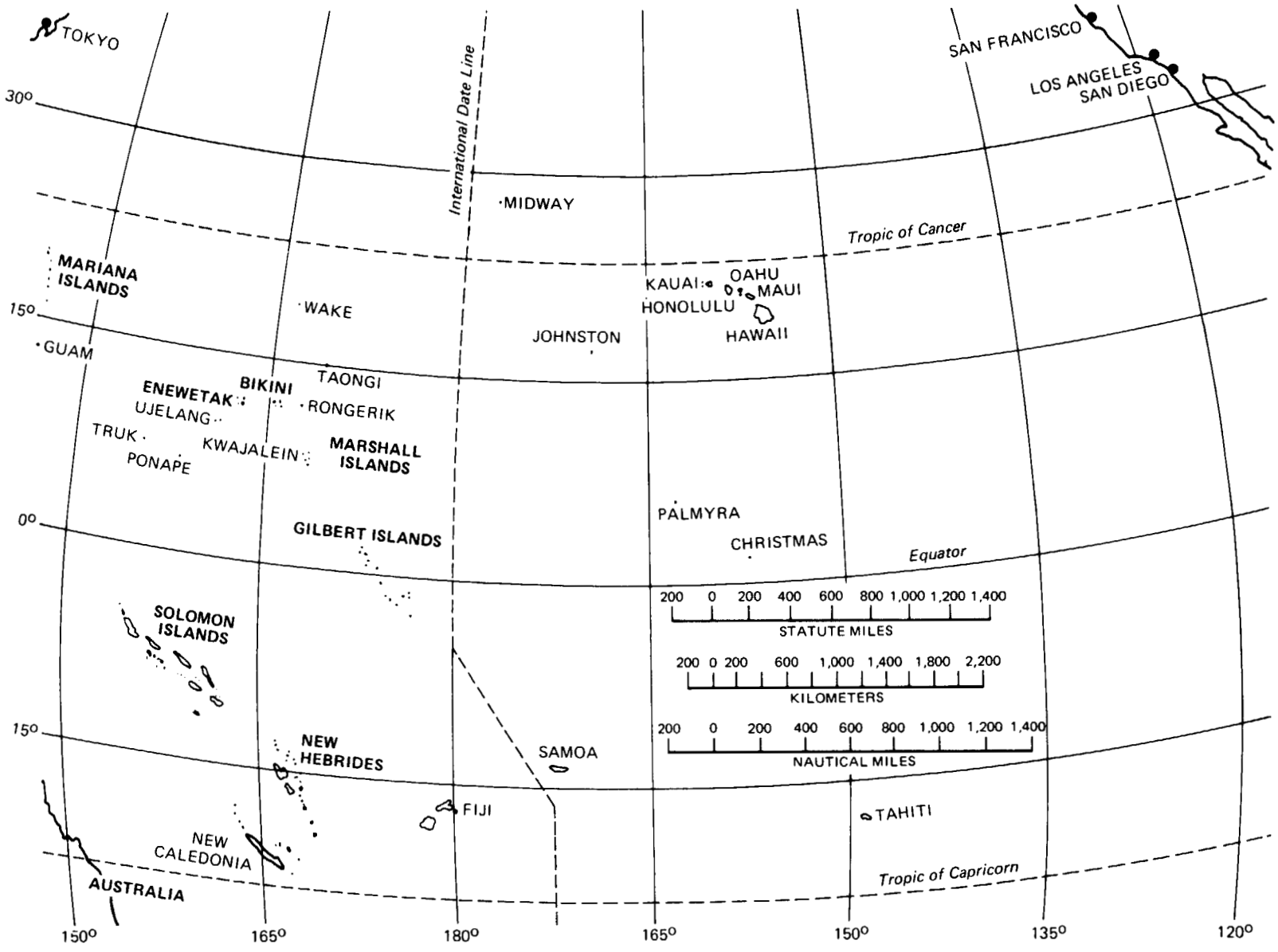


Figure 1. The Central Pacific.

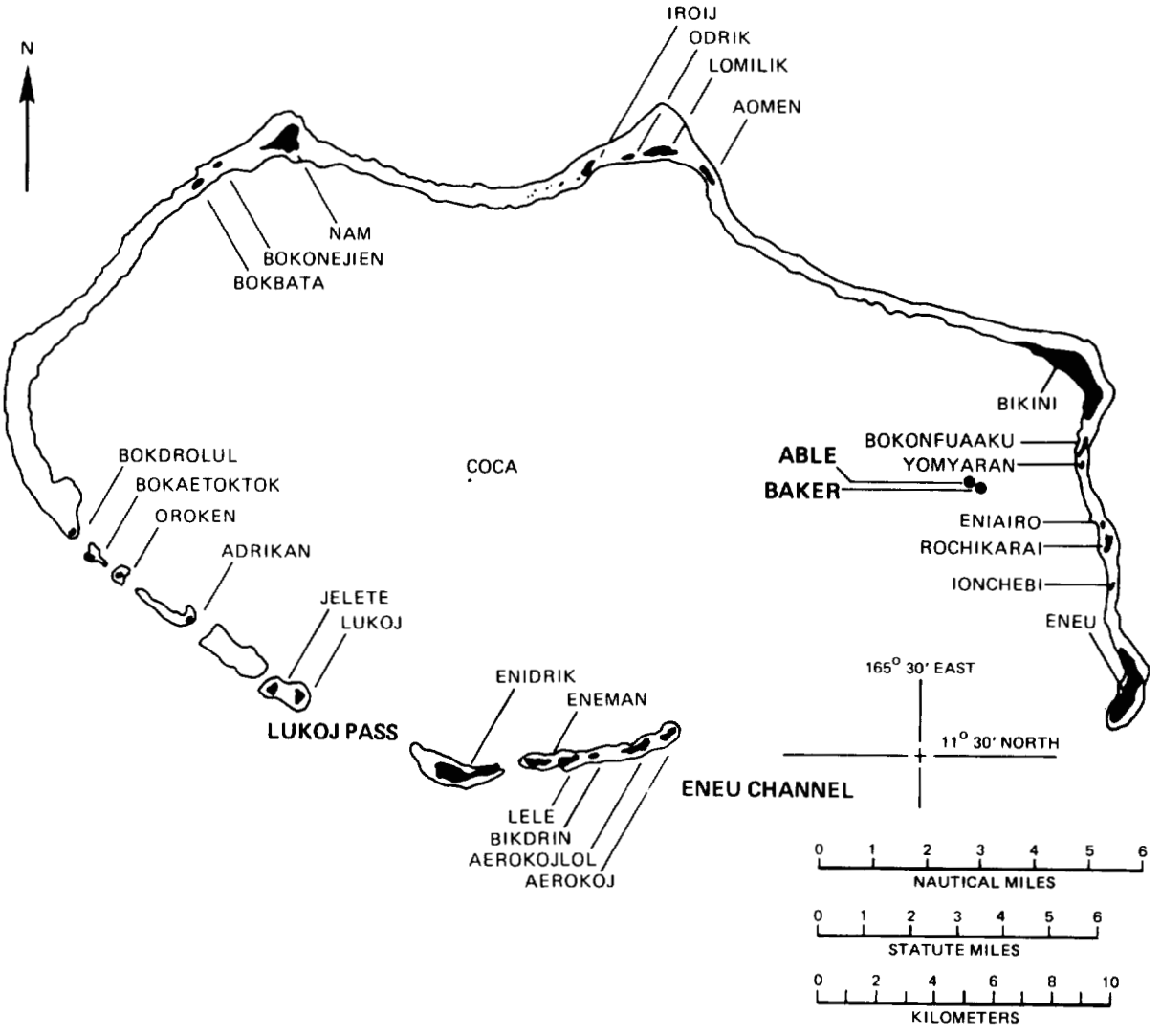


Figure 2. Bikini Atoll, 1946, showing ABLE and BAKER test sites.

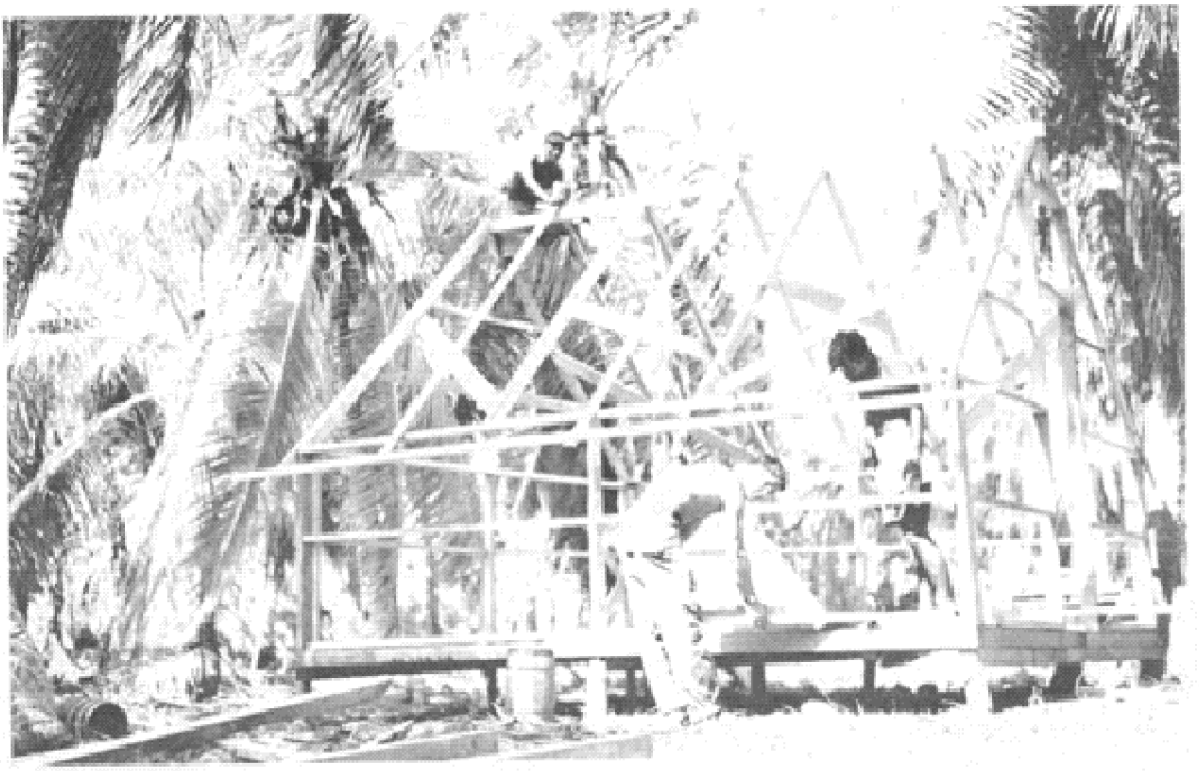


Figure 3. Navy Construction Battalion personnel, assisted by Marshallese, construct wooden house frames on Rongerik for Bikinians.



Figure 4. Bikinians collecting their belongings for move to Rongerik.

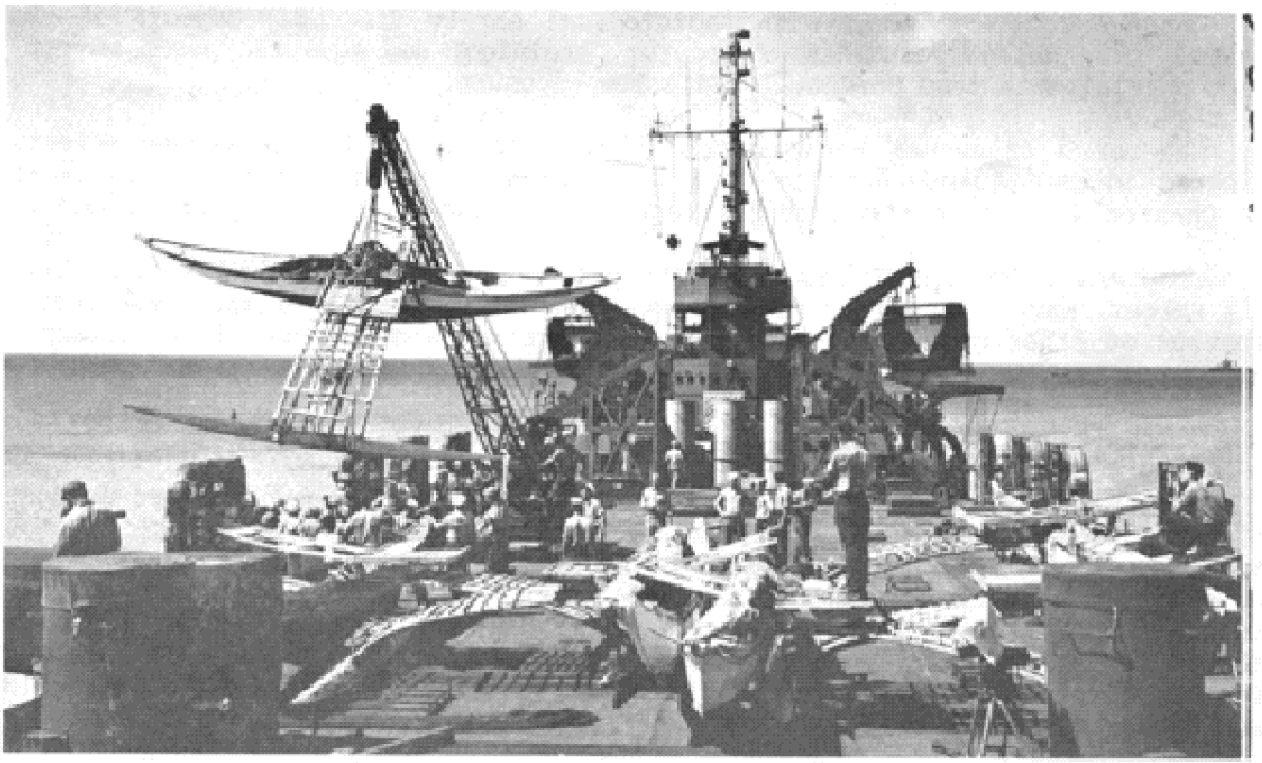


Figure 5. Bikini outrigger swung aboard LST for transport to Rongerik.



Figure 6. USS LST-1108 arrives at Rongerik, 8 March 1946.

Chapter 2 is concerned with radiological safety (radsafe) aspects of the tests. This chapter documents procedures, training, and equipment used to protect participants from potential radiation exposure.

Chapter 3 discusses the general role of personnel in the weapon effects program in CROSSROADS, leading to a discussion of operations for test events in Chapter 4, and in the post-test operations discussed in Chapters 5 and 6.

Chapters 7 through 10 report participation by the Army Ground Forces, Army Air Forces, Navy, and Marine Corps, respectively. Chapter 11 summarizes participation of other government agencies, contractors, and universities. Personnel exposures are discussed in Chapter 12.

NUCLEAR TESTS AND RADIATION EXPOSURES

In general, nuclear testing before 1961 consisted of the unconfined detonation of nuclear devices (usually not weapons) in the atmosphere. The devices might be placed on a platform or a barge on the ocean's surface; emplaced on or slightly beneath the Earth's surface; atop a tower; or supported by a balloon, dropped from an airplane, suspended underwater, or fired from cannon or rocket launchers. CROSSROADS employed two operational weapons: one was dropped from an aircraft and detonated in the air; the other was suspended from a ship and detonated underwater.

In theory, personnel can be exposed either to the radiation emitted at the time of explosion and for about 1 minute thereafter -- usually referred to as initial radiation -- or the radiation emitted later (residual radiation). Initial radiation is part of the violent nuclear explosion process itself.

The neutron component of initial radiation indirectly contributes to the later exposure of personnel. Neutrons are emitted in large numbers by nuclear weapon detonations. They have the property of altering certain nonradioactive materials so that they become radioactive. This process, called activation, works on sodium, silicon, calcium, manganese, and iron, as well as other common materials. Activation products thus formed are added to the inventory of the radioactive products produced in the explosion process. The radiation emitted by this inventory more than 1 minute after detonation is referred to as residual radiation.

The potential for personnel exposure to residual radiation was much greater than the potential for exposure to initial radiation. In the nuclear explosion process, fissioning atoms of the heavy elements, uranium and plutonium, split into lighter elements, called fission products, releasing energy. When the uranium and plutonium fission, they produce a variety of fission products. Different fission products have different half-lives. In general, the lighter fission products have half-lives that are shorter than the mother elements. The residual radiation produced by these products, given their shorter half-lives, is initially quite high. However, over a period of time, the radioactivity diminishes. The decay of the original fission products produces other, lighter fission products that may (or may not) be radioactive themselves. The net result is that initial decay of fission products produces fairly high levels of radioactivity that dissipate over time. While a radioactive fission product

theoretically continues to exist forever (albeit in diminishing amounts), a point is reached where it is practically undetectable.

Overall radioactivity of all the fission products formed decays at a rate that is closely approximated by a rule that states that for each sevenfold increase in time the intensity of the radiation will decrease by a factor of ten. Thus, a radiation rate of 1 roentgen per hour (R/hr) at 1 hour after the detonation would be expected to be 0.1 R/hr after 7 hours and 0.01 R/hr after 49 hours. This rule seems to be valid for about 6 months following a nuclear detonation, after which the observed decay rate is somewhat faster than that predicted by this relationship. Activation products, in general, decay at a faster rate than the fission products.

Fission products and the activation products, along with unfissioned uranium or plutonium from the device, are radioactive components of the material in the debris cloud. This cloud and its fallout are the primary sources of potential exposure to residual radiation.

In a nuclear airburst, the central core of intensely hot material, or fireball, does not touch the surface. The bomb residues (including the fission products, the activation products resulting from neutron interaction with device materials, and unfissioned uranium and/or plutonium) are vaporized. These vapors condense as the fireball rises and cools, and the particles formed by the condensation are small and smoke-like. They are carried up with the cloud to the altitude at which its rise stops, usually called the cloud stabilization altitude. Spread of this material then depends on the winds and weather. If the detonation is of relatively low yield, the cloud stabilization altitude will be in the lower atmosphere and the material will act like dust and return to the Earth's surface in a matter of weeks. Essentially all debris from detonations with yields equivalent to kilotons of TNT will be down within 2 months (Reference A.9). Areas in which this fallout material will be deposited will appear on maps as bands following the wind's direction. Thus, airbursts result in less potential for residual radiation exposure to personnel at the testing area from the debris, although there may be some residual radiation fission products from rapid settling of large particles and short-lived radiation coming from activated surface materials under the burst (if the burst altitude is sufficiently low for neutrons to reach the surface).

Underwater nuclear detonations are muffled by the great mass of water that surrounds them. Initial nuclear radiation is absorbed by the water surrounding the device and the intense heat vaporizes the water near the burst. This forms a bubble beneath the surface of the water that expands as the energy released in the explosion works against the mass of water. This expansion continues until the energy is expended, at which point the bubble begins to collapse as it rises toward the surface. Depending upon the depth of the burst and the size of the bubble (which in turn depends on the detonation yield, or total energy released), the bubble may break the surface of the water near its fully expanded size or smaller. Some radioactive products (including activated salt) are vented into the air as the bubble breaks the surface, but most of the device debris and activation products remain trapped in the volume of water that collapses on the bubble. This volume of water is called the radioactive pool.

When the burst is close enough to the bottom, as in the BAKER shot of CROSSROADS, an underwater crater may be formed, and the material excavated from it will be radioactive and contribute to the residual radiation inventory.

The primary source of personnel exposures from the BAKER shot was not the radioactive pool of water, however, but from contact with the target ships, which had been bathed in the radioactively contaminated water, sand, and coral that rained down upon them from the cloud and from the radioactive mist (base surge) that rolled out from the base of the underwater explosion column.

A nuclear explosion produces three types of radiation that posed a potential hazard to CROSSROADS participants: alpha, beta, and gamma radiation. When any of these encounters living tissue, it transfers some of its energy to the target atoms, tearing off some or all of their electrons. This leaves the atoms with a positive electrical charge. The process is called ionization. This tearing off of the electrons destroys the bonds holding together the complex molecules making up living tissue and leaves the tissue damaged to some extent. At low levels of radiation, the damage is minor and probably does not adversely affect the individual's health or longevity. At higher levels, the reverse is true.

Gamma rays are electromagnetic radiation, differing from the more familiar radio waves and x-rays in that they have higher frequency and shorter wavelength. They are produced in great quantities and with very high energy during a nuclear explosion. They are also given off during the decay of the radioactive isotopes produced by a nuclear explosion. They can travel long distances and can readily penetrate clothing and skin. Because the personnel conducting Operation CROSSROADS were miles from the two detonations, the gamma hazard to them came from radioactive isotopes left in the target area or carried from it by wind or tide or on the participating ships or planes or even on the bodies of the personnel themselves. The radiation detection instruments used during CROSSROADS readily detected gamma rays.

Beta particles are electrons. Like gamma rays, they are given off by a nuclear explosion or by the radioactive isotopes produced by the explosion. Unlike gamma rays, however, beta particles do not travel far and, except at high energies, are stopped by clothing or the outer layers of skin. They are a greater hazard if isotopes emitting them are taken into the body or are left in contact with skin for a long period. Beta radiation was measured fairly well by several types of safety instruments used during CROSSROADS.

Alpha particles are made up of two protons and two neutrons. With the addition of two electrons, each becomes a helium atom. Alpha particles are given off by some radioactive isotopes created in a nuclear explosion and by unfissioned uranium or plutonium. Because alpha particles are relatively massive, they do not travel far, about 1 or 2 inches in air. The skin, clothing, or even a piece of paper will stop them. However, if the material emitting them enters the body and lodges there, the alpha particles can do great harm because they cause a high rate of ionization. The decay time of many alpha emitters is long. Plutonium only loses half of its alpha particles in 24,000 years! As described in detail in Chapter 2, the safety instruments available at CROSSROADS for detecting alpha particles directly were few in number and would not operate

outside the controlled conditions of the laboratory on the ship housing the radiation safety organization. Therefore, the only expedient way to estimate alpha radiation was to assume that some relatively stable ratio existed between alpha emitters and gamma or beta emitters. One could then measure gamma or beta radiation and calculate the alpha hazard. As beta and gamma radiation decreased, however, alpha radiation remained because of the long decay time of the plutonium and other alpha emitters.

EFFECTS EXPERIMENTS

Central to the test series was the experimental program. This program and its requirements dictated the form of the test organization and the detail of personnel participation. CROSSROADS had two experimental programs. The first was to determine the effects of nuclear detonations on animals and on military equipment such as ships, aircraft, and various supplies. The second program was to measure weapon phenomena such as heat, blast, radiation, and wave action. CROSSROADS was not a weapon development operation; the bombs used were of the same design as the one dropped on Nagasaki.

Effects experiments were intended to acquire urgently needed military data. These experiments may be classed into two general kinds. The first class of measurements was made to document the hostile environment created by the nuclear detonation. The second class of effects experiments documented the response of systems to the hostile environment; these measurements are termed systems response experiments.

Environmental Measurements

The purpose of environmental effects measurements was to gain a comprehensive view of the hostile environment created by a nuclear detonation to allow military planners to design survivable military hardware and systems and to train personnel to survive. Examples of environmental measurements taken at CROSSROADS include static (crushing) and dynamic (blast) pressure, heat generated by the detonation, and fallout radiation. Measurement techniques employed for CROSSROADS varied with the effects being measured, but usually measuring devices were placed at a variety of ranges from surface zero and their measurements recorded in some way. Many types of gauges and data-recording techniques were used. Measuring devices or instruments were airborne, underwater, on shore towers, or on a technical support vessel; the majority were placed on target vessels (Reference C.9.208, p. 2).

Rugged, self-recording gauges were developed for blast and thermal radiation measurements so that complete loss of data from a project would not occur if instrument recovery were delayed, for example, by heavy fallout. For nuclear radiation measurements, however, early data recovery was still desirable as the gauges might be thin aluminum foil meters that could be made radioactive by the initial neutrons. Early observation was necessary before the information contained in the induced radiation pattern decayed to undetectable levels.

The potential for radiation exposure of personnel responsible for environmental measurements in general depended on the proximity of the instruments to

the device and the time that elapsed between detonation and instrument recovery; the nearer in space or time to the detonation, the greater the potential for exposure.

Systems Response Experiments

To document the response of systems to the hostile environment, military hardware (aircraft parts, ammunition, radar, petroleum, tanks, field stoves, clothing, and medical equipment) was exposed to nuclear detonation effects. Techniques used for these experiments were conceptually simple: exposure of the system of interest and observation of its response. Actual conduct of the experiments was far more complex. The level of threat to which the system was exposed almost always required measurement to properly understand the response, necessitating an environmental experiment along with each systems response experiment. It was often not enough to know whether the system survived, but rather what the effects were on the component parts and their interactions. This required the placement of extensive instrumentation and recording devices throughout the test area.

While the potential radiological exposure of personnel during these systems response experiments was governed primarily by the proximity of personnel in space or time to the detonation, an additional problem arose. Often, when the exposed object was recovered for closer examination, it could be contaminated by device debris or even be radioactive itself due to neutron activation. Personnel recovering or handling such objects could be exposed to radiation. For this reason, reboarding parties who inspected vessels, aircraft, and equipment after each detonation were given published guidelines and radsafe instructions (see Appendix B).

MARSHALL ISLANDS SETTING

The Marshall Islands are in the easternmost part of the area known as Micronesia ("tiny islands"). The Marshalls are spread over 770 thousand mi^2 (2 million km^2) of the Earth's surface, but of this area only about 70 mi^2 (180 km^2) is land. Two parallel chains form the islands: Ratak (or Sunrise) to the east, and Ralik (or Sunset) to the west; Bikini is in the Ralik chain at its northern extreme. Figure 1 shows these islands in the Central Pacific; Figure 2 is a map of Bikini Atoll.

A typical atoll, Bikini is a coral cap set on truncated, submerged volcanic peaks that rise to considerable heights from the ocean floor. It consists of 27 small islands that encircle a broad lagoon 25 miles (40.2 km) long and 15 miles (24.1 km) wide, with a maximum depth of about 200 feet (61 meters). The dry land area, 2.72 mi^2 (7 km^2), is covered with low, scrubby brush and coconut and pandanus trees. The land area is concentrated in the eastern islands, from Bikini to Eneu islands, which form about 53 percent of the land total, with 24 percent taken up by the southern section of Enidrik to Aerokoj.

Climate is tropical marine, generally warm and humid. Temperature changes are slight, ranging from 70° to 90°F (21° to 32°C). Rainfall is moderate, and prolonged droughts may occur. North of the atoll is open ocean for a thousand miles, the only inhabited island being Wake. East of Bikini are

several atolls, with Rongelap at 80 nmi (148 km) the closest. Storms are infrequent, although typhoons occur; nevertheless, both wind and sea are continuous erosional agents. Although possible at any time, most tropical storms occur from September to December. Cumulus clouds are abundant in the area.

The Bikini region incorporates three basic wind systems. Northeast trade winds extend from the surface to 25,000 to 30,000 feet (7.6 to 9.1 km), upper westerlies from the top of the trades to the base of the tropopause at 55,000 to 60,000 feet (16.8 to 18.3 km), and Krakatoa easterlies from the tropopause up into the stratosphere. These systems are all basically east-to-west or west-to-east air currents. Day-to-day changes reflect relatively small north-south components, which are markedly variable. Greatest variation occurs in the upper westerlies, particularly during late summer and fall.

Steady northeast trade winds in the lower levels cause water at the surface of the lagoon to flow from northeast to southwest, where it sinks to the bottom and returns along the lower levels of the lagoon, rises to the surface along the eastern arc of the reefs and islands, and is moved by winds to the southwest again. Lagoon waters moving in this closed loop also mix with those of the open ocean, resulting in a flushing action.

At Bikini, ocean water flows in over northern and eastern reefs and flows out of the western portion of Eneu Channel. Water exchanges over the western reefs with the tides, ocean water flowing in and mixing with the flood and lagoon water flowing out with the ebb. The net rate of flushing of Bikini waters is such that one-half of the lagoon waters is replaced by ocean water in 22 days and the original volume will account for only 10 percent of the lagoon volume after 2-1/2 months (Reference C.9.209, p. F-25).

During CROSSROADS, the Marshall Islands were under the jurisdiction of a U.S. military governor who reported to the Chief of Naval Operations and ultimately to the Secretary of the Navy. Since July 1947 these islands have been part of the Trust Territory of the Pacific Islands, a strategic area trusteeship of the United Nations, administered by the United States (Reference A.8, pp. 507-551).

In order to prepare Bikini Atoll for test operations, a considerable amount of work was required in the lagoon and on the principal islands. First, it was necessary to clear the lagoon of Japanese mines. On 10 March a survey unit arrived and began hydrographic and land surveys to augment the data recorded on the available Japanese charts. After the survey several coral heads were blasted out to permit safe navigation of large ships and to permit proper placement of ships in the proposed target arrays. Navigational and mooring buoys were laid in the lagoon and beacons placed on shore. On the islands, photographic towers (Figure 7), recording stations, recreational facilities (Figure 8), and landing facilities were constructed. This work was started on 20 March with the arrival of the 53rd Special Naval Construction Battalion, assisted by elements of the service groups and minesweeping units of the Pacific Fleet (Reference C.9.206, p. V-(B)-4).

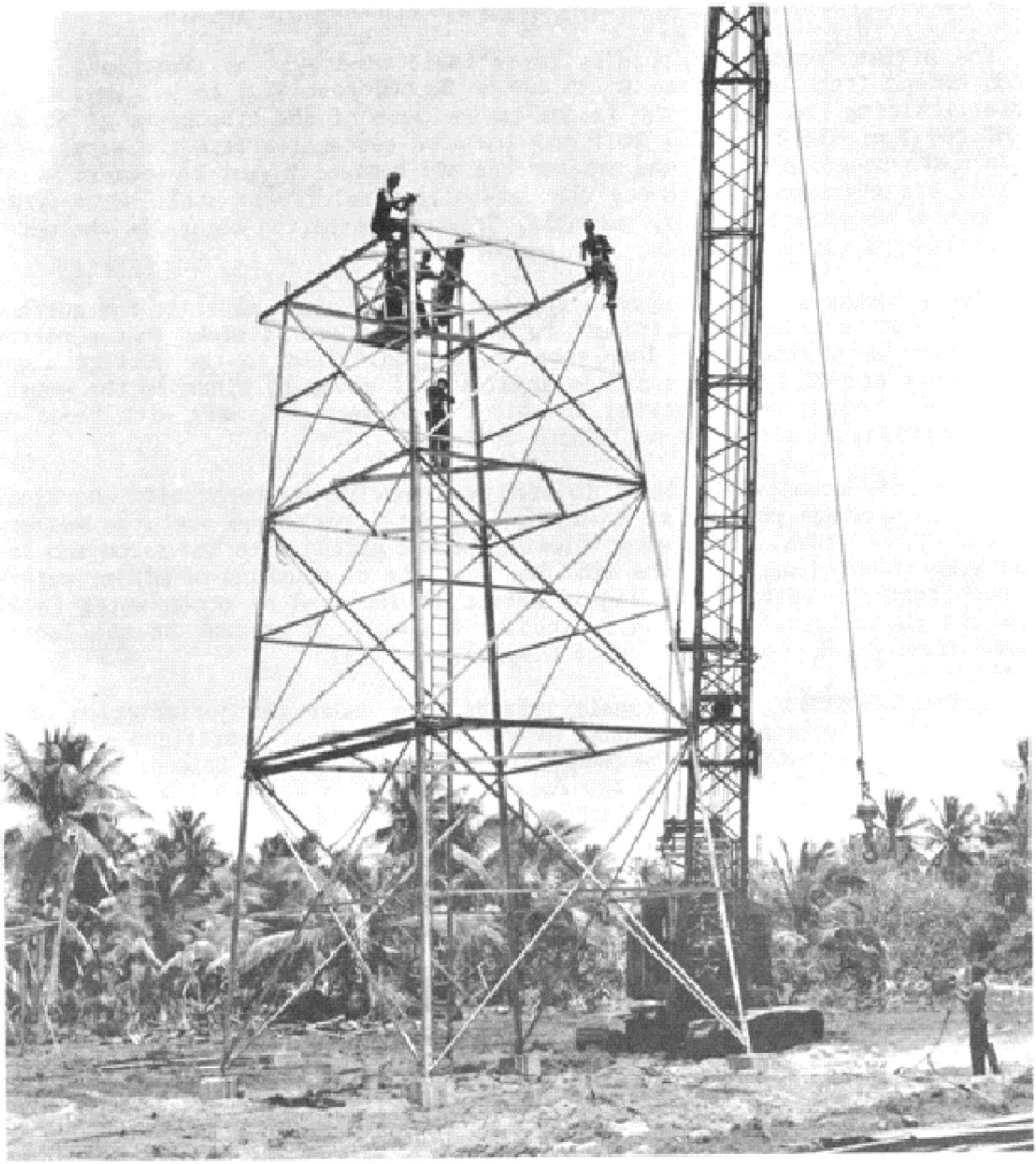


Figure 7. Erection of photo towers on Bikini, prior to CROSSROADS, 1946.



Figure 8. Bikini recreation area during CROSSROADS.

SPECIAL PROBLEMS IN THE CROSSROADS TESTS

The remoteness of Bikini Atoll posed significant logistics problems in procuring and transporting personnel, materials, and supplies to the new test site. Special security arrangements were also required to transport the nuclear weapons from the United States to the test area. However, there were many advantages to testing at Bikini. It offered a large, uninhabited area for test activities and normally steady directional winds to clear the airborne test debris.

Another major problem was design, procurement, and installation of the many scientific instruments required to measure effects of the detonations. These included instruments for observing shock waves, water pressure, airblast, wave action, deformation of structures, and radioactivity. Remotely controlled (drone) boats and aircraft had to be provided to obtain important measurements in radioactive zones without endangering personnel. Laboratories had to be

installed on ships and on shore to repair instruments and carry out test analyses (Reference C.9.206, p. I-(B)-7).

In addition, CROSSROADS posed other problems (Reference A.1, pp. 20 through 23):

- Scientific resources were declining from wartime peaks
- The number of nontechnical Service personnel was diminishing
- Civilian scientists participating from universities were insistent upon returning by early September
- Army and Navy budgets were expected to become smaller after the war
- Obsolete target vessels could not be held available indefinitely.

JOINT TASK FORCE ONE

JTF 1 was organized on 11 January 1946. It followed the basic principles employed during World War II to develop amphibious task forces, but incorporated needs of the scientific program. The joint task force staff comprised Army, Navy, and civilian scientific personnel. This joint staff maintained liaison with the War and Navy Departments, the Manhattan Engineer District, and other government agencies.

CJTF 1 maintained liaison with two boards of special interest, the JCS Evaluation Board and the President's Evaluation Commission. The Evaluation Board was to advise CJTF 1 during preparation for the tests and evaluate test results. The Evaluation Commission was to cooperate with the War and Navy Departments in conducting the tests, and to undertake a study of the tests and to submit its observations to the President along with findings, conclusions, and recommendations (Reference C.9.206, pp. VI-(B)-1 and VI-(B)-2).

JTF 1 was subdivided into eight task groups, each of which performed some specific function. Figure 9 details the structure of JTF 1, which was headquartered on USS Mount McKinley (AGC-7).

Task Group 1.1 (Technical Group)

Task Group (TG) 1.1 was responsible for instrumenting all target ships and target areas. Selected ships assigned to the group were equipped with laboratory facilities to service scientific instruments and record all data. The primary mission of its Drone Boat Unit (Task Unit [TU] 1.1.3) was to obtain early samples of radioactive water after each test and conduct remotely controlled radiological reconnaissances of the lagoon area after shot BAKER. TG 1.1 also did the following:

- Operated and performed technical services
- Observed and measured physical phenomena
- Furnished technical advice and assistance.

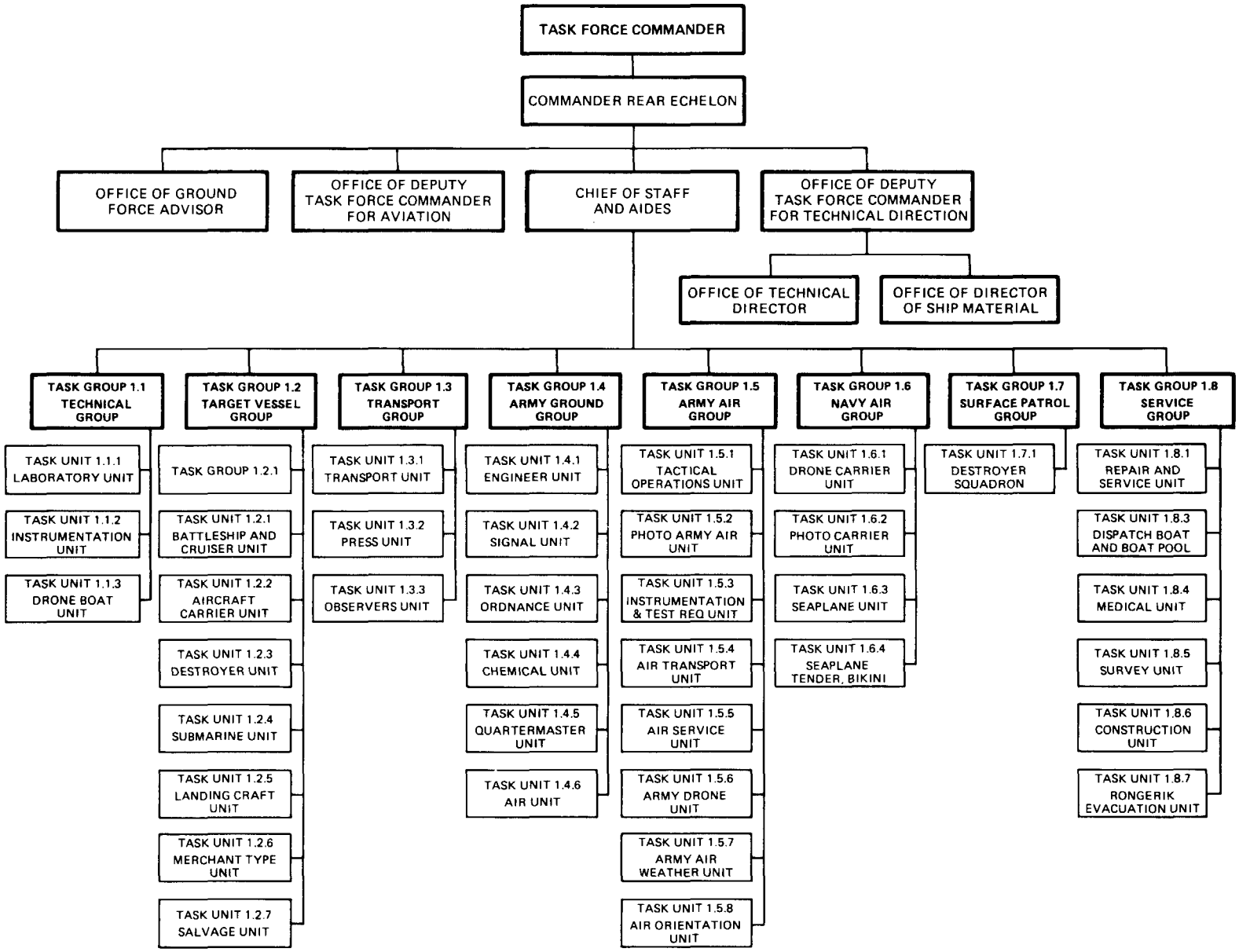


Figure 9. Joint Task Force 1 organization, CROSSROADS.

TG 1.1 had the following three task units, listed below with the ships on which they were based.

- TU 1.1.1 (Laboratory Unit)
  - -- USS Albemarle (AV-5) (Flagship)
  - -- LCT-1359
  - -- LSM-60 (BAKER surface zero vessel)
- TU 1.1.2 (Instrumentation Unit)
  - -- USS Avery Island (AG-76)
  - -- USS Burleson (APA-67)
  - -- USS Cumberland Sound (AV-17)
  - -- USS Haven (AH-12)
  - -- USS Kenneth Whiting (AV-14)
  - -- USS Wharton (AP-7)
- TU 1.1.3 (Drone Boat Unit)
  - -- USS Begor (APD-127)

Task Group 1.2 (Target Vessel Group)

TG 1.2 did the following:

- Prepared and placed target vessels for tests
- Salvaged and provided rescue assistance to damaged, strained, or distressed vessels
- Evacuated ships at time of tests
- Furnished boats and boat crews to the boat pool
- Provided boats from target vessels for radsafe reconnaissance and transport of initial inspection parties.

TG 1.2 was composed of seven task units during the testing period; their respective ships are listed in Table 1. USS Fall River (CA-131) was the flagship for TG 1.2. Not all TG 1.2 ships were target ships, although most were. Nontarget ships listed supported preparation, placement, and salvage of the targets. An eighth task unit, TU 1.2.12 (Kwajalein Maintenance Force), provided radiological decontamination and ammunition removal and disposal services for the JTF 1 ships moved from Bikini to Kwajalein during August and September 1946. Other activities included rollup of operations at Bikini, radiological survey of marine life around Wotho, Rongerik, and Rongelap islands, preparation of ships for movement to other shipyards, and aid in the training of radiological safety school graduates who had been sent to Kwajalein for practical experience. The unit initially consisted of about 1,500 men based ashore and on assorted small craft as well as the following vessels:

Table 1. Task Group 1.2 (Target Vessel Group) ships participating in CROSSROADS.

Task Group 1.2	Task Unit 1.2.3	Task Unit 1.2.4	Task Unit 1.2.5	Task Unit 1.2.6	Task Unit 1.2.7
Flagship	Destroyer Unit	Submarine Unit	Landing Craft Unit	Merchant Type Unit	Salvage Unit
USS Fall River (CA-131)[a]	Destroyer Division 31	Submarine Division 111	LST Group 9	Transport Division 91	ATR-40[a]
Task Unit 1.2.1	USS Anderson (DD-411)	USS Searaven (SS-196)	USS LST-52	USS Banner (APA-60)	ATR-87[a]
Battleship and Cruiser Unit	USS Hughes (DD-410) (Flagship)	USS Skate (SS-305)	USS LST-125	USS Brule (APA-66)	ATA-180[a]
Battleship Division 7	USS Lamson (DD-367)	USS Skipjack (SS-184)	USS LST-133	USS Carlisle (APA-69)	ATA-185[a]
USS Arkansas (BB-33) (Flagship)	USS Rhind (DD-404)	USS Tuna (SS-203)	USS LST-220	USS Carteret (APA-70)	ATA-192[a]
Nagato (captured Japanese battleship)	Destroyer Division 2	Submarine Division 112	USS LST-545	USS Fallon (APA-81)	USS Achomawi[a] (ATF-148)
USS New York (BB-34)	USS Ralph Talbot (DD-390)	USS Apogon (SS-308)	USS LST-661	Transport Division 92	USS Chickasaw[a] (ATF-83)
Battleship Division 9	USS Stack (DD-406)	USS Dentuda (SS-335)	LCI Group 7	USS Barrow (APA-61)	USS Clamp[a] (ARS-33)
USS Nevada (BB-36)	USS Wainwright (DD-419) (Flagship)	USS Parche (SS-384)	LCI-327	USS Butte (APA-68)	USS Conserver[a] (ARS-33)
USS Pennsylvania (BB-38) (Flagship)	USS Wilson (DD-408)	USS Pilotfish (SS-386)	LCI-329	USS Cortland (APA-77)	USS Coucal[a] (ASR-8)
Cruiser Division 23	Destroyer Division 3		LCI-332	USS Crittenden (APA-77)	USS Current[a] (ARS-22)
USS Pensacola (CA-24)	USS Conyngham (DD-371)		LCI-620	USS Dawson (APA-79)	USS Deliver[a] (ARS-23)
Prinz Eugen (captured German cruiser)	USS Flusser[a] (DD-368)		LCI(L)-549	Transport Division 93	USS Etlah[a] (AN-79)
Sakawa (captured Japanese cruiser)	USS Mugford (DD-389)		LCI(L)-615	USS Bladen (APA-63)	USS Gypsy[a] (ARSD-1)
USS Salt Lake City (CA-25) (Flagship)	USS Mustin (DD-413)		LCT Group 15	USS Bracken (APA-64)	LCT-581[a]
Task Unit 1.2.2	Destroyer Division 4		LCT-816	USS Briscoe (APA-65)	LCT-746[a]
Aircraft Carrier Unit[b]	USS Mayrant (DD-402)		LCT-818	USS Catron (APA-71)	LCT-1184[a]
Carrier Division 31	USS Trippe (DD-403)		LCT-874	USS Fillmore (APA-83)	LCT-1420[a]
USS Independence (CVL-22)			LCT-1078	USS Geneva (APA-86)	USS Mender[a] (ARSD-2)
USS Saratoga (CV-3)			LCT-1112	USS Niagara (APA-87)	USS Oneota[a] (AN-85)
			LCT-1113	Transport Division 94	USS Palmyra[a] (ARST[T]-3)
			LCT-1114	USS Appling[a] (APA-58)	USS Preserver[a] (ARS-8)
			LCT-1115	USS Artemis[a] (AKA-21)	USS Reclaimer[a] (ARS-42)
			LCT-1116[a]	USS Gasconade (APA-85)	USS Shakamaxon[a] (AN-88)
			LCT-1130[a]		USS Suncock[a] (AN-88)
			LCT-1132[a]		USS Widgeon[a] (ASR-1)
			LCT-1155[a]		
			LCT Group 21		
			LCT-412[c]		
			LCT-414		
			LCT-705		
			LCT-812		
			LCT-1013		
			LCT-1175		
			LCT-1187		
			LCT-1237		
			LCT-1268[a]		
			LCT-1341[a]		
			LCT-1377[a]		
			LCT-1415[a]		
			Miscellaneous		
			ARDC-13		
			YO-160		
			YOG-83		

NOTES:

[a] Nontarget vessels.

[b] Two PB2Y-5H Coronado seaplanes were also moored in the target array. They were not assigned to any task unit.

[c] BAKER target only.

USS Conserver (ARS-39)
USS Current (ARS-22)
USS Geneva (APA-86)
USS Haven (AH-12)
APL-27
LCI-329
LCI(L)-549
LCI(L)-615
YF-753

Task Group 1.3 (Transport Group)

TG 1.3 transported personnel and equipment to Bikini Atoll as well as evacuating personnel of the Target Vessel Group. It also furnished boats and boat crews to the boat pool, supplied two AKAs and two LSTs for the construction unit, and transported and quartered the press and observers. This task group was composed of three task units; their respective ships are listed below.

TU 1.3.1 (Transport Group)

Transport Division 31

USS Bayfield (APA-33)
USS Bexar (APA-227)
USS Bottineau (APA-235)
USS George Clymer (APA-27)
USS Henrico (APA-45)
USS LST-817
USS LST-881
USS Ottawa (AKA-101)
USS Rockbridge (APA-228)
USS Rockingham (APA-229)
USS Rockwall (APA-230)
USS Rolette (AKA-99)
USS Saint Croix (APA-231)

TU 1.3.2 (Press Unit)

USS Appalachian (AGC-1)

TU 1.3.3 (Observer Unit)

USS Blue Ridge (AGC-2)
USS Panamint (AGC-13)

An alphabetically arranged list of participating target and support ships, which includes a summary of their activities, forms Appendix A of this report.

Task Group 1.4 (Army Ground Group)

TG 1.4 was responsible for determining damage to selected Army equipment exposed at varying distances from the detonation point and measuring radii of effectiveness for each detonation. Each of the operating task units had Army equipment on certain ships and on Bikini Island for exposure to the nuclear detonations. Figure 10 shows the TG 1.4 organization. Each unit had inspection teams that were assigned to target ships and responsible for loading, securing, maintaining, and inspecting assigned test items. These teams also instructed crews of each target ship concerning exposed test items. Teams were to reboard

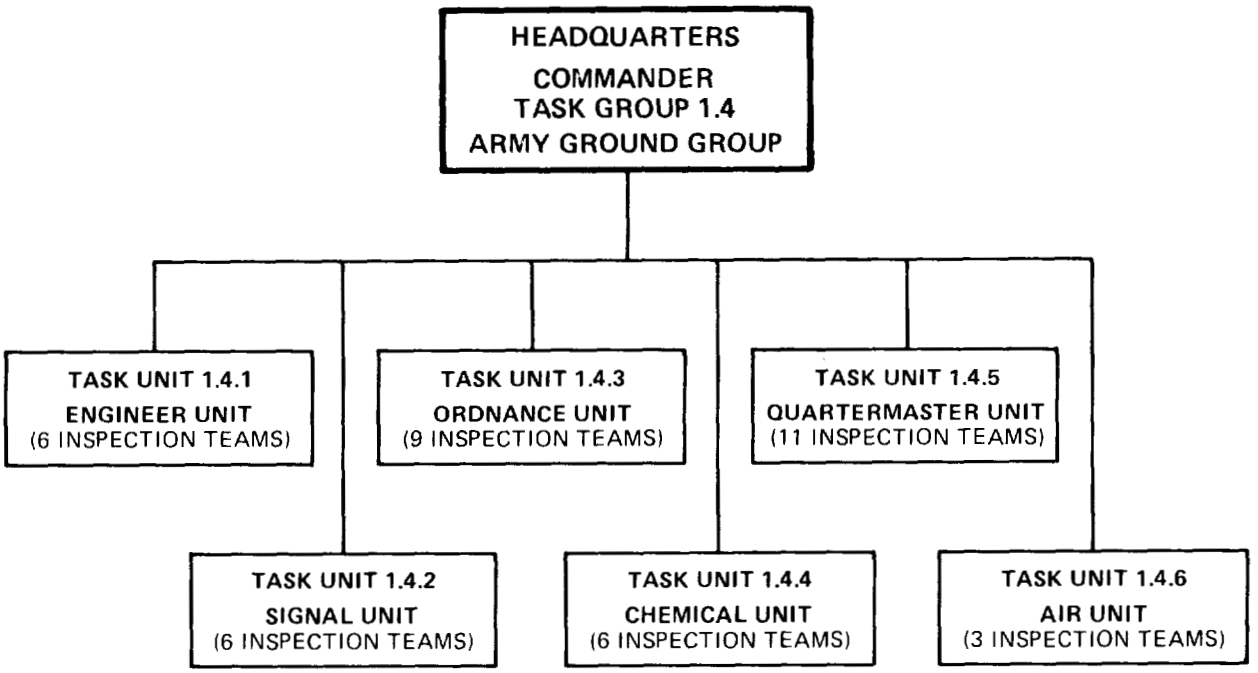


Figure 10. Task Group 1.4 organization, Operation CROSSROADS.

ships after the tests when ships were radiologically cleared and safe for boarding (Reference C.9.149, p. 3). TG 1.4 was composed of a headquarters and the following six operating task units:

- TU 1.4.1 (Engineer Unit)
- TU 1.4.2 (Signal Unit)
- TU 1.4.3 (Ordnance Unit)
- TU 1.4.4 (Chemical Unit)
- TU 1.4.5 (Quartermaster Unit)
- TU 1.4.6 (Air Unit).

Task Group 1.5 (Army Air Group)

TG 1.5, the Army Air Group, composed of provisional Army Air Forces units, was assigned the mission of dropping the ABLE weapon on the target array in Bikini Lagoon. In addition, it furnished aircraft, facilities, and crews for photography, weather reconnaissance, air-sea rescue, cloud sampling, pressure gauge drops, and air transport. Table 2 lists the Army aircraft used during CROSSROADS. B-29s and F-13s, which were modified B-29s, have become intermingled at some points in the historical accounts of Army Air Group operations. The totals for each shown here are correct by most accounts. TG 1.5 was composed of the following 10 task units (as shown in Figure 11).

TASK UNIT 1.5.1 (TACTICAL OPERATIONS UNIT). TU 1.5.1 trained crews, prepared equipment for the tests, airdropped the test ABLE weapon, set up the air search radar in the Bikini area, and provided radar analyses of practice bomb

Table 2. Army aircraft, CROSSROADS.

Task Unit	Type	Quantity	Mission
1.5.1	B-29	1	Command
	B-29	1	Bomb drop
	B-29	2	Pressure gauge drop
	F-13[a]	2	Radiological reconnaissance
	B-29	3	Spare
1.5.2	C-54	2	Photographic
	F-13[b]	8	Photographic
1.5.3	B-17	10	Drone samplers
	B-17	6	Drone controllers
1.5.4	C-46[c]	20	Transport
	C-54[c]	10	Transport
1.5.6	This unit was combined with TU 1.5.3 before ABLE and BAKER tests.		
1.5.7	WB-29	3	Weather reconnaissance
1.5.8	B-29	2	Radio broadcast, press, observation
	C-54[d]	---	
1.5.9	B-17	2	Air-sea rescue

Notes:

[a]Borrowed from TU 1.5.2.

[b]B-29s modified for photography.

[c]Includes those used to carry supplies to and from the continental United States.

[d]Borrowed from TU 1.5.4 on shot days.

Source: Reference C.9.189, p. VII-E, Appendix II.

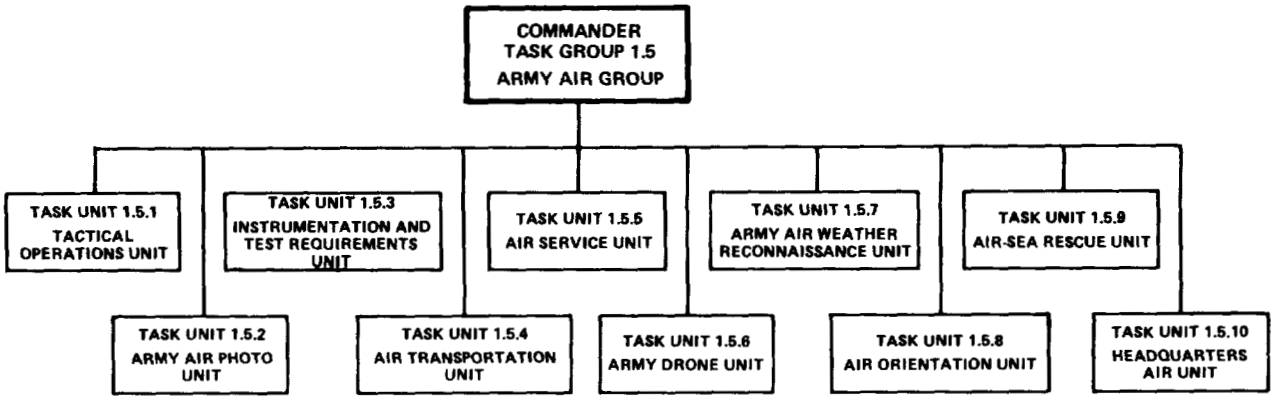


Figure 11. Task Group 1.5 organization, Operation CROSSROADS.

runs. It also operated two B-29s that dropped pressure gauges during each test. In addition, after each detonation it tracked the radioactive clouds and sampled air around the clouds. The unit was based on Kwajalein Island.

TASK UNIT 1.5.2 (ARMY AIR PHOTOGRAPHIC UNIT). TU 1.5.2 conducted air photographic operations and furnished aircraft for radiological reconnaissance flights. It was stationed on Kwajalein Island.

TASK UNIT 1.5.3 (INSTRUMENTATION AND TEST REQUIREMENTS UNIT). TU 1.5.3 and TU 1.5.6 (Army Drone Unit) were combined before the operation began. It was responsible for providing the B-17 drone and B-17 drone-controller aircraft for cloud-sampling operations. The drone mission required that the unit provide and maintain special equipment for sampling and for drone control operations. This included special cameras mounted in the drones. This unit was located on Enewetak Island.

TASK UNIT 1.5.4 (AIR TRANSPORT UNIT). TU 1.5.4 provided airlift for personnel, supplies, and equipment between Roswell Army Air Field, New Mexico, and the Pacific Test Area. It also provided air shuttle service among Kwajalein, Bikini, and Enewetak islands. Both C-46s and C-54s were available. This unit, stationed on Kwajalein Island, was responsible to assist in evacuating Enewetak Island in case of radiological danger to personnel on that island.

TASK UNIT 1.5.5 (AIR SERVICE UNIT). TU 1.5.5 serviced and maintained Army aircraft at Kwajalein Island. In addition to service and maintenance personnel, the task unit had engineers, military policemen, and weather-forecasting personnel.

TASK UNIT 1.5.7 (ARMY AIR WEATHER RECONNAISSANCE UNIT). TU 1.5.7 had three WB-29 aircraft with crews trained in weather reconnaissance. It flew long-range weather reconnaissance missions before each test. This unit was located on Kwajalein Island.

TASK UNIT 1.5.8 (AIR ORIENTATION UNIT). TU 1.5.8, based on Kwajalein Island, was responsible for accommodating visitors, observers, the press, and

news broadcasters. It flew these groups in two B-29s and two borrowed C-54s to witness CROSSROADS detonations.

TASK UNIT 1.5.9 (AIR-SEA RESCUE UNIT). TU 1.5.9 was initially part of TU 1.5.3 but was made a separate unit before testing started. It had two B-17 aircraft (called "Dumbos") for air-sea rescue and provided coverage between Enewetak and Bikini. The unit was based on Enewetak Island.

TASK UNIT 1.5.10 (HEADQUARTERS, AIR UNIT). TU 1.5.10 contained the command and staff elements of TG 1.5. It was based on Kwajalein Island and operated the task group headquarters. It was also known as Hq TG 1.5 (Reference B.5.1).

Task Group 1.6 (Navy Air Group)

TG 1.6 had three different functions: drone plane and drone boat control, aerial photography, and seaplane transportation. TG 1.6 was composed of four task units:

TU 1.6.1 (Drone Carrier Unit)

TE 1.6.11

USS Shangri-La (CV-38)

TE 1.6.12

USS Charles P. Cecil (DD-835)

USS Furse (DD-882)

USS Newman K. Perry (DD-883)

USS Turner (DD-834)

TE 1.6.13 (Navy Field Recovery Subunit, NAB Roi-Namur, Kwajalein)

TE 1.6.14

Air Development Squadron 2 (VX-2)

TU 1.6.2 (Photo Carrier Unit)

USS Saidor (CVE-117)

Plane guard destroyers from TE 1.6.12 as assigned.

TU 1.6.3 (Seaplane Unit, NAB Ebeye Island, Kwajalein)

Patrol Seaplane Squadron 32 (VPB-32)

Air-Rescue Squadron 4 (VH-4)

Carrier Aircraft Service Unit (Fleet) 34 (CASU[F]-34)

TU 1.6.4 (Seaplane Tender, Bikini)

USS Orca (AVP-49).

Shangri-La carried drone aircraft and operated off Roi Island, Kwajalein, where an airfield was used for landing and experimenting with drone planes.

Between tests, Saidor operated from Bikini Lagoon with drone boat control and photographic unit personnel on board. Except on ABLE and BAKER days, Orca was stationed at Bikini as a terminal and service unit for transport seaplanes. The ship maintained seaplane runways and furnished overhaul servicing required for all planes on turn-around service (Reference C.9.206, p. V-B-10).

Task Group 1.7 (Destroyer Surface Patrol Group)

TG 1.7 performed the following tasks during CROSSROADS:

- Furnished radsafe patrols
- Anchored one ship at Bikini Atoll lagoon entrance, except when it was evacuated, and supplied arrival information to incoming vessels
- Advised the Senior Officer Present Afloat (SOPA) about each arrival and departure from Bikini Lagoon
- Deployed two destroyers to act as approach markers for the bombing aircraft in test ABLE.

TG 1.7 was composed of only one task unit, TU 1.7.1 (Destroyer Squadron Unit), and contained the following ships.

Destroyer Division 71

USS Barton (DD-722) (Flagship)	USS O'Brien (DD-725)
USS Laffey (DD-724)	USS Walke (DD-723)
USS Lowry (DD-770)	

Destroyer Division 72

USS Allen M. Sumner (DD-692)	USS Moale (DD-693)
USS Ingraham (DD-694)	USS Robert K. Huntington (DD-781)

Task Group 1.8 (Service Group)

This task group had the following responsibilties:

- Base facilities and services including repair, fuel, water, mail service (USS LST-861); general supply, provisions, hospital, and recreation (USS LST-388)
- Island commander functions for land areas of Bikini Atoll, such as policing recreational areas, conducting shore patrol, and controlling boat traffic at landings
- Boat services
- Medical and hospital services
- Quarters and laboratory facilities on USS Fulton (AS-11) for the Oceanographic Wave Measurement Group
- Surveys in accordance with the Oceanographic Survey Plan
- Construction in accordance with Logistic Plan

- LCI shuttle service between Bikini and Kwajalein atolls
- Evacuation of Rongerik Atoll population if necessary.

TG 1.8 was composed of the following six task units (Reference B.0.1, pp. 5 and 6).

TU 1.8.1 (Repair and Service Unit)

USS Ajax (AR-6)
ARD-29
ATA-124
ATA-187
USS Cebu (ARG-6)
USS Chikaskia (AO-54)
USS Chowanoc (ATF-100)
USS Coasters Harbor (AG-74)
USS Creon (ARL-11)
USS Dixie (AD-14) (Flagship)
USS Enoree (AO-69)
USS Fulton (AS-11)
USS Hesperia (AKS-13)
USS Limestone (IX-158)
USS LST-388
USS LST-861
USS Munsee (ATF-107)
USS Phaon (ARB-3)
USS Pollux (AKS-4)
USS Quartz (IX-150)
USS Severn (AO-61)
USS Sioux (ATF-75)
USS Sphinx (ARL-24)
USS Telamon (ARB-8)
USS Tombigbee (AOG-11)
USS Wenatchee (ATF-118)
USS Wildcat (AW-2)
YC-1009
YF-385
YF-733
YF-734
YF-735
YF-752
YF-753
YF-754
YF-990
YF-991
YF-992
YO-132
YO-199
YOG-63
YOG-70
YW-92

TU 1.8.2 -- No units assigned

TU 1.8.3 (Dispatch Boat and Boat Pool)

USS Gunston Hall (LSD-5)
LCI(L)-977
LCI(L)-1091
LCI(L)-1062
LCI(L)-1067
LCT-1361
LCT-1461
PGM-23
PGM-24
PGM-25
PGM-29
PGM-31
PGM-32
USS Presque Isle (APB-44)
USS San Marcos (LSD-25)

TU 1.8.4 (Medical Unit)

USS Benevolence (AH-13)

USS Bountiful (AH-9)

TU 1.8.5 (Survey Unit)

USS Bowditch (AGS-4)

USS James M. Gillis (AGS-13)

USS John Blish (AGS-10)

YMS-354

YMS-358

YMS-413

YP-636

TU 1.8.6 (Construction Unit)

53rd Construction Battalion (later, Construction Battalion Detachment 1156)

TU 1.8.7 (Rongerik Evacuation Unit)

USS LST-871

USS LST-989

POST-OPERATION ORGANIZATION AND ACTIVITIES

After 7 September all survey and construction activites at Bikini were rapidly brought to a close, and the atoll was evacuated by 26 September 1946. Following a meeting on the West Coast from 17 to 20 September concerning decontamination procedures, some officers from JTF 1 were ordered to temporary duty under Commander Western Sea Frontier to follow up and coordinate the decontamination, monitoring, and clearance of exposed ships. On 24 September, in a joint speedletter, the Bureau of Ships and the Bureau of Medicine and Surgery assumed responsibility for giving final radiological ship clearances and prescribed detailed decontamination and clearance procedures. JTF 1 was formally dissolved on 1 November; its successor was a JCS committee, the Joint CROSSROADS Committee, whose task was to oversee the final test activities, publish the final reports, and supervise the Bikini Resurvey Operation of summer 1947, described in Chapter 6 (Reference C.9.206, pp. V-(D)-5 through V-(D)-7).

CHAPTER 2
RADIOLOGICAL SAFETY

PLANNING

Proposals to test atomic weapon effects on ships were made at the end of World War II, but the first discussion of radiological safety appears to have occurred at a meeting held 8 December 1945. Among those attending were the commanding general of the Manhattan Engineer District, the chief of the District's Medical section, and a Navy officer closely associated with the atomic bomb project and trained in chemical warfare technology. This officer became Safety Advisor to Commander Joint Task Force 1 (CJTF 1) and headed the task force safety organization. The chief of the medical section, an Army medical officer, became Radiological Safety Advisor to CJTF 1 and headed the task force Radiological Safety Section within the safety organization (Reference A.1, pp. 9, 48, and 49; Reference B.0.1; Reference C.9.206, pp. VII-(C)-1 and VII-(C)-2).

During the next several months, training of radiological safety (radsafe) personnel, organization of the radsafe unit, and writing of the radsafe plan went forward. By 15 December medical officers from the Army, Navy, and Public Health Service had been selected for training in radiological safety. The Manhattan Engineer District took responsibility for radiological safety as the result of a meeting on 7 January 1946 between the joint task force commander designate and the commanding general of the Manhattan Engineering District. The Safety Advisor, the Radiological Safety Advisor, and the Radiological Safety Section were part of the joint task force from the time of its formal establishment on 11 January 1946. By April 15 a radsafe plan was submitted to CJTF 1. The plan was approved with revisions on 28 April. The plan underwent no significant revisions until after shot ABLE (Reference C.9.206, pp. VII-(C)-1 and VII-(C)-2). Relevant portions are reproduced in Appendix B.

Radiological safety, however, was only part of the task force's comprehensive safety program. It also included protecting personnel from fire, explosions, and toxic material. By exposing a fleet of warships, many loaded with ammunition, fuel, and lubricants, to nuclear explosions, the task force added nuclear safety to the many concerns damage control officers had faced for years.

The radsafe plan emphasized detection and avoidance of radiation to protect personnel. Systematic reconnaissance was to begin shortly after each detonation. Navy patrol seaplanes (PBMs) were to conduct aerial surveys over the lagoon and destroyers were to patrol the open ocean upwind and downwind of the atoll. Drone patrol boats were to enter the lagoon first to take water samples. Radsafe monitors aboard gunboats (PGMs) and landing craft (LCPLs) were to measure the lagoon's radioactivity. B-29s were to track the nuclear cloud. Radsafe monitors were to accompany all units and working parties reentering the target area to recover data or work on the target vessels.

RADIOLOGICAL SAFETY RESPONSIBILITY AND ORGANIZATION

Although the Manhattan Engineer District had taken responsibility for radiological safety at CROSSROADS, the District's role actually consisted of providing radsafe equipment and senior radsafe personnel. CJTF 1 was in command at Bikini and major radsafe orders were issued in his name. A Radiological Safety Section was established to advise CJTF 1 in this area and to implement his orders. Its chief was also CJTF 1's Radiological Safety Advisor. During test operations the section operated directly under the JTF 1 Assistant Chief of Staff for Operations. For the purposes of technical advice and instrumentation, the Radiological Safety Section reported to the Technical Director. This dual chain of command caused no difficulty during CROSSROADS (Reference C.9.206, p. VII-(C)-2).

The mission of the Radiological Safety Section was (Reference B.0.1, p. E-II-1):

> . . . to protect personnel from the hazards peculiar to the use of the atomic bomb during Operation CROSSROADS and to enable personnel to return safely to the target area at the earliest possible moment.

The task force operation plan specified the following elements for the Radiological Safety Section (Reference B.0.1, p. E-II-1):

1. Radiological Safety Control Unit
2. Radiological Safety Advisory Board
3. Radiological Safety Reconnaissance Units
4. Radiological Safety Monitor-Advisors
5. Radiological Safety Technical Service Units.

Documents written during CROSSROADS provide additional details on the section's organization. Figure 12 gives a composite picture based on information from the available sources.

The section chief, his staff, and supporting personnel, such as clerks and radiomen, made up the Radiological Safety Control Unit, based aboard USS Mount McKinley (AGC-7), the task force flagship. They were to (1) receive, plot, and analyze radiological data from all sources, (2) control the radsafe reconnaissance units, and (3) advise CJTF 1 on the location and amount of radioactivity. They were also to predict the path of the radioactive cloud and the pool of radioactive water.

The Committee for Review of Radiological Safety Measures functioned during most of its existence at Bikini under the title of Medico-Legal Board. It was convened on 15 June 1946 by the chief of the Radsafe Section, after which it met irregularly at his call or when one of more of its members felt a matter required its attention. Initially, it served to evaluate the regulations and safety measures adopted to protect personnel from radiological hazards. Later the board initiated a number of investigations, believing itself warranted in defining its own field of action. A total of 14 men served on the board at one time or another. All were medical doctors, specializing in radiology or with

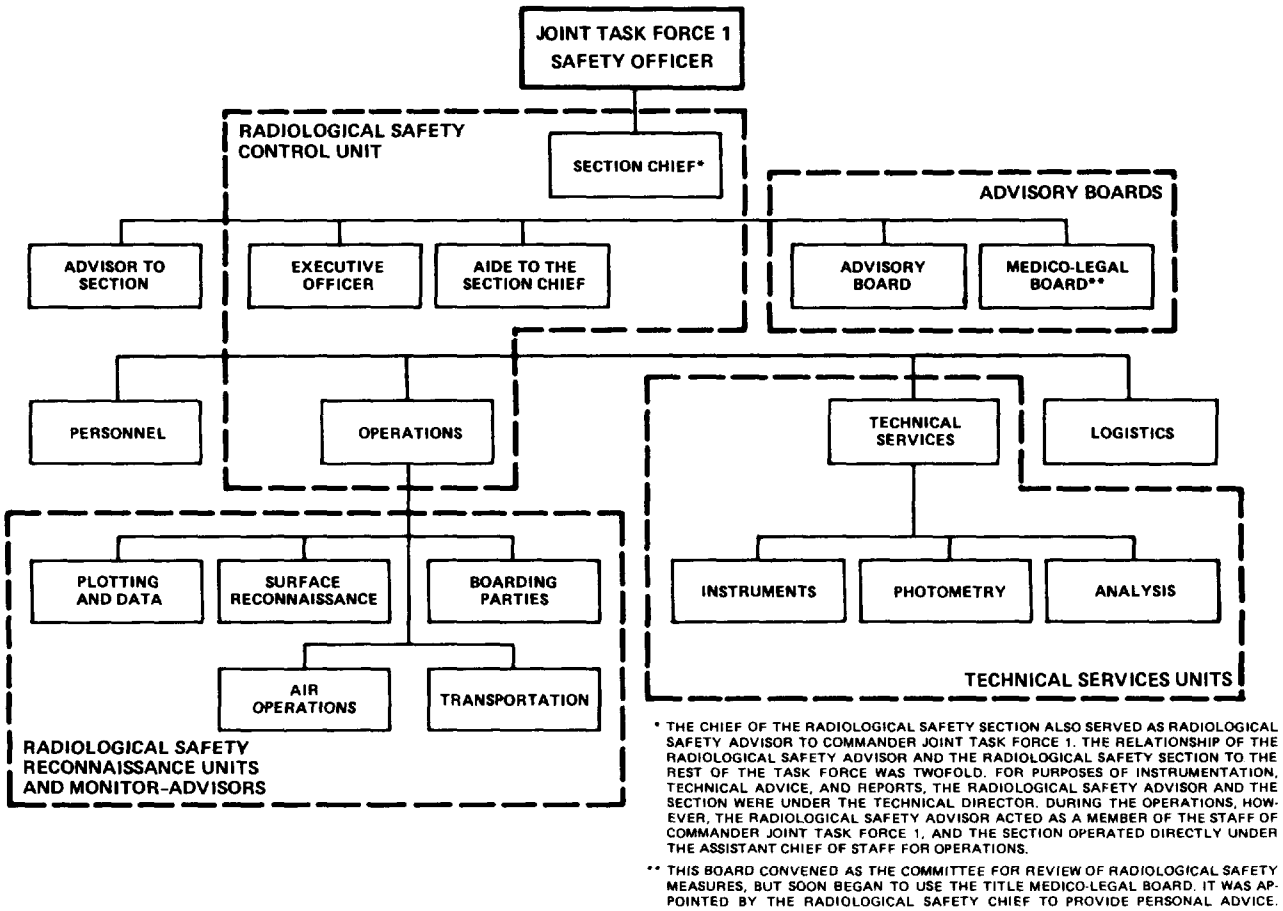


Figure 12. Organization of the Radiological Safety Section, CROSSROADS (sources: References C.9.206, B.0.2, B.0.4, and B.0.7).

radiation safety experience. The board held 14 meetings and considered such topics as the plutonium hazard, permissible beta exposure, fission products in the air, decontamination of personnel, control of overdoses, urinalyses, blood counts, monitoring procedures, and removal of equipment from target vessels (References B.0.7, C.0.5, C.0.6, C.0.7, C.0.8, and C.0.9b).

Planning called for each radsafe reconnaissance unit to consist of a monitor and one or more assistants. Initially, units were assigned as follows: two for PBMs, two for HSO-1 helicopters, nine for destroyers, six for PGMs on lagoon patrol, twenty for LCPLs on lagoon patrol, six for cloud-tracking aircraft, and two for drone boat operations (Reference B.0.1, p. E-II-1). However, as ABLE shot approached it became clear that many more monitors would be needed; in fact, over 225 monitors were used for each of the two shots (Reference C.9.206, p. VII-C-5).

Radsafe monitor-advisors were assigned to commands and aircraft likely to encounter radioactivity. The major function of these monitors was to advise their commands and pilots on radiological safety. In addition, they had a reconnaissance function. Thus, they could quickly communicate with the radsafe control unit to report radiation levels and receive advice on safety measures (Reference B.0.1, p. E-II-8).

The Radiological Safety Technical Service Units were composed of instrument repair personnel, photometrists, and analysts. The instrument repair personnel maintained, repaired, and calibrated all instruments used by the radsafe section. They supplied monitoring equipment to all aircraft operating in the test area that did not carry monitors, and they trained pilots in use of that equipment. The photometrists (dosimetry technicians) calibrated film dosimetry badges, prepared casualty and personnel badges, processed film from badges that had been worn, calculated exposure from film data, and recorded the results. Analysts collected and analyzed samples of water, soil, and marine life for radioactivity (Reference B.0.1, p. E-II-8; Reference B.0.4).

PERSONNEL PROTECTION

Tolerance Exposure

The Operation Plan set the maximum allowable dose or tolerance for exposure over a long period at 0.1 roentgen (R) per 24 hours (Reference B.0.1, p. E-I-3). The National Bureau of Standards had established that limit in 1934, and it was used in manufacturing plants in the United States (Reference B.0.8). The Chief of the Radsafe Section stated that this dosage was based on 2 to 2-1/2 years of experiments with dogs, mice, and fruit flies, and on experience with a workforce of 8,000 people (Reference B.0.9). The Operation Plan also stated that an individual was not to have a total exposure of over 50 or 60 R in 2 weeks. If an individual received 10 R in 1 day or 60 R in 2 weeks he was to be withdrawn from active participation in the operation (Reference B.0.1, p. E-I-3). Such action was never required. The highest accumulated recorded exposure for the operation was 3.72 R, which was received by an Army assistant radsafe monitor badged for 6 days. The highest number of badges issued to a single individual was 19. He also was a radsafe monitor and his cumulative exposure was 2.48 R.

Provision was made for special situations (Reference B.0.1, p. E-II-9) that might:

> . . . permit the assuming of a calculated risk in order to let certain key personnel enter a hazardous area to make highly desirable observations when the total amount of radiation to be received is less than 10 roentgen units. This may be permitted only on direct instructions from Radiological Safety Control. Details of the situation and clearance therefore will be carefully logged by the accompanying monitor and at Radiological Safety Control.

There is no record that this special provision was invoked during the operation.

On 5 August the Medico-Legal Board recommended that three monitors refrain from monitoring for 1 or 2 days because of badge readings in excess of 0.1 R (Reference C.0.10). Later, monitors who exceeded the tolerance were removed from work on USS Salt Lake City (CA-25) (Reference C.0.11).

Film Badges

Two types of film badges were used at CROSSROADS. One type, called a personnel or mission badge, had a range from 0 to 2 R. Badges were issued to some of the men about to enter possibly radioactive areas and most badges were collected after the men returned, usually the same day. Some badges were worn for 2 or 3 days, and a few worn for as long as 9 days have been noted. Each badge contained a piece of Kodak Type K double-coat film in a dental film packet holder. Strips of lead were crossed over the film at right angles, leaving the film's corners without lead covering. Each badge was sealed in a tropical weather-proof envelope to protect it against the hot, humid Bikini climate (Reference C.0.5, p. 2-2).

The badges were designed to measure both beta and gamma exposure, but the beta readings obtained and recorded are now considered questionable (Reference C.13.2). There are several reasons for this. One is that the response of the double-coated film dosimeter emulsions depends on the energy of the beta particles they are exposed to. Unless additional thin metal foils are used over the films to filter or sort the beta radiation into known energy groups, or unless the energy distribution of the beta radiation is otherwise known, very large errors in interpreting the film darkening can result. There also appear to have been some incorrect assumptions made concerning whether gamma as well as beta would darken the unfiltered areas (Reference C.13.2). Despite the doubtfulness of the validity of the beta readings, the values as originally assigned have been accepted and used in total dose assignment in the NTPR program (Reference C.13.2).

After a badge was returned to the Radsafe Section, the photometrists of the Radiological Safety Technical Service Units developed the film in it and measured the film's optical density. This was a measure of the amount of radiation to which the film had been exposed. The film number, the wearer's last name, and the exposure date and time were written on a line on the left-hand page of an open ledger book of the type then widely used by Federal agencies. Sometimes the individual's first name, initials, or rank were written in. Sometimes the name of the ship where he was quartered or, more often, the target ship on which he had worked that day was entered. If the badge had been used on an island or ship as a radiation recorder, the location information was recorded instead of a person's name. Optical densities under the lead cross and on the corners of the badge were entered on the right-hand page. The radiation exposure was calculated from these densities and recorded as the final beta and gamma readings at the page's far right. Years later, the pages were removed from the ledgers and microfilmed. Information from badges worn during September, October, November, and December of 1946 was recorded on large (5- x 8-inch) cards for each individual.

Neither the detached pages nor the microfilm is easy to work with. The penmanship of the radsafe staff is not always legible, and incomplete identification of the badge wearers and inconsistent ship identifiers are additional problems. In 1968 the Reynolds Electrical and Engineering Company (REECo) transferred the information from the ledgers to a computer data base, allowing easier manipulation and analysis of the material. The REECo list is used as the basis of the personnel exposures in this report.

Multifilm badges, called casualty badges, were used to record high-range exposures. They were placed aboard a small number of ships and aircraft that might enter areas of high radiation. Casualty badges were also placed aboard target ships as part of the scientific program to determine exposure from the detonations.

Radiological Safety Instruments

CROSSROADS requirements for radsafe instruments turned out to be far greater than had been expected when planning for the operation began. No comprehensive program existed for development and manufacture of rugged instruments for use under field conditions; thus, the head of the Radsafe Section had to make do with what the Manhattan Engineer District could provide from its inventory and what the Victoreen Instrument Company could manufacture quickly (Reference C.11.1; Reference C.0.12, p. 18).

Each monitor unit or monitor-advisor was equipped with a Geiger-Mueller counter (X-263 Survey Meter) and an ionization meter (Model 247 Survey Meter), as well as other equipment, depending on the nature of the mission (Reference B.0.1, pp. E-II-2 through E-II-8).

The X-263 measured beta and gamma radiation from about 0.001 R/24 hours to about 0.4 R/24 hours (References B.0.10 and C.0.13). This range made the meter too sensitive for some radiation fields encountered during CROSSROADS (Reference A.2, pp. 7 and 8). The X-263 proved too delicate to function consistently under field conditions (Reference C.0.14, p. 3). Three hundred twenty of these instruments were available 2 days before BAKER (Reference C.0.12, p. 9). Every monitor tried to have three or four of them to assure that at least one would be working when he reached his post (Reference C.0.15, p. 3).

The 263 G.M. Set, an older version of the same instrument, also was used at Bikini, but information is lacking on the number available. Experienced monitors preferred it whenever accurate and reliable data were required (Reference C.0.12, p. 18).

The 247 Survey Meter measured gamma radiation only. Its range was from 0.5 to 200 R/24 hours, and it was often used for measuring intensities beyond the range of the X-263. It was rugged, spray resistant, and held its calibration well (Reference A.2, pp. 7 and 8; Reference C.0.12, p. 23). Twenty of these were available for monitoring after the BAKER detonation (Reference C.0.14, p. 3).

Pocket dosimeters were designed to measure cumulative gamma dose up to about 0.3 R. About 160 were issued for the BAKER test. They were relatively rugged and easy to repair. Apparently they were often issued to divers (Reference C.0.12, pp. 27 and 28).

Several other instruments were available to the monitors, although in numbers smaller than the X-263, the 247, and the pocket dosimeter. The L&W survey meter measured between 0.001 and 25 R/24 hours. Twelve were in service following BAKER. They were used mostly by boarding parties and by special groups, such as the target monitor group. The head of the monitor group wrote

that the L&W meter was the most reliable instrument for these measurements because it was energy-independent and insensitive to temperature and humidity changes (Reference C.0.16). Six assault meters, brought out by individual monitors, were used during the operation. They were very rugged and ideal for quick and rough determination of radiation levels from 0.1 to 10 R/24 hours. They proved useful for boarding ships and similar operations (Reference C.0.12, p. 31). The "cutie pie" survey meter was a small instrument capable of measuring beta and gamma radiation up to 100 R/24 hours. Few of these were available for CROSSROADS, but a monitor aboard PGM-32 after BAKER used one and decided it was an excellent portable rate meter (Reference C.0.15, p. 4).

The task force had several instruments for measuring alpha contamination. None, however, proved reliable for field surveys. Photographs of task force activities show the Zeus counting meter, the Zeuto, and the X-323. These three instruments were mentioned in training lectures for monitors (References C.0.17 and B.0.11). One or all may have been the Poppy or Walkie Poppy referred to in radsafe reports after BAKER. The three devices appear to have been small, and each had a carrying handle, but apparently they did not work well outside of USS Haven's (AH-12) air-conditioned laboratories in the hot, humid Bikini climate (Reference C.0.14, p. 4). In addition, the Radsafe Section had five Filter Queen Air Samplers. Basically, these were tank-type vacuum cleaners with an alpha detector and filter paper mounted in the intake tube. Samples collected in the filter papers aboard the target ships had to be returned to Haven where alpha counts were made. Initially, the alpha detectors worked well, but humidity, along with personnel opening the detectors improperly, caused them to fail (Reference C.0.12, pp. 8 and 9).

Personnel Decontamination

Personnel working in radioactive areas sometimes picked up radioactive particles on their bodies and their clothing. Procedures were established to minimize the spread of this contamination and potential internal and external exposure from these radioactive sources. The procedures spelled out for the USS Ajax (AR-6) crew working on repair of Salt Lake City following BAKER were typical and are summarized in the following paragraphs.

Ajax crewmembers slated for work on Salt Lake City left their own compartments wearing only their own shoes. These shoes were removed and left in a compartment adjacent to a designated head (bathroom) where the men donned work clothing. They then left Ajax via a Jacobs ladder into a small boat while carrying canvas gloves and shoe covers. The gloves and shoe covers were put on immediately before boarding the target ship for work and were taken off just before leaving.

Upon return to Ajax, the men boarded by Jacobs ladder and went to the upper deck where they were monitored. They walked only on a deck covering, which presumably was disposed of after use. The men first washed their hands and forearms with hot water and salt-water soap. Then each man washed his own clothing. These were first scrubbed in hot water and salt-water soap and then rinsed in a special hot rinse and rinsed again in plain hot water. The clothes were hung on lines to dry on the upper deck.

Clothing so contaminated that it read more than 0.10 R/24 hours (gamma) was placed in paper bags, and radiation was allowed to decay for a period of time before the clothing was washed. If the radiation did not decrease to less than 0.10 R/24 hours, the clothing was disposed of at sea.

After the clothing had been washed or put aside to cool, the men took a shower in the decontamination head in a designated stall with hot water, thoroughly soaping themselves with salt-water soap. They then proceeded to a second stall where they again showered with ordinary soap. The men were monitored again and if free of contamination could return to their own compartments; otherwise they continued showering (Reference B.0.12).

Commander Task Group (CTG) 1.2 set a slightly lower radiation level, 0.05 R/24 hours, above which the clothing was to be disposed of at sea. The contaminated clothing was to be bundled and weighted and the Radsafe Section was to be notified. An LCT picked up the bundles the next day and dumped them 10 nmi (18.5 km) from Bikini at sea.

Clothing in small lots was laundered in separate buckets (like the Ajax procedure above) or done in the ships' laundry if in large lots. If the ships' laundry were used, however, the clothing had to be separately done and the laundry machinery had to be specially cleaned after use (Reference C.10.8).

Urine Testing

The discovery of alpha emitters, including plutonium, led to urine tests for personnel thought to have been exposed to determine whether any had taken these substances into their bodies. The water-testing laboratory on Haven was converted for testing urine. By 15 August, 2,600 samples had been tested. The men doing the work had to use instruments that were on hand and develop techniques as they worked. The widespread presence of radioactive material led to high background counts and made it difficult to determine whether an individual had low levels of alpha emitters in his urine. On 15 August the Radsafe Section reported slight beta activity had been found in the urine of 2,600 men checked (Reference A.2, pp. 117, 118, and 121 through 125; Reference C.10.9; Reference C.10.15). Despite all the concern and discussion about it, there is no indication in CROSSROADS documentation that positive alpha counts were found in any urine samples.

Eye Protection

Eye protection from the ABLE flash was a major concern. Approved darkened goggles were provided to personnel on ships 25 nmi (46 km) or less from the ABLE detonation and to all observers on the press and observer ships. Men without goggles within 30 nmi (56 km) were to turn away from surface zero, look down at the deck, close their eyes, and cover their eyes with their arm (Reference B.0.1, pp. E-I-1, E-I-2, and E-IV-2). Pilots airborne at the time of the detonation were to wear approved goggles and turn their heads away from the detonation. In addition, each copilot was to close his eyes and cover them with his arm so that he would be ready to fly the aircraft if the pilot was flashblinded (Reference B.0.1, p. F-XII-5).

EXCLUSION AREAS AND OPERATIONS LIMITS

Surface Operations

To reduce the chance of exposing task force personnel to radiation, several surface areas were defined by the Operation Plan to which access was forbidden or restricted (Reference C.9.206, p. VII-(C)-9):

1. Surface Survey Sector. This was a forbidden surface area outside the lagoon. It was bounded by two bearings drawn from the detonation point and by a radius that increased with time after the detonation.

2. Red Line. This line surrounded the lagoon area within which the radiation level was 1 R/24 hours or higher. This boundary was separate from the Red Arc that defined airspace limits.

3. Blue Line. This line marked the boundary between the lagoon area with a radiation level more than 0.1 R/24 hours and the area with a lower level. Vessels could operate in the lagoon area between the Blue and Red Lines only for specified periods of time with permission from the Radiological Safety Control Unit. Vessel movement outside of the Blue Line was governed only by regular Navy rules.

4. Anchorage Area Able. Ships could anchor in this area, provided they were ready to get underway on 1 hour notice.

5. Anchorage Area Baker. An unrestricted anchorage area.

In addition, certain operational limits were specified. No manned ships were to be closer than 10 nmi (18.5 km) from the ABLE detonation, and most were to be 20 nmi (37 km) away (Reference B.0.1, p. E-IV-1). In case of fallout on the ships, nonessential personnel were to be sent below decks, the ship closed up, and exposed personnel were to strip off their outer clothing before taking cover. If necessary, men in coveralls and gas masks were to decontaminate contaminated areas of the ship after fallout ended (Reference B.0.1, p. E-IV-7).

Before each test all ships were to have full freshwater tanks. Distilling plants and heat exchangers were not to be operated until the Radiological Safety Section had declared the saltwater to be used was radiologically safe. If the equipment had to be operated before radiological clearance had been given, special monitoring attention was required (Reference B.0.1, p. E-IV-10).

In order to gain access to classified or radioactive areas, the leader of a work party was required to present an identification card and a letter of authority. There were letters for damage control, instrumentation, observer, press, and radsafe parties, among others (Reference B.0.3).

Aerial Operations

Initially Joint Task Force One Operation Plan 1-46 (OpPlan 1-46) prescribed certain general safety precautions for air operations. It specified that all aircraft aloft from H-2 hours to H+30 minutes carry a radiation monitor with monitoring equipment. Exceptions were the bomb-drop and pressure-gauge-drop

B-29s, single-seated aircraft, and those other aircraft so designated by CJTF 1 as exempt. The crewmembers of all aircraft aloft during that period were to wear film badges, and each aircraft was to carry at least one casualty badge capable of recording radiation much higher than personnel film badges. In actuality, these plans were modified somewhat for both shots. For shot ABLE, radiation monitors were aboard all photographic aircraft, reconnaissance aircraft, drone control aircraft (except the Navy F6Fs), air-sea rescue aircraft, and press/observer aircraft. The F6Fs were single-seated, fighter-type aircraft in which radiation monitoring equipment was installed for the pilot's protection. On shot BAKER, radiation monitors were aboard all photographic aircraft, reconnaissance aircraft, and press/observer aircraft (Reference C.9.206, pp. VII-(C)-10 and VII-(C)-19).

The prohibited airspace for aircraft was defined separately for each of the two tests and was a function of time and range. For the first 6 minutes after detonation, no aircraft was to approach closer than 10 nmi (18.5 km) to surface zero. From H+6 to H+30 minutes, a radiation danger sector (radex) was defined, consisting of two bearings drawn from surface zero, e.g., 320° clockwise to 120°. From H+6 to H+18 minutes, the aircraft exclusion area consisted of all space in this sector within the Red Arc. From H+18 to H+30 minutes, the exclusion area was all space in this sector within the Blue Arc. The Red and Blue Arcs were decided upon based on wind speeds the morning of each detonation. The morning of each shot, the radex sector was updated from the one predicted the previous evening. The Red Arc was, by definition, nearer surface zero than the Blue Arc. Specific values for radex sectors and the Red and Blue Arcs for the ABLE and BAKER shots are discussed in Chapter 4 (Reference B.0.6). In addition, no aircraft without radiation detection instrumentation was to approach closer than 20 nmi (37 km) to the visible column or downwind clouds. From H+30 minutes to H+30 hours, no aircraft was to be within 30 nmi (56 km) of surface zero unless engaged in radsafe work or cleared by the Deputy Commander for Aviation (Reference B.0.1, p. F-XII-3).

All aircraft, manned and drone, airborne from H-hour until H+30 were to be monitored upon landing. Aircraft oil filters and any surface oil spots were to receive special monitoring attention. All drones were considered heavily contaminated until proven otherwise (Reference B.0.1, pp. E-IV-3 and E-IV-4).

STAFFING AND TRAINING

Selection of Personnel

When the Radiological Safety Section was established in January 1946, it was believed that 50 to 60 monitors would be needed. Between 20 and 30 were to be experienced radsafe practitioners from the Manhattan Engineer District and thirty were to be doctors from the Army, Navy, and U.S. Public Health Service. The latter group, including a chemical warfare officer, reported to Oak Ridge National Laboratory on 15 January for an intensive 11-week course. The course included the physics of radioactivity, nuclear safety techniques, biological effects of radioactivity, field training, and hazards of ingested radionuclides. Experts from Oak Ridge and Los Alamos laboratories and from the universities of Rochester, Chicago, and California at Berkeley provided instruction (Reference C.9.206, p. VII-(C)-4).

As the Chief of the Radiological Safety Section and his staff continued work on the radsafe plan, they realized that a much larger group of monitors and other experts would be required than would be available from the Manhattan Engineer District. To fill this gap, the section chief called on a number of scientists who had already returned to civilian life from wartime service with the government. Few were eager for another extended period of government service, and they and the universities or laboratories employing them demanded, and received, promises of strict limits on the duration of their CROSSROADS service. Apparently, all were to be back in the United States by late August or early September (Reference C.9.206, p. VII-(C)-4).

On 23 March 1946, efforts to staff the Radiological Safety Section were dealt a major setback when the President announced that the first test was to be postponed from 15 May to 1 July (Reference B.12.1, p. 1), with the result that the second test also was delayed. This change raised the prospect that personnel from colleges and universities would not be back on campus for the start of the fall semester. The Chief of the Radiological Safety Section struggled to hold his civilian recruits, but many resigned and he was forced to search for replacements. He asked for more military officers and was supplied with 55 from the Navy and 15 from the Army, almost all of whom were reservists. He also was able to obtain some additional civilians (Reference C.9.206, p. VII-(C)-5; Reference B.0.5).

Bikini Activities

Most of the Radiological Safety Section reached Bikini on 12 June aboard Haven (Reference A.2, p. 11). Some personnel, however, did not arrive until after the ABLE shot or the BAKER rehearsal, and some civilians left Bikini before the BAKER detonation. The Radiological Safety Section was able to muster over 300 personnel for ABLE. Over 225 monitors were available for each of the two shots, but they were stretched thin. During ABLE there were more monitors than during BAKER (Reference A.1, p. 31; Reference C.9.206, p. VII-(C)-5).

Training of Radiological Safety Section personnel had three phases. First, intensive training for the original group of military and public health personnel at Oak Ridge and other locations beginning in mid-January; second, training of the entire section aboard Haven on the way to Bikini; and, third, additional training for the section and for later arrivals once at Bikini.

One of the monitors, a medical doctor drafted into the Army late in the war and assigned to CROSSROADS, characterized the group aboard Haven as follows (Reference A.2, p. 5):

> Most are older men, some are well-known scientists. Some have worked with radiation in the Manhattan District, but the majority come with little more than a scientific background. Test ABLE is only one month away. Since this group is to have the responsibility for protecting task force personnel from the invisible dangers of radioactivity, the problem of briefing them on the fundamentals and the practical aspects of radiation is acute.

Training for the entire section began aboard Haven on 31 May as the ship steamed for Bikini. It consisted of lectures and work with radiation detection

instruments. The 12-day curriculum is shown in Table 3. On the seventh day, personnel were divided into groups by job: destroyer monitors, aircraft monitors, PGM monitors, etc. They were issued instruments, and radium sources in lead "pigs" (containers) were used to give the men experience calibrating and reading their instruments under a semblance of field conditions (Reference A.2, p. 7; Reference C.9.206, pp. VII-(C)-6 and VII-(C)-7).

Haven arrived at Bikini on 12 June, and a task-force-wide rehearsal, called Queen Day, was held on 14 June. Two problems for the radsafe section became immediately apparent. First, because of a shortage of electronics technicians, radios on Mount McKinley used by the Radiological Safety Control Unit could not be kept operating adequately under the heavy load put upon them. Second, the 24 landing craft assigned to the Radiological Safety Section were in very poor repair and their radios were even worse. Only six of the twenty-four landing craft could participate in this first exercise, and four of them broke down within 3 hours. Neither Mount McKinley's radios nor the landing craft were fully ready for the ABLE rehearsal. Their first completely satisfactory performance was on ABLE day (Reference C.9.206, p. VII-(C)-8).

Task force personnel had various means of learning about the upcoming operation and the safety procedures and the problems that might be encountered. Ships' newspapers and Plans of the Day carried many articles on CROSSROADS. The Operation Plan was available on each ship and formed the basis for indoctrination of the ship's force about what to expect and what safety precautions were to be taken. A bulletin addressed to the officers and men of USS Wharton (AP-7) and signed by the Director of Ship Materials (DSM) gave a description of the projected detonation and the arrangement of the target fleet. The bulletin also included the statement that from time to time members of the staff would give lectures on various aspects of the bomb tests that would be of general interest (Reference B.0.14). This bulletin probably was typical of the briefing materials used throughout the task force. In addition, there was a full-scale rehearsal stressing safety before each test. Most of the scientific personnel collecting data on phenomenology and blast effects were probably fairly well-versed in radiation safety from their service with the Manhattan Engineer District. Units designated to enter possibly radioactive areas received briefings from members of the radsafe staff, usually the unit's assigned monitor, on radsafe procedures needed for their particular assignment (for example, see Reference B.0.1, p. F-XII-3). The radsafe monitors were responsible for the safety of personnel reboarding target ships. Task force personnel received general indoctrination on radiation safety and nuclear effects.

Continuing Need for Radiological Safety Personnel

Even after ABLE and BAKER had been detonated and the first phase of CROSSROADS drew to a close, the need for radsafe monitors and other radsafe personnel continued. The contaminated target and support ships presented a relatively long-term problem, and CHARLIE, the third test in the CROSSROADS Series, was still planned. Moreover, the series' first phase had brought home to the military leadership the need for a substantial military radsafe organization.

August saw the beginnings of activity designed to begin meeting these long-term needs. On 5 August, CJTF 1 asked the Navy Bureau of Ships for 100 naval

Table 3. Basic intensive courses for CROSSROADS radiological safety monitors.

Day	Time	Course Title
1	0830-0920	Introduction: Mission of the Radiological Safety Section
	0930-1020	Mechanics, Force, and Energy
	1030-1120	Electricity
	1300-1400	The Atom Speaks
	1430-1520	Casualties at Hiroshima
	1530-1620	Conference
	1900	Physical Damage at Hiroshima
2	0830-0920	Atomic Structure
	0930-1020	The Bohr Theory
	1030-1120	Ionization and Quantum Concepts
	1300-1520	Group Seminar
	1530-1620	Instruments Demonstration
	1900	Radioactivity
3	0830-0920	X-rays; Alpha, Beta, and Gamma Rays
	0930-1020	Mass and Energy
	1030-1120	Nuclear Composition
	1300-1520	Demonstration and Group Seminar
	1530-1620	Demonstration of the X-263
	1900	Thermal Radiation
4	0830-0920	Artificial Radioactivity
	0930-1020	Fission Process
	1030-1120	Fission Products
	1300-1520	Demonstration and Group Seminar
	1530-1620	Demonstration of the 247
	1900	Effect of Radiation on the Human Body: Radiation Sickness and Other Pathology
5	0830-0920	Chemistry of Plutonium, Uranium, and Fission Products
	0930-1020	Nuclear Cross-Section and the Production of Plutonium
	1030-1120	Mesons and the Synchro- or Frequency-Modulated Cyclotron
	1300-1520	Demonstration and Group Seminar
	1530-1620	Demonstration of the Pocket Dosimeter
	1900	Physical Damage to the Principal Hospitals and First-Aid Stations in Nagasaki

(continued)

Table 3. Basic intensive courses for CROSSROADS radiological safety monitors (continued).

Day	Time	Course Title
6	0830-0920	Ionization Chamber and Geiger-Mueller Counter
	0930-1020	Tolerance Dose
	1030-1120	Radiobiology
	1300-1520	Practical Problems of Radiation Exposure
	1530-1620	Proteximeters [radiation detectors used in aircraft]
	1900	Physical Damage at Nagasaki
7	0830-1120	Calibration of the X-263 and the Pocket Dosimeter
	1300-1620	Practical Exercise with the X-263
	1900	Thermal Radiation
8	0830-1120	Calibration of the 247 and the Pocket Dosimeter
	1300-1620	Practical Exercise with the 247
	1900	Radioactivity from a Nuclear Blast
9	0830-1020	Principles of Radiological Survey
	1030-1120	Radiological Operations
	1300-1400	Air Monitoring
	1430-1520	Sea Monitoring
	1530-1620	Land Monitoring
	1900	Biological Studies
10	0830-0920	Initial Boarding Party Monitoring
	0930-1020	Target Ship Clearance
	1030-1120	Analysis of Radioactive Water
	1300-1520	Laboratory Analysis of Radioactive Water
	1530-1620	Instrument Repair
	1900	Biological Studies
11	0830-0920	Principles of Health Physics
	0930-1020	Protection Against Radioactive Hazards
	1030-1120	Analysis of Radioactive Solids
	1300-1520	Laboratory Analysis of Radioactive Solids
	1530-1620	Instrument Repair
12	0830-0920	Ventilation Clearance
	0930-1020	Evaporator Clearance
	1030-1120	Ship Clearance
	1300-1620	Field Exercise

officers with technical or scientific backgrounds to be assigned to radsafe work. The officers were to be available by 1 September to begin intensive training designed to prepare them to replace the existing monitor personnel no later than 1 November so that study of the BAKER results and decontamination of the ships for test CHARLIE would not be delayed (Reference C.10.10). On 10 August, CJTF 1 ordered his rear echelon element in Washington to secure approval from the Chief of Naval Operations, Navy Bureau of Personnel, and the Navy Surgeon-General for a program to be set up by JTF 1 to train 100 new monitors. He also indicated that these new radsafe personnel might be needed to help monitor the drydocking of task force ships returning to the United States (Reference C.10.12). Most radsafe personnel left Bikini for the United States on 16 August aboard USS Henrico (APA-45), leaving a much reduced radsafe organization on Haven to continue radsafe work at Bikini (Reference C.9.206, p. VII-(C)-24). Personnel traveling on Henrico probably were mostly civilians returning to their campuses and laboratories or military officers at the end of their terms of service. Under discussion by 20 August was a proposal to add 25 members from West Point's class of 1946 to the group to undergo monitor training (Reference C.10.13). The training program was to start on 9 September at the Navy Department in Washington, with field work at Alamogordo and on the target ships at Kwajalein or Bikini. After their training, the new monitors would be assigned to JTF 1 (Reference C.0.2). One attendee wrote he received 4 weeks of instruction in "basic radiology" in Washington, D.C., and did laboratory work at the Radiation Safety Laboratory, San Francisco Naval Shipyard, Hunters Point, California, before reporting to the Radiological Safety Section at Kwajalein (Reference B.0.8).

The potential radsafe needs created by Test CHARLIE disappeared, however, when President Truman cancelled that test on 7 September.

OCEANOGRAPHIC SURVEY

While radsafe planning and organization of the Radiological Safety Section went forward in the United States, important radsafe preparations also took place at Bikini. Beginning on 10 March 1946, civilian and military scientists at Bikini aboard USS Bowditch (AGS-4) conducted detailed oceanographic, biological, and geological surveys of the atoll. From the radsafe perspective, their most important work was an effort to chart the currents in the atoll's lagoon. This information was needed to estimate what might happen after BAKER when a large amount of radioactive contamination would be dispersed in the lagoon and perhaps into the surrounding ocean. The safety of the task force and the ability of its recovery teams to reenter the target area were involved (Reference A.1, p. 92).

After the shots, the radsafe section monitored the radiation level in the lagoon water through the use of drone boats, PGMs, and LCPLs (Reference A.2, p. 100). Monitors accompanied scientists collecting fish, coral, and samples of the bottom. On 9 August, a monitor with a collection party found the first bottom sample so radioactive he ordered it pitched over the side (Reference A.2, p. 108). Highest recorded activity on a bottom core sample was 0.292 microcuries/gram in newly deposited sand and mud from the first 6 inches of the core (Reference C.9.209, Annex J, Figure 7).

WEATHER PREDICTION

Accurate weather predictions at least 24 hours in advance were needed to allow the task force to complete the complex final preparations for a detonation and to give reasonable assurance that radiological safety could be maintained. Cloud cover had to be at a minimum for the ABLE airdrop to allow the bombardier to see the target ship. Wind direction, not only near the surface but up to 60,000 feet (18.3 km), had to be such that it would not carry fallout over the task force. Moreover, wind direction had to be fairly steady so that fallout areas would be predictable. Tropical meteorology was not well developed at that time, and detailed data of past weather patterns at Bikini were lacking. The exacting forecasting requirements for CROSSROADS posed a major challenge.

The official forecast issued the day before a planned detonation and used as a major element in the decision to proceed included: the amount, in tenths of sky coverage, of low, middle, and high clouds; the altitude of the base and top of the low clouds and the altitude of other cloud layers; precipitation (if expected); the wind direction and velocity in 5,000-foot (1.5-km) increments from the surface to 60,000 feet (18.3 km); height of the tropopause; and visibility, temperature, and relative humidity (Reference C.9.207, p. VII-(O)-17).

Responsibility for furnishing weather forecasts or weather advice for task force operations was vested in the Staff Aerological Unit located on Mount McKinley. The unit was to prepare special forecasts for the Radiological Safety Unit to help anticipate movement of the radioactive cloud (Reference B.0.1, p. T-2). Because of lack of space on Mount Mckinley, a significant portion of the personnel doing weather data analysis was stationed on Kwajalein at the Weather Central. To supply upper air and surface data, aerological units of from four to six personnel were stationed on USS Shangri-La (CV-38), USS Saidor (CVE-117), USS Fall River (CA-131), and USS Albemarle (AV-5). These personnel also provided weather briefings to task group commanders and aircrews. To gather surface data, one-man aerological units were stationed aboard USS Orca (AVP-49), Bowditch, USS Kenneth Whiting (AV-14), USS Blue Ridge (AGC-2), and USS Appalachian (AGC-1). Weather Central received reports daily or more often from weather stations on Wake, Enewetak, Tarawa, Majuro, Kwajalein, and Marcus islands and from two weather ships northeast and northwest of the Marshall Islands at 12°45'N, 180°0'W and 12°0'N, 153°40'E, respectively (Reference C.9.207, p. VII-(O)-22). Data from more distant U.S. and foreign weather stations funneled through Fleet Weather Central in Hawaii were also used.

At least one B-29 and one PB4Y-2 flew out of Kwajalein each day for weather reconnaissance, the B-29s usually toward the east and the PB4Y-2s toward the west. More flights were scheduled as necessary. On ABLE and BAKER days, three flights passed through the Bikini area.

The weather forecast for the following day was presented to CJTF 1 each day at 0830. From that he decided if the weather would allow the next day's planned operations. A second briefing for the commander was held daily at 2200. On the basis of this briefing, he decided whether to hold to the morning's decision or alter it. Continued weather input was provided the commander (Reference C.9.207, pp. VII-(O)-9, through VII-(O)-19).

RADIOLOGICAL SAFETY PREPARATIONS FOR BAKER

Because BAKER was the first underwater detonation of a nuclear weapon, neither the participating scientists nor the task force leadership could predict with certainty how the lagoon water would react to and modify the explosion cloud. Spread of radioactive contamination and creation of damaging waves were major concerns. Simulation using conventional explosive charges was one approach to estimate the effects. In one effort to predict the spread of radioactivity, 1,000-lb charges of TNT were detonated and the results extrapolated upward to the expected 20-KT yield of the BAKER device (Reference B.0.15, pp. 13 through 16).

During the period March to May 1946, several organizations under the supervision of a professor from the University of California carried out experiments for the task force on wave action in shallow water (Reference C.0.18; Reference C.0.12.3, p. 6). In 1946, computer simulations were still in the future, but various scientists applied their slide rules and scientific imagination to the forecasting problem. One study analyzed the possibilities largely on the basis of the height to which the column of contaminated water might rise. A rise of only 10,000 feet (3.1 km) would present the greatest hazard because most of the contamination would fall on the target ships or back into the lagoon. Reboarding some target ships within 1,000 yards (9.1 meters) of the detonation might be dangerous for weeks because of the contamination deposited from the water column (Reference C.0.19, pp. 5 and 9).

In an early overview of the operation, CJTF 1 offered the opinion that following BAKER (Reference B.0.16, p. 7)

> It will be undoubtedly be some weeks before the lagoon and target ships are again habitable. During this period, some of the task force ships may be sent to anchor at Kwajalein. If it should turn out that the target ships will not be habitable for months, other arrangments will be made.

On 18 June, an appendix was added to the Operation Plan that gave a description of the underwater detonation's expected effects (Reference B.0.1, pp. E-X-1 through E-X-17 and E-IX-1 through E-IX-4). The ball of fire or steam caused by the detonation was predicted to rise to an altitude of from 10,000 to 60,000 feet (3.1 to 18.2 km). The most likely altitude was predicted to be 30,000 feet (9.1 km) (Reference B.0.1, p. E-IX-1, Change No. 6). However, a postoperation document indicates that planning was based on a prediction of maximum altitude of 15,000 feet (4.6 km) (Reference C.9.206, p. VII-(C)-18).

The appendix further predicted that a plume of water might rise, extend for several thousand feet above the surface, and then fall back into the lagoon. Radioactive material would be deposited initially in the lagoon within boundaries represented by a cylinder several hundred yards in diameter and extending from the surface to the bottom of the lagoon. The trail of water and steam following the ball of fire would be heavily contaminated. Distribution of radioactivity in the water was anticipated to be more widespread than following ABLE and would persist for a longer period. Target ships within 1,500 yards (1.4 km) of the explosion would be seriously contaminated. Downwind serious contamination would occur beyond 1,500 yards (1.4 km). It was expected that

some target ships might be so heavily contaminated they could not be boarded safely for an indefinite period (Reference B.0.1, pp. E-IX-1 and E-IX-2).

Following conferences attended by senior radsafe personnel, a new appendix to the CJTF 1 Operation Plan radsafe annex was issued in 15 July. Under the revised radsafe plan, the Radiological Safety Section retained its five major elements. Since radioactivity from the underwater explosion was expected to be last longer and be more intense than from ABLE, personnel were added to the Radiological Safety Control Unit for around-the-clock operation (Reference C.9.206, p. XII-(C)-16). Some additions and subtractions were made to the radsafe reconnaissance units. A third PBM unit and one upwind destroyer unit were added to improve lagoon reconnaissance. Three cloud-tracking units were dropped, presumably because the underwater explosion was not expected to create a cloud as high and far-reaching as ABLE (Reference B.0.1, pp. E-X-1 and E-X-5).

The total number of civilians and military officers in the Radiological Safety Section changed between ABLE and BAKER as follows (Reference C.9.206, p. VII-(C)-5):

	ABLE	BAKER
Civilians	130	93
Navy Officers	77	102
Army officers	96	63
Total	303	258

The number of monitors probably decreased, but more than 225 were available for BAKER (Reference A.1, p. 31).

The distribution of radsafe monitors was changed for BAKER: fewer were put on LCPLs and more were assigned to the DSM. Sixty-one were placed under the control of the DSM with duties as follows (Reference B.0.1, pp. E-X-14 and E-X-15):

1. The DSM and his deputy each were to have a monitor acting as his technical advisor and administrative assistant on radsafe matters
2. Six monitors were to have radsafe duties in support of emergency firefighting and salvage operations as directed by the DSM or his radsafe advisor
3. Two monitors were to accompany each of the ten initial boarding teams and to act as radsafe advisors to the team captains
4. Thirty-three personnel were to act as monitors for the target ship crews when they reboarded their ships and as radsafe advisors to the ships' captains

Monitor duties were basically the same for ABLE and BAKER. For BAKER, however, monitors were admonished to (Reference B.0.1, p. E-X-16):

> . . . frequently check radioactivity of various parts of their own ship or craft including underwater hull and all intakes, particularly condensers, boilers and other places where there may be a concentration from contaminated water.

Definitions of the radex area and surface survey sector were changed so that no real difference between them existed (Reference B.0.1, p. E-X-3). Both names were retained, however, since operational personnel were familiar with them. The definitions of the Red and Blue Lines remained the same, but a few special salvage vessels with senior monitors aboard were allowed to operate independently between the Red and Blue Lines. The definitions of the anchorage areas remained unchanged, but a boating area was established where unrestricted movement of small boats was allowed. By implication, small boat traffic beyond that area was more strictly controlled (Reference C.9.206, p. VII-(C)-18).

As before ABLE, training was an important feature of the radsafe organization's activities. Newly arrived monitors were given instuction by experienced personnel. Daily communication drills were held by the Radiological Safety Control Unit using the PGM, LCPL, and drone boat circuits. On 16 July the Radiological Safety Control Unit held a drill on Mount McKinley to train new members of its expanded staff. On 19 July the entire radsafe organization participated in William Day, the joint task force rehearsal for BAKER. So that radsafe personnel would not be caught unaware by major new hazards, they met on several occasions with scientists in charge of the BAKER test and were briefed on the expected results (Reference C.9.206, p. VII-(C)-17). The monitors met with the commanders of the LCPLs and PGMs between William and BAKER days. Two more communications drills were held and by 22 July all radsafe personnel and equipment were considered ready (Reference C.9.206, p. VII-(C)-18).

Radsafe operations immediately before and after the BAKER detonation are described in Chapter 4, "Test Operations." Chapter 5, "Post-BAKER Operations: Bikini, Kwajalein, and the United States," continues the discussion of radsafe operations as the contaminated target ships are moved to Kwajalein Atoll and, later, as some of them are returned to the United States for final examination and disposition.

CHAPTER 3
CROSSROADS EXPERIMENTAL PROGRAM

INTRODUCTION

In late 1945 and early 1946 several conferences were held by the Manhattan Engineer District Project with the military services. It was agreed that the CROSSROADS program should gather data:

- On the nature, range, and duration of radiation danger
- On bomb efficiency, burst location, wave formation, and ship movement
- For ship designers and ordnance designers to aid in assessing damage from and designing protection against nuclear weapons
- That would be helpful in learning to detect nuclear detonations.

As a result, CROSSROADS had two experimental programs. The first was to determine nuclear weapon effects on military equipment, such as ships, planes, and supplies, and on animals. The second was to measure weapon phenomena such as blast, heat, radiation, and wave action. The ABLE and BAKER tests were not weapon development tests; in fact, the bombs used were of the same design as the one dropped on Nagasaki, Japan.

The Deputy Task Force Commander for Technical Direction had responsibility for both experimental programs. To accomplish this mission he had two organizations under his control. The first was the Ship Material and Inspection Division, headed by the Director of Ship Material (DSM), and the second was the Instrumentation Division, headed by the Technical Director.

EFFECTS ON MILITARY EQUIPMENT

The Ship Material and Inspection Division was responsible for determining weapon effects on military equipment. The organization of the Ship Material and Inspection Division contained both Army and Navy elements (see Figure 13). Responsibilities included preparing the ships, aircraft, equipment, supplies, and animals for each test and determining the exact cause and extent of damage. Decontaminating ships and material after the second test also became a responsibility of this group. Duties included distinguishing between damage caused by the direct effects of the explosion and damage caused by indirect effects such as fires and flooding. Table 4 shows the exposures received by personnel in each of the groups under the DSM.

The DSM set up a two-phase program to accomplish his mission. The first phase was readying the target ships, aircraft, and equipment and included conditioning, loading, instrumenting, and preparing specific equipment, and

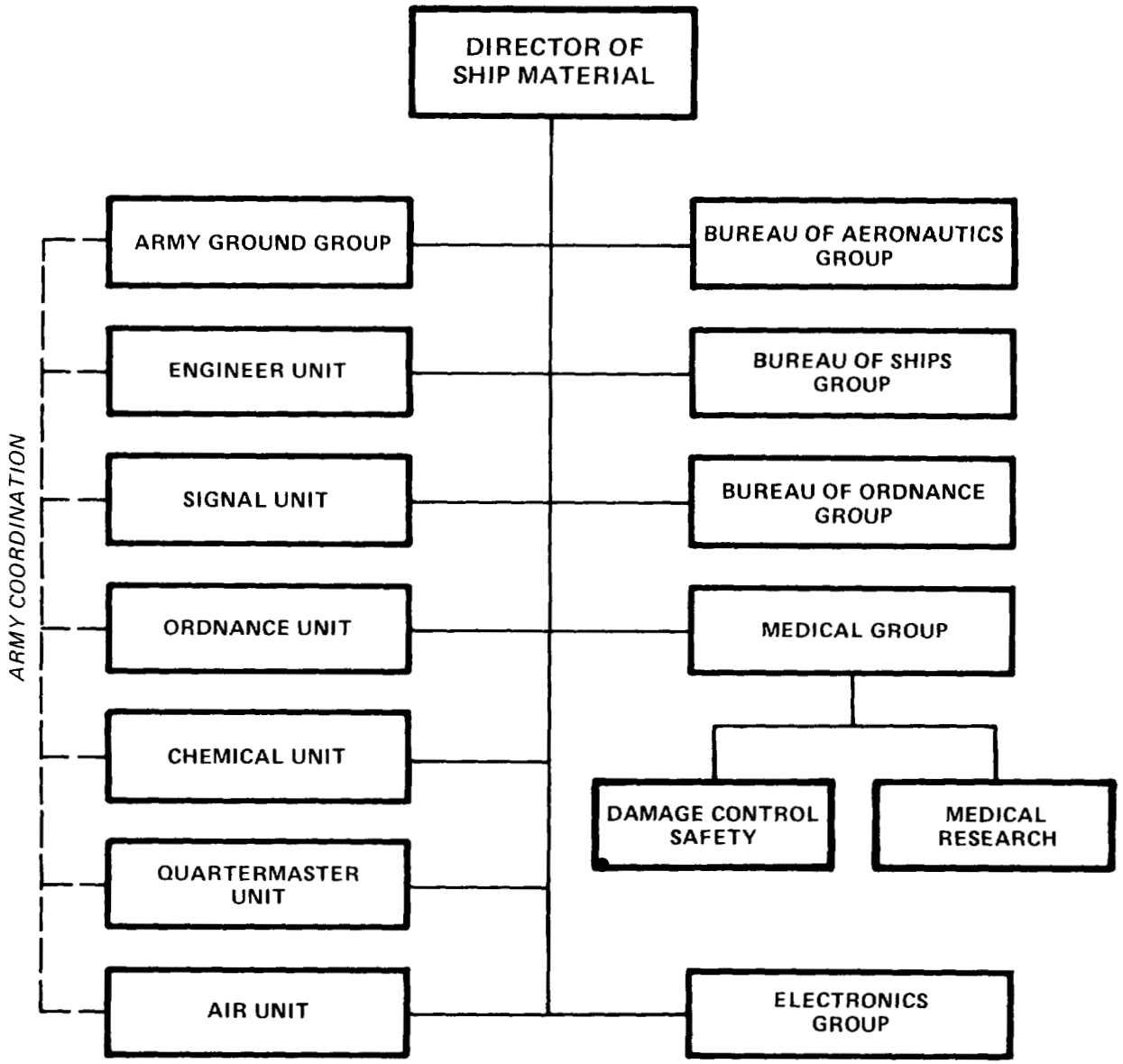


Figure 13. Organization of Ship Material and Inspection Division, Operation CROSSROADS (source: Reference C.9.206).

Table 4. Ship Material and Inspection Division recorded personnel exposures, CROSSROADS.

Element	No. of Persons Listed	No. of Persons Badged	Exposure Ranges (R)			High (R)
			0	0.001-0.5	0.5-1	
Office of the Director	31	9	3	5	1	0.590
Army Group	322	7	1	6		0.310
Bureau of Aeronautics Group	15	11	2	9		0.230
Bureau of Ships Group	113	55	12	40	3	0.650
Bureau of Ordnance Group	116	68	20	48		0.420
Medical Group						
Damage Control Safety Section	17	11	5	6		0.220
Medical Research Section	117	71	44	27		0.340
Electronics Group	411	56	23	32	1	0.600

Note:

[a]Data taken from Reynolds Electrical and Engineering Company exposure list. Since personnel were not badged all the time, these figures should be recognized as a partial statement of potential total exposure for these groups.

Sources: References C.13.4 and B.0.17.

inspecting, mooring, and anchoring the target ships before each test. The second phase of his program was the inspection of ships, aircraft, and equipment after each detonation. Detailed instructions were published to provide the necessary guidance to boarding parties who were to inspect the equipment after each shot. Extensive use was made of photography to permanently record "before" and "after" conditions of the ships, aircraft, and equipment. Most of the equipment was packed and shipped to continental U.S. locations for further analysis after Test BAKER (Reference C.9.208, p. 7.3). Six subordinate groups under the DSM were responsible for carrying out the details of the experimental program.

Army Ground Group

The exposure of Army equipment was a mission of Commander, Army Ground Group. Under his command were engineer, signal, ordnance, chemical warfare, quartermaster, and air units. Personnel from these units were berthed on USS Wharton (AP-7). They exposed a wide variety of equipment on both tests ranging from ammunition, radar, trucks, petroleum, and tanks, to field stoves, clothing, and medical equipment. Figure 14 shows armored vehicles and other equipment on board USS Saratoga (CV-3) before the test. While most equipment was positioned on board the target vessels, some was placed on nearby islands of Bikini Atoll to provide a better range of effects. Members of the Army Ground Group were evacuated from the Bikini Lagoon on Wharton the day before each test and planned to return the afternoon of each test day. Inspection of equipment after ABLE began on 2 July and was completed by 12 July. The heavy concentration of radioactivity in the lagoon after BAKER slowed inspection efforts. Inspections were not begun until 30 July and were not completed until 10 August. Items on USS Nevada (BB-36) and the concrete drydock, ARDC-13, remained too contaminated to be inspected. The drydock was finally scuttled with all equipment.

Engineer equipment was exposed on three attack transports (APAs). Signal equipment was exposed aboard ships and on nearby islands. Several different items of ordnance equipment were on the decks of four target battleships and on four tank landing ships and one oil barge. Chemical equipment was exposed

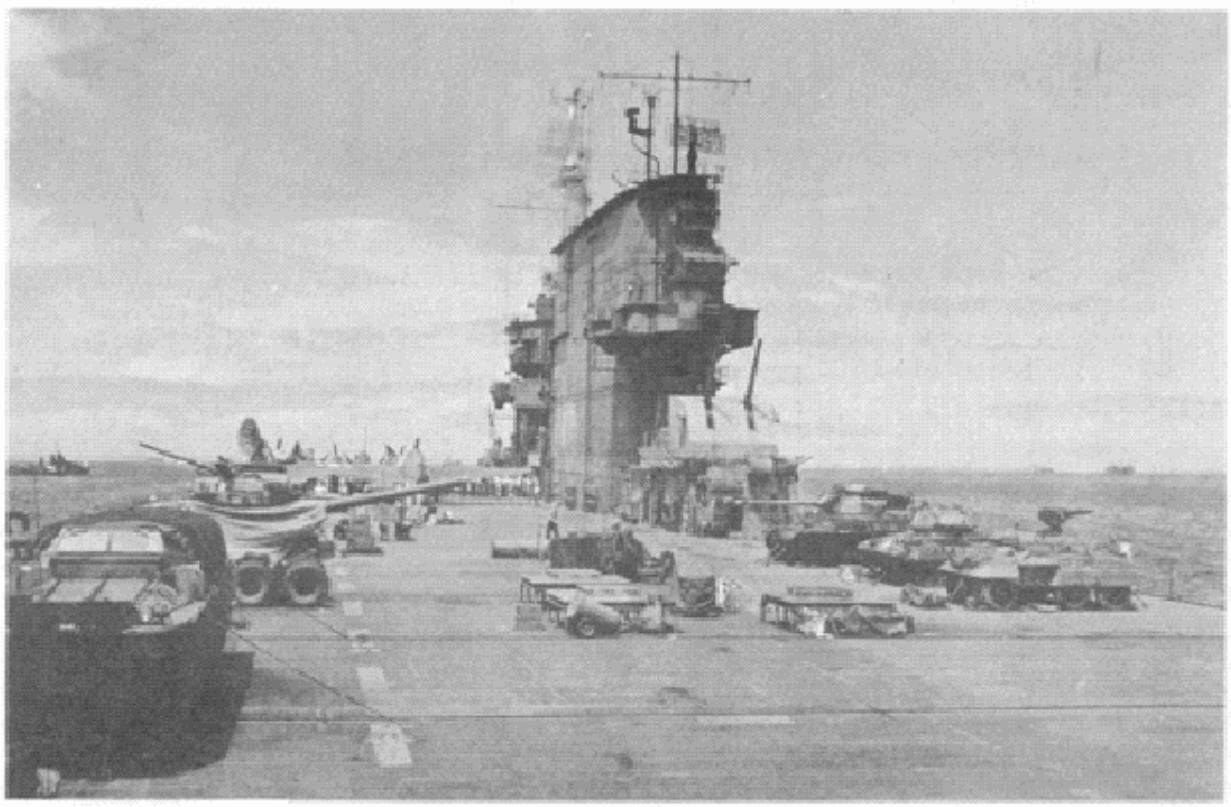


Figure 14. Armored vehicles and other Army equipment aboard USS Saratoga (CV-3), ready for exposure to atom bomb, CROSSROADS.

only on shot ABLE. Sample kits of food and clothing were stored in normal storage spaces aboard Nevada, USS Arkansas (BB-33), USS Carteret (APA-70), and Saratoga. Test lots of over 150 items of food and clothing were exposed on the decks of 11 target vessels. Field equipment, lubricants, and fuels were exposed on four tank landing craft and on the concrete drydock, ARDC-13.

Aircraft parts were placed on the decks of target ships. Several types of wing panels made of various materials were secured to the decks. In addition, wing tanks, stabilizers, a P-47 fuselage, an altimeter, and several fire extinguishers were exposed. No aircraft parts were exposed on BAKER test (Reference C.9.208, p. 7.10).

Bureau of Aeronautics Group

The Navy Bureau of Aeronautics (BuAer) Group was responsible for providing, exposing, and inspecting Navy aircraft and aeronautical equipment. It also provided special instruments to be placed in the Navy F6F aircraft drones to determine radiation intensities and blast effects. Velocity and acceleration gauges were installed on various target aircraft located on the target ships. The BuAer group, berthed on Wharton and USS Avery Island (AG-76), was evacuated with the ships the day before each shot and planned to return to the lagoon the afternoon after each shot. Inspection of equipment commenced on 2 July for ABLE and 30 July for BAKER. Records of F6F drone aircraft reaction to the detonations were removed from the aircraft after they landed at Roi Island, Kwajalein, and aircraft were inspected for damage (Reference C.9.208, pp. 3.51 and 7.8).

Bureau of Ships Group

This group was responsible for preparing target ships (and certain non-target ships) to determine effects of the detonations on the ships and carrying out decontamination activities. The group prepared Op Plan 1-46 Annexes W and X entitled "Ship Preparation Plan" and "Reboarding and Inspection Plan," respectively. Readying the target ships for the tests took place initially in shipyards at Philadelphia; Terminal Island, Long Beach, California; San Francisco, California; Mare Island, Vallejo, California; Bremerton, Washington; and Pearl Harbor, Hawaii. Target ship crews did much of this work, both at Pearl Harbor and on site at Bikini.

Members of the Bureau of Ships (BuShips) Group were berthed on Wharton. They were aboard that ship when it sortied from Bikini the day before each test and returned after each test. Ship inspection began on 2 July after ABLE and on 26 July after BAKER. Interim repairs after ABLE to prepare ships for BAKER were completed by 5 July; however, ship inspections continued for several more days. The ship inspection program was broken down into six categories: hull, ship stability, machinery, electrical, electronics equipment, and measurement of any change in magnetic fields within the ship. Inspection of ships after BAKER was hampered by radioactivity on the ships and in the lagoon. Five attack transports, one destroyer, two infantry landing craft, and four submarines were reboarded and manned in August and September and were sailed back to U.S. ports. The remaining target ships, however, were too contaminated to be boarded except for short visits and were towed to Kwajalein during August

and September. By 26 September, Bikini Atoll was cleared of the target fleet and all personnel were evacuated. Eight target ships and two target submarines were subsequently towed from Kwajalein to Pearl Harbor. Six of these were towed to U.S. west coast ports in 1946 and 1947 for further radiological examination (Reference C.9.208, pp. 3.51 and 7.5). The disposition of the target fleet is summarized in Chapter 9.

Bureau of Ordnance Group

The Bureau of Ordnance (BuOrd) Group was responsible for obtaining and exposing naval ordnance equipment and for appraising the damage after each detonation. The group was organized into six sections: fire control, gun mounts, explosives, aviation ordnance, underwater ordnance, and armor metallurgy. The group was berthed on Wharton.

Its personnel left Bikini Lagoon the day before each shot and reentered after each shot. Inspection of equipment after ABLE shot was easily and quickly accomplished, but high levels of radioactivity after BAKER severely restricted activities (Reference C.9.208, pp. 3.52 and 7.10).

Medical Group

The Medical Group was comprised of two sections: Damage Control Safety Section and Medical Research Section. Personnel of the Damage Control Safety Section were to reboard target ships with the initial boarding party and evaluate and reduce nonradiological hazards to boarding parties. Hazards that had to be addressed included falling objects, slippery decks, weak ladders, drowning, fires, steam, electrical shock, chemical hazards, and ammunition hazards. The personnel trained extensively, and in turn trained members of designated boarding parties both on the U.S. west coast and at Bikini. There were no incidents on either test day. This section was berthed on USS Haven (AH-12) (Reference C.9.208, p. 3.52).

The Medical Research Section was responsible for the biological research program, which involved exposing animals, seeds, bacteria, and medical and dental materials, and for studying the resulting damage and injury. Principal animals used were pigs, goats, guinea pigs, rats, and mice.

For ABLE, the animals and other biological samples were placed on USS Geneva (APA-86), USS Niagara (APA-87), USS LST-133, LCI-327, and LCI-329. Goats in exposure position are shown in Figure 15. They were retrieved by section personnel operating from USS Burleson (APA-67) at approximately 1600 on 1 July.

For BAKER, the animals and samples were on USS Gasconade (APA-85), USS Briscoe (APA-65), USS Catron (APA-71), and USS Bracken (APA-64). Section personnel could not retrieve animals and samples from Bracken until 1351 on 28 July (D+3). At 1447 the same day, about one-half the animals were removed from Catron. Daily radiation tolerances prohibited the personnel from continuing to work on Catron. On 29 July, animals and samples remaining on Catron and on Briscoe were recovered. On 30 July, animals and samples on Gasconade were recovered (Reference C.9.206, pp. VI-B-12 and VI-D-30 through D-44; Reference C.9.208, pp. 3.54 and 25.3).

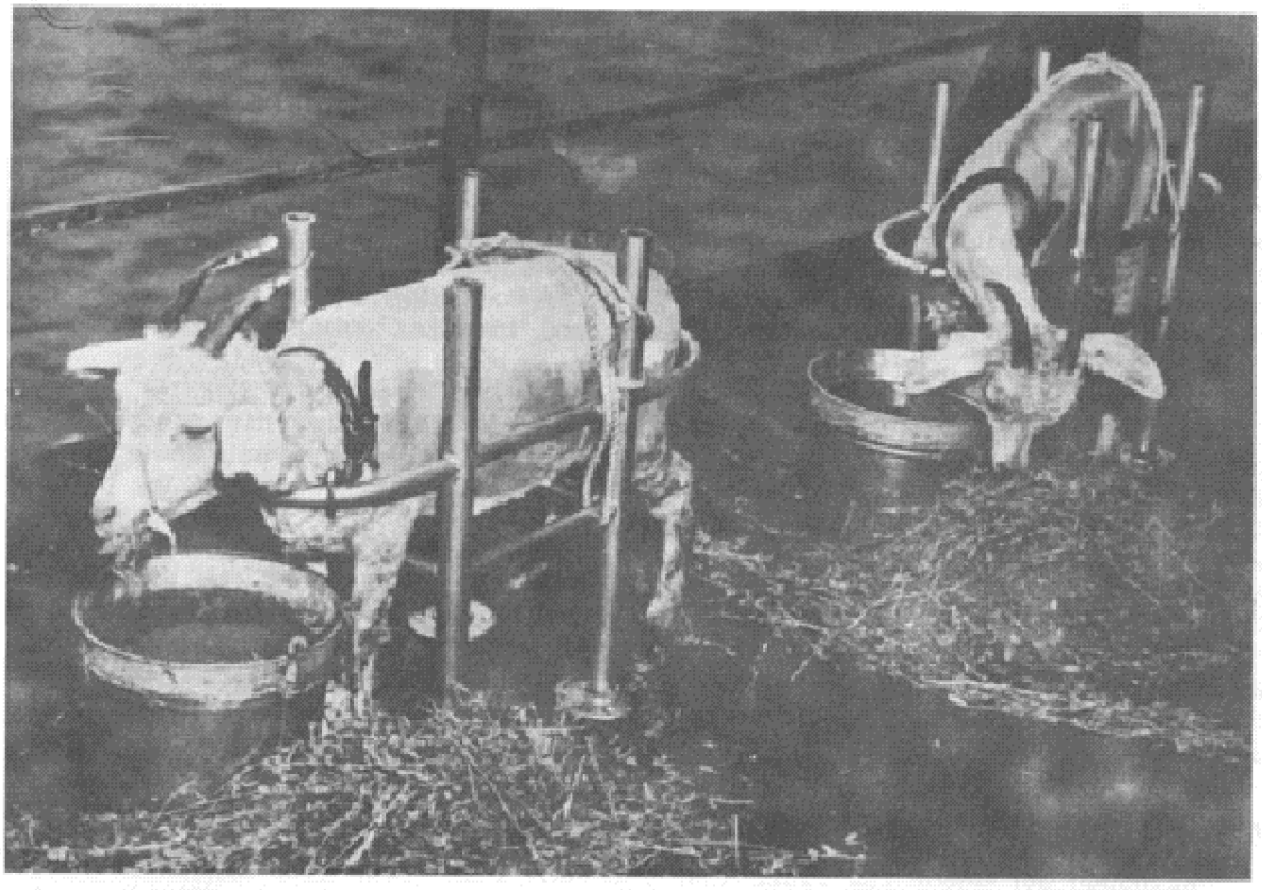


Figure 15. Goats in exposure position on target ship deck during CROSSROADS.

Electronics Group

This group and the 013D Electronics Group in the Technical Director's organization (see the section on Nuclear Weapon Phenomena below) were one and the same. They performed a dual function in working for both the DSM and the Technical Director.

As planned initially in January 1946, this group's primary responsibility was to determine the damage to electronic equipment aboard ships after exposure to each detonation. After a series of meetings in February 1946, the group's responsibilities were significantly expanded. It took over electronic equipment responsibilities from BuAer and the Army Signal Corps. It assumed full responsibility for execution of electronics instrumentation projects as specified in the Instrumentation Plan (Annex G, Op Plan 1-46) and the Communications and Electronic Plan (Annex C, Op Plan 1-46). It carried out most of the studies associated with the electromagnetic propagation program and provided support to wave motion, blast pressure, shock, drone boat, and telemetering projects. As a result of all these added responsibilities, the size of the group was expanded and liaison officers from several other groups were assigned. Also because of these added responsibilities, the group became accountable to the Technical Director, although it maintained close liaison with the DSM.

Specific projects included preparation and inspection of shipboard electronic equipment; provision of technical communications for the flagship USS Mount McKinley (AGC-7), press ships, and instrumentation ships; electromagnetic propagation studies and provision of sonobuoys for pressure recording; telemetering technical data from certain target ships; television recording of wave motion and wave heights; provision of timing signals for most projects (excluding bomb detonation timing signals); and provision of electronics equipment necessary for operation of the drone boats. The types of shipboard electronic equipment that had to be prepared and inspected included radios, radiosondes, radars, Identification Friend or Foe (IFF) systems, sonars, radar repeaters, homing devices, radar beacons, and interior communications systems.

The Electronics Group was berthed aboard Avery Island. USS Coasters Harbor (AG-74) was designated as an electronics repair ship for this group. Group personnel were evacuated from Bikini Lagoon the day before each shot and returned to the lagoon after each shot. For ABLE, group members were not part of initial boarding teams, but began their inspections when general reboarding was authorized. After BAKER, radioactivity delayed most inspections until mid-August. In fact, on 7 August the Target Inspection Section of the Electronics Group was reberthed aboard USS Fulton (AS-11), and Avery Island returned to the United States with most of the Electronics Group personnel. The Instrument Repair Unit also remained behind aboard Wharton and Haven to repair and maintain radiac instruments (Reference C.9.208, p. 3.43; Reference C.9.190, pp. 192-225).

Army Air Group (Task Group 1.5)

Although not under the control of the DSM, Task Group (TG) 1.5 assisted the DSM in determining the bombs' effects on in-flight aircraft. In addition to its several missions as TG 1.5, this group carried out blast and radiation experiments using B-17 drone and B-29 and F-13 aircraft. The drones were equipped with flight analyzers that recorded acceleration, airspeed, and overpressure. Some data were telemetered by a television arrangement. Upon landing at Enewetak, the instrumentation was removed for analysis. The drones were monitored for radiation and inspected for damage. The B-29 and F-13 aircraft had similar instrumentation except for the television system. Additional information on TG 1.5 is found in Chapter 8.

Table 4 is a tabulation of badging and exposures of personnel in the various groups of the Ship Material and Inspection Division. Since personnel were not badged all the time, these figures should be recognized as a partial statement of potential total exposure for these groups. Dose reconstruction techniques, discussed in Chapter 12, provide a way of estimating total dose figures.

NUCLEAR WEAPON PHENOMENA

The program to measure and record the various effects produced by the ABLE and BAKER nuclear detonations was the responsibility of the Technical Director, who headed the Instrumentation Division. The Instrumentation Division was responsible for measuring and recording weapon diagnostic data (blast, heat, radiation, etc.). The plan to measure and record the weapons' effects

was broken down into numbered programs, categorized and described in Table 5. For control reasons, the Technical Director set up an administrative organization (see Figure 16) and a functional organization (Figure 17). The administrative organization was used for personnel assignments. Personnel rosters were maintained using this organizational breakdown. The functional organization was used for grouping experimental projects. Table 5 and the functional organization in Figure 16 show the similarity between the programs. Over 130

Table 5. Instrumentation Division programs and responsible groups, CROSSROADS.

Program	Title	Responsible Groups
I	Bomb Preparation	Los Alamos Laboratory
II	Blast Pressure and Shock	Navy Bureau of Ordnance Los Alamos Laboratory Navy Bureau of Ships Army Air Forces Navy Air Group
III	Wave Motion Oceanography	Smithsonian Institution U.S. Geodetic Survey U.S. Fish and Wildlife Service Woods Hole Oceanographic Institution
IV	Propagation of Electromagnetic Waves	Navy Bureau of Ships Army Air Forces Los Alamos Laboratory National Bureau of Standards Federal Communications Commission
V	Radiological Safety	Los Alamos Laboratory
VI	Radiometry	Army Air Forces Navy Bureau of Ordnance
VII	Radiation Measurements	Los Alamos Laboratory
VIII	Remote Measurements	U.S. Geodetic Survey Carnegie Institute National Bureau of Standards Naval Research Laboratory David Taylor Model Basin U.S. Weather Bureau
IX	Technical Photography	Army Air Forces U.S. Navy Los Alamos Laboratory

Source: References C.9.209 and C.9.210.

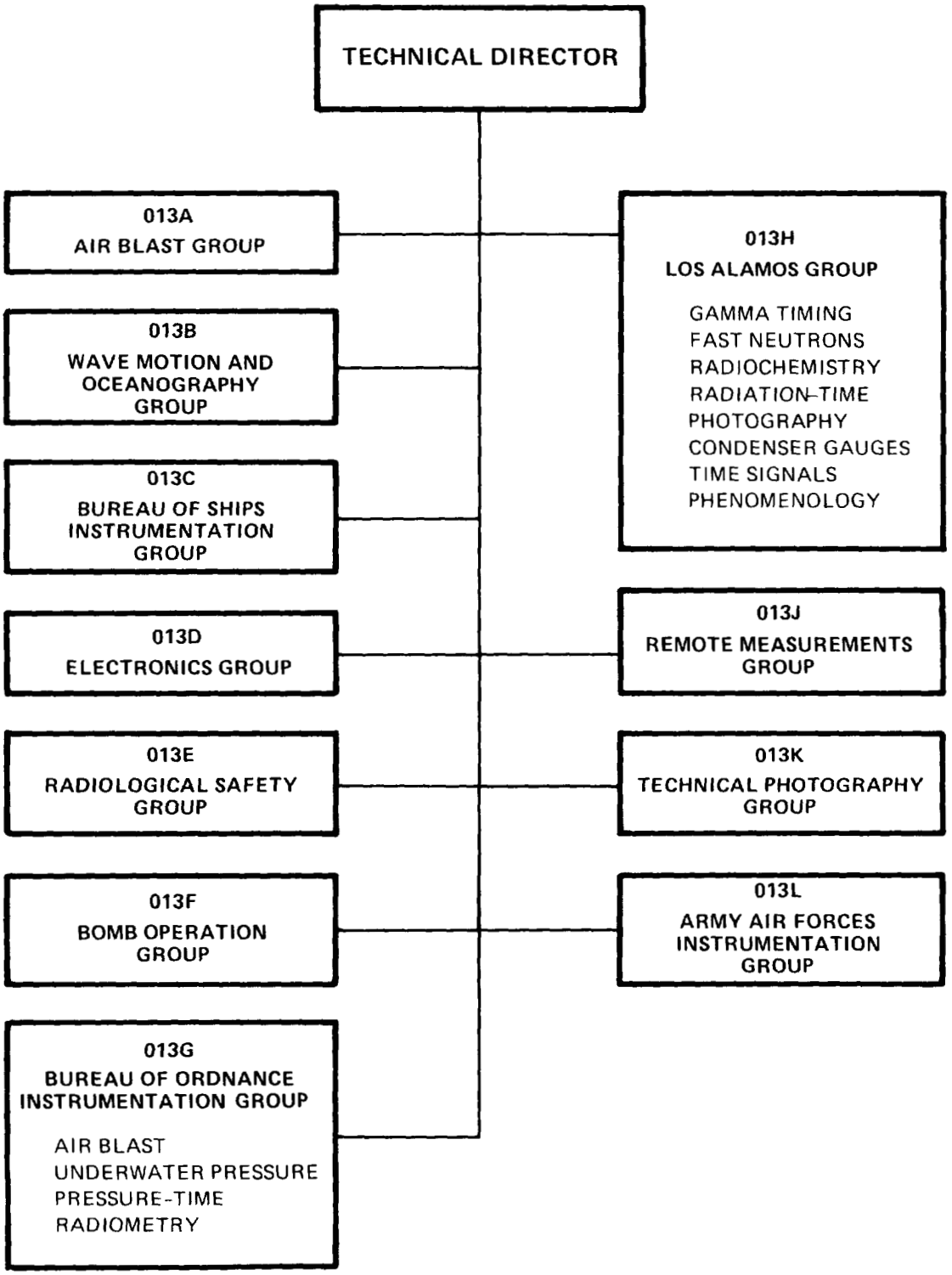


Figure 16. Instrumentation Division (administrative organization), CROSSROADS (source: Reference C.9.210, N 138A).

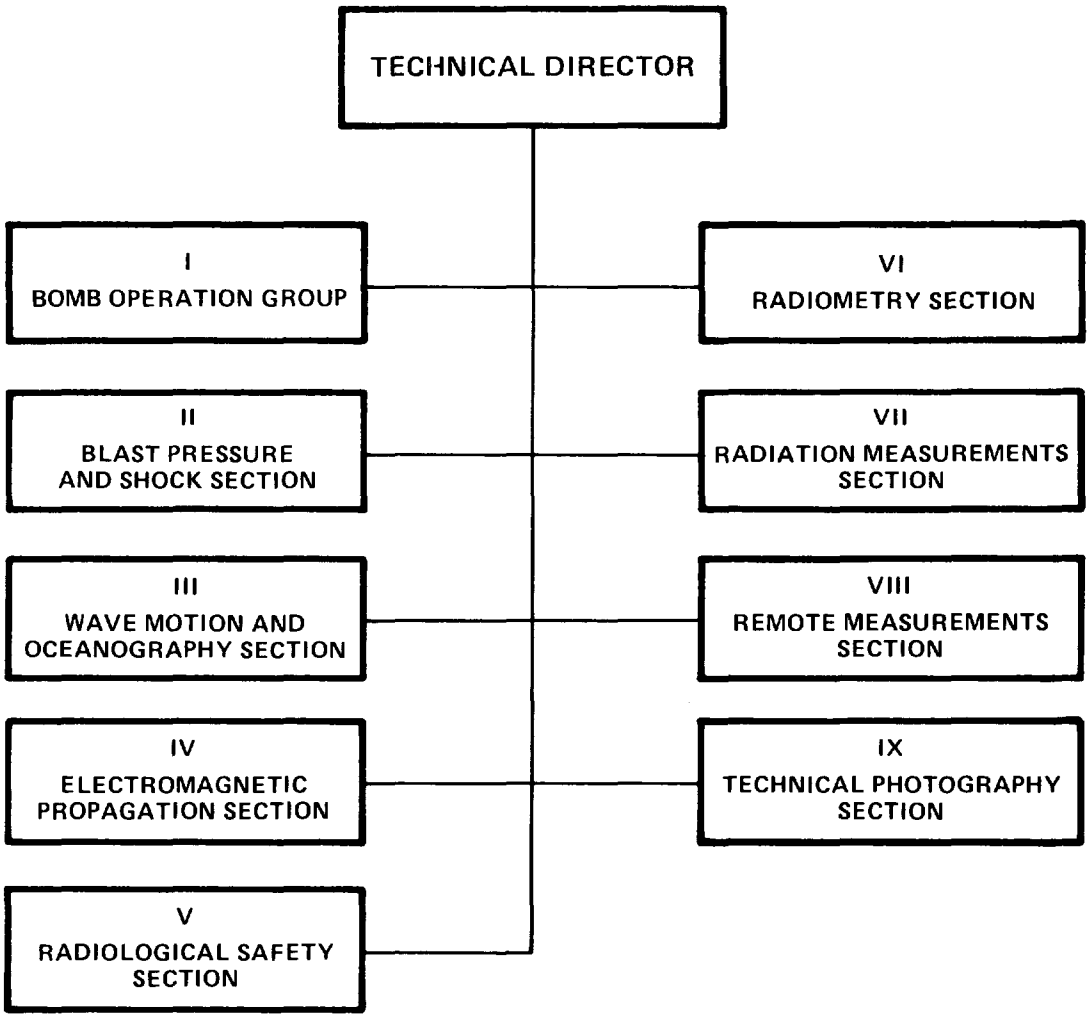


Figure 17. Instrumentation Division (functional organization), CROSSROADS (source: Reference C.9.210, N 138B).

projects were associated with Programs II through IX. Appendix C lists these projects by title and shows which group in the Instrumentation Division was responsible.

Table 6 presents exposure information for the groups in the Instrumentation Division. The Remote Measurements Group is not shown in the table because its personnel were not present in the Bikini area and had no one badged during CROSSROADS. The highest exposures recorded were for personnel in the Radiological Safety Group. These personnel monitored the contaminated ships and other areas to determine dangerous radiation levels. The accumulated high individual exposure in this group was 3.720 R. This monitor was badged six days.*

* Since personnel were not badged all the time, these figures reflect only a part of the total potential exposure. Dose reconstruction techniques discussed in Chapter 12 can be used to produce an estimate of total dose.

Table 6. Instrumentation Division personnel exposure, CROSSROADS.[a]

Element	No. of Persons Listed	No. of Persons Badged	Exposure Ranges (R)					High (R)
			0	0.001-0.5	0.5-1	1-1.5	Over 1.5	
Office of the Director	3	1		1				0.050
Air Blast Group	9	3	1	2				0.120
Wave Motion and Oceanography Group	93	30	19	11				0.180
BuShips Instrumentation Group	58	36	3	27	6			0.990
Electronics Group[b]	411	56	23	32	1			0.600
Radiological Safety Group	436	316	88	181	33	7	7	3.720
Bomb Operation Group	70	3	3					0
Bureau of Ordnance Instrumentation Group	208	47	24	23				0.470
Los Alamos Laboratory Group	70	12	6	6				0.330
Tech Photo Group	36	9	6	2	1			0.820
Army Air Forces Instrumentation Group[c]	1							0

Notes:

[a]Data taken from Reynolds Electrical and Engineering Company List. Since personnel were not badged all the time, these figures should be recognized as a partial statement of potential exposure for these groups.

[b]Same as the Electronics Group in Ship Material and Inspection Division.

[c]Personnel almost entirely supplied by Army Air Group, Task Group 1.5.

Sources: References C.13.4 and B.0.17.

The nine programs managed by the Instrumentation Division are discussed in the following paragraphs. Where appropriate, individual projects within each program are discussed.

Program I -- Bomb Preparation

Agency:

Los Alamos Laboratory

Operations: The bomb for ABLE was prepared at Kwajalein and loaded onto the B-29 drop aircraft at Kwajalein airfield. The bomb for BAKER was prepared on Kwajalein and on medium landing ship LSM-60 in Bikini Lagoon. It was placed in a waterproof caisson and lowered 90 feet (27 meters) under the LSM.

Staffing: Seventy Los Alamos Laboratory employees worked on this program. The radioactivity of the nuclear components of the bombs presented a very low risk of exposure. Personnel in this program were not required for reentry operations so they should not have been exposed to significant amounts of radiation. According to exposure records only three individuals were badged (see Table 6).

Program II -- Blast, Pressure, and Shock

Agencies: Los Alamos Laboratory
Navy Bureau of Ordnance (BuOrd)
Navy Bureau of Ships (BuShips)
Army Air Force
Navy Air Group
Air Blast Group (013A)

Operations: This program had 28 projects, some with several subprojects (see Appendix C). Except for Project II-12, which measured fireball growth using cameras, all these projects were associated with pressure, blast, and shock measurements. A variety of self-recording airblast gauges were placed on Bikini islands, in the lagoon, on target ships, and on aircraft aloft in the area above the target area. Condenser gauges were dropped from two B-29 aircraft just before each detonation and they transmitted readings to recorders in the two B-29 aircraft. Water-shock gauges were also used. All B-29, F-13, and B-17 aircraft participating in either shot carried instrumentation also.

Staffing: Personnel from the Air Blast Group, Los Alamos Laboratory Group, Electronics Group, and the BuOrd Instrumentation Group worked on projects in Program II. Although there were probably more, 51 personnel have been identified with this project from existing records, 35 of whom were badged. The highest exposure of these 35 was 0.99 R for an individual working on Project II-18 who got all of his exposure the first week in August.

Placement of gauges in aircraft, target ships, islands, etc. should have provided little or no exposure to project personnel. Removal of gauges after ABLE should have been relatively easy as radioactivity was limited to a few target ships and decayed rapidly. BAKER, however, contaminated islands due north of the detonation, the lagoon, and most of the target

ships. Gauge removal was closely monitored by radiological safety (radsafe) personnel.

Project Report: Reference C.9.209, Enclosure C.

Program III -- Wave Motion Oceanography

Agencies Smithsonian Institution
U.S. Geodetic Survey
U.S. Fish and Wildlife Service
Woods Hole Oceanographic Institution

Operations: This program had 20 separate projects to measure and record wave motion and to study detonation effects in the area of Bikini Lagoon. Some instrumentation was placed on the bottom of the lagoon, some suspended in the water from target ships, and some on nearby islands.

Staffing: Program III personnel were from the Wave Motion and Oceanography Group of the Instrumentation Division. Ninety-three personnel were assigned, 30 of whom were badged. Recorded exposures during the periods they were badged were all less than 0.5 R.

Removal of instrumentation from target ships, particularly after BAKER, exposed personnel to radioactivity on the ships. Removal of instrumentation from the lagoon bottom also exposed recovery personnel to some radiation after BAKER since the water in some areas of the lagoon was radioactive. However, recovery times apparently were relatively short and this minimized radiation exposure. Some islands were also contaminated after BAKER and instrument recovery there created exposure potential depending on recovery date and stay time.

Project Report: Reference C.9.209, Enclosure F.

Program IV -- Propagation of Electromagnetic Waves

Agencies: Los Alamos Laboratory
Army Air Forces (AAF)
Electronics Group
National Bureau of Standards (NBS)
Federal Communications Commission (FCC)

Operations: There were 18 separate projects in Program IV. Radars and radios, some operating at detonation time, were placed on selected islands at Enewetak, Kwajalein, Bikini, and on selected target ships. Television cameras were installed on B-17 drones and controllers. Two projects provided timing and firing signals for BAKER. Four projects measured electromagnetic properties from remote locations in Hawaii, Germany, Manila, Alaska, and the United States. One project telemetered air- and water-pressure readings from target ships to receivers on Avery Island.

Staffing: Personnel from the Electronics Group of the Instrumentation Division accomplished all the projects in this program except for IV-9 through IV-13, which were done by Los Alamos Laboratory and the Army Air Forces.

NBS and FCC personnel involved were not in the Bikini area. This Electronics Group was the same as that in the Ship Material and Inspection Division under the DSM. The highest recorded exposure in the Electronics Group was 0.6 R.

Since the experiments measured interference with electromagnetic waves at and after detonation time there was no urgency to recover equipment in radioactive areas such as the Bikini islands and target ships.

Project Report: Reference C.9.209, Enclosure G.

Program V -- Radiological Safety

Agency: Radiological Safety Group

Operations: There were 12 projects in this program (see Appendix C). The first eight involved radsafe monitors who measured radioactivity in the air, water, and on ships to obtain data on radiation in order to protect personnel. The eight monitor groups were: destroyer, seaplane, boat, boarding party, fixed base, gunboat, Bikini Lagoon channels, and airborne. Monitoring instruments used were: 275 Victoreen Geiger counters (Model No. 263), 150 Victoreen ionization chambers (Model No. 247), 12 alpha meters, and an unknown quantity of self-reading dosimeters. All monitors also wore film badges whenever there was a probability of encountering radioactivity. Film badges were normally exchanged daily. All monitor groups had Geiger counters and ionization chambers except the Bikini Lagoon Channel Group, which used battery-operated, deep-channel counters with submersible probes. Project 9 (Photometric Film Badges) measured radiation at various locations in the target array and recorded radiation received by all who wore film badges. They used 5,000 sulfur and calcium triphosphate capsules in addition to a large number of film badges. Projects 10 and 11 measured gamma radiation over a period of time on several target ships. Project 12 personnel measured total gamma intensity on several target ships.

Staffing: As shown in Table 6, 436 personnel of the Radsafe Group have been identified (Reference B.0.19). Of these 316 were badged at least one time (see Table 21 for badging summary). Personnel in all 12 projects on the Radsafe Program had a high potential for exposure because of their assigned duties. Monitors who reboarded ships with boarding parties (Project 4) after Test BAKER accumulated the highest exposures. The highest individual accumulated recorded exposure was 3.720 R. Most of those badged in Program V were military personnel performing monitoring duties.

Project Report: Reference C.9.209, Enclosure J.

Program VI -- Radiometry

Agencies: Navy Bureau of Ordnance (BuOrd)
Army Air Forces (AAF)

Operations: Measurement of the bombs' radiant energy was attempted from several locations. For ABLE, instruments were installed on one ship 18 nmi

(33 km) from the detonation and on an aircraft flying 18 nmi (33 km) from the detonation. For BAKER, instruments were installed on a ship positioned 10.9 nmi (20 km) from the detonation and spectroscopes were placed on an aircraft flying 7.2 nmi (13 km) from the burst.

Staffing: BuOrd Instrumentation Group personnel manned the projects in this program with some help from AAF. Potential for exposure of Program VI personnel was quite low. Aircraft and ships involved remained clear of radioactive areas in and downwind of the Bikini Lagoon. BuOrd Instrumentation Group personnel had low exposures as can be seen from Table 6. Most personnel working in Program VI were not badged and those that were had readings less than 1.0 R.

Project Report: Reference C.9.209, Enclosure H.

Program VII -- Radiation Measurements

Agency: Los Alamos Laboratory

Operations: The first of the three projects in this program was the measurement of fast neutrons on ABLE test by placing sulfur samples on several target ships.

The second was measurement of gamma-ray emissions from BAKER detonation. During this project, gamma-ray measurement signals were transmitted from the bomb case to USS Cumberland Sound (AV-17) just before the transmitters were destroyed.

The third project was collection and measurement of air and water samples to determine the efficiency of the detonations. This included the use of drone aircraft (B-17 and F6F) and drone boats to obtain radioactive air and water samples.

The Army B-17 drones were guided from Enewetak to Bikini by B-17 controller aircraft. On ABLE they sampled at 12,000, 18,000, 24,000, and 30,000 feet (3.66, 5.49, 7.32, and 9.14 km) between 6 and 15 minutes after the detonation. On BAKER they sampled at 6,000 and 10,000 feet (1.83 and 3.05 km) between 5 and 10 minutes after the detonation. Each B-17 drone aircraft had a filter box mounted in place of its top turret and a large inflatable rubber bag in its bomb bay. The air filter unit with its special filter paper was designed to filter 90 cubic feet (7.5 cubic meters) of air in 30 seconds. The rubber bag was opened on command of the controller in the B-17 control aircraft when the drone entered the cloud. It automatically closed 30 seconds later, capturing 90 cubic feet (7.5 cubic meters) of air. The drones were guided back to Enewetak where they were landed by ground controllers. Los Alamos Report No. 613 (Reference C.1.1) describes removal of the filter unit:

> The AAF filter unit was fixed to the top turret of a drone B-17. A lanyard ran from the unit down along the outside fuselage and ended in a handle fixed near the door of the plane. One sharp pull on the lanyard brought the filter unit tumbling down. Each door of the unit itself was fitted with a short lanyard. One sharp pull of this lanyard, and the door leaped

off in an amazing shower of springs and bolts. The filter papers sandwiched between their screens could then be picked up, a few wires snipped to separate the screens, and the paper removed.

Figure 18 shows a drone B-17 landed at Enewetak after shot ABLE. A monitor is shown walking away from the rubber bag in the background. The bag had been dropped from the bomb bay into a wheeled contrivance and was pulled away from the B-17 with long ropes. The top filter unit is visible on the top of the B-17 fuselage. Los Alamos personnel removed the filter papers from the boxes and flew to Kwajalein on the waiting C-54 with the filter papers and the large rubber bags filled with air samples. The samples were analyzed at Kwajalein.

Navy F6F drones were guided to Bikini from the carrier USS Shangri-La (CV-38) by drone control F6Fs. For ABLE, three drones sampled at 10,000, 15,000, and 20,000 feet (3.05, 4.57, and 6.1 km) approximately 8 to 15 minutes after the detonation. For BAKER, three drones sampled at 5,000, 9,000, and 14,000 feet (1.52, 2.74, and 4.27 km) 5 to 10 minutes after the detonation. After the sampling was complete they were guided to the island of Roi-Namur in Kwajalein Atoll and were landed there by ground control pilots. The F6F drones had a single unit with filter paper mounted under the left wing. A 10-foot (3.05-meter) pole with a hook was used to unhook and drop the unit from the wing. Six bolts were then removed on the doors



Figure 18. Air sampling gas bag and drone B-17 at Enewetak Island following shot ABLE, CROSSROADS.

by specially adapted 10-foot (3.05-meter) poles. The doors were then pulled off with another special 10-foot (3.05-meter) pole. The filter paper and securing screens were attached to the doors and came out of the unit with the doors. The filter papers were picked up with long-handled tongs (Figure 19) and placed in special lead receptacles. They were then flown by C-54 to Kwajalein for analysis.

Drone boats from USS Begor (APD-127) collected radioactive water samples throughout the target array. Radioactive samples were taken from Begor to Kwajalein and then to Los Alamos Laboratory for analysis.

Staffing: Los Alamos Laboratory supplied the personnel for the projects in this program. Removal of sulfur samples from target ships on ABLE test would have exposed men to low-level radiation on those ships that were near surface zero, viz. Sakawa (a captured Japanese cruiser), USS Crittenden (APA-77), USS Carlisle (APA-69), and USS Arkansas (BB-33) (Reference C.9.210, p. N-212). Measurement of gamma rays at detonation time for BAKER should not have created any radiation exposure to personnel. Removal of radioactive air and water samples from planes and boats was a very sensitive operation with a high exposure potential. Only 12 of 70 personnel in

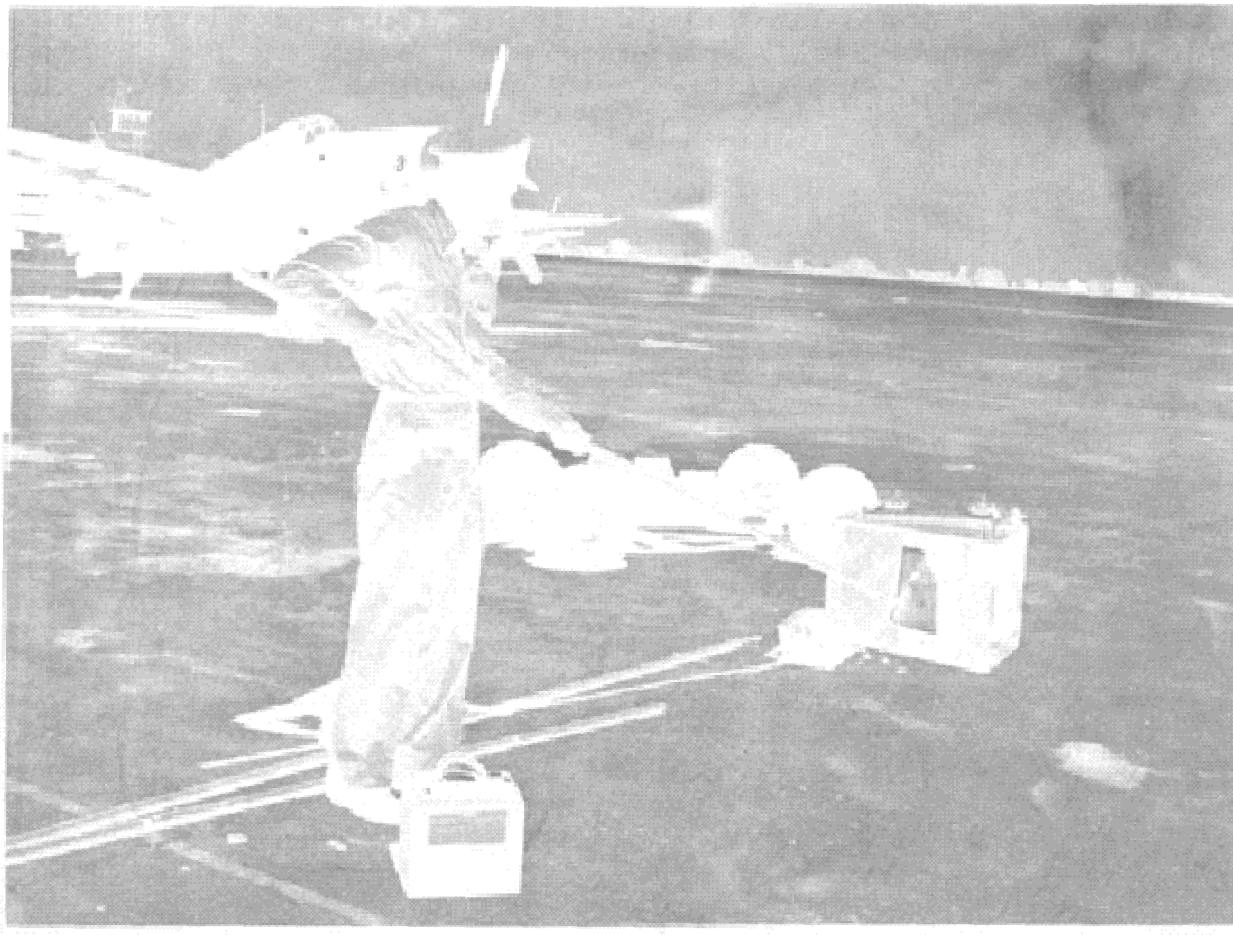


Figure 19. Removal of filter papers from the F6F filter units at Roi-Namur Island following shot ABLE, CROSSROADS.

the Los Alamos Laboratory Group were badged and their exposures were very low (see Table 6).

Project Report: Reference C.1.1 (Los Alamos Laboratory Report No. 613, November 1946).

Program VIII -- Remote Measurements

Agencies:
- U.S. Coast & Geodetic Survey
- Carnegie Institute
- National Bureau of Standards
- Naval Research Laboratory
- David Taylor Model Basin
- U.S. Weather Bureau
- University of Washington
- University of Texas
- Bartol Foundation
- Mt. Wilson Observatory
- Evans Signal Laboratory
- Federal Communications Commission
- Puget Sound Naval Shipyard
- Army Air Forces (AAF)

Operations: This program consisted of 18 projects. Experiments were conducted at sites around the world to measure changes produced by the detonations. Measurements were made of tides, wave action, atmospheric reflectivity, atmospheric pressure, atmospheric ionization, atmospheric noise, radioactivity, and long-range radio waves. Only Project 14 used locations in the Bikini area, specifically Eneu Island and USS Kenneth Whiting (AV-14).

Staffing: Organizations involved in each of the projects are listed above. Names of individuals associated with these organizations cannot be separately identified. Except for Project 14, which had instrumentation on Eneu Island and Whiting, exposure potential was extremely low for everyone working with this program. The Eneu site was not contaminated after ABLE but the beach was contaminated after BAKER. Eneu was visited on 25 July (BAKER day) and all experiments removed during the afternoon. Three days later it was radiologically cleared and reopened for troop use.

Project Report: Reference C.9.209, Enclosure K.

Program IX -- Technical Photography

Agencies:
- Los Alamos Laboratory
- Army Air Forces (AAF)
- U.S. Navy
- Technical Photography Group

Operations: There were 19 projects in Program IX associated with technical photography. Project 1, operated by Los Alamos Laboratory, used high-speed cameras to record the growth rate of the ABLE fireball. Half of the cameras were in a tower on Bikini Island and half in a tower on Eneu Island. Projects 2 through 7 used cameras mounted in six camera towers to observe water waves, ship motion, burst location, light intensity, and record damage. There were two camera towers each on Bikini, Eneu, and Aomen islands. These six projects were operated by the Technical Photography Group of the Instrumentation Division. Projects 8, 9, and 10 consisted of technical photography from AAF planes. Cameras were mounted in B-17 drones, C-54s,

and F-13s. Pictures were taken of fireball development, nuclear cloud formation, the target area, and radar scopes inside the aircraft. Projects 11 through 14 consisted of technical photography from U.S. Navy aircraft. A variety of cameras were installed in PBMs, TBMs, F6Fs, and F6F drones to photograph wave motion, target array, target damage, and detonation effects on ships in real time. Project 15 used 20 cameras placed on target ships and nearby islands for shot ABLE and 24 cameras on target ships and nearby islands for shot BAKER to observe ship reaction to the detonation. Project 16 consisted of mounting high-speed cameras in a C-54 to measure the ABLE fireball growth. Project 17 consisted of mounting 50 icaroscopes on nine observer ships to observe bomb flash intensities (Reference C.9.190, p. 207). Project 18 mounted two drum spectographs in a camera tower on Eneu to record the light's spectrum as a function of time. Projects 15 through 18 were conducted by the Technical Photography Group of the Instrumentation Division. Project 19 used a high-speed camera on Bikini to photograph ABLE fireball development. This project was accomplished by the BuOrd Group of the Instrumentation Division.

Staffing: Personnel in the Technical Photography Group consisted of officers and enlisted men from the U.S. Navy and civilians. Of the civilians assigned, at least one was from Los Alamos Laboratory. The Navy Photographic Unit was aboard USS Saidor (CVE-117). In addition to the Technical Photo Group, the Army Air Task Group, TG 1.5, had one task unit devoted completely to photography. Army Air Photo Unit, TU 1.5.2, with several photographic aircraft, provided substantial support to this program.

For ABLE there was little chance for exposure on any of the projects except for Projects 8, 13, and 15, where cameras had to be recovered from B-17 and F6F drones and target ships. The drones were contaminated; however, none of the target ships with cameras were contaminated on shot ABLE. For BAKER, recovery of several projects created an exposure potential. Projects 2 through 7 required recovery of film from contaminated islands around the lagoon after BAKER. Projects 8 and 13 required recovery of film from contaminated B-17 and F6F drones. Project 15 required recovery of film from contaminated target ships after BAKER. Projects 18 and 19 required recovery of film from Eneu and Bikini, the beaches of which were contaminated after BAKER.

CHAPTER 4

TEST OPERATIONS

CROSSROADS was primarily a sea-based operation. The islands of Bikini Atoll* were used as sites for instrument locations and as recreation areas. However, a Navy Construction Battalion had quarters for its men on Bikini Island. Joint Task Force 1 (JTF 1) personnel lived at Kwajalein, Enewetak, and aboard ships in Bikini Lagoon. They commuted to their work sites in the target array or at island-based measurement sites.

In Test ABLE, the weapon was dropped from an Army Air Forces B-29 (nicknamed "Dave's Dream") based at Kwajalein. The bomb burst in the air 520 feet (158 meters) over the target ships. In the BAKER test the weapon was suspended in a waterproof container 90 feet (27 meters) below LSM-60, anchored at the center of the target fleet. A third test, to have been called CHARLIE, would have been a deep underwater test, but it was cancelled after Test BAKER.

The target fleet was unmanned for both tests and was anchored in the northeastern area of Bikini Lagoon off Bikini Island. For ABLE 22 landing craft and for BAKER 24 landing craft were beached on the lagoon side of this island, simulating boats in an amphibious operation. Military equipment (including airplanes), animals, and scientific instruments were aboard the target ships. Two anchored seaplanes were also part of the target fleet.

The manned JTF 1 support ships withdrew from the lagoon before the tests and remained east of the atoll or were at other atolls until it was safe to reenter the lagoon. Nontarget small craft were moored (unmanned) in the lagoon off Eneu Island about 5 nmi (9.3 km) south of the test area. Among these were several drone boats equipped to be remotely controlled. After each detonation the drones were guided by aircraft and USS Begor (APD-127) to areas in the target array to collect water samples and take radiation readings. After the water samples were collected, the drones were guided back to Begor where they were hosed down to remove radioactive contamination (Figure 20) and the samples removed. After each test the drones were followed by six patrol motor gunboats (PGMs) and twenty landing craft (LCPLs) with radiation monitors aboard. Radiation intensity measurements were sent by radio to the Radsafe Control Center. From this information and that gathered from aircraft equipped with radiation detectors, it was determined when a safe reentry to the lagoon by the main body of the fleet could be made.

PRE-TEST OPERATIONS

Preparation for the tests began in January 1946 when the atoll was surveyed by USS Allen M. Sumner (DD-692) and USS Bowditch (AGS-4). The survey was finished in April.

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* The islands of Bikini Atoll and their various transliterations and synonyms are listed in Appendix D.

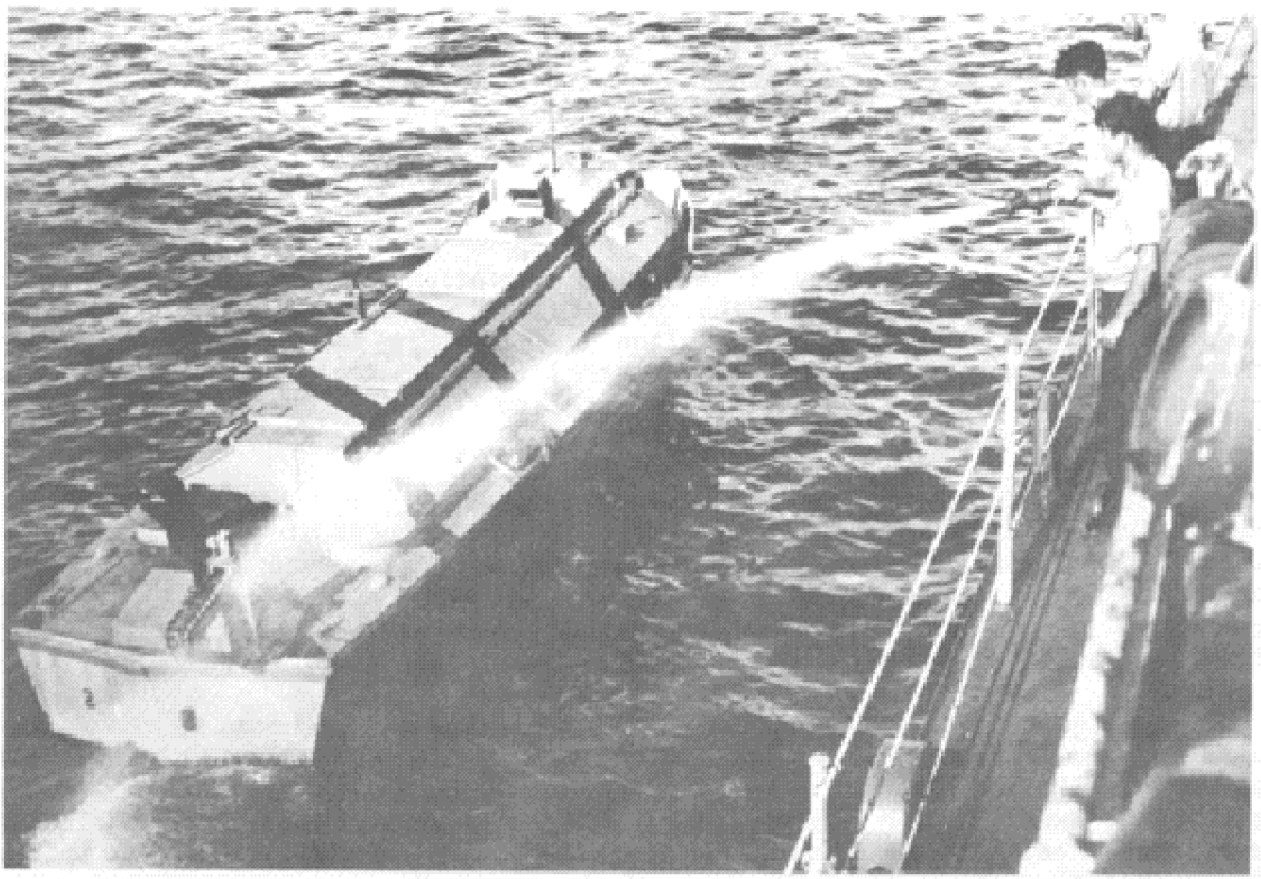


Figure 20. Drone boat being washed down before radioactive water samples were removed, CROSSROADS.

On 7 March 1946, 167 Bikinians embarked aboard USS LST-1108 and were taken to Rongerik Atoll. At the same time the Navy 53rd Construction Battalion began arriving to build the various phototowers, instrumentation sites, workshops, and recreation facilities on the islands of the atoll. One hundred tons of dynamite were used to clear coral heads in the lagoon. Five naval mines were discovered and disposed of during March.

Movement of participating ships from eastern U.S. shipyards and ports toward Bikini also began in March. Movement from closer ports began later, and by mid-May there were over 100 CROSSROADS-bound ships stopping over in Pearl Harbor on their way to Bikini. Interior spaces of some support ships were modified as laboratories or machine shops, and USS Burleson (APA-67) was being converted to a "great dirtless farm" (Reference A.1), a living place for the experimental animals that were used during CROSSROADS.

The target ships also required special preparation. For Test ABLE, 93 target vessels were assembled. For Test BAKER, 92 target vessels were arrayed. The target fleet was led by older U.S. capital ships like the famous USS Saratoga (CV-3) and the old battleships USS Nevada (BB-36), USS Pennsylvania (BB-38), and USS New York (BB-34). The German battle cruiser Prinz Eugen and two major captured Japanese ships, the battleship Nagato and the cruiser Sakawa, were also targets. All target vessels were accurately moored and made ready for the

tests. This involved a great deal of work by Task Group (TG) 1.2 in making the ships watertight so that pumping would not be required to keep them afloat. Many of the target ships could be classed as "war weary," making this task difficult. For the sake of the experiment, the ships were to be in as near to fighting condition as was reasonable, which included loading them with ammunition, torpedoes, fuel, radar equipment, etc.

The target ships also required close pretest inspection since the aim of the tests was to measure the effects of the nuclear detonations. This was done by inspection teams of the Ship Material and Inspection Division and ships' crews and was documented extensively with photographs. Instrument placement aboard these vessels also was extensive. Compartments in nearly every target vessel were inspected and the condition recorded before and after each test. An aerial view of the target array is shown in Figure 21.

ABLE OPERATIONS

By mid-June the task force was in place. Burleson, with its cargo of experimental animals, was one of the last arrivals (14 June). Several small-scale rehearsals and one major rehearsal on 24 June 1946 (Queen Day) preceded the test. For the Queen Day rehearsal a number of non-self-propelled or slow-moving vessels were evacuated to Kwajalein, some not to return to Bikini until after ABLE. Projected ABLE Day remained 1 July.

At the morning weather conference on 30 June 1946, favorable weather was forecast for the following day, so Commander JTF 1 (CJTF 1) set 0830, 1 July, as shot time. At the evening weather conference, conditions still appeared



Figure 21. CROSSROADS, ABLE target array in Bikini Lagoon. View is looking south.

favorable. However, fairly heavy cloud cover was reported early on the morning of 1 July, and shot time was changed to 0900.

Evacuation of task force support ships began soon after CJTF 1 set the hour for ABLE. All destroyers except USS Moale (DD-693) got underway and were clear of the lagoon by early afternoon on 30 June. Most of the support ships of TG 1.2 were out of the lagoon shortly thereafter, except for the TG 1.2 flagship USS Fall River (CA-131) and three small support ships. Throughout the afternoon the vessels of TG 1.8 cleared the lagoon. Three tugs towed barges to Kwajalein and USS Chowanoc (ATF-100) towed YO-130 to the open sea, more than 20 nmi (37 km) northeast of Bikini Atoll. Small craft had evacuated task force personnel from Enidrik and Eneman islands and transferred them to Fall River, which then left the lagoon along with the smaller ships of TG 1.2. Ten ships remained in the lagoon after 1800 hours.

Preparations ashore had included removal of the roofs of buildings to prevent blast damage and removal of the pontoon-supported docks and causeways that had been installed on the islands. Machinery such as refrigerators, generators, and water-distilling units had been covered by tarpaulins.

USS Chilton (APA-38) evacuated 691 nonessential U.S. personnel and natives from Enewetak before the test. Provision had been made to evacuate essential U.S. personnel on Enewetak if necessary, and five C-54 air transports were at Enewetak for this purpose. The Marshallese on Rongerik to the east had been taken aboard USS LST-989 in case evacuation was necessary there.

Two additional C-54s were sent from their Kwajalein base on 30 June, one to Enewetak and one to Roi Island. These were scheduled to receive the radioactive cloud samples to be collected by the B-17 drone samplers based at Enewetak and the F6F drone samplers returning to Roi following the shot.

At 0512 on 1 July, PGM-23 had all task force personnel from Iroij, Nam, and Aomen islands embarked and was underway for the fleet assembly area. At 0524 USS Kenneth Whiting (AV-14) had all personnel from Bikini and Eneu islands aboard and was underway. The last ship out of the lagoon was USS Mount McKinley (AGC-7). These ships joined the other JTF 1 ships in operating areas east of Bikini. These operating areas were designated by the names of automobile manufacturers.

The first airborne aircraft were three B-29s that had made weather reconnaissance flights in the shot area and northeast and northwest of Bikini Atoll. At 0540 CJTF 1 ordered the drop aircraft to take off from Kwajalein. This was a specially modified B-29 on which the bomb had been loaded about midnight (Figure 22). At 0555 the bomber was reported as being airborne. The four F6F drones and sixteen F6F controllers from USS Shangri-La (CV-38) were airborne shortly after 0700. In all, 79 aircraft were airborne on the morning of ABLE. By 0800 all aircraft and ships were on station. One F6F drone went out of control and crashed in the sea just as the B-29 began its live run at 0850. The bombing aircraft had made one practice run before the live run. Aircraft participation in Test ABLE is summarized in Table 7, and Table 8 summarizes the designated orbiting points for these aircraft.

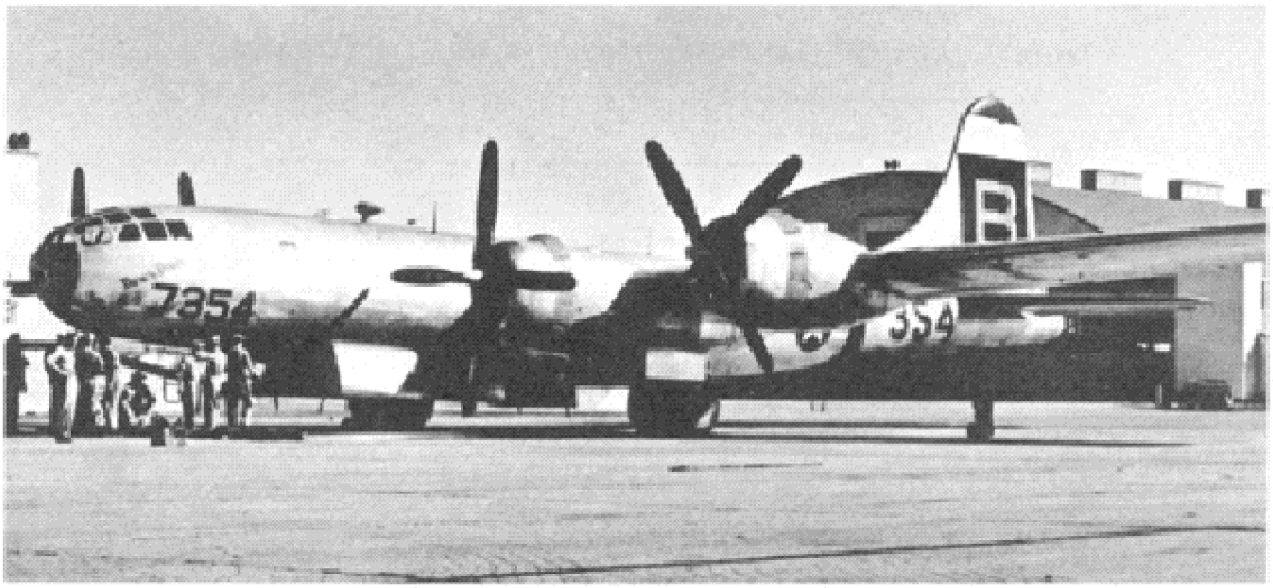


Figure 22. "Dave's Dream," the B-29 from which the CROSSROADS, ABLE weapon was dropped.

All other air operations within 500 nmi (927 km) had been suspended 12 hours before the shot.

Observers included Congressmen, the President's Evaluation Commission, the Joint Chiefs of Staff (JCS) Evaluation Board, United Nations representatives, and media correspondents. The live run was made at 28,000 feet (8.5 km). The bomb was released at 0859 and detonated with a yield of 23 KT 15 seconds before 0900, 1,500 to 2,000 feet (457 to 610 meters) west of the planned surface zero (Figure 23).

An Army doctor trained as a radiological safety (radsafe) monitor made the following observation from a PBM aircraft 20 nmi (37 km) away (Reference A.2, p. 55):

> At 20 miles it gave us no sound or flash or shock wave. . . . Then, suddenly we saw it -- a huge column of clouds, dense, white, boiling up through the strato-cumulus, looking much like any other thunderhead but climbing as no storm cloud ever could. The evil mushrooming head soon began to blossom out. It climbed rapidly to 30,000 or 40,000 feet, growing a tawny-pink from oxides of nitrogen, and seemed to be reaching out in an expanding umbrella overhead. . . . For minutes the cloud stood solid and impressive, like some gigantic monument over Bikini. Then finally the shearing of the winds at different altitudes began to tear it up into a weird zigzag pattern.

An aerial view of the cloud from the southeast is shown in Figure 24.

The radiological danger sector (radex) designated for aircraft at 0730 on the shot day predicted the downwind danger area to be between 325° clockwise

Table 7. Aircraft participation, Test ABLE, CROSSROADS.

Type	Quantity	Mission
Army		
B-17	3	Air-sea rescue
B-17	4	Drone samplers
B-17	6	Drone controllers
B-29	1	Command
B-29	1	Bomb drop
B-29	1	Radio broadcast
B-29	1	Press and newsmen
B-29	2	Pressure-gauge drop
B-29	2	Radiological reconnaissance
WB-29	3	Weather reconnaissance
C-54	2	Photography
C-54	2	Observers
F-13[a]	8	Photography
Navy		
F6F[b]	4	Drone samplers
F6F	16	Drone controllers
F6F	6	Photography
PBM	2	Radiological reconaissance
PBM	3	Air-sea rescue
PBM	4	Photo-radiometry
TBM	2	Air-sea rescue
TBM	2	Photography
TBM	4	Drone boat control

Notes:

[a]A B-29 modified for photography.

[b]One F6F drone crashed in the ocean 10 minutes before the shot.

Source: Reference C.9.206, Part VII, p. F1.

Table 8. CROSSROADS, Test ABLE aircraft orbit points.

Orbit Designation	Bearing From Surface Zero (°)	Horizontal Range[a] from Surface Zero (nmi)	(km)
Able	50	20	37
Charlie	170	15	28
Dog	80	15	28
Easy	90	25	46
King	125	15	28
Love	315	30	56
Nan	0	20	37
Peter	240	35	65
Sugar	135	20	37
Tare	135	40	74
Uncle	40	30	56
Victor	315	20	37
William	270	20	37
Yoke	45	20	37
Zebra	0	40	74
I.P.	225	30	56

Note:

[a]Slant ranges of aircraft vary with aircraft-orbiting altitude. Orbiting altitudes were from 1,000 feet (305 meters) to 31,000 feet (9.5 km).

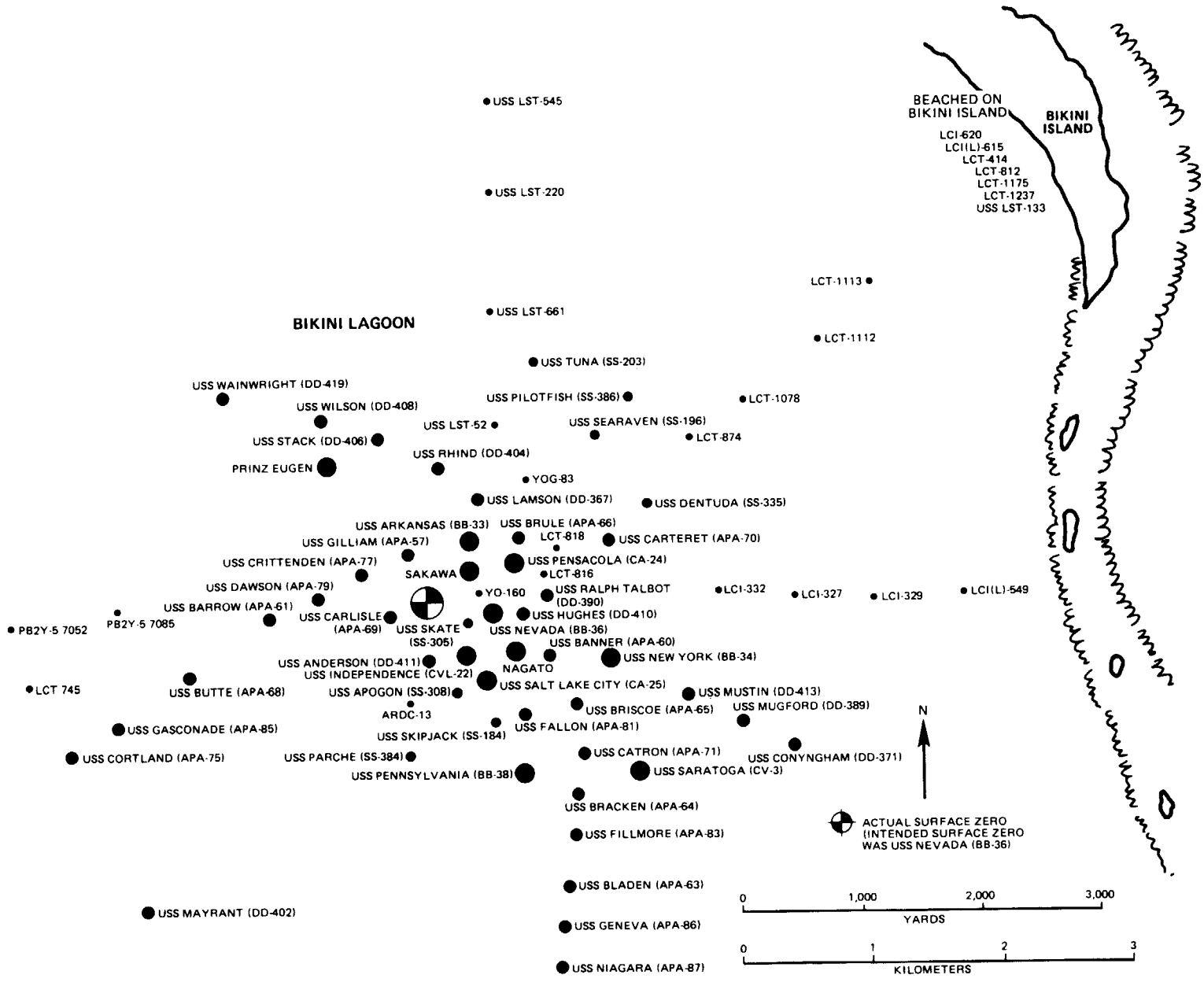


Figure 23. CROSSROADS, ABLE target ship locations.

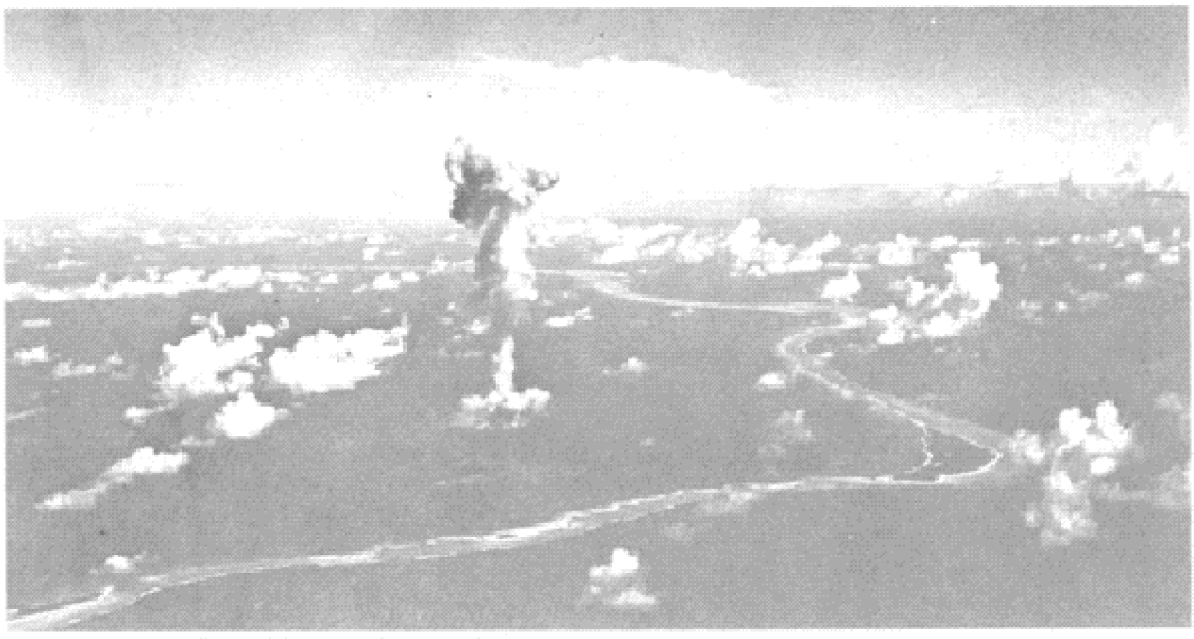


Figure 24. CROSSROADS, Test ABLE cloud.

to 125° from surface zero. At 1000 it was changed to 350° clockwise to 180°. The Red Arc was set 16 nmi (30 km) downwind from surface zero, and the Blue Arc 22 nmi (41 km) downwind from surface zero. Radsafe monitors were placed aboard all aircraft airborne in the vicinity of Bikini at shot time except in the single-seat F6Fs. The F6F pilots had Geiger counters whose clicking signals were fed into their earphones to warn of increasing radioactivity (Reference C.9.206, Part VII, p. C10).

Two radiological reconnaissance PBMs began making passes over the target area at 0952, starting at an altitude of 2,000 feet (610 meters) and working down to 500 feet (152 meters). They continued until 1427 and then returned to Ebeye Island, Kwajalein. The two radiological reconnaissance B-29s began tracking and photographing the cloud at 1000 and were relieved during the day by two other B-29s. Four TBM aircraft were launched from USS Saidor (CVE-117) between 0910 and 0918. Two developed engine trouble and returned; the remaining two took stations upwind from the drone boats and transmitted boat locations to Begor, which was controlling the drone boats. They completed their mission and departed the area for Saidor at 1238.

Army and Navy aircraft involved with photography and cloud sampling accomplished their missions before 1000. B-17 sampler drones penetrated the cloud at altitudes of 13,000, 18,000, 24,000, and 30,000 feet (3.96, 5.49, 7.32, and 9.14 km) about 20 minutes after the detonation, obtained their samples, and were guided back to Enewetak Island. Three remaining Navy F6F drones sampled the radioactive cloud between 0906 and 0920 at altitudes of 10,000, 15,000 and 20,000 feet (3.05, 4.57 and 6.10 km). All three drones were guided back to Roi and were landed without incident. C-54 aircraft waiting at Enewetak and Roi transported the cloud samples in airbags and filters to Kwajalein. The samples were analyzed as soon as they were removed from the drones by Los Alamos

Laboratory personnel. Filters were then sent to Los Alamos Laboratory for further analysis.

The drone control ship Begor started two of the drone boats and, using instructions from the TBMs, guided the boats into the target area. Both boats took several water samples based on radiation readings they transmitted back to Begor. Both drones departed the target area before 1200. Begor met the two drones in the anchorage area in the lee of Eneu and removed samples. Samples were transferred to Moale, which steamed to Kwajalein at 1255 (Reference C.9.206, Part VII, p. R19 through R22).

Reentry into Bikini Lagoon commenced at H+2 when six manned PGMs and twenty LCPLs entered to conduct radiological reconnaissance. They carefully approached the area around the target vessels and measured radiation. Information from these boats was used to define the Red and Blue lines. Boarding teams and salvage units for the target vessels entered the lagoon at H+4 and proceeded with operations as the radiological situation permitted, remaining outside the Blue Line except for designated ships. At 1430 on 1 July the lagoon was declared safe and task force ships reentered and anchored in the southern part of the lagoon. By 2030, 18 target ships had been boarded and reported radiologically safe. By the evening of 2 July, 47 ships had been radiologically cleared. The Red Line was eliminated early on the morning of 2 July, indicating that the maximum intensity of the water fell below 1 R/24 hours during the night. The Blue Line was eliminated at 1008 on 2 July.

Two F6Fs took off at 1615 on 1 July to conduct an oceanographic survey of the Bikini Lagoon by taking photographs with strip cameras (Reference C.9.206, Part VII, pp. E141 through E175). At 2039 and 2047 on 1 July, two B-29s took off and sampled the remnants of the radioactive cloud. Both obtained good samples. However, both aircraft were too contaminated to permit maintenance crews to perform postflight inspections. Several WB-29 weather flights with monitors on board plus a low-altitude photo mission over the target area were flown on 2 July (Reference C.9.206, Part VII. p. C14).

The Marshallese at Rongerik disembarked from LST-989 the afternoon of 1 July (Reference C.9.206, Part VII, pp. C10 through C15). Burleson picked up caged animals from five target ships shortly after 1600 on 1 July (Reference C.9.206, p. 189). At 2142 on 1 July all ships in the lagoon were ordered not to use their evaporators (saltwater-to-freshwater converters) because of possible radioactive contamination (Reference C.9.206, Part VI, p. B14). At 1332 on 2 July CJTF 1 lifted this restriction (Reference C.9.206, p. VI-B-16). Also on 2 July the submarine USS Skate (SS-305) was beached to prevent sinking. The islands of Eneu and Bikini were inspected and declared safe the same day. By 4 July all target ships had been "initially boarded" by one of the ten initial-boarding teams (Reference C.9.206, pp. V-C-6 and VII-10 through VII-15).

Damage to ships and aircraft of the target array was as follows (References C.9.2, C.9.3, and C.9.157):

- 5 ships sunk
- 6 ships seriously damaged
- 8 ships seriously impaired efficiency

- 9 ships moderately damaged
- 43 ships negligible damage
- 22 landing craft beached at Bikini Island, no damage
- 14 aircraft destroyed
- 30 aircraft seriously damaged
- 10 aircraft lightly damaged
- 19 aircraft no damage.

In general all target vessels within 500 yards (457 meters) of actual surface zero were sunk or seriously damaged. Those beyond 1,500 yards (1.37 km) received minor damage (Reference C.9.206, Part V, p. C6). Those ships beyond 750 yards (686 meters) had little induced activity or contamination; they were reboarded on 1 July and were used for crew quarters beginning on 2 and 3 July. Figure 25 shows a group of VIPs and CJTF 1 inspecting New York after ABLE. By 5 July all target vessels (except those sunk) had been rehabilitated to the extent necessary for the upcoming BAKER event.

More than 50 percent of the test animals within 1,000 yards (914 meters) died, between 15 and 30 percent died between 1,000 and 2,000 yards (0.91 and 1.83 km), and between 5 and 15 percent died outside 2,000 yards (1.83 km). Airblast was the principal cause of injury and death. However, radiation exposure was the principal cause of death for those animals who died after the first few hours.

During Test ABLE, 200 cameras, 300 5-gallon (18.93-liter) cans, 400 photographic radiation badges, 5,000 sulfur capsules, 850 ball-crusher gauges, and over 5,000 other gauges of various types were used to measure and record the detonation effects (blast, heat, and radiation). The timing signal relied on to start a number of instruments was sent out about 10 seconds late because of errors by the timing signal operator. The following instruments obtained no data as a result of this 10-second delay: free-piston gauges, shock wave velocity cameras, O'Brien and Bowden cameras on Bikini, Fastex cameras on Bikini and Eneu, and the drum spectrograph.

PREPARATION FOR BAKER

As soon as the extent of damage from ABLE had been determined, CJTF 1 tentatively set 25 July for BAKER. The news media ship USS Appalachian (AGC-1) returned to Pearl Harbor to allow some media people to depart and others to join the group. Some observers were taken on a cruise to Ponape, Truk, Majuro, and Guam islands while the task force prepared for BAKER (Reference C.9.206, Part V, p. C7).

Several target ships had sustained boiler and/or stack damage. Wreckage was cleared and repairs made so that every target ship (except those sunk) was able to steam under its own power on at least one boiler. USS Independence (CVL-22) needed considerable work to ensure watertight integrity. The submarine Skate needed superstructure repairs, including a temporary bridge (Figure 26). One by one the target ships were moved to their positions in the new target



Figure 25. VIPs and Commander Joint Task Force 1 inspect USS New York (BB-34) following Test ABLE.



Figure 26. Damaged USS Skate (SS-305) on 3 July following Test ABLE.

array for BAKER. Test ABLE blast damage inspections were completed (Figure 27), and new instrumentation and new experiments were set up on these target ships in preparation for Test BAKER (Reference C.9.206, Part VII, p. A73).

Some turnover of task force personnel occurred following ABLE. A continuous training program was in effect after ABLE to train new personnel in preparation for BAKER. A large quantity of radiac instruments was received during this period, alleviating a minor shortage experienced during ABLE. The underwater BAKER shot was expected to create a much larger radsafe problem and require more radiac meters than did ABLE (Reference C.9.206, Part VII, p. C17).

The Army Air Forces conducted a major rehearsal on 14 July. All Army air units participated. Locations, communications, and coordination were tested,



Figure 27. Inspection of Army vehicle on deck of USS Nevada (BB-36) following Test ABLE, CROSSROADS.

checked, and rechecked. Then on 19 July, JTF 1 conducted a full-scale dress rehearsal, dubbed "William Day." All units of the task force participated fully except the air task units. Heavy cloud cover and rain limited aircraft participation in the rehearsal (Reference C.9.206, Part VII, p. E180).

On D-1 (24 July) CJTF 1 confirmed BAKER Day as 25 July and designated shot time for 0835. Weather forecasts indicated that there would be favorable weather on that day. Evacuation of task force ships and personnel began immediately. Personnel and ships not needed immediately after the shot were evacuated to Rongelap Atoll instead of Kwajalein because it was closer to Bikini. USS Saint Croix (APA-231) evacuated 607 U.S. personnel and natives from Enewetak on 21 July.

The day before BAKER, two C-54s were again sent to Enewetak and Roi islands to transport the cloud samples to Kwajalein on 25 July. Five C-54s were again positioned at Enewetak in case evacuation of essential personnel was necessary. Except for minor changes, the aircraft missions were similar to the ABLE shot missions. Table 9 shows the aircraft that participated in BAKER, and Table 10 summarizes their orbit areas.

By 1735 on 24 July all but 13 support ships were clear of the lagoon. These cleared the lagoon by 0700 the following morning. Task force personnel on the islands at Bikini were evacuated by 1555 on 24 July. Three sailors on USS Gasconade (APA-85), a target ship, were somehow overlooked. They filled the yardarms with bunting (the signal that they needed evacuation) and were picked up by USS Conserver (ARS-39) at 0530 on 25 July (Reference C.9.206, Part VII, pp. H5-H7).

The bomb was suspended 90 feet (27.4 meters) beneath the surface of the lagoon from medium landing ship LSM-60. The LSM had been extensively modified to provide rigging facilities, a laboratory, and special radio receivers and transmitters. The bomb was encased in a strong, watertight, steel caisson and had a coaxial cable running from it to the LSM. The TG 1.1 laboratory personnel associated with the bomb arming were evacuated from LSM-60 at 0545 on 25 July (Reference C.9.206, p. 5.12).

There were 68 target vessels in the array for Test BAKER. Twenty-four small craft were beached on Bikini Island. Their positions are shown in Figure 28. The submarine USS Searaven (SS-196), which had been submerged on 24 July, partially surfaced later in the day. It was finally resubmerged by 2300 on 24 July. Of the eight target submarines, six were submerged and two were on the surface for the test (Reference C.9.206, Part VII, p. F10).

Weather was not quite as important for BAKER as for ABLE because the underwater detonation was expected to limit the cloud height and thus localize the radioactivity. Good visibility, however, was important for photography (Reference C.9.206, Part IV, p. C7).

BAKER TEST

BAKER was detonated on schedule at 0835 on 25 July 1946. The detonation command was sent by radio using coded signals. The weapon yield was 23 KT.

Table 9. Aircraft participation, CROSSROADS, Test BAKER[a].

Type	Quantity	Mission
Army		
B-17	3	Air-sea rescue
B-17	4	Drone samplers
B-17	6	Drone controllers
B-29	1	Radio broadcast
B-29	1	Press and newsmen
B-29	2	Command
B-29	2	Pressure-gauge drop
B-29	2	Radiological reconnaissance
WB-29	3	Weather reconnaissance
C-54	1	Observers
C-54	2	Photography
F-13[b]	8	Photography
Navy		
F6F	3	Drone samplers
F6F	12	Drone controllers
F6F	6	Photography
PBM	3	Radiological reconnaissance
PBM	5	Air-sea rescue
PBM	5	Photo-radiometry
TBM	2	Photography
TBM	4	Drone boat control

Notes:

[a]Does not include aircraft taking off after 1200, 25 July.

[b]A B-29 modified for photography.

Source: Reference C.9.206, VII 5, Encl. 9.

Table 10. CROSSROADS, Test BAKER aircraft orbit points.

Orbit Designation	Bearing from Surface Zero (°)	Horizontal Range[a] from Surface Zero (nmi)	(km)
Able	45	20	37
Charlie	180	10	19
Dog	330	9	17
Easy	90	20	37
King	225	10	19
Love	315	30	56
Sugar	135	20	37
Tare	135	40	74
Victor	315	20	37
William	270	20	37
Yoke	45	7	13

Note:

[a]Slant ranges of aircraft vary with orbit altitude. Orbit altitudes were from 500 feet (152 meters) to 30,000 feet (9.1 km).

Source: Reference C.9.206, p. VII-(E)-194.

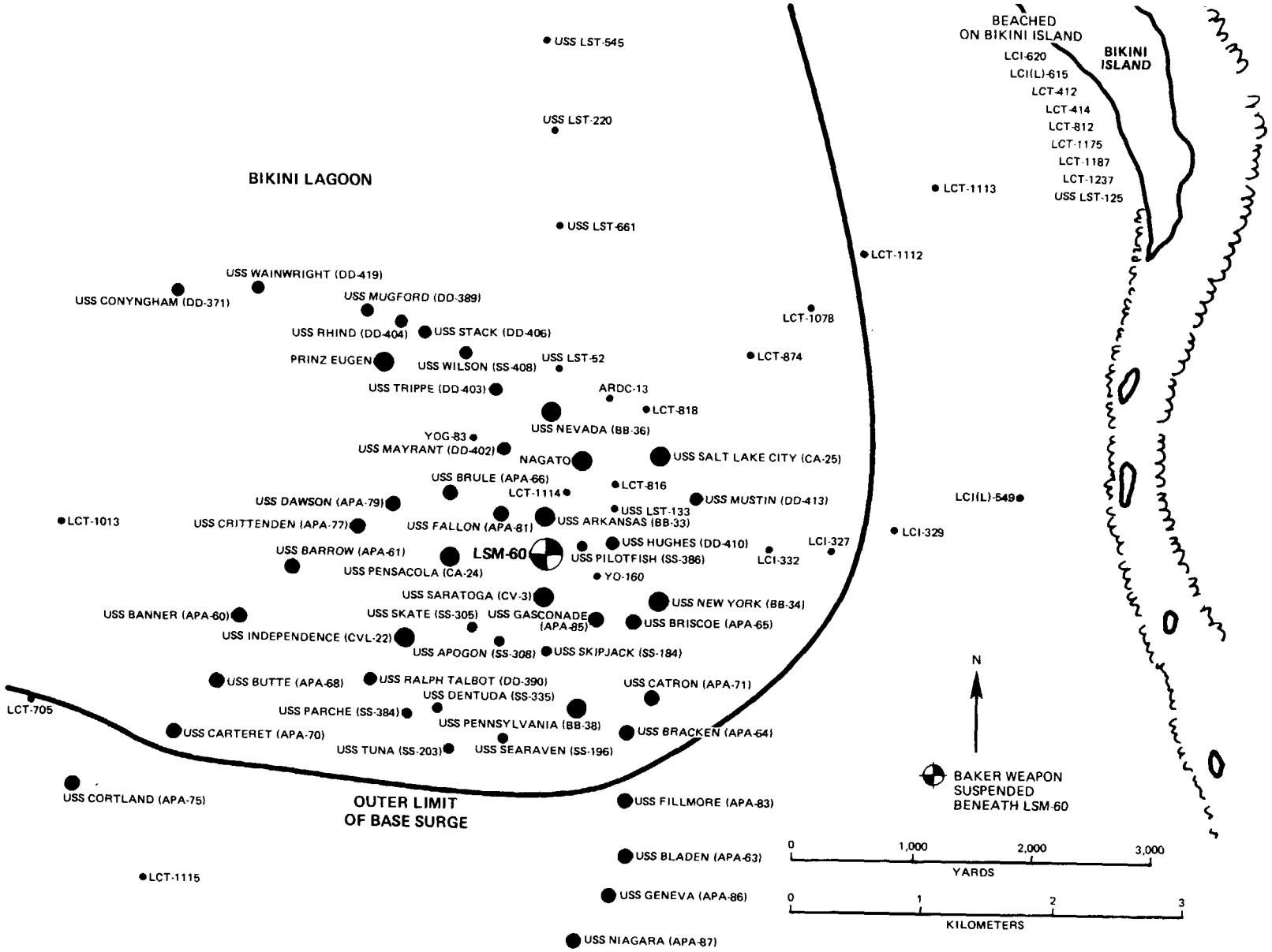


Figure 28. Target ship locations for CROSSROADS, Test BAKER.

Observers included United Nations representatives, Congressmen, the President's Evaluation Commmission, the JCS Evaluation Board, and media representatives (Reference C.9.206, Part V, p. C8).

The Army radsafe monitor previously quoted was again aboard a Navy PBM about 15 nmi (28 km) away and described the visual effects as follows (Reference A.2, p. 93):

> The flash seemed to spring from all parts of the target fleet at once. A gigantic flash -- then it was gone. And where it had been now stood a white chimney of water reaching up and up. Then a huge hemispheric mushroom of vapor appeared like a parachute suddenly opening. . . . By this time the great geyser had climbed to several thousand feet. It stood there as if solidifying for many seconds, its head enshrouded in a tumult of steam. Then slowly the pillar began to fall and break up. At its base a tidal wave of spray and steam rose to smother the fleet and move on towards the islands. All this took only a few seconds, but the phenomenon was so astounding as to seem to last much longer.

Another aircraft observer reported seeing a major ship "on [its] nose" before it sank and saw a water wave pass over one of the small islands between Bikini and Eneu islands about 2 minutes after the detonation (Reference C.9.206, Part VI, p. D9). Figure 29 shows the BAKER detonation wave as it lifted the stern of Saratoga some 43 feet (13.1 meters). The dark area to the left of Saratoga is believed to be a cavity in the column formed by the hull of USS Arkansas (BB-33). When the air over the fleet cleared, Arkansas, LSM-60, and four LCTs were not in sight. Saratoga was listing to starboard and her stern was low. Figure 30 shows the BAKER cloud as viewed from the manned support ships in their operating areas.

The underwater burst inflicted heavy damage on the target fleet. Eight ships were sunk or capsized (See Table 11). Eight ships were immobilized or seriously damaged. Generally, ships beyond 1,500 yards (1.37 km) were undamaged. Those between 1,100 and 1,500 yards (1.01 and 1.37 km) sususstained only slight damage. Those between 900 and 1,100 yards (0.82 and 1.01 km) suffered moderate damage. Those inside 900 yards (823 meters) were seriously damaged or were sunk (Reference C.9.208, p. 23.3).

At 0912, the drone control ship, Begor, began moving two drone boats from the lee of Eneu towards the target array using directions from the orbiting drone control TBMs as in Test ABLE. Each boat took ten 5-gallon (18.93-liter) samples of lagoon water and by 1030 was en route back to its anchorage. The drone boats were so radiologically contaminated that boarding parties from Begor could not go aboard. The drone boats were taken to USS Albemarle (AV-5) where the water samples were finally removed about 1430. Two additional drone boats were guided into the target area the same afternoon using the same combination of TBMs and Begor. Each took 10 samples of water, which were transferred to Albemale about 1800. Albemarle then headed for Kwajalein with the samples. Four more runs were made on 26 July and two more on 27 July using the same control procedures. The radiation intensities had lessened somewhat, allowing boarding parties from Begor to remove these samples and transfer them to USS Haven (AH-12) (Reference C.9.206, Part VII, p. R28-34).

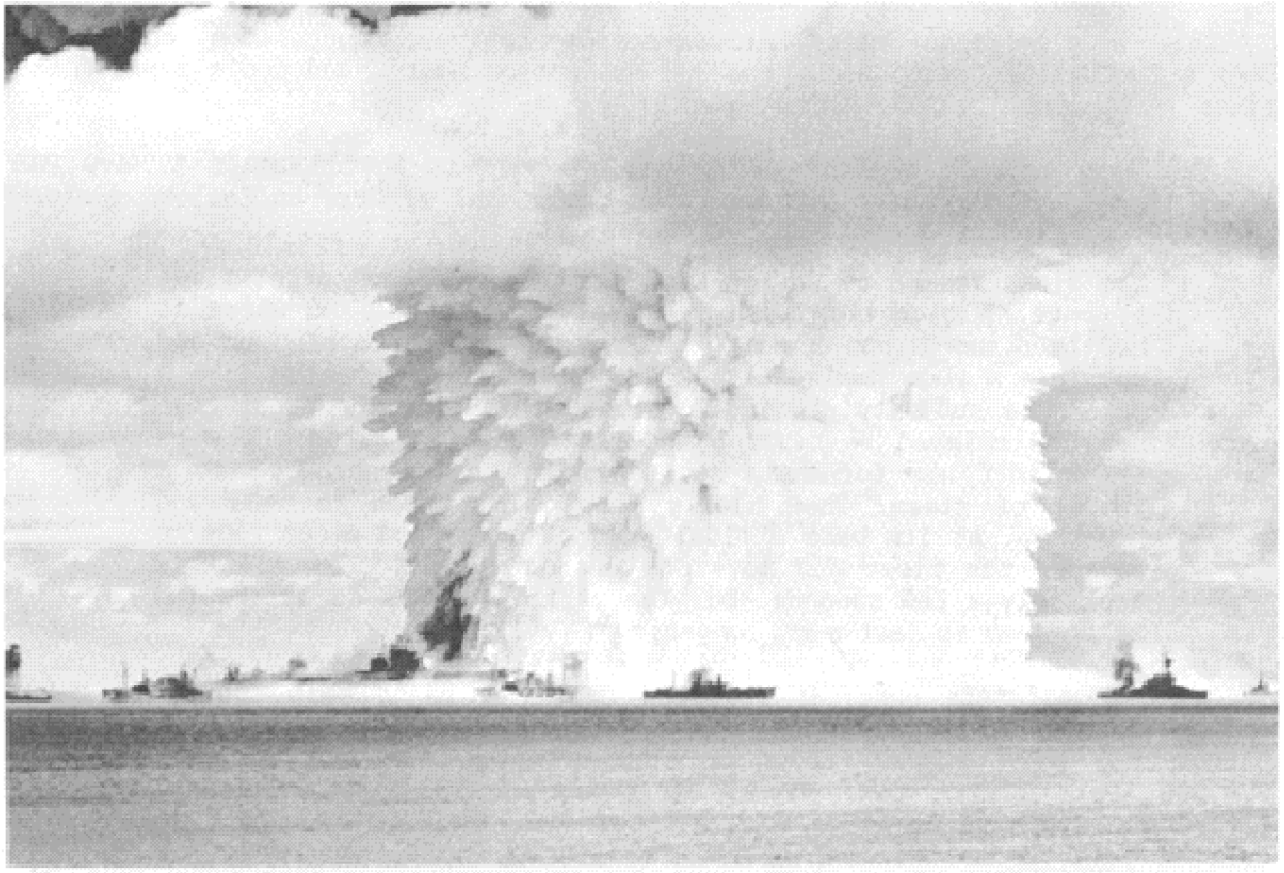


Figure 29. CROSSROADS, Test BAKER column at about 10 seconds, photographed by remote-control camera on Eneu Island.

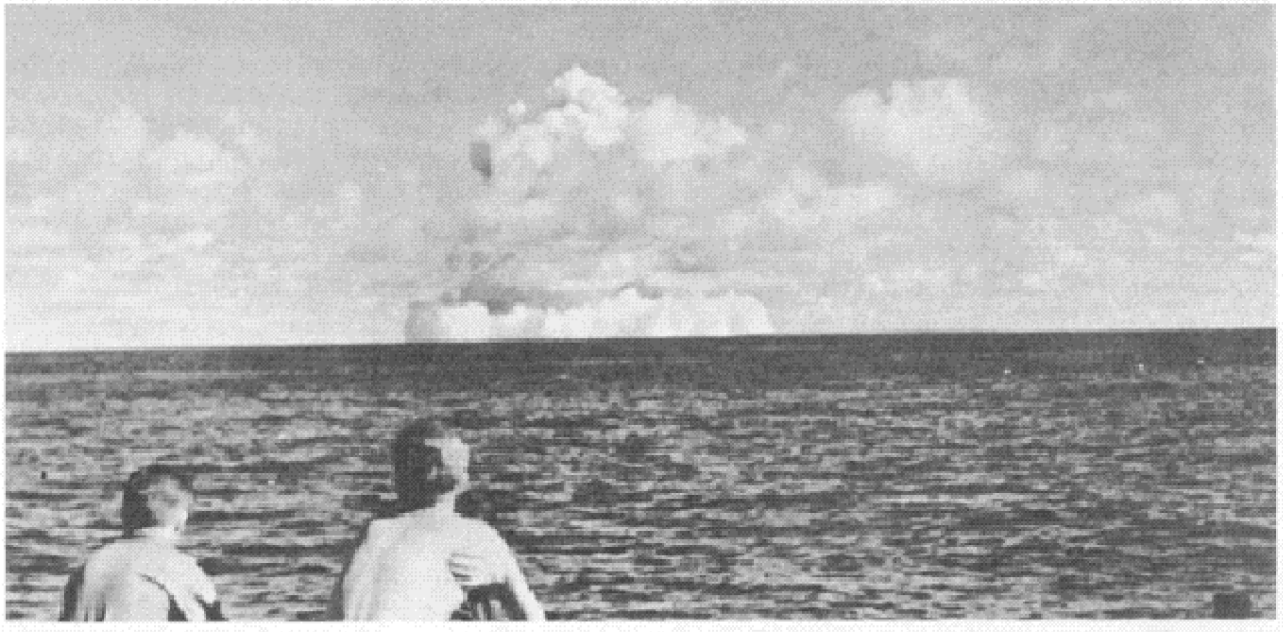


Figure 30. CROSSROADS, BAKER cloud as viewed from the manned support ships in their operating areas.

Table 11. Target ships sunk at CROSSROADS[a].

ABLE	BAKER	
USS Anderson (DD-411)	USS Arkansas (BB-33)	ARDC-13
USS Carlisle (APA-69)	LSM-60[b]	USS Apogon (SS-308)
USS Gilliam (APA-57)	USS Pilotfish (SS-386)	Nagato
USS Lamson (DD-367)	YO-160	USS Saratoga (CV-3)
Sakawa		

Notes:

[a]USS Dentuda (SS-335), submerged for test, flooded and sank; later it was raised and taken to Pearl Harbor and is not included in the ship sunk category. Six LCTs were sunk at Bikini after Test BAKER.

[b]Surface zero ship.

Sources: Reference A.1, pp. 130-132; Reference C.9.2, pp. 32-33.

Three air-sea rescue B-17s patrolled the area between Enewetak and Bikini to protect the six drone-control B-17 crews. Four drone-sampler B-17s took part in the test. Two were flown over surface zero at detonation time, one at 6,000 feet (1.83 km) and one at 16,000 feet (4.88 km). The one at 6,000 feet (1.83 km) had its bomb bay doors warped, its inspection plates blown open, the tail gunners hatch blown inside the aircraft, the canvas cover over the tail wheel split, and the standard aircraft cushions inside split open. The other B-17 drone jumped 300 feet (91 meters) in altitude but sustained no damage. The third B-17 drone sampled in the cloud at 7,000 feet (2.13 km) 5 minutes after the burst, and the fourth B-17 drone sampled above the cloud at 11,000 feet (3.35 km) 7-1/2 minutes after the burst. Three Navy F6F drones and their twelve F6F controllers took off from Shangri-La and sampled at altitudes of 14,000, 9,000, and 5,000 feet (4.27, 2.74, and 1.52 km). Only the drone at 5,000 feet (1.52 km) passed through the cloud. Sampling was completed by 0850 and all aircraft returned safely to base (Enewetak for the B-17s and Roi for the F6Fs). The airbags and filters were removed by Los Alamos Laboratory personnel and transported in the waiting C-54s to Kwajalein for analysis.

Eight B-29s and three WB-29s participated in shot BAKER. The radio broadcast, press, and command B-29s orbited the area accomplishing their missions at a safe distance. The two pressure-gauge drop B-29s dropped their gauges from 24,000 and 25,000 feet (7.32 and 7.62 km) just before the detonation. The two radiological reconnaissance B-29s tracked and photographed the remnants of the cloud until almost 1400 when they were relieved by two other B-29s. The three WB-29s were airborne by 0231 the morning of the detonation to report on cloud cover and other weather phenomena north and east of Bikini until 0500, when they returned to Bikini to provide current weather reports at that location. The three C-54 and eight F-13 Army aircraft were involved with transporting observers and photography (Reference C.9.206, Part VII, p. E195 through E207). All aircraft except the F6F had radsafe monitors aboard. As at Test

ABLE, the F6F pilots used earphones connected to Geiger counters to monitor radioactivity.

Early reports from radiological reconnaissance PBMs and drone boats indicated that the lagoon and surrounding atmosphere were intensely radioactive. A drone boat recorded about 730 R/24 hours near the center of the target array. The three PBMs made several passes over the lagoon on 25 July, starting at 4,000 feet (1.22 km), then at 3,000, 2,000, 1,000 and 500 feet (914, 610, 305, and 152 meters); the first pass was made at 0915 and the last at 1615. The preshot radex sector bearings of 360° clockwise to 220° were modified slightly at 0940 to 360° to 270°. The Red Arc was set at 9 nmi (17 km) from surface zero and the Blue Arc at 11 nmi (20 km) from surface zero (Reference C.9.206, Part VII, p. C-19).

Reentry into the lagoon commenced at 0916 when the PGM and LCPL radiological patrol boats with monitors aboard entered. They were closely followed by TU 1.2.8 and Kenneth Whiting. Fall River took up its position at the lagoon entrance at 0947 to control entry and exit. The Salvage Unit (TU 1.2.7) entered the lagoon at 1015 and began checking and boarding target vessels. A total of 49 support ships with 14,920 personnel entered the lagoon by the end of 25 July.

For BAKER, ten initial boarding teams were established, a total of 86 men, including one monitor for each team. These teams were the first groups to return to the target vessels, although five of the firefighting officers may not have actually reboarded unless there was a fire to fight (Reference B.0.1, pp. X-X-1 through X-X-17). In addition, representatives of the groups responsible for the scientific experiments and tests of military equipment returned to retrieve data and materials when given permission by the monitors. Film and other data were recovered from Bikini and Eneu islands during the afternoon. Twelve target ships were temporarily boarded, ten of which were declared radiologically safe (no radiation measured above 0.1 R/24 hours) before nightfall on 25 July (Reference C.9.206, p. VII-C-53). The remaining target ships were too radioactive to board and the water near the detonation site remained radioactive as well (Reference C.9.206, p. VII-C-54).

The radioactive cloud had apparently moved north of the burst. Radiological reconnaissance F-13s discovered weak radioactivity while flying 43 nmi (80 km) north of the lagoon at 1318 and a highly radioactive cloud at 80 nmi (148 km) almost directly north of Eneu Channel at 1610 (Reference C.9.206, Part VI, p. D13). An F-13 due west of Bikini at 50 nmi (93 km) made no contact with radioactivity by 1415. Apparently based on this information, the alert at Enewetak Atoll west of Bikini was dropped at 1418 and clearance was given to return evacuees there (Reference C.9.206, Part VI, p. D13).

At about 1608 Saratoga sank (Figure 31). Until that time it had been the oldest U.S. aircraft carrier afloat. Saratoga was laid down as a battle cruiser in 1920, but was completed as an aircraft carrier. Radiological conditions prevented any attempt to save the ship.

The radioactivity persisted through 26 July. Films from cameras on Aomen Island were recovered using helicopters. An oil slick with radioactive debris

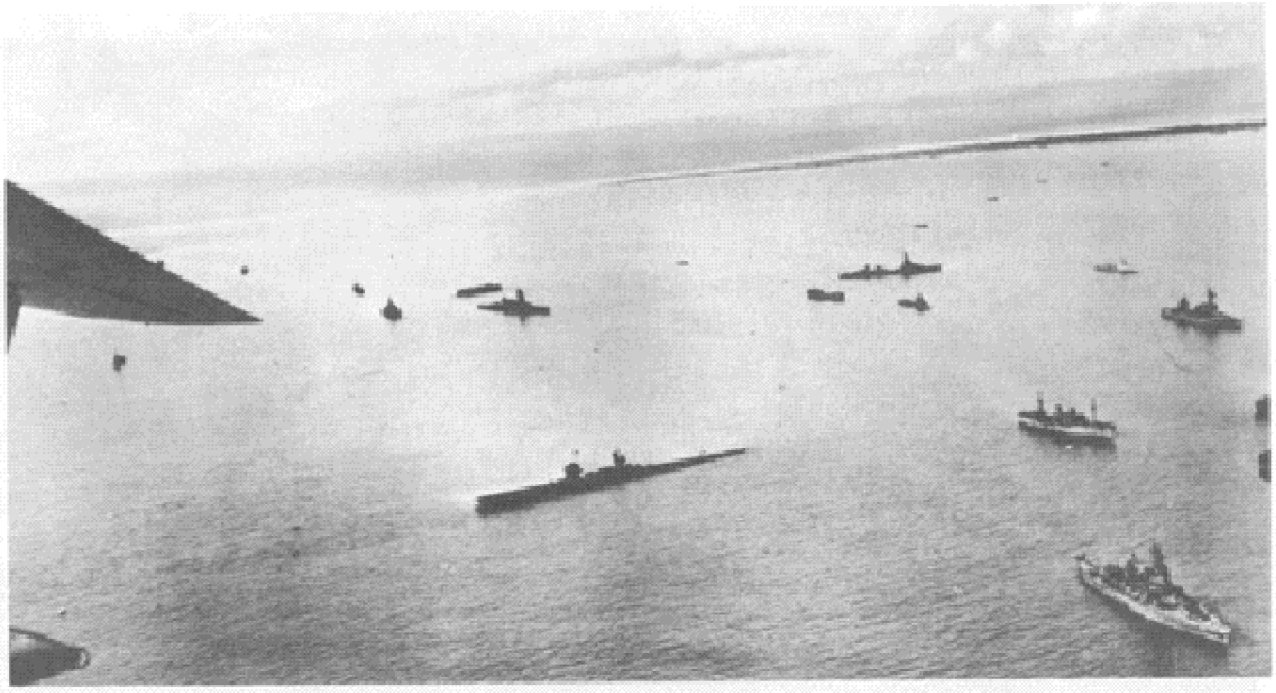


Figure 31. USS Saratoga (CV-3) sinks following CROSSROADS, Test BAKER.

was observed north of Nam Island (outside the lagoon). Task force ships in the lagoon stayed in the southeast sector near the entrance in order to keep clear of the radioactive water. Their evaporators were allowed to be used on 26 July. The target ship USS Hughes (DD-410) was towed to Eneu and beached by USS Reclaimer (ARS-42) to prevent sinking. Figure 32 shows a welder aboard Hughes during preparations for towing. Note the respiratory protection device being worn and the nearby monitor. The same situation persisted on 27 July; however, some instrumentation was recovered from the target ships. USS Preserver (ARS-9) attempted to get a line aboard the damaged and heavily contaminated USS Fallon (APA-81) so that it could also be beached beside Hughes. This could not be accomplished until the following day, however.

Because of the persistent radiation in the lagoon, several radiological reconnaissance flights took place over the next few days. Eight missions were flown on 26 July and two on 27 July. Five photography flights were made on 26 July and four on 27 July. Six drone boat control TBMs flew on 26 July and two on 27 July. Photo and radiological reconnaissance flights continued through 30 July, while drone boat control flights were not needed after 28 July (Reference C.9.206, Part VII, S, Encl 13-14).

On 28 July, radioactive water in the lagoon spread southeast to some of the task force ship anchorage areas, forcing some ships to relocate to uncontaminated areas. However, the Red Line (1 R/24 hours) was eliminated at 1455 on 28 July. On 28 July at 2352, Sumner reported readings of 0.156 R/24 hours on outboard bunks and 0.204 R/24 hours at the evaporators. On 29 July it was sent out of the lagoon and into the open sea in an attempt to decontaminate the hull. PGM-24 and PGM-29 had become contaminated earlier, reading 1.56 R/24 hours amidships. Their crews were evacuated to USS Appling (APA-58) and Haven.

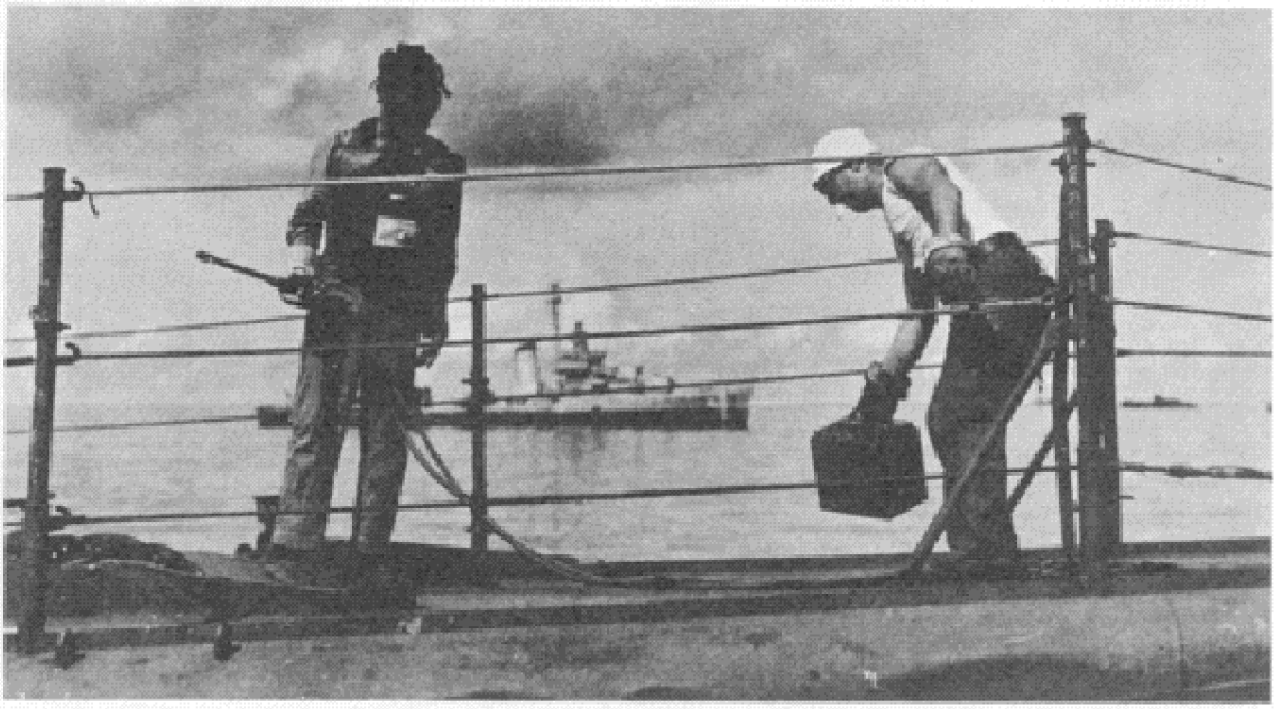


Figure 32. Welder aboard USS Hughes (DD-410) during preparations for towing it after CROSSROADS.

Some test animals were recovered from target ships (USS Bracken [APA-64], USS Catron [APA-71], and USS Fillmore [APA-73]) on this date. Also, attempts to surface the submarines that had been submerged were begun. The next day more animals were removed from Catron, USS Briscoe (APA-65), and Gasconade.

By 29 July it was apparent that the target fleet was much more heavily contaminated than had been expected. The inspection and documentation of BAKER's effects -- a major reason for CROSSROADS -- could not proceed if target vessels were too contaminated for reboarding and thorough examination. The effort to develop and apply decontamination methods to the target fleet are described in Chapter 5.

During the fourth night after BAKER, the captured Japanese battleship Nagato sank. The next day, resurfacing of submarines continued, as did the recovery of animals from target ships. The radiological situation improved slightly, allowing a few more target ships to be boarded. Pieces of highly radioactive steel, believed to be from LSM-60, were found on the quarterdeck of USS Pensacola (CA-24) (Reference C.9.206, P VI-D-45). Figure 33 shows a monitor amidship on Pensacola and illustrates the general level of damage on its weather decks.

On 30 July most target ships remained too radioactive for boarding; however, radioactivity of the lagoon waters continued to decrease. The Blue Line (0.1 R/24 hours) was eliminated at 1041 on 30 July (Reference C.9.206, p. VII-C-23), although a report from Burleson stated that between berths 113 and 115 a reading of 0.1 R/24 hours was obtained 3 feet (0.9 meter) above the water's surface on 30 July (Reference C.10.17).

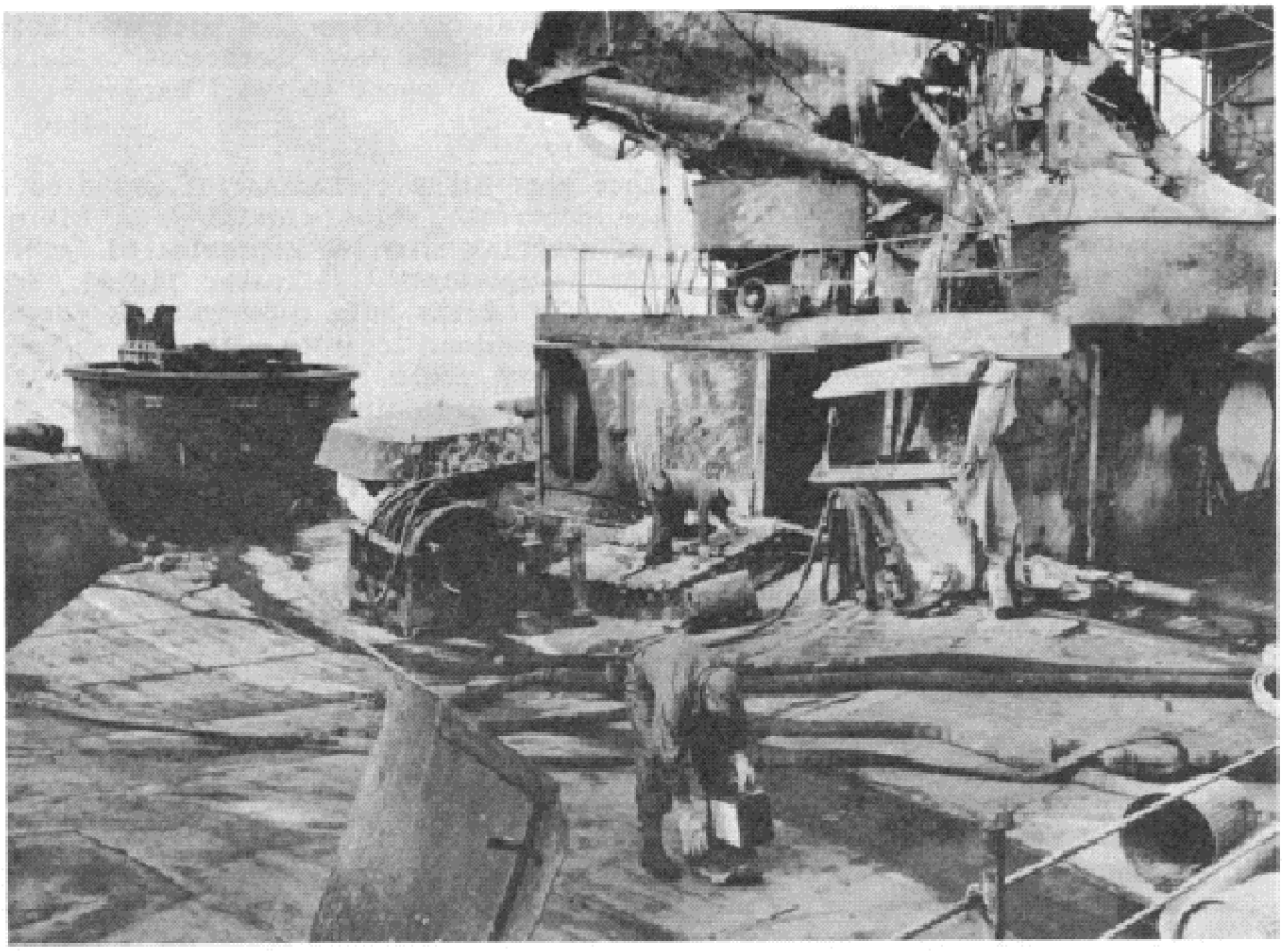


Figure 33. Monitor amidship on USS Pensacola (CA-24) after CROSSROADS, BAKER.

On 30 July the last of the animals were removed from Gasconade and Conserver. Although most animals were located below deck, the great majority of them died by 1 November 1946. In nearly all cases, the cause of death was gamma radiation resulting from Test BAKER's radioactive rainout and base surge (Reference C.9.208, p. 8). Also, many of the fish in the northeast corner of the lagoon were killed by the explosion.

On 31 July, Bikini Island was declared safe and personnel were permitted to go ashore. The beaches were declared off limits, however, because of radioactive debris that may have washed up. Many target vessels still remained too contaminated to board and the persistent radioactivity on these ships made the prospect of reboarding "very discouraging" (Reference C.9.206, Part VI, p. D48). Three submarines remained submerged in the lagoon. The lagoon water, except near the bottom, had reached safe levels by the evening of 31 July. Complete recovery of instrumentation and records was not completed until 7 August (Reference C.9.206, Part VI, p. D5-47).

On 8 August CJTF 1 requested authority from the Chief of Naval Operations to decommission, or place out of service, 38 target vessels at Bikini. He

argued that the ships were in such radiological condition that with available personnel and equipment they could not all be made safe (Reference C.10.11) for the work needed either to prepare them for movement to Pearl Harbor or to assess their damage fully (Reference C.10.17).

By 11 August it was recognized that post-BAKER contamination was also a continuing and increasing problem for nontarget ships remaining in Bikini Lagoon (Reference C.10.14). Radioactive material from the contaminated lagoon was accumulating in the support ships' evaporators, saltwater piping, and marine growth on the outside of their hulls. Plans were made to move target vessels and support ships to Kwajalein, a convenient location with good anchorages, where the problems resulting from BAKER could be faced free from the environmental contamination present at Bikini. Beginning 19 August, 53 target ships were towed to Kwajalein and by 5 September the last of the target fleet had left Bikini.

CHAPTER 5

POST-BAKER OPERATIONS: BIKINI, KWAJALEIN, AND THE UNITED STATES

In early August it became apparent that while the radiation levels in the water and on the land areas were below tolerance levels, the accumulation of radioactivity in the remaining ships' evaporators, saltwater piping, and marine growth on their hulls presented an increasing problem. Consequently, the base of operation of the task force had to be moved from Bikini. Kwajalein Atoll was selected for the new base (Reference C.0.22, p. 1). On 19 August 1946, movement of all remaining ships to Kwajalein was initiated, and by 26 September 1946 Bikini Atoll was completely evacuated. Subsequently, a large number of them were sunk, others were returned to naval shipyards in the United States for inspection and additional decontamination.

The experience, problems, and solutions associated with ship decontamination at Bikini and in naval shipyards and a discussion of radiological and other problems associated with off-loading ammunition from target ships and securing them at Kwajalein are addressed in this chapter.

REMANNING LIGHTLY CONTAMINATED TARGET SHIPS AT BIKINI

Five target vessels, attack transports USS Bladen (APA-63), USS Cortland (APA-75), USS Fillmore (APA-83), USS Geneva (APA-86), and USS Niagara (APA-87), were on the outer fringes of the target array and were not heavily contaminated by the rainout or the base surge (see Figure 28, Chapter 4). The crews of Bladen, Fillmore, Geneva, and Niagara returned to their ships on 29 July, and Cortland's crew returned on 30 July (Reference A.3, Bladen, Cortland, Fillmore, Geneva, and Niagara).

The ships needed some decontamination work (Reference C.9.185, pp. 4 and 10). Although the radioactivity on these ships' weather surfaces was not sufficient to prevent reboarding and cleanup work, they were found to have radioactivity on the outside of their hulls at the waterline, apparently because marine growth there was taking up radioactive isotopes from the lagoon water. Radioactivity was 0.4 R/24 hours on the inner surface of Niagara's hull, decreasing to 0.1 R/24 hours 5 feet (1.5 meters) toward the center of the ship (Reference C.2.1). After the waterline areas of the five ships were scraped, they steamed in the open ocean for 24 hours in an effort to reduce contamination. Niagara steamed alone on 1 and 2 August and the other four steamed as a group on 4 and 5 August (Reference A.3, Bladen, Cortland, Fillmore and Geneva). In addition, Geneva's entire bottom was scraped by passing wires under the hull from one side to the other and pulling them toward the stern (Reference C.9.185, p. 18). Upon reaching Pearl Harbor, the small boats of both Cortland and Fillmore were found to be radioactive (References C.2.4 and C.2.5).

DECONTAMINATION OF HEAVILY CONTAMINATED TARGET VESSELS AT BIKINI

Decreasing lagoon radioactivity by 27 and 28 July allowed the Director of Ship Material (DSM) aboard USS Reclaimer (ARS-42) to survey other target ships from a distance of 50 to 100 feet (15 to 30 meters). Of the 92 target vessels, only 10 ships in the target array and 20 landing craft beached on Bikini islands had readings less than 0.1 R/24 hours by 2000 on 3 August (Reference C.11.19). Since "the nature and extent of contamination of the targets was completely unexpected, no plans had been prepared for organized decontamination measures" (Reference C.9.185, p. 4). As a result, the Technical Director and the DSM could not complete their programs in a timely way unless a means could be found to decontaminate the target vessels.

Washdown of Target Ships

After conferring with members of the Radiological Safety Section, the DSM took the lead in trying to remove contamination from the target vessels with materials and equipment immediately available to the task force at Bikini. First, task force firefighting equipment was used. Use of firefighting equipment is shown in Figure 34 as USS Achomawi (ATF-148) uses its forward monitor to wash down USS New York (BB-34).

Firefighting vessels of Task Unit (TU) 1.2.7, the Salvage Unit, twice attempted to wash down the heavily contaminated USS Hughes (DD-410) with saltwater on 27 July. The first effort produced a 50 percent reduction in radiation levels, but the second did not lower the radiation level. Next, foamite, a foam-like preparation used for smothering fires, was tried. Foamite was plentiful and was hoped to have a detergent action on the contamination adhering to Hughes. Fireboats sprayed Hughes with foamite and then with saltwater. Figure 35 shows the beached Hughes whitened by the foamite as two Salvage Unit ships stand by.

The reduction in radioactivity led to a decision to use foamite and saltwater until a better method was devised. The foamite and saltwater method, however, could be used only after waiting for the lagoon water to become virtually free of contamination. Radioactivity from the lagoon would itself contaminate both target and firefighting ships. Moreover, because the foamite and saltwater method was not totally effective, a search for better methods continued (Reference C.9.185, pp. 5 and 6).

Early Experiments in Decontamination

At a meeting on 27 July, attended by the DSM and members of the Radiological Safety Section, the radiological safety (radsafe) group was directed to study the decontamination problem. It selected pieces of contaminated equipment and blasted them with ground corncobs, coconut shells, barley, rice, ground coffee, rice hulls, and sand. Sandblasting worked best, but it was not suitable for general decontamination of the more than 60 contaminated vessels of the target fleet (Reference C.9.185, pp. 6 and 7).

Observation had revealed that most radioactivity stemmed from radioactive material collecting on painted or rusty surfaces, or on exposed organic materials, such as canvas, life rafts, manila lines, swabs, brooms, wood decks,

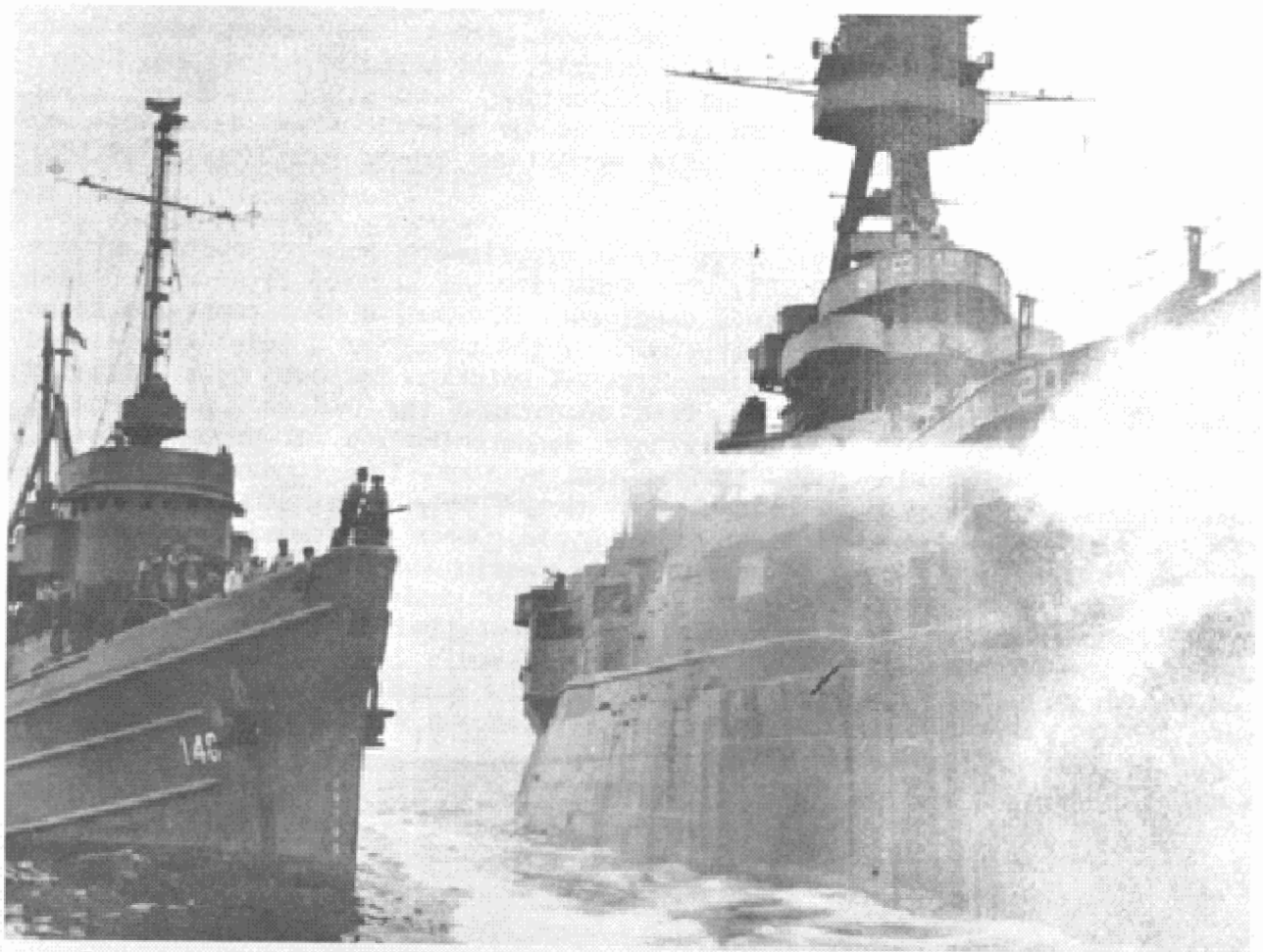


Figure 34. USS Achomawi (ATF-148) spraying USS New York (BB-34) with saltwater after BAKER, CROSSROADS.

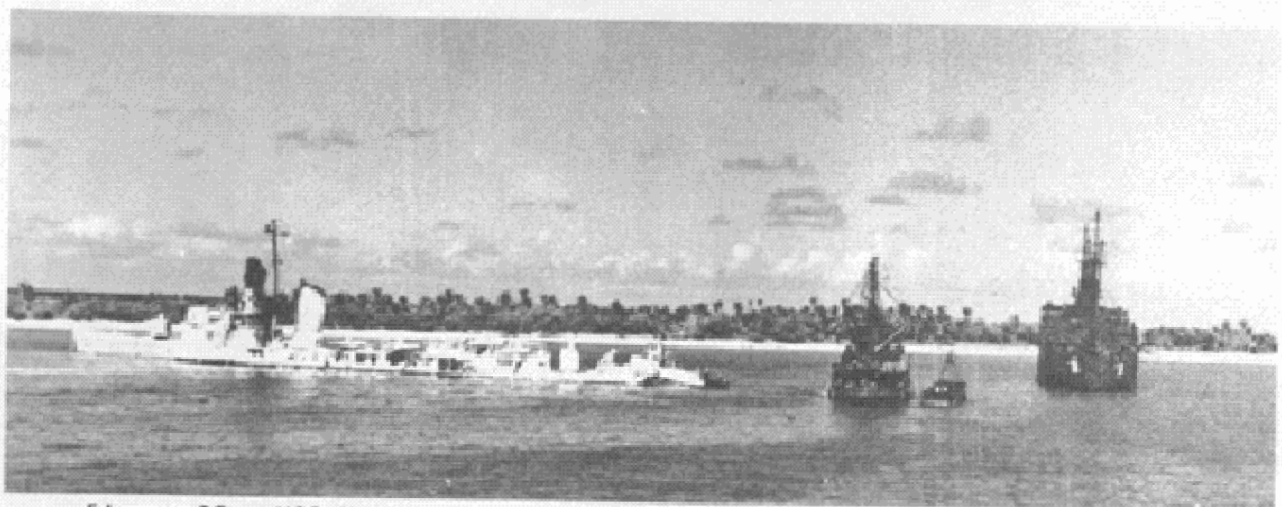


Figure 35. USS Hughes (DD-410) beached off Eneu Island, covered with foamite following BAKER, CROSSROADS (two Salvage Unit ships are to the right).

and tar and caulk used to plug seams. On 28 and 29 July, the DSM conducted a small-scale laboratory study on painted wood, steel, and canvas using soap powder, lye and naphtha; acetic, hydrochloric, and sulfuric acids; and flour, cornstarch, activated charcoal, and sandblasting. Removal of the outer layer of paint or removal of the rust proved to be an effective, if laborious, approach. Apparently only acetic acid worked on canvas (Reference C.9.185; Reference A.2, p. 109).

From 28 through 30 July, large-scale experiments were conducted on the target submarine USS Tuna (SS-203). The submarine was sprayed first with diesel oil, which proved ineffective as a detergent. However, a 66 percent reduction in radiation level was observed after much of the submarine's paint was removed by applications of a lye and boiler compound solution followed by a saltwater rinse (Reference C.9.185, p. 8). This encouraged the DSM to issue general instructions on 31 July for preliminary decontamination of target vessels, followed on 4 August with more detailed instructions. The procedure called for the fireboats to spray each contaminated target ship with saltwater and with the lye and boiler compound solution if needed. Once the radiation level was reduced to the point where personnel could remain for at least 2 hours, the ship's crew was to work in relays thoroughly scrubbing the ship. Figures 36 and 37 show ships' forces scrubbing an unidentified submarine and a ship. Clearly, the DSM expected that this procedure would lead to radiation levels low enough to allow continuous habitation of the ships so that they could return to home ports under their own power (Reference C.9.187, pp. 4, 7, and 10).



Figure 36. Work crews scrubbing down an unidentified target submarine, CROSSROADS.

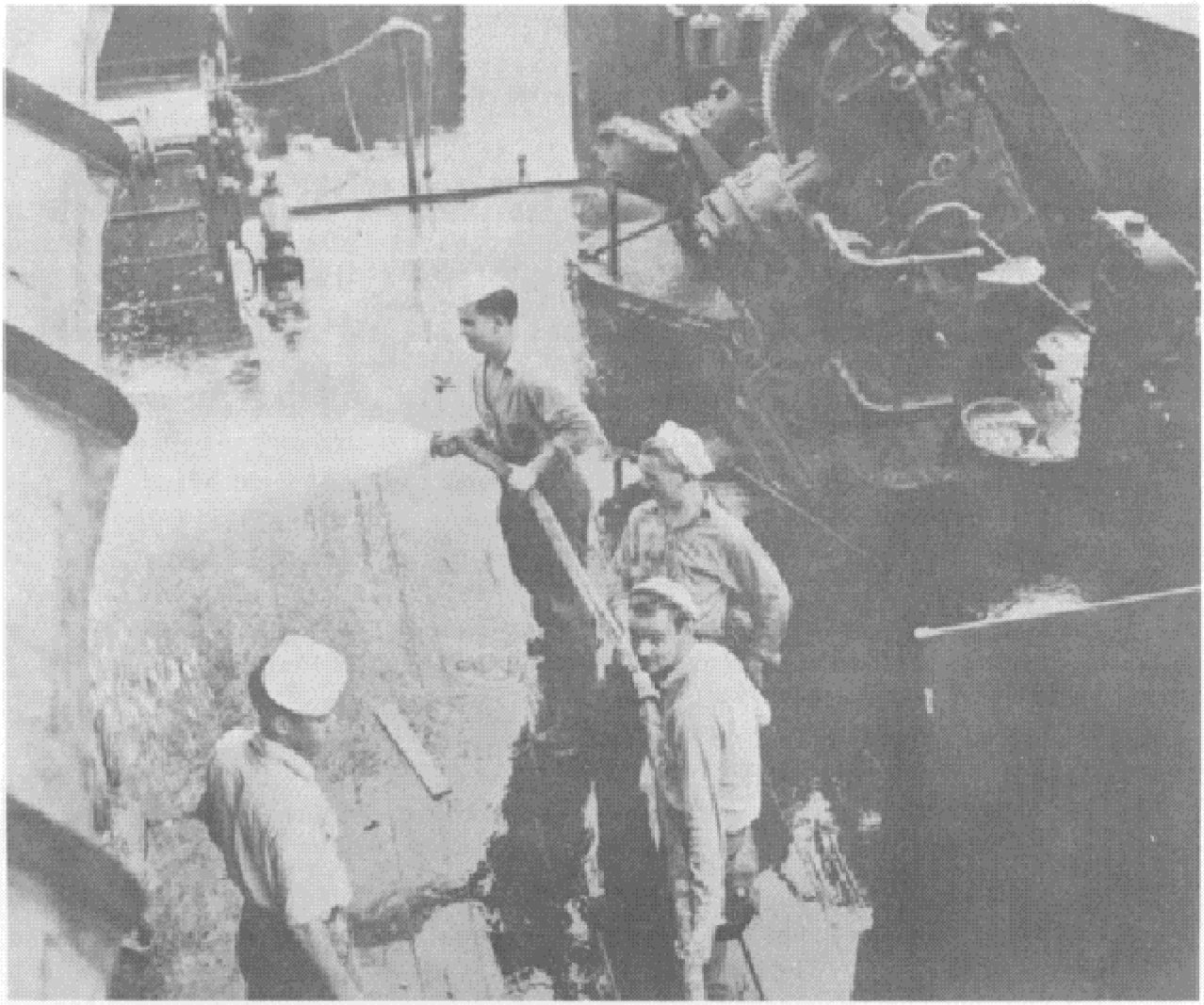


Figure 37. Work crews use a firehose on the superstructure of an unidentified target ship, CROSSROADS.

Radiological Safety Considerations During Decontamination

Radsafe precautions, also promulgated as part of the decontamination procedures, included these instructions (Reference C.9.187, pp. 5 through 7):

1. Monitors were to be present at all times while the work was in progress
2. Personnel were not to overstay the time limit set by monitors
3. All personnel were to be fully clothed, and to shower and change clothes after finishing decontamination work
4. All clothing worn during decontamination work was to be laundered before rewearing
5. Personnel were to remain upwind of spraying and washing operations

6. K-rations and water in canteens for decontamination crews were to be brought aboard daily

7. "Radiological dangers" were to be clearly marked and, if necessary, roped off.

The Chief of the Radsafe Section (who was also entitled Radsafe Advisor) in a memorandum to Commander Joint Task Force 1 (CJTF 1), however, warned on 3 August of various problems and hazards. He wrote that high residual radiation on and in most target ships presented "an extremely difficult and dangerous problem," about which basic decisions had to be made soon. Early radiation surveys and decontamination experiments had led him to the following conclusions (Reference C.0.20):

1. The contaminated decks and superstructures of the target fleet totaled about 100 acres (40.5 ha)

2. In most cases, dangerous contamination remained even after strenuous decontamination efforts

3. Some ships were badly contaminated below decks, and the task force had no way to deal with it

4. No practical method had been found to decontaminate wooden or rusty surfaces short of removing the contaminated outer layer of the material

5. Most decontamination methods possible, other than water washing, were themselves potentially hazardous

6. The need for thoroughly washing the bodies and the clothes of boarding party members was putting a severe strain on the freshwater supply.

Moreover, the memorandum observed that even after repeated washings decks and superstructures of important target ships remained contaminated to levels between 1 and 10 R/24 hours. Average and maximum readings for CROSSROADS target vessels are given in Appendix F. These levels were high enough to severely restrict the amount of time men could work on ships without risking overexposure. Furthermore, months would pass before natural decay would lower intensities to the point where crews could occupy and operate the ships. Overexposures had been a problem in the work so far and probably would continue to be. The Chief of the Radsafe Section was concerned that even if exposures could be kept at or below 0.1 R/24 hours, over the long term they might cause sterility, anemia, and genetic damage, the latter of particular concern because the majority of the men were young. Finally, the departure on 15 August of 350 monitors and other radsafe personnel would leave about 24 military and a few civilian personnel to protect the many working on the over 70 target ships.

Consequently, to reduce the potential for radiological risk, the Chief of the Radsafe Section recommended that (Reference C.0.20):

1. The time until 14 August be spent working on relatively uncontaminated vessels and those of greatest value to the task force

2. Other target vessels, such as USS Independence (CVL-22) and USS Pensacola (CA-24), be declared hopelessly contaminated and beached to let their radioactivity decrease by natural decay

3. Scientific equipment be retrieved where it was safe to do so.

Decontamination Operations

Decontamination operations encountered the same basic obstacle that had been encountered during the program to develop decontamination methods. The radioactive particles were firmly attached. Initial efforts produced significant results by removing lightly attached radioactive particles, but more deeply embedded radioactivity could be reduced only slowly by additional hosing and scrubbing. The exact number of men involved in the decontamination effort cannot now be determined, but 41 percent of the task force personnel was assigned to units involved in decontamination, inspection, towing, or salvaging. Many of these personnel, because of their skills or occupations however, were not directly involved in that work. The brunt of the reboarding and decontamination effort was borne by the 8,463 target ship crewmembers, although it appears that only a portion of them actually worked on contaminated ships. See Chapter 12 for a discussion of personnel exposures.

On 7 August, in another memorandum to CJTF 1, the Chief of the Radsafe Section argued that under the conditions at Bikini it was not possible to decontaminate the target vessels without exposing personnel to a serious radiation hazard. Safety measures on target vessels were deteriorating, and adequate monitoring personnel and instruments were no longer available. Contamination was erratically distributed so that an individual's exposure could not be estimated. The potential of inhalation of contamination was a major concern. Furthermore, the untrained men doing the decontamination work could not be expected to follow safety precautions consistently (Reference C.0.14).

On 8 August, CJTF 1 asked the Chief of Naval Operations (CNO) to allow him to decommission, or place out of service at Bikini, 39 target vessels because with the resources at hand (Reference C.10.11):

> They cannot all be made absolutely safe to board in the near future for sufficiently long periods to either prepare them for movement to Pearl [Harbor] or to assess fully in all cases the damage sustained.

During this period, problems developed in strict enforcement of radsafe regulations. Inadequate supervision of men doing decontamination work on Prinz Eugen and New York was reported (References C.0.11, C.2.2, and C.2.3). Monitors visiting Prinz Eugen noted an apparent indifference among the ship's officers to the 0.1 R/24 hours standard, and the monitors suspected some men had been on the ship overnight (Reference C.2.2). As a result there was concern that unbadged working parties aboard the target ships might have overexposures similar to those recorded by their monitors (Reference C.0.8). No substantiation of these serious allegations about activities on Prinz Eugen can be found in the ship's deck log or that of USS Rockingham (APA-229) where its evacuated

crew was berthed. The decontamination report (Reference C.2.54) written by Prinz Eugen's commanding officer on 13 August appears to indicate a definite concern for radsafe matters.

The officer in charge of target ship monitors complained that work on the target ships had increased to the point where his men could not adequately protect the decontamination crews. As an example, he described the situation on USS Salt Lake City (CA-25), where from 3 to 7 August four of six monitors received exposures in excess of 0.1 R/24 hours, along with twenty other personnel of the ship's working teams (Reference C.0.11). On 10 August, the Medico-Legal Board recommended that work cease on Salt Lake City until 20 September, and the board's chairman in a minority report called for the ratio of monitors to decontamination personnel be increased from one to sixteen to one to ten and for all personnel working on target ships to be badged (References C.0.8 and C.0.21).

Discovery of Plutonium Contamination

Into this situation a new element was introduced (Reference C.9.185, p. 13):

> On 9 August, The Director of Ship Material requested the Radiological Safety Officer and the Commander Target Group to visit ships on which ship's forces were employing the detailed decontamination procedures. During that inspection, samples of materials were obtained from areas of the wardroom of PRINZ EUGEN for which geiger counter readings showed radiation intensities sufficiently low to permit extended personnel exposure [8 hours] without danger of injury. An analysis of the samples revealed the presence of alpha emitters which were not detectable with monitoring instruments in use at Bikini. Further investigation showed probable widespread presence of the alpha emitter [plutonium] in the target area even in spaces not obviously contaminated.

It is unfortunate that this discovery, which so markedly affected subsequent CROSSROADS operations, is so poorly reported in the surviving documents. The only direct reference is the quotation above from the DSM report. It is not mentioned in the portion of the Technical Director's Report devoted to nuclear radiation (Reference C.9.209, Enclosure J), and although allusions to the existence of plutonium contamination and reports of laboratory determinations of the presence of plutonium can be found in the voluminous collection of papers of the Radsafe Section Chief, these do not appear to directly relate to Prinz Eugen.

The Chief of the Radsafe Section and his staff probably did not directly detect alpha emitters on Prinz Eugen. Instead, indirect evidence convinced them the hazard existed.

The difficulty of directly measuring alpha emissions with the field instruments of 1946 has been discussed earlier. The Radsafe Chief in a speech in 1947 said that beta activity was measured and then a ratio used to calculate alpha activity (Reference C.12.4, p. 23). Direct determination of alpha

contamination were made by removing samples to laboratories where analyses could be made. Field assessments were made by assuming that the alpha emitter plutonium was mixed with the other weapon debris, made up of fission products and activated materials. The ratio of this mixture was apparently assumed to be constant so that there was a ratio between the measurable radiations, gamma and beta, emitted by the fission products and activated materials and the unmeasurable alphas from the unfissioned plutonium. Since the emissions from the beta and gamma emitters decayed while the alpha emissions remained nearly constant, this ratio changed with the passage of time -- but in a way that was predictable.

The laboratory on Kwajalein operated by Los Alamos informed the Radsafe Advisor that on BAKER day + 13 (7 August) 4.5 alpha counts [per minute] per square centimeter of contaminated area could be expected when a survey meter gave a reading of 1 R/24 hours (presumably gamma) (Reference C.10.16). This theoretical determination was made in conjunction with samples that had been taken on 7 August from the forward lookout platform of New York. These samples had been collected by using concentrated hydrochloric acid to dissolve the paint and surface material, which were then collected for analysis. The result was forwarded by teletype to the Chief of the Radsafe Section on 10 August and stated that the reading in the collected material was 25 alpha counts [per minute] per square centimeter [of the contaminated platform] for a [gamma] reading of 3 R/24 hours. The laboratory said that this count was twice as high as expected due to "washing." By this it is presumed the laboratory meant that the fission and activation products had been more easily washed away during decontamination activities before 7 August than had the plutonium particles. It should be noted that this anaysis took three days from sample collection to report.

The account from the DSM report continues (Reference C.9.185, p. 13):

> A conference was called by the Task Force Commander on 10 August to discuss the matter [Prinz Eugen contamination]. As a result of this conference, continuation of detailed decontamination was considered unsafe under the existing conditions, and all further decontamination work on the targets by ship's force was ordered discontinued. Subsequently, all further work on these vessels by Task Force Personnel was limited to recovery of instruments, limited surveys, salvage work and preparations for towing from the area.

Judging from the time required to analyze and report the New York samples, it does not appear that the samples from Prinz Eugen taken on 9 August could have been analyzed by the next day.

There is a further difficulty with this sole surviving account of the discovery. It appears in the last sentence of the first quotation wherein "widespread presence . . . in spaces not obviously contaminated" is deemed "probable." If "not obviously contaminated" means not easily measured with existing field survey meters, then the statement is not confirmed by surviving records of the measurements that were taken of alpha contamination. Reports available after 4 September on alpha contamination in samples taken from the target vessels and sent back to Los Alamos for analysis show that alpha emissions were always reported in conjunction with gamma and beta emissions.

It seems more reasonable to assume that the phrase "not obviously contaminated" refers to more obvious criteria such as visible deposit of coral sand or presence of blast damage. What had actually been discovered was radioactivity in places that, because they were below decks or closed, were not expected to be contaminated. This probably was announced in an undated memorandum from the "Pill Counting Lab" (presumably the laboratory on USS Haven [AH-12] set up to analyze Program VII activation samples) to the Radsafe Advisor. The subject was "Dust Samples Taken in Crew Spaces on Prinz Eugen 9 August 1946." The memo states that B counts (the typewriter perhaps lacked Greek characters and this refers to beta counts) on four dust samples taken from certain given crew spaces were made and the results were from 0.00005 to 0.68 mc (perhaps microcuries) per gram of dust. This memo further states that the background radiation measured in these spaces by an X-263 meter was 0.10 R/24 hours (Reference C.11.31).

This discovery, along with the assumption of the presence of plutonium wherever there was any radioactive material, led to the inference that plutonium had been discovered. This assumption was perhaps reinforced by the New York data that showed that plutonium was actually present in paint on the lookout platform. That information became available the same day as the CJTF 1 conference.

This interpretation of the events is strengthened by a telegram sent by the Radsafe Section Chief to the United States on 13 August and probably intended for the Oak Ridge Laboratory of the Manhattan Engineer District (Reference C.11.29).

> UPON USING RATIONAL [sic] ALPHA BETAS FURNISHED BY YOU FIND INNER COMPARTMENTS ALL TARGET SHIPS HIGHLY CONTAMINATED BY ALPHAS.

The reference to the ratio provided may refer to the results of analysis of ABLE or BAKER cloud samples done at Oak Ridge and made available at some time before 9 August.

In the light of what the surviving records show to be the actual knowledge of the degree of plutonium contamination, the decision to halt all further decontamination work appears to have been prudent and conservative. As the Medico-Legal Board recorded at their 13 August meeting at 1300 (Reference C.0.9.a):

> For safe guidance of the Operations from this time onwards, we need to know:
>
> a. The number of alpha particles per second per square centimeter
>
> b. The alpha tolerance for different types of surfaces.

Furthermore, special clothing and intensive training would have been required if major work on the target ships was to continue. According to a senior radsafe official (Reference C.11.4, p. 2):

> In the laboratory, radioactive material was handled by remote controls. At Bikini, it was scattered over the decks of the ships. Men walked through it, tracked it around, and got it on their clothing and hands and faces. There was some tendency on the part of the men to disregard a danger which they could not see, nor touch, nor smell. It was known that the men could not taste the radioactive material. But they could eat it! The situation was fraught with grave danger if the enlisted men could not be trusted to do exactly as he was told. It became apparent that it would be necessary to subject these men to long periods of training before they could be expected to abide by the precautions which are commonplace in a nuclear laboratory.

On 4 September, Los Alamos reported by message an analysis of samples taken from target ships that showed measured levels of alpha contamination. The maximum alpha reading came from USS Skate (SS-305) periscope mast sample, reportedly taken on 19 July. This pre-BAKER test date conflicts with the DSM final report of late 1946, which states that no extensive deposits of alpha emitters were found following Test ABLE (Reference C.9.185, p. 3). This fact, plus additional circumstantial evidence, suggests that the date was a typographical error, and should have read 19 August (Reference C.13.12). The periscope mast sample read 1,830 alpha disintegrations (assumed to be disintegrations per minute per gram [dpm/gm]) and 9,100,000 beta disintegrations for a beta-to-alpha ratio of 5,000 to 1. Other Skate readings were:

> Bow -- 28 alpha dpm/gm, 93,400 beta dpm/gm, ratio 3,500
>
> Frame 120 -- 0 alpha dpm/gm, beta 9,160 dpm/gm
>
> Base of 5-inch gun -- 50 alpha dpm/gm, 115,000 beta dpm/gm, ratio 2,300.

Four samples from USS Wainwright (DD-419) collected on 18 August show alpha counts of 263 (beta-to-alpha ratio 3,500), 12 (ratio 2,500), and two zero alpha counts, but both of the latter with beta.

Three samples of unknown collection date, two from USS Searaven (SS-196) and one from USS Parche (SS-384), show alpha counts of 38 (beta-to-alpha ratio 1,400), 28 (beta-to-alpha ratio 66,000), and 23 (beta-to-alpha ratio 5,600) (Reference C.11.2).

A later analysis of 31 samples from 23 target ships all indicated the presence of alpha radiation. All but six of the samples had less than 10 dpm/cm^2. Nine of the samples were 1 dpm/cm^2 or less. The highest reading was a sample from USS LST-52, at 183 dpm/cm^2 and a beta-to-alpha ratio of 677. After Test BAKER, it was calculated that LST-52 received one of the highest radiation exposures from deposition of material in the rainout and base surge (Reference C.11.28).

There were also some later determinations at the San Francisco Naval Shipyard of alpha contamination of support ships. These are discussed later in this chapter.

Cessation of Bikini Decontamination Efforts

As a result of the 10 August conference, decontamination efforts stopped but apparently someone proposed at a 12 August conference that the capital ships be entered for the purpose of starting their engines and machinery to pump them out and thoroughly inspecting their internal structures. The reply was a staff CJTF 1 memorandum to Commander Task Group (CTG 1.2), dated 13 August and signed by the Chief of the Radsafe Section. The tone of this document can only described as stern and didactic. It dismisses the argument that the low gamma readings would permit such operations with a terse, "This is not the case," and continues, "The widespread presence of an alpha emitter has been demonstrated." The memorandum then catalogs the sources of possible exposure of personnel on the target ships, introducing the list with the statement, "The following facts have been observed in these vessels." It concludes with several "uncontestable conclusions." These conclusions amounted to a denial of the request to enter the ships on a large scale (Reference C.11.30).

It was directed that no one go aboard ships after 14 August without a badge. However, while the percentage of badging does increase after 14 August, 100 percent badging was not achieved. Only recovery of instruments, limited surveys, salvage work, and preparations for towing were allowed (Reference C.9.185, p. 13; Reference C.11.3). Virtually no target ships were boarded on 11 August, and only a few on 12 August. Beginning on 13 August some limited decontamination was done as part of the effort to ready the ships for towing. Inspections of target ships were conducted between 13 and 19 August.

CTG 1.2, however, requested that restoration work on USS Carteret (APA-70), USS Conyngham (DD-371) and Wainwright be continued. All surfaces of spaces to be occupied by personnel for working, berthing, or messing were to be painted, presumably to prevent alpha emitters from becoming airborne or being picked up on the men's clothing or skin (Reference C.10.2). In the end, however, only Conyngham was decontaminated sufficiently to be remanned. On 28 August, it departed Kwajalein for Pearl Harbor under its own power, arriving there on 6 September (Reference C.0.3, p. 3; Reference C.9.206, p. V-(D)-6). On advice from the Radsafe Section, all work on Carteret and Wainwright ceased on 18 August. The crews of both ships were transported home on 20 August because of possible overexposure to radiation (Reference C.0.3, p. 3).

Although radiation levels in the lagoon and on the atoll's islands were below tolerance levels, the accumulation of radioactivity in the support ships' evaporators and saltwater piping and in the marine growth and rust on their hulls below the waterline presented an increasing problem. The base of operation had to be moved from Bikini, and Kwajalein was selected (Reference C.10.4).

Contamination made it difficult to prepare most target ships for movement to Pearl Harbor or to systematically study the damage they had sustained. A series of decisions resulted in towing target ships to Kwajalein beginning 19

August. By 5 September the last of the target ships afloat had left Bikini (Reference C.10.11; Reference C.0.3, p. 1; Reference C.0.4, p. 1). By 26 September 1946, Bikini Atoll was completely evacuated.

All survey and construction activities at Bikini were rapidly brought to a close, and the atoll was completely evacuated. For safety and security reasons, a recommendation was made to CNO to declare Bikini Lagoon a defensive sea area. CNO ordered continued surveillance of this area to restrict entry of foreign, merchant, or private shipping that had not been duly authorized. This restriction was promulgated through a Notice to Mariners declaring the area bounded by latitudes 11°28'N and 11°43'N and longitudes 165°10'E and 165°35'E dangerous to shipping and personnel, and restricting entry except to those duly authorized by proper authority. (Reference C.0.31, p. 6).

TARGET VESSEL OPERATIONS AT KWAJALEIN

All target vessels at Bikini had some ammunition on board to serve as test material. Some ships had a great deal, placed there to determine the effects of the atomic bomb on warships having different loading conditions. For example, USS Nevada (BB-36) had more than 1,100 tons of ammunition. Most of the ammunition was service type and highly stable, but some experimental ammunition and some obtained from foreign navies was included. Some service ammunition had been flooded. There was a presumption that ammunition on certain ships was, or would soon become, unstable from the heat and pose a considerable and growing hazard. Its removal would be necessary, and the longer such operations were deferred the more dangerous the work would become. After careful consideration, it was decided that the total hazard would be less if the work were accomplished in 1946 than if it were deferred to a later year when the radioactivity would be reduced but the explosive hazard increased (Reference C.11.4). Because the ships were contaminated, work parties had to wear special clothes and were accompanied by radsafe monitors when aboard them. When working below deck, the men were required to wear rescue breathing apparatus.

For work on the target vessels, the Kwajalein Maintenance Force, Task Unit (TU) 1.2.12 was formed on 28 August 1946 (Reference C.11.5). The flagship was Haven, on which the radsafe unit had its headquarters and laboratories. Geneva was the hotel ship and APL-27 was the change ship, where working party members donned their protective clothing before going aboard target vessels and where they removed that clothing and showered after their work was done. In addition, the unit consisted of USS Conserver (ARS-39), USS Current (ARS-22), LCI-329, LCI(L)-549, LCI(L)-615, YF-753, and assorted small craft for towing, ammunition disposal, and personnel transportation (Reference C.0.22, pp. 4 and 5). At its peak, the total manpower of the unit was approximately 1,500 officers and enlisted men. Haven departed Kwajalein on 10 October, Geneva on 13 October, and Current departed on 2 December; Conserver remained until February 1947.

On 29 August, CTG 1.2 (Target Vessel Group) directed the removal of the approximately 2,700 tons of unstable ammunition from target ships by personnel of the Ammunition Disposal Unit of JTF 1 (Reference C.11.6). Actual unloading commenced on 4 September. The unit consisted of about 10 officers and 275 enlisted personnel (Reference C.10.18). Its personnel were divided into six working teams (one initial boarding team and five ammunition disposal teams),

each consisting of one or two officers and about 40 enlisted personnel. The duties of the initial boarding team were to board, make initial inspection for flooding and other hazardous conditions, obtain current radiological data with the assistance of radsafe monitors, and obtain information pertinent to ammunition inspection and removal as required. When conditions were satisfactory for working on a vessel, the initial boarding team proceeded with opening up, ventilating as necessary, and rigging hoists and other equipment required to proceed with ammunition removal. Then an assigned ammunition team or teams would remove and transfer the ammunition to the lighter YF-753 for disposal at sea or, in certain cases, would leave the ammunition topside and tow the vessel itself to sea and dump the ammunition directly into the sea (Reference C.11.5, p. 2).

Ammunition was removed from each target ship without using any of its own facilities or equipment. Sufficient equipment was obtained to undertake five ammunition-handling operations at one time, which might be on one to five ships. The basic plan was to use pneumatic hoists to lift the ammunition topside on the ship. Portable lighting was used in the magazines and handling rooms. Spaces containing concentrated ether fumes or other explosive gases were ventilated before commencing ammunition removal. Flooded spaces were pumped out sufficiently so that men wearing rubber boots could work in them. Wood chutes were used to transfer the ammunition from the ships' topside to YF-753. To minimize carrying the ammunition across the decks of the ship and barge, roller sections were used where practicable.

Personnel were transported to and from work in LCMs. Five of these were each equipped with a gasoline-engine-driven air compressor and generator. These were connected, respectively, to the portable hoists and the portable lights. A gasoline drum in each equipment boat held a reserve fuel supply.

Working party members entered the change ship, APL-27, from the clean side. Each was issued freshly laundered fatigues, canvas or rubber gloves, rubber boots or field boots with removable canvas covers, and a rescue breathing apparatus, intended to prevent inhalation of radioactive particles. Members of the working party then boarded an LCM from the contaminated side of the change ship for their trip to the target vessel. Upon return to the change ship, each man showered twice, was checked with a Geiger counter to make sure he had removed all contamination, and then changed into his regular clothing. Used canvas gloves and canvas boot covers were thrown overboard. Fatigues were laundered for reuse. The rescue breathing apparatus was checked for contamination and sterilized. Rubber boots and gloves probably were washed (Reference A.2, pp. 143 and 144; Reference C.11.5, pp. 1 and 2).

Ammunition removal was exhausting and potentially dangerous work. Personnel suffered considerably from being required to work fully clothed and wearing the breathing apparatus in the hot, humid Kwajalein climate. Under these trying conditions a man could work only about 30 minutes below decks without a topside break for air. The breathing apparatus restricted their vision, and lighting inside of the ships was poor. The belief, however, at the command level apparently was that the rate of ammunition deterioration required immediate action if an even greater overall hazard was to be avoided (Reference C.11.4, p. 3).

Pensacola posed the most urgent removal problem due to the deterioration of the gunpowder for the 8-inch guns in its forward magazines, with resultant concentration of ether-alcohol fumes believed to be within explosive limits (Reference C.0.22, p. 4). The same conditions, to a lesser degree, were felt possible in some of the other target vessels. CTG 1.2 issued supplementary orders to the officer in charge of the Ammunition Disposal Unit covering Pensacola. The progressive opening up of Pensacola preparatory to removal of ammunition was initiated following the procedures laid down by CTG 1.2 (Reference C.0.4, p. 4). In early September ammunition breakout was started on New York, Carteret, and Wainwright.

By mid-September, because of the acute shortage of radiological monitors questions were raised as to the advisability of continuing ammunition disposal at the rate of progress imposed earlier (Reference C.0.23, p. 4). At this time questions were also raised by CTG 1.2 regarding the dangers attendant to leaving large quantities of stable ammunition aboard ships exposed to tropical temperatures in unventilated and uncooled magazines without adequate inspection and surveillance. He cautioned that removal of such ammunition would multiply the difficulties of the ongoing task several times over and should not be considered lightly. Although he felt that the hazard of leaving the ammunition aboard was acceptable in view of the well-established stability of the smokeless powder under the expected range of temperature, he recommended that the advice and recommendations of the Navy Bureau of Ordnance be obtained before a decision was made (Reference C.0.23, p. 6).

The potential for plutonium contamination continued to be a concern, and rescue breathing apparatus was used to reduce the risk. One monitor was especially concerned because as time passed the detectable emissions, "our warning signals," were "dying away," leaving behind the difficult-to-detect alpha emitters (Reference A.2, p. 147). Urine testing continued, apparently on a relatively large scale. This testing failed to produce any positive findings of alpha exposure (Reference C.0.32, p. 4; Reference C.11.12).

On 14 September the concern about alpha emitters manifested itself from another quarter in instructions from the Commander in Chief, Pacific (CINCPAC), prohibiting all hoisting and underwater repairs on boats at Kwajalein. Apparently CTU 1.2.12 was able to get permission to follow instead the 9 September message from CJTF 1 to commanders of nontarget ships suspected of being contaminated, which allowed scraping of underwater portions of the hulls as long as the working area was kept wet (Reference C.9.185, p. 136). Because no copy of the directive could be found, boat repairs at Kwajalein were temporarily curtailed (Reference C.11.5, p. 2).

Despite the severe problems imposed by the shortage of monitors and handling equipment, the ammunition removal and disposal proceeded according to schedule without incident. During the week ending 13 October, radsafe operations were routine, but the instrument situation was becoming critical due to the lack of spare parts. Only ten X-263 Geiger counters were operable, and no spare parts for repairs were on hand. None had been received since 14 August, and it was estimated that within 3 weeks none of the instruments would be operating (Reference C.0.24, pp. 3 and 4). By the week of 19 October, ammunition safety tasks (i.e., removing and disposing of unstable ammunition and

obtaining surveillance powder samples from target ships) were completed. Approximately 1,036 tons of ammunition had been removed from about 35 ships in about 45 days with no serious injuries (Reference C.11.5, p. 1). In the process, 145 rescue breathing apparatus, 900 green fatigue shirts, 900 pairs of green fatigue trousers, 660 pairs of undershorts, 1,500 undershirts, 500 pairs of field shoes, 1,700 towels, 6,180 pairs of canvas work gloves, and 12,500 canvas shoe covers had been discarded. In addition, 150 rescue breathing apparatus were usable but contaminated, as were air compressors, generators, air hoists, and portable blowers used in the operation (Reference C.11.5, pp. 3-4). Exposures for the Ammunition Disposal Unit are discussed in Chapter 12.

In mid-October Commander Marianas requested Commander Service Force, Pacific (ComServPac), to transfer the Ammunition Disposal Unit intact to Guam to dispose of surplus ammunition. In view of the task they were just completing and the length of time they had been in the forward area, Commander Navy Task Group (CNTG) JTF 1 strongly advised against such a transfer and recommended that the entire unit be given leave before reassignment. ComServPac concurred (Reference C.0.24, p. 2).

Concurrent with the completion of this disposal, CNO ordered USS Gasconade (APA-85), USS Fallon (APA-81), USS Crittenden (APA-77), USS Brule (APA-66), Independence, and USS Mayrant (DD-402) towed to San Francisco and Hughes, Pensacola, Salt Lake City, New York, USS Rhind (DD-404), and Nevada towed to the Puget Sound area for examination. The towing was to be in the order listed, with one ship arriving in each area every 2 months. Only six of these twelve ships were ultimately towed to the United States. Brule, Fallon, Rhind, and Mayrant were eventually sunk in the vicinity of Kwajalein. New York and Nevada were towed to Pearl Harbor for inspection and were later sunk off Oahu.

In connection with this, CNO directed that CNTG insure, insofar as practical in the forward area, the removal of all ammunition, including projectiles, before the vessels' arrival at the mainland. This, of course, called for a radical change of plans for the Ammunition Disposal Unit at Kwajalein. The rollup orders already issued for its dissolution on 23 October were cancelled and action was initiated to transfer the entire unit to Atoll Command Kwajalein (AtComKwaj) on 23 October at the same time that the target ship maintenance unit was transferred.

When the rollup plans were cancelled, the officer in charge of the disposal unit flew to Pearl Harbor to confer with CNTG. As a result of this conference, it was decided that removal of powder and small-caliber projectiles before the vessels' departure from Kwajalein would be practical and could be done well within the time limits imposed by the towing schedule. Removal of the large-caliber projectiles however, especially the 14-inch projectiles in New York and Nevada and the 8-inch projectiles in Pensacola, would present a very difficult, if not impossible, problem in view of the limited facilities at Kwajalein, but the task was initiated (Reference C.0.25, p. 1). All unstable ammunition and all pyrotechnics, catapult charges, igniters, detonators, boosters, torpedo expelling charges, and bulk black powder were removed from all target vessels at Kwajalein.

The status of ammunition in the eight target ships that were finally towed from Kwajelein was (Reference C.0.25, p. 12):

USS Crittenden (APA-77)	No ammunition aboard
USS Gasconade (APA-85)	No ammunition aboard
USS Hughes (DD-410)	No ammunition aboard
USS Independence (CVL-22)	No ammunition except two-thirds of the unfuzed normal bomb allowance remained aboard
USS Nevada (BB-33)	Two-thirds of the normal allowance remained aboard
USS New York (BB-36)	Ten percent of the 14-inch projectiles and eight percent of the remaining normal allowance remained aboard
USS Pensacola (CA-24)	No ammunition except two-thirds of the 8-inch projectile allowance and two-thirds of the unfuzed bomb allowance remained aboard
USS Salt Lake City (CA-25)	Ten percent of the normal allowance remained aboard.

When the initial phase of the ammunition disposal was completed, the last of the experienced radiological monitors departed Kwajalein. When work was resumed to unload the target ships due for transfer to the continental United States, the only available monitors were still receiving additional training at Kwajalein after intensive instruction in Washington, D.C. In addition, serious morale problems were developing in the Ammunition Disposal Unit due to doubts and unanswered fears about the effects of radiation and fatigue due to the long, uninterrupted arduous and hazardous duty.

The officer-in-charge dispatched a letter dated 11 November 1946 to the Chief, Navy Bureau of Medicine and Surgery (BuMed) (Reference C.11.7) detailing the concerns of personnel in his unit regarding radiation hazards. He described the problems in the use of the rescue breathing apparatus and the added hazards in handling heavy ammunition when wearing the apparatus in confined dangerous spaces. He recommended better indoctrination and training for those working under similiar conditions, suitable limitation on the length of continuous duty, and -- if it was determined that a protective mask was required -- discontinuance of all unloading until a suitable mask could be developed.

On 29 November the officer-in-charge was advised by the Safety Advisor to JTF 1 (Reference C.11.8) that the answers to some of the questions asked by the men were classified and, in any event, the officer in charge of the Ammunition Disposal Unit should discuss these questions with the Radsafe Advisor and then disseminate the proper information to his personnel. He was further informed that the rescue breathing apparatus was considered necessary by senior radsafe experts and would continue to be worn and that if all safety regulations were complied with no hazard to health was involved in the work. Hence, BuMed did not feel it was necessary to limit the time spent in this type of work (Reference C.11.8).

Clearly, operations at Kwajalein were intense during the early months of the target fleet's presence. The order from CNO to remove additional ammunition prevented the dissolution of the Ammunition Disposal Unit and forced work to continue, apparently with the same personnel (Reference C.0.26). From 1 September 1946 to 31 December 1946, 5,734 badges were issued to personnel of this unit. The period of heaviest issue was September and October; thereafter, very few badges were issued (Reference C.13.4).

The deck logs of Conserver and Current indicate that these ships were extremely busy during this period in mooring, diving, towing, and housekeeping operations on the target fleet at Kwajalein. Between 31 August and 30 November 1946, 14,532 personnel decontaminations (similar to those described in Chapter 2) were carried out aboard the change ship APL-27, an average of 158 each day (Reference C.13.7).

In October the preliminary examination and securing of target ships at Kwajalein was completed. On 1 October, CNO directed that upon dissolving JTF 1, these ships and their caretaking unit be turned over to CINCPAC.

TARGET SHIP ACTIVITIES AFTER JOINT TASK FORCE 1 DISSOLUTION

In accordance with directives of the Joint Chiefs of Staff (JCS), steps were carried out rapidly to complete the work of the task force and to turn over operational control of all units to appropriate commands. As of 24 October no ships or units remained under the operational control of the CJTF 1, and only staff activities were left. The task force was formally dissolved on 1 November 1946 (Reference C.9.206, pp. V-(D)-5 and V-(D)-6).

In all, 63 target ships (12 were remanned after CROSSROADS) passed through Kwajalein. Of these, 41 remained at Kwajalein until sunk. These ships were radiologically contaminated and could not be disposed of until cleared by CNO and Radiological Section BuShips.

On 31 January 1947, Chief BuMed issued additional safety regulations for work on the target ships. The potential internal radiation hazard was emphasized. The exposure of persons boarding ships was to be kept to a minimum, and their exposure was to be appropriately interrupted to reduce the chance of injurious effects. All persons who were to board target ships and who might encounter radiation were to have a preduty physical examination. All personnel connected with work on target ships were to have monthly physical examinations with special attention to their hands. Each individual was to have a weekly urinalysis, including a gross beta count.

Various measures were to be taken to protect the men while at work. A change house was to be provided where the men would dress in hard hats, coveralls fastened at the neck, canvas or rubber gloves, canvas booties over their boots or work shoes, appropriate breathing apparatus, and goggles. Each man was to have a film badge pinned on the left breast of his coveralls. The tolerance limit was 0.1 R per 8-hour day. A work party could not board target vessels without the permission of the radsafe unit and each party had to be accompanied by a monitor. While aboard a target vessel, the men were not to

eat, drink, smoke, or to chew gum or tobacco. They were to avoid pools of water, dust clouds, and piles of rust, paint chips, or the like since each might be a radiation source. When below decks, the men were to wear the rescue breathing apparatus at all times. Upon returning to the change house they were to turn in their film badges, disrobe, and wash thoroughly. The regulations appear to have broken little new ground but instead codified existing CROSSROADS practice (Reference C.11.9, pp. 1 through 8).

On 3 March 1947, Navy Bureau of Personnel reduced the Kwajalein ships' security detail to 5 officers and 127 enlisted men. Both CINCPAC and AtComKwaj considered this to be a minimum number. However, on 31 March there were only 27 men in the unit. The attempt by Kwajalein personnel to keep up with the towing schedule in spite of the manpower shortage operated to contravene the requirement for radiological safety (Reference C.11.10, p. 2).

In a letter to AtComKwaj dated 9 April 1947, the senior monitor assigned to the radsafe section at Kwajalein on 23 January described violations of radsafe procedures he had seen or had good reason to suspect during his time there. Upon arrival he had been given some instructions about radsafe procedures to be followed in working on the target ships, but he had been shown no written regulations. In his work, this Navy ensign observed men smoking and lounging about the decks of target ships and boarding parties going aboard Pensacola without first passing through the change ship. He believed that personnel sometimes ate aboard the target vessels and that work parties unaccompanied by a monitor sometimes boarded them. He believed looting was common. The monitor was also very concerned that men were not wearing rescue breathing apparatus while on the decks of the target vessels, but the BuMed regulations of 31 January did not make it mandatory in all circumstances (Reference C.0.27, pp. 7 and 8).

When the ensign reported his observations and suspicions to the Medical Radsafe Officer at Kwajalein, the doctor showed him a list of safety precautions for boarding target vessels sent by BuMed. From the monitor's letter it cannot be determined, however, whether these were the regulations of 31 January as amended or some other document. The doctor apparently had not been aware of the violations of BuMed's rules. On 13 March the monitor showed the safety precautions to the officer in charge of the change ship. Together they checked fatigues and found "numerous" high readings. The monitor's letter gives the impression that the officer in charge of the change ship had not previously seen the list of safety precautions.

The senior monitor also showed the precautions to the captain of the salvage vessel from which work parties had boarded Pensacola without passing first through the change ship. The captain visited the radsafe officer to discuss the precautions. The monitor's revelations led to a meeting on 20 March attended by the Medical Radsafe Officer, the captains of Conserver and Current, AtComKwaj, the monitors, and another official. Greater efforts to follow BuMed's guidelines apparently followed. The monitor also had been concerned about the unreliability of the radiation detection instruments, but the meeting did not produce actions that relieved his apprehension. He wrote that "our instruments are still very unreliable and I felt unsafe in boarding without proper equipment. I told [the radsafe officer] that I thought operations should cease

because we knew so little about the dangers we were dealing with" (Reference C.0.28).

The complaints of the senior monitor to AtComKwaj were passed to higher authorities. CINCPAC, in a letter endorsement to Chief BuMed, stated that AtComKwaj had been instructed on 10 April to fully comply with existing safety regulations at the cost of curtailing security measures and, if necessary, falling behind in towing schedules. He noted that a serious health hazard existed if safety regulations were not strictly maintained (Reference C.11.22).

The problem was essentially one of manpower, as less than 200 personnel were assigned to the ship's security detail. This was too few personnel to maintain the desired schedule of preparing ships for tow back to Navy shipyards. This fact and its consequences were acknowledged in a letter from CNO to Chief of Naval Personnel dated 15 July 1947. The letter observed that in many instances certain recognized safety precautions were violated, attributable to the towing schedule, inadequate indoctrination of men, and insufficient supervisory personnel. It stated, however, that in the opinion of responsible persons experienced in the subject that, in fact, no individual actually was subjected to danger. In order to substantiate that opinion, the letter stated that a broad survey of all persons involved had been instituted (Reference C.0.33).

The results of this broad survey have not been located. The survey may refer to the blood tests administered to all Navy CROSSROADS participants (Reference C.11.23). There is evidence that action at Kwajalein in this regard was underway at least by April 1947. A 17 May message from AtComKwaj to BuMed advised that blood tests given at Kwajalein established that exposed personnel were disqualified from additional work detail. He noted that the results had urgent medical implications and impacted on personnel rotation policies (Reference C.11.24).

A standard gamma source to calibrate instruments was provided by 5 June 1947, and the hope was voiced that a suitable alpha counter could be provided "eventually." Moreover, the bureaus concerned were going to supply "essential technical help," apparently meaning more personnel (Reference B.11.1). This last effort probably was related to the monitor shortage at Kwajalein. During April 1947, the radsafe unit was down to one monitor; hence only one working party at a time could enter radiologically suspect areas (Reference C.0.29).

Commencing in June 1947, Kwajalein and all shipyards where target ships were located began monthly reports of personnel film badge exposures. These monthly reports to BuMed continued until November 1948. Until at least July 1948, a ship's security detail existed at Kwajalein to care for the target ships. Protective clothing was apparently worn by U.S. shipyard personnel when working with the CROSSROADS target ships, judging from an inspection photo (Figure 38) of the engine room of Hughes at Puget Sound in April 1948.

CONTAMINATION OF SUPPORT SHIPS

The majority of the support ships did not reenter Bikini Lagoon until after 31 July when the lagoon water was below 0.1 R/24 hours. Within 3 days,

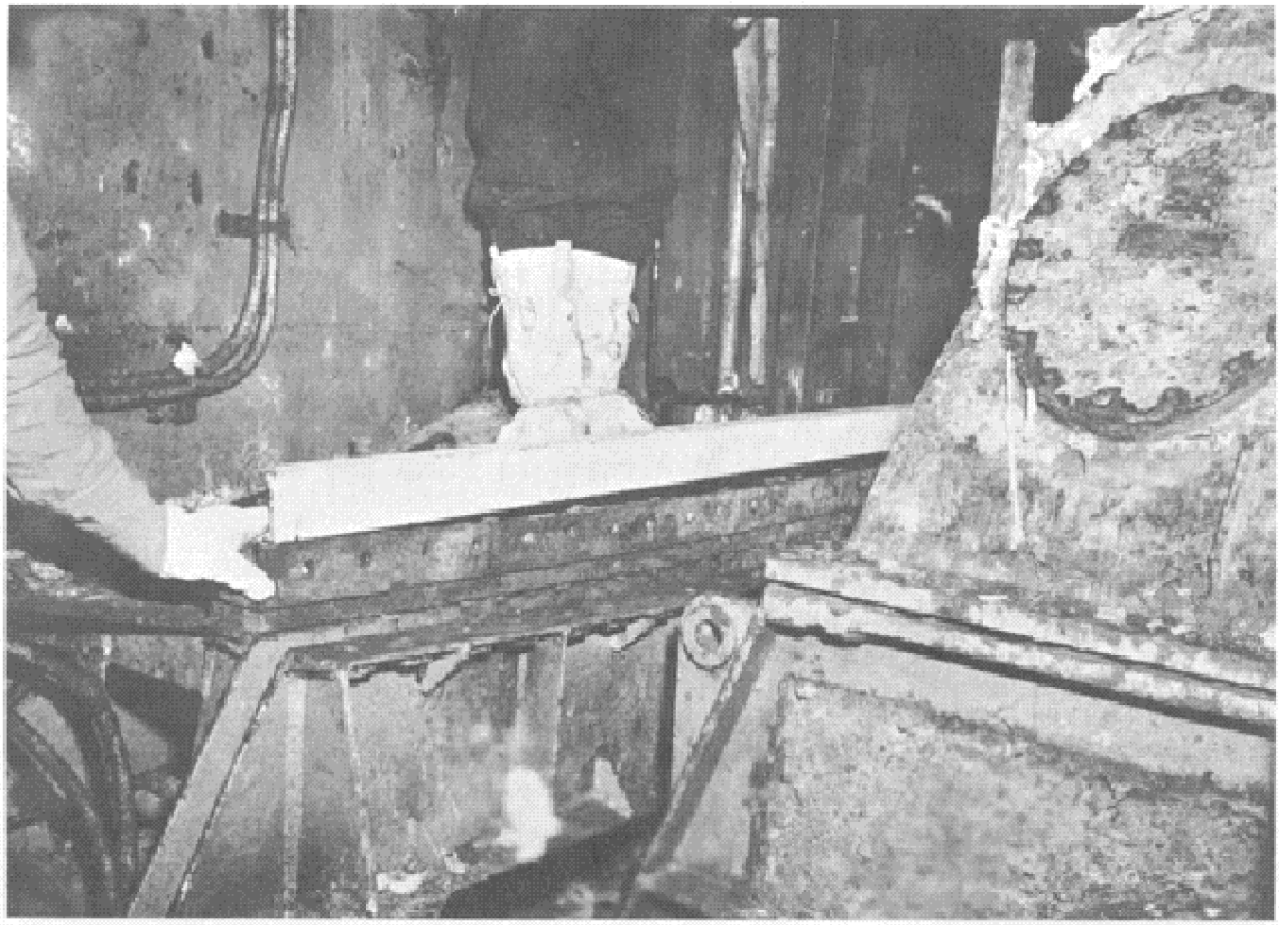


Figure 38. Inspection of USS Hughes (DD-410) at Puget Sound Naval Shipyard in 1948 showing workers wearing protective shoe covers and gloves.

concentrations of radioactive contamination were observed in the marine growth and rust on their hull exteriors at the waterline. Even though the water in which the ships were anchored showed a radiation intensity of only about 0.01 R/24 hours, the radioactivity collected on the hulls to such an extent that several ships had interior readings in the vicinity of the waterline exceeding 0.1 R/24 hours (Reference C.9.185, p. 18).

Decontamination at Bikini

On 29 July, faced with increasing radioactivity in the water where the ships were anchored and hoping to deal with problems of contamination, the support ships and the target ships that had been cleared as radiologically safe were moved to a new anchorage in the southeast portion of the lagoon (Reference C.9.185, p. 19; Reference A.2, p. 101). All ships were ordered to list ship, that is, change ballast, causing them to list and expose portions of their hulls below the waterline for scraping (Reference C.9.185, p. 19). Rather than immerse themselves in the lagoon water, personnel were to use long-handled scrapers (Reference C.10.7). Because the ships' evaporators used to distill freshwater concentrated radiation from the lagoon water in the scale on the inner surfaces of their shells and tubing, radiation levels near some of them exceeded the 0.1 R/24 hours limit.

Orders were issued not to open evaporators without specific authorization of the radsafe section and then only with a monitor present (Reference C.10.3). Experiments showed that the evaporators would not pass radioactivity over into distilled water if they were operated at somewhat reduced rates. Orders to operate at reduced rates were issued, although sources available disagree on whether the approved rate was 75 or 80 percent (Reference C.9.185, p. 19; Reference C.10.6). To remove some of the contaminated scale, ships were to use the "cold-shock" treatment; that is, cold water was run through the hot evaporator tubes that had accumulated radioactive scale. The pipes' rapid contraction caused the scale to flake off and be flushed out (Reference C.10.6). To decrease the formation of new scale, ships were ordered to use a standard scale reduction technique of introducing a mixture of boiler compound and cornstarch continuously into the evaporators (Reference C.10.1). In an effort to reduce contamination on hulls and in evaporators, a number of support ships left the lagoon for one-day trips in the open ocean to flush the sides and interior systems with clear saltwater.

These measures reduced the radiation level inside most ships to 0.1 R/24 hours (gamma) or less. To keep radiation levels down, the ships, where possible, were kept in water indicating 0.001 R/24 hours (gamma) or less. Numerous exceptions to this were necessary, however, to carry out the duties of the task force. Ships used for salvage, radsafe, and survey work sometimes needed to enter waters with higher levels of radioactivity. One source indicated that in some cases a ship's crew was evacuated and the ship was allowed to stand idle, presumably in water with low radioactivity levels, until the readings inside fell below the 0.1 R/24 hours level (Reference C.9.185, p. 20). The source does not indicate the number of ships in this category.

Shift to Kwajalein

On 11 August, CJTF 1 asked the CNO for permission to shift the task force's base to Kwajalein, asserting that the tendency of ships to accumulate radioactivity, especially in their evaporators and in the marine growth on their hulls, mandated leaving Bikini. He emphasized that no hazard to Kwajalein would result and that preparations for CHARLIE (the anticipated third CROSSROADS shot) would not be compromised (Reference C.10.4).

On 19 August the task force was ordered to shift base to Kwajalein. Non-target ships that had reentered the lagoon were monitored before departure and given conditional operational clearances, subject to employing safety procedures to meet each ship's condition. Most were restricted on the amount of time personnel could spend in certain compartments and near certain pieces of equipment (Reference C.9.206, p. V-(D)-4; Reference C.9.185, p. 20).

Commander Joint Task Force 1 Letter of 19 August 1946

Although it was hoped that natural decay and steaming in the open ocean would minimize radioactive expoure of personnel, the Chief of Staff of JTF 1 sent a letter on 19 August to commanding officers of all ships that had been in the lagoon between 25 July and 10 August and hence were radiologically suspect. He wrote that before these ships could be considered completely clear, further monitoring would be needed, especially to ensure the safety of personnel

scraping ships' bottoms or working on their evaporators. Arrangments were being made for radiological monitors to be available at naval shipyards and principal ports on the U.S. west coast and Pearl Harbor. Commanding officers of the ships involved were to request these monitors before having evaporators opened, having work done on other contaminated machinery, or entering drydock (Reference C.9.185, pp. 144 and 145).

After further study, the task force radsafe and safety advisors decided the precautions set forth in the letter of 19 August were inadequate to protect personnel from alpha emitters associated with the detected radiation. Moreover, considerable cleaning would be required to eliminate radioactivity, and the cleaning itself and the wastes created would pose yet another problem. After a conference with the safety advisors, the ComServPac on 29 August issued special precautions to be applied to all vessels that had spent more than 10 days in Bikini Lagoon after 25 July (Reference C.9.185, p. 21). In summary, the precautions were as follows:

1. Avoid drydocking until further notice
2. Avoid opening saltwater plumbing
3. Avoid exposing the external surface of the hull below the waterline
4. Avoid exposing personnel to fumes or dust from welding, cutting, or other work on contaminated saltwater surfaces.

He also recommended the ships be examined at San Francisco or Pearl Harbor to determine their exact radiological status and to indoctrinate crews in proper radsafe procedures (Reference C.10.5).

CJTF 1 concurred with ComServPac, but argued that ships in the western Pacific should return to Guam for radiological monitoring. He advised that JTF 1 was organizing a monitoring group for use at San Francisco, Pearl Harbor, and other ports as required. He recommended that docking or yard work on the affected ships be avoided until they had been monitored and declared radiologically safe. Finally, he suggested that the precautions applied to the ships also be applied to the small boats they carried (Reference C.9.185, p. 22). On 28 August CNO directed compliance with these recommendations and two days later ordered all small boats found radiologically unsafe sunk in deep water (Reference C.9.185, pp. 22 and 23; Reference C.10.4, p. 1).

RADIOLOGICAL CLEARANCE OF NONTARGET SHIPS

CJTF 1 dispatched his Chief Medical Officer to head the program for giving radiological clearance to nontarget vessels. On 26 August the medical officer established his headquarters in the offices of the 12th District Medical Officer at San Francisco Naval Shipyard. He encountered immediate difficulties. Radsafe monitors were not available at San Francisco in numbers sufficient to check the many ships expected to arrive during the coming weeks. Monitors were drawn from the ranks of those who had served during CROSSROADS and from the radsafe organization at Kwajalein, but at some cost to operations there. The first graduates of the JTF 1 radsafe school became available for duty by mid-October. Although some were assigned to Kwajalein, most were assigned to

shipyards or laboratories on the west coast or in Hawaii where they worked on problems presented by the contaminated nontarget vessels. Because no safe and effective methods had yet been developed for removing the known or suspected contamination on the nontarget ships, only a list of precautionary measures could be given to ships' captains. These measures were principally as follows (Reference C.9.185, p. 24):

1. Treat evaporators using starch and boiler compound, cold shocking, or, in the case of vapor compression stills, standard cleaning
2. Sink at sea all radiologically hazardous equipment made from wood and plant fibers, such as lines, fenders, nets, camels, and swabs
3. Prohibit burning, welding, chipping or wire-brushing of saltwater lines or exposed saltwater surfaces except under the supervision of a monitor. Scraping is permitted on surfaces provided they are kept wet at all times.
4. When dropping anchor avoid the dust raised from the outgoing chain, keep the anchor wet, use gloves when handling the anchor and chain, and discard the gloves after use
5. Sink small boats with readings greater than 0.1 R/24 hours
6. Scrub urinals and head troughs with abrasive cleaner or acid solution.

In an effort to determine accurately the contamination level on nontarget ships exposed at Bikini, Commander Western Sea Frontier (ComWestSeaFron) on 30 August ordered Commander 12th Naval District to drydock one of the destroyers from the joint task force at the San Francisco Naval Shipyard. USS Laffey (DD-724) was drydocked and inspected on 5 September under supervision of the JTF 1 Chief Medical Officer. The underwater portion of the hull and portions of the saltwater plumbing were monitored. Shipyard workers in protective clothing and breathing apparatus chipped off samples of rust, paint, and scale. Radiation levels detectable with hand-held instruments were found to be below the accepted tolerance level. Samples were also taken from USS Whiting (AV-14), USS Henrico (APA-45), and USS Mount McKinley (AGC-7). The samples were sent to the University of California's Crocker Radiation Laboratory for further analysis, especially for the presence of alpha emitters. Encouraged by the low readings, the medical officer gave permission for overhaul work on USS Walke (DD-723), USS Barton (DD-722), USS Lowry (DD-770), and Laffey, except that work involving the exterior of the hull below the waterline or the saltwater plumbing had to await the arrival of sufficient monitors. A decontamination center was established for yard employees working on the ships (Reference C.9.185, pp. 28 and 32; Reference C.12.2, pp. 84 and 85).

In late August and early September, however, concern increased in command circles that unless a means could be found to service the underwater hulls and saltwater plumbing of the nontarget vessels, they would eventually be rendered useless.

On 9 September 1946, CJTF 1 sent a letter (Serial 079) to commanding officers of all nontarget ships suspected of being contaminated. His purpose was

to make them aware of the discussion in progress, to summarize safety precautions, and to give information on the clearance procedure under development (Reference C.9.185, pp. 125 and 145). His letter, however, did not (Reference C.9.185, pp. 25 and 26):

1. Establish adequate decontamination procedures or a plan for developing them
2. Establish the final tolerance level for alpha emitters, the alleged principal hazard
3. Assign responsibility for decontamination and final clearance.

During the next several months the Navy put considerable effort into filling these gaps.

ComWestSeaFron on 11 September recommended to CNO that highest priority be given to providing staff for the JTF 1 Medical Officer, that BuShips have the responsibility for developing decontamination methods, and that the DSM be dispatched to the west coast as BuShips' representative. On 13 September CNO advised that ComWestSeaFron and BuShips had been assigned the responsibility and that the DSM was on his way, to arrive on 17 September (Reference C.9.185, pp. 26 and 27).

Decontamination Experiments at San Francisco Naval Shipyard

Meanwhile, efforts to measure contamination continued. On 12, 13, and 19 September portions of Laffey's hull were sandblasted and particle samples collected in filter devices set up nearby. A section of contaminated saltwater pipe was burned through in a small, closed compartment and particulate samples collected in a filter device (Reference C.9.185, p. 29). The samples were taken to the University of California Crocker Radiation Laboratory for analysis.

Methods for cleaning contaminated saltwater lines were tested. On 13 and 17 September various acid solutions were pumped into sections of Laffey's saltwater plumbing and then the sections were flushed a number of times. The result was a considerable reduction in radiation levels. These experiments were judged completely successful. Also on 17 September preparations were made to test acid solutions on the saltwater plumbing of a second ship, Henrico (Reference C.9.185, pp. 30 and 32).

The DSM arrived on 17 September, and during the next few days, he conferred with officials supervising contamination measurement and decontamination experiments. He inspected the work being done on Laffey and USS Benevolence (AH-13) (Reference C.9.185, pp. 30 through 33).

On 20 September, laboratory assays of rust, evaporator and condenser scale, saltwater lines, algae from the hull, and other samples from Laffey, Kenneth Whiting, Henrico, and Mount McKinley were completed. They indicated that the amount of plutonium (an alpha emitter) associated with fission products (beta and gamma emitters) was quite constant. Thus -- the plutonium concentration -- could therefore be estimated from the fission product activity with a Geiger counter (Reference C.11.17).

Taking samples for laboratory analysis was unnecessary, since analysis of the filter samples taken while sandblasting portions of Laffey's hull showed no detectable plutonium. Using the ratio of plutonium to fission products to calculate the amount of plutonium present led to an estimate that a worker using a respirator would have to spend 100 million days of wet-sandblasting to inhale a dangerous amount of plutonium. From this came the conclusion that ships up to 100 times as contaminated as Laffey could be sandblasted without exposing shipyard personnel to a lung hazard. Filter samples collected during welding of contaminated saltwater lines also revealed no plutonium. Calculations using the plutonium-fission products ratio indicated an individual would need to weld for 1,000 days to accumulate a dangerous amount of plutonium in his body (Reference C.9.185, pp. 32 and 33). The findings of the laboratory assays appeared to show that nontarget ships of JTF 1 could be decontaminated and overhauled without radiological hazard to personnel, but, as discussed below, that work did not go forward immediately because of fears among the experts that hard-to-detect dangers were still present (Reference C.9.185, pp. 32 and 33).

The Question of Clearance Standards

About 20 September, the DSM left San Francisco for Washington, D.C., to present the findings from the decontamination experiments to higher authority. In Washington he prepared a directive setting forth the decontamination procedures established up to that point. Issued on 24 September as a joint BuShips-BuMed speedletter, it included authority and direction for decontamination of evaporators, heat-transfer apparatus (except condensers*), hulls beneath the waterline, and ships' boats of all contaminated ships scheduled to remain in the active fleet. Members of each ship's crew were to clean the evaporators and heat-transfer apparatus as soon as practical. Hulls were to be cleaned below the waterline using standard wet sandblasting methods at the time of a ship's next scheduled drydock period. Debris from cleaning evaporators and heat-transfer devices and sand from sandblasting were to be kept wet until dumped at sea. Monitors were desirable but not essential for this work. Saltwater lines could be cut and welded without hazard, but sections removed were to be dumped at sea. All zinc plates used to retard electrolytic action were to be removed from main and auxiliary condensers and discarded at sea. Different rules were being developed to cover ships scheduled for disposal or deactivation (Reference C.9.187, pp. 16 and 19).

The DSM's directive was greeted with great enthusiasm by all commands concerned. The message from CJTF 1 on 9 September had led to fears that a great and indeterminant hazard to personnel was present. Now the hazard had been found to be minimal if the indicated safety precautions were taken. The methods to remove contamination were not too complicated, and regular maintenance could proceed more or less on schedule. BuShips representatives taking part in the work at San Francisco visited the 11th, 13th, and 14th Naval Districts at San Diego, Seattle, and Pearl Harbor, respectively, to brief shipyard management

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* A condenser is a low-pressure heat-transfer device for changing steam to water in a propulsion or similiar closed-cycle system. It should not be confused with the evaporators used to distill freshwater.

on the decontamination procedures (Reference C.9.185, p. 36). Meanwhile, a vigorous program of decontamination experiments went on at the San Francisco Naval Shipyard in an effort to develop better methods.

However, considerable uncertainty persisted about whether the 0.1 R/24 hours standard, as measured with a Geiger counter or similiar device, could be used for determining when a vessel required decontamination and when it could be considered safe and given clearance. No reliable instrument was available for determining the presence or absence of alpha contamination in the field. Analyses of the samples taken from Laffey, Whiting, Henrico, and Mount McKinley had provided an approximate ratio of plutonium to fission products, but no radsafe expert of recognized reputation was ready to declare that a Geiger reading of 0.1 R/24 hours or less assured protection from the total alpha hazard, that is, from plutonium or any other alpha emitters (Reference C.9.185, p. 41).

Consequently, BuShips called a conference in San Francisco on 1 October to grapple with the problem. The decision was made to study contamination of USS Rockbridge (APA-228). At that time it was considered the most heavily contaminated ship to arrive in the area, and it was of a size and type judged suitable for a detailed study of wide implications. The hope was not only to improve the accuracy of the plutonium ratio, but particularly to determine the total amount of plutonium on the ship. The figure could then be used as the basis for the needed standards. Numerous samples were taken from the ship and sent to the University of California for analysis, but the University's facilities for radiochemical analysis were sufficiently limited that weeks passed before the results were available (Reference C.9.185, pp. 41, 45 and 46).

While awaiting the results of the work on Rockbridge, BuShips in Washington, D.C., on 10 October proposed a set of contamination limits. After discussions between naval and civilian radsafe experts on the west coast and BuShips and BuMed in Washington, the final clearance standard for all ships was set at 0.001 R/24 hours (gamma) from shielded sources and 0.005 R/24 hours (combined beta and gamma) from exposed surfaces, subject to change if required by new information. These limits required decontamination of almost all nontarget ships that spent more than one day in the Bikini Lagoon after BAKER (Reference C.9.185, p. 49). Twelve ships were found to be within radiological limits. These ships were associated with CROSSROADS, but either had never entered Bikini after Baker or had been in the lagoon following BAKER for 1 to 3 days. They were USS Charles P. Cecil (DD-835), USS Limestone (IX-158), USS LST-871, USS LST-989, USS Albemarle (AV-5), USS Panamint (AGC-13), USS Appalachian (AGC-1), USS Blue Ridge (AGC-2), USS Furse (DD-882), USS Turner (DD-834), USS Shangri-La (CV-38), and USS Bountiful (AH-9).

Decontamination work on a large scale apparently started after 14 October, when BuShips authorized crews of all nontarget ships, including those scheduled for disposal and deactivation, immediately to go forward with acid cleaning of evaporators and of firefighting, flushing, cooling, and drainage systems. At least 55 nontarget ships that had arrived at one of the west coast naval districts were involved. CINCPAC and ComWestSeaFron were to see that the work was done. The final clearance limits recently agreed upon by BuShips and other interested parties were used, however, only as a temporary standard for

"operational, conditional, or preliminary" clearance, pending the analysis and availability of Rockbridge data (Reference C.9.185, pp. 50 through 52).

Results of the assay of fission products and plutonium on Rockbridge were available on 25 October 1946 from the University of California. At the time of the collection of the samples, radsafe monitors reported the external hull readings were 0.009 to 0.010 R/24 hours (beta plus gamma). The total activity calculated to be present on Rockbridge was 376 millicuries of fission product activity and 2.020 milligrams of plutonium. This material was distributed inside 23,207 ft^2 (2.16 km^2) of saltwater piping, inside 12,780 ft^2 (1.18 km^2) of condenser and evaporator interiors, and the entire underwater hull. The hull contamination when removed was contained in the 125 tons of sand used to sandblast the external hull. Although about two tolerance doses of plutonium were detected, these and the fission products were spread over an extremely large area and in locations that greatly reduced the potential exposure to personnel (Reference C.11.18; Reference C.9.185, p. 56).

In addition to continuing uncertainty about final clearance standards, the decontamination regulations promulgated up to that time had two gaps: (1) how to determine contamination of a ship's hull without time-consuming and expensive drydocking, and (2) how to remove contamination from condensers. At that point BuMed appointed a special medical board to advise the Navy's Surgeon General, who was Chief of BuMed, on radiological matters presented to it for study. It was chaired by the Medical Officer dispatched to San Francisco in late August by CJTF 1 and included the Radsafe Advisor to CJTF 1 and radiation experts from the University of California (Reference C.9.185, p. 54).

The medical board held its first general meeting on 4 November to consider results of analysis of Rockbridge samples. After much discussion, the members of the board suggested a set of final clearance standards, but these were not acceptable either to BuMed or BuShips. BuShips sent a representative to the west coast, and after consultation with the BuShips representative and additional study, the board proposed a new set of final radiological clearance standards as follows (Reference C.9.185, p. 56):

1. Habitually closed saltwater systems were not to have exterior readings exceeding:
   a. 0.001 R/24 hours (gamma) for 94 percent of the system
   b. 0.005 R/24 hours (gamma) for 5 percent of the system
   c. 0.01 R/24 hours (gamma) for 1 percent of the system.
2. Open systems were not to exceed an average of 0.001 R/24 hours (gamma) and 0.005 R/24 hours (gamma plus beta)
3. Underwater portions of the hull exposed by listing and trimming were not to exceed an average of 0.02 R/24 hours (gamma plus beta) wet or dry.

BuShips accepted these standards for final clearance. For operational or preliminary clearance, the bureau took the standards the board had originally set for active ships, namely (Reference C.9.185, pp. 54 and 55):

1. For shielded systems -- 0.01 R/24 hours (gamma)
2. For unshielded systems and surfaces -- 0.05 R/24 hours (gamma plus beta)
3. For underwater body -- 0.05 R/24 hours (gamma plus beta).

During the development of clearance standards, work had continued at the San Francisco Naval Shipyard on removing radioactivity from condensers and satisfactory methods had been worked out.

Clearance Standards Adopted

On 22 November, BuMed, and BuShips jointly issued a letter giving agreed-upon decontamination methods and clearance standards (Reference C.9.187, pp. 30 through 51), which superseded all previous directives (Reference C.9.185, pp. 57 and 58).

The criteria for clearance are:

(1) The existence of any areas of radioactivity with readings in excess of 0.1r (gamma) or 0.5r (beta) combined will be considered as above safety tolerance for external radiation and will be immediately decontaminated or disposed of, and there will be taken such other precautions as are required to insure safety of personnel. Serious radioactive hazard, not involving external radiation, will exist in enclosed salt water systems which give a reading of 0.1r (gamma) through the metal of the system. All areas of contamination within closed saltwater systems with readings between 0.1 and 0.01 gamma on external reading will be decontaminated immediately.

(2) Operational Clearance MAY be granted for urgent reasons when readings are:

(a) Maximum, shielded, between 0.1 and 0.001r gamma

(b) Maximum, unshielded, between 0.5 and 0.005r beta gamma combined except underwater bodies with surface readings having statistical averages between 0.5 and 0.02 beta gamma combined.

Operational Clearance WILL be granted when readings are:

(a) Maximum, shielded, between 0.01 and 0.001r gamma

(b) Maximum, unshielded, between 0.05 and 0.005r gamma beta combined except hulls of external surface readings having statistical averages between 0.05 and 0.02 R beta gamma combined.

(3) Final Clearance will be granted when readings are:

(a) Maximum, shielded, not above 0.001r gamma

(b) Maximum, unshielded, not above 0.005r gamma beta combined.

> Exception (a) Underwater body, readings statistically averaged not above 0.02r beta gamma combined and with no single localized area in excess of 0.1r beta gamma combined
>
> Exception (b) salt water systems having external readings ninety-four (94) per cent of which are not above 0.001r gamma, five (5) per cent not above 0.005r (gamma) and, one (1) per cent not above 0.01r gamma.

The letter also stated:

> All of the ships involved (target vessels not included) have low radiation intensities and small amounts of contaminating materials. They present no danger from external radiation. Any danger to personnel which may exist involves the introduction of contaminating toxic materials into the body . . . . Considering the relatively small quantities of toxic material present in any one ship and the great amount of gross material with which it is mixed (marine growth, scale, rust) and the quantities of this gross material necessary to gain access to the body in order to produce physical injury due to radioactive effects it is NOT LIKELY that personnel engaged in routine operations or maintenance of these vessels will suffer injury. It is CERTAIN they will not suffer injury if the precautions directed are followed, and the established clearance procedures complied with. The Bureau of Medicine and Surgery has established certain tolerance limits on the basis of recommendations made by an advisory board of experts in this field of toxicology. These are in conformity with nationally accepted standards for safety in regard to external radiation and to radioactive hazards within the body.

On 27 November at a conference on radiological safety convened by Buships in Washington D.C., a University of California scientist speaking to the question of dangers from scraping CROSSROADS nontarget ships took much the same position. He stated that much authoritative information indicated the insoluble form of plutonium used in nuclear weapons was not absorbed in the digestive tract or the lungs unless quantities as large as a gram were present. He argued that the health hazards from long-lived fission products, such as strontium and cesium, were far greater than from plutonium. The amount of such fission products would be on the order of 50 millicuries in many tons of scrap. This quantity of radioactive material was equivalent to the amount of radium found in ordinary rock. Therefore, he was willing to state positively that there was absolutely no possibility of physical injury from the amounts of radioactive material present on the nontarget ships (Reference C.9.187, pp. 112 and 113).

On 18 December, results from tests at the University of California indicated that decay rates of gamma emitters were much greater than had been realized. This led to some revision of the clearance instructions, and a reestimation that all nontarget ships would receive final clearance by 15 March 1947 (Reference C.9.185, pp. 60 and 61).

Activities at Other Shipyards

In order to avoid overtaxing the facilities at San Francisco, ComServPac, CJTF 1, and CNO issued orders that established decontamination and clearance centers at San Francisco, Pearl Harbor, Guam, and other selected shipyards (Reference C.9.185, p. 22). This culminated in the ultimate dispersal of ships to the various shipyards as follows (target ships are noted with an asterisk (Reference C.13.3):

SAN FRANCISCO

USS Achomawi (ATF-148)
USS Appalachian (AGC-1)
USS Appling (APA-58)
USS Artemis (AKA-21)
ATR-40
ATA-187
ATA-192
USS Avery Island (AG-76)
USS Barton (DD-722)
USS Benevolence (AH-13)
*USS Bladen (APA-63)
USS Bottineau (APA-235)
USS Bowditch (AGS-4)
USS Cebu (ARG-6)
USS Chickasaw (ATF-83)
*USS Conyngham (DD-371)
*USS Cortland (APA-75)
*USS Crittenden (APA-77)
USS Deliver (ARS-23)
USS Dixie (AD-14)
USS Enoree (AO-69)
*USS Fillmore (APA-83)
USS Gasconade (APA-85)
*USS Geneva (APA-86)
USS Henrico (APA-45)
*USS Independence (CVL-22)
USS James M. Gillis (AGS-13)
USS John Blish (AGS-10)
USS Laffey (DD-724)
*LCI(L)-549
*LCI(L)-615
USS Lowry (DD-770)
USS LST-338
USS LST-817
USS LST-861
USS LST-871
USS LST-881
USS LST-989
USS Moale (DD-693)
USS Munsee (ATF-107)
*USS Niagara (APA-87)
USS O'Brien (DD-725)
USS Palmyra (ARS[T]-3)
USS Rockbridge (APA-228)
USS Rockingham (APA-229)
USS Rockwall (APA-230)
USS San Marcos (LSD-25)
USS Walke (DD-723)
USS Widgeon (ASR-1)

MARE ISLAND

*USS Dentuda (SS-335)
USS Fulton (AS-11)
*USS Parche (SS-384)
*USS Searaven (SS-196)
*USS Skate (SS-305)
*USS Skipjack (SS-189)
*USS Tuna (SS-203)

PEARL HARBOR

ARD-29
USCG Bramble (WAGL-392)
USS Chowanoc (ATF-100)
USS Current (ARS-22)
USS Flusser (DD-368)
USS Hesperia (AKA-13)
LCI(L)-1062
*USS Nevada (BB-36)
*USS New York (BB-34)
USS Oneota (AN-85)
USS Orca (AVP-49)
USS Ottowa (AKA-101)
PGM-23
PGM-24
PGM-31
USS Shakamaxon (AN-88)

PUGET SOUND

USS Allen M. Sumner (DD-692)
ATR-87
ATA-124
ATA-180
USS Bayfield (APA-33)
USS Chikaskia (AO-54)
USS Etlah (AN-79)
USS Ingraham (DD-654)
*USS Hughes (DD-410)
USS Robert K. Huntington (DD-781)
*USS Pensacola (CA-24)
USS Pollux (AKS-4)
USS Quartz (IX-150)
*USS Salt Lake City (CA-25)
USS Suncock (AN-80)
USS Wharton (AP-7)
USS Wildcat (AW-2)

GUAM, MARIANAS

LCI(L)-977
LCI(L)-1067
LCI(L)-1091
LCT-1130
LCT-1155
LCT-1184
LCT-1341
LCT-1361
LCT-1377
LCT-1420
LCT-1461
YF-990
YMS-354
YMS-358
YMS-413
YMS-463
YO-132

SAN DIEGO

USS Ajax (AR-6)
ATA-185
USS Begor (APD-127)
USS Bexar (APA-237)
USS Coucal (ASR-8)
USS George Clymer (APA-27)
USS Mount McKinley (AGC-7)
USS Newman K. Perry (DD-883)
USS Rolette (AKA-99)
USS Saidor (CVE-117)
USS Saint Croix (APA-231)

LOS ANGELES

USS Albemarle (AV-5)
USS Blue Ridge (AGC-2)
USS Clamp (ARS-33)
USS Coasters Harbor (AG-74)
USS Creon (ARL-11)
USS Cumberland Sound (AV-17)
USS Dutton (AGS-8)
USS Fall River (CA-131)
USS Furse (DD-882)
USS Gunston Hall (LSD-5)
USS Haven (AH-12)
USS Kenneth Whiting (AV-14)
USS Mender (ARSD-2)
USS Panamint (AGC-13)
USS Phaon (ARB-3)
USS Preserver (ARS-8)
USS Presque Isle (APB-44)
USS Reclaimer (ARS-42)
USS Severn (AO-61)
USS Sioux (ATF-75)
USS Sphinx (ARL-24)
USS Telamon (ARB-8)
USS Tombigbee (AOG-11)

KWAJALEIN

APL-27

PHILIPPINES

PGM-32

NORFOLK, VIRGINIA

USS Burleson (APA-67)

NEW ORLEANS, LOUISIANA

PGM-25
PGM-29

Information is lacking on decontamination procedures used at shipyards other than San Fransisco. San Francisco was, however, the center of research and expertise on the problem and decontamination is considered to have been standard at all naval yards. Moreover, warnings and instructions flowed at a fairly brisk rate from CJTF 1, BuMed, and BuShips. In dealing with such a new and unfamiliar problem, responsible officials at other shipyards had little to depend on except the procedures developed at San Francisco and ordered by central naval authorities.

By 1 January 1947, 80 nontarget ships had been granted final radiological clearance (Reference C.9.185, p. 59). On 28 February, the status of nontarget ship clearance was as follows (Reference C.0.1, p. 3):

Ships with final clearance, including 12 not exposed	128
Ships with operational clearance and recommended for final clearance	4
Ships with operational clearance but requiring more work for final clearance	3
Ships without either clearance	22
Nontarget ships destroyed since BAKER	2

Disposal of Sand and Acid Used in Decontamination

Cleaning ships' hulls using wet sandblasting and cleaning saltwater piping using various acid solution began early in the effort to decontaminate nontarget CROSSROADS vessels. Until 4 December 1946, the sand and acid solution used in decontamination was segregated and disposed of at sea.

The problem of disposal was discussed at the Washington BuShips conference on 27 November. The conferees concluded that (Reference C.9.187, pp. 108 and 109):

1. Special disposal of sand used in sandblasting underwater bodies of radioactively contaminated nontarget ships is not required, provided marine growth is removed first and disposed of.
2. Solutions used in removal of radioactivity from saltwater systems of nontarget ships may be discharged into harbors, preferably at a slow rate or after dilution, without security or health hazard.

Based on experience at the San Franciso Naval Shipyard and the discussion at the conference, CJTF 1 issued a message on 4 December stating, in part, that (Reference C.9.187, p. 53):

1. Special disposal of sand used in wet sandblasting of underwater bodies of CROSSROADS nontarget vessels is not required.
2. Marine growth and scale removed from vessels at first drydocking shall be segregated and sunk at sea as previously prescribed.

3. Acid and other decontaminating solutions used in cleaning saltwater systems may be discharged into the harbor. Solutions should be discharged at slow rate or by providing a flow of water along with the discharge so as to dilute the solution by about one-fourth. Discharge should be made well clear of docks and shorelines during ebb tide.

4. Scales and marine growth removed manually from evaporators and saltwater systems shall be segregated and sunk at sea.

Of the approximately 54 ships decontaminated at San Francisco only 9 were decontaminated after 4 December. In a 1982 letter from the U.S. Navy to the mayor of San Francisco regarding her concern of radiation contamination of San Francisco Bay, the issue was readdressed (Reference C.13.3):

> Records of the quantities of radioactive fission products which were discharged into San Francisco Bay could not be located. As a result of the Navy's current review, it is estimated that a maximum of 1 curie of fission products of the most highly contaminated ship could have been disposed of in this manner. It is concluded that the total quantity of fission products which could have been disposed of in San Francisco Bay as a result of all nine ships decontaminated after 4 December 1946, could also be discharged today from a commercial nuclear facility and meet the requirements of the Nuclear Regulatory Commission.

The procedures used in 1946 to dispose of sand and acid solutions produced no greater concentrations of radioactivity than are currently acceptable from commercial nuclear reactor operations.

CHAPTER 6
BIKINI SCIENTIFIC RESURVEY

BACKGROUND

Following the conclusion of Operation CROSSROADS, the Joint CROSSROADS Committee gave preliminary consideration to the possibility of a Bikini Scientific Resurvey. Members of the Joint Committee carried out feasibility assessments and consulted with scientists from Joint Task Force 1 on potential studies and the logistics support that would be required for the operation. A subcommittee was formed to analyze proposed operational details and make recommendations (Reference C.8.1, p. 1).

Acting in response to recommendations from the Joint CROSSROADS Committee, on 16 May 1947 the Joint Chiefs of Staff (JCS) issued a memorandum to the Secretary of the Navy requesting that the Joint CROSSROADS Committee and its successor organization, the Armed Forces Special Weapons Project, undertake technical supervision of the Bikini Scientific Resurvey. The operation was to be conducted by the Navy in cooperation with the War Department and with the participation of the U.S. Geological Survey, the Fish and Wildlife Service of the Department of Interior, and the Smithsonian Institution. A target date of 15 July 1947 was proposed (Reference C.8.1, p. 75).

The objectives of the Bikini Scientific Resurvey, as formulated by JCS, were to (Reference C.8.1, p. 75):

- Collect biological samples
- Carry out diving operations to recover instrumentation from target ships and conduct structural examinations of these vessels
- Collect water, bottom samples, and cores
- Conduct radiological studies of the lagoon, surrounding islands, and organisms, with particular emphasis on the analysis of hazards from alpha radiation and from possibly contaminated food organisms.

Following the issuance of the JCS memorandum, the Joint CROSSROADS Committee immediately began to prepare for the operation. Building on the guidance contained in this memorandum, a number of specific scientific objectives were established (Reference C.8.1, p. 3):

- Analysis of the amount and nature of radioactivity remaining in the lagoon water and on the reef and land structure of the atoll wherever it exceeded normal background levels of radioactivity. Particular attention was to be given to the portion of the reef between Aomen and Bikini islands at a stage of tide as close as possible to that which existed 15 minutes after Test BAKER. These investigations

would include charting the exposed portion of the reef through aerial photography.

- Examination of the concentration and kinds of radioactive materials found in plants and animals in the area and assessment of the effects the radioactivity had on these organisms
- Physiological, geological, and oceanographic studies of organisms and reef-building processes, including the drilling of cores down to 1,000 and perhaps 2,500 feet (305 and 762 meters)
- Detailed observation (including photographic recording) of target ships sunk as a result of Test BAKER, with special attention to be given to USS Saratoga (CV-3), Nagato (captured Japanese battleship), USS Pilotfish (SS-386), USS Apogon (SS-308), and perhaps USS Arkansas (BB-33) and USS Gilliam (APA-57) if time permitted. Detailed structural inspections were to be made to determine the exact cause of sinking and to identify minor structural failures.
- Recovery of four instruments from Nagato -- one ionization gauge, two linear time-pressure recorders, and one diaphragm-type damage gauge. Since these instruments were watertight they would be in good condition and yield recordings of considerable value.
- Attempt to locate a section of LSM-60, believed to have been identified in photographs and to inspect this section for type of rupture, heat effects, and radioactivity.

TASK GROUP 10.12

In a directive issued on 2 June 1947, the Chief of Naval Operations (CNO) ordered that the Bikini Scientific Resurvey be carried out under the operational control of the Commander-in-Chief, Pacific Fleet (CINCPACFLT). On 3 June 1947, CNO sent a dispatch to CINCPACFLT designating three ships for participation in the operation:

- USS Chilton (APA-38) (flagship)
- USS Coucal (ASR-8)
- LCI(L)-615.

The same message ordered Chilton to depart San Diego on 1 July for Bikini Atoll via Pearl Harbor (Reference C.8.1, p. 6). On 12 June CINCPACFLT designated a commander for the task group (TG 10.12) that would conduct the Bikini Scientific Resurvey. CINCPACFLT Operation Order No. 101-47 dated 29 June 1947 (Reference C.8.1, p. 6) detailed the task group's organization.

Commander Task Group (CTG) 10.12 was a Navy captain who had a subordinate Navy officer for a technical director and a staff of 36. One Navy Medical Corps officer on the staff was assigned as Radiological Health Officer and seven officers were assigned duties involving radiological safety (Reference C.8.1,

pp. 6 through 9). In addition, one individual from Scripps Institution of Oceanography was assigned to the radiological safety (radsafe) group as a radiological monitor and three pharmacist's mates were assigned to assist the Radiological Health Officer (Reference C.8.1, p. 13).

Navy Construction Battalion Detachment 1800, consisting of 1 officer and 36 enlisted personnel, was assigned to TG 10.12 to provide engineering support for the resurvey. This unit also operated one amphibian aircraft in support of the operation (Reference C.8.1, p. 6).

The X-Ray Division, commanded by one of the staff officers of TG 10.12, was formed to provide technical support to the resurvey scientific teams. This unit contained 183 Navy enlisted personnel (Reference C.8.1, p. 8).

Primarily for reporting results and findings of the investigations, a scientific group organization was set up, drawing from the military, civilian government employees, and civilian contractor personnel assigned to TG 10.12 (Reference C.8.1, pp. 8 through 14). This organization had ten divisions as listed below (number of personnel shown in parentheses):

- Geology
  - -- Island and Reef Geology (5)
  - -- Submarine Geology (2)
  - -- Contractor Support Team (8)
- Radiobiology -- (11)
- Fisheries
  - -- Reef and Lagoon Fishes (4)
  - -- Pelagic Fishes (6)
  - -- Population and Taxonomic Studies (1)
- Biology
  - -- Experimental Biology (6)
  - -- Ecology and Morphology (3)
- Radiochemistry and Radiophysics
  - -- Fission Products Chemistry (5)
  - -- Plutonium Chemistry (3)
  - -- Soils Chemistry (1)
  - -- Radiophysics (2)
- Radiological Safety (8 personnel -- 7 were TG 10.12 staff officers)
- Radiological Health (4 personnel drawn from the TG 10.12 staff)

- Diving, Underwater Photgraphy and Television (6)
- Army Engineers (2)
- Aerology (Weather Observation) (1 person from the TG 10.12 staff).

The members of the scientific and military groups came from a large number of organizations -- the Navy (including officers taken from the TG 10.12 staff), the War Department, and (Reference C.8.1, p. 8):

- Atomic Energy Commission
- Clinton Laboratories
- Colorado School of Mines
- Columbia University
- Cornell Aeronautical Laboratory
- Department of Interior Fish and Wildlife Service
- Hanford Engineering Works
- International Pacific Fisheries Halibut Commission
- Ohio State University
- Scripps Institution of Oceanography
- Stanford University (including Stanford Research Institute and Hopkins Marine Station)
- U.S. Geological Survey
- U.S. National Museum, Smithsonian Institute
- University of Hawaii
- University of Minnesota
- University of Tennessee
- University of Washington
- Washington State Department of Game.

PREPARATIONS

Relatively little preparation time was available between the CNO order of 2 June 1947 directing that the Bikini Scientific Resurvey be undertaken and initiation of onsite operations in July 1947 (Reference C.8.1, p. 20).

Chilton, which was to serve as the task group's flagship, had been recently overhauled. The first members of the resurvey team boarded Chilton in San Diego on 17 June 1947. Construction of laboratory facilities was started immediately. Stores were loaded between 23 June 1947 and when the ship departed on 1 July 1947 (Reference C.8.1, p. 17).

Chilton arrived at Pearl Harbor on 7 July. Additional personnel and supplies were taken aboard and Chilton departed Pearl Harbor en route Bikini on 8 July (Reference C.8.1, p. 17).

Coucal departed Pearl Harbor en route Bikini on 7 July 1947. LCI(L)-615 loaded supplies at Kwajalein and arrived on station at Bikini on 17 July (Reference C.8.1, p. 17).

An operation plan was prepared while Chilton was en route from San Diego to Pearl Harbor. This plan generally restated the objectives outlined in the JCS memorandum.

Various annexes of the operation plan covered the operational, scientific, and radsafe aspects of the mission.

The plan (Reference C.8.1, pp. 23 and 24) detailed the procedures to be followed to ensure radiological safety, including the initial radiological reconnaissance of Bikini Atoll. Appendix I of Annex J of the Operation Plan (reproduced in Appendix B) contains these sections:

- Radiological hazards were defined and estimated for the Bikini area.
- Provision was made for special pre- and postoperational medical examinations.
- Provision for the issue of special clothing for personnel working in contaminated areas was made.
- Regulations covering shore operations were established. Restrictions were placed on eating foods and drinking water from the islands, swimming in the area was prohibited (these restrictions subsequently were lifted), and provision made for a radsafe officer to accompany all initial trips to onshore areas.
- Radsafe equipment was specified:
  - -- Type 263 Geiger tube survey meters would be used to detect beta and gamma radiation in the field
  - -- Portable "Zeuto" nylon window ionization chambers would be employed to detect heavy alpha radiation
  - -- Type 235 survey meters with ionization chambers in an extended probe would be used for gamma radiation monitoring on sunken ships
  - -- As dictated by circumstances, pencil-type quartz fiber dosimeters for detection of gamma radiation would be employed by divers and other personnel.
- Provisions were made for the establishment of a photographic dosimetry unit to process film badges.
- All divers and other personnel expected to encounter significant radiation would wear Type K film badges, and an individual would not be allowed to reengage in the same

activity if his total body radiation exceeded 0.1 R/24 hours the previous day.

- Plans were made for the establishment of decontamination stations and decontamination techniques were outlined.
- Rules governing the handling of radiologically active scientific specimens, the conduct of laboratory work, and disposal of laboratory waste were established.
- Procedures for reentry into Bikini Atoll and for offloading of equipment (presupposing favorable results from the initial radiological reconnaissance) were established.

Additional technical support for radsafe operations was available from the two radiochemistry laboratories and the counter room established on Chilton (Reference C.8.1, pp. 27 through 29).

Daily staff conferences were held during the trip to Bikini Atoll. During these meetings, detailed plans and procedures for the implementation of the operation plan were developed (Reference C.8.1, p. 27). A Scientific Advisory Board was established on 2 July 1947. This board provided advice to the project officer on administrative matters, particularly allocation of laboratory space and facilities and implementation of the scientific work program (Reference C.8.1, p. 33).

On the recommendation of the Scientific Advisory Board, a series of seminars was conducted. The purpose of these seminars was to provide scientific personnel with information concerning the background, objectives, and methodologies of the studies to be conducted during the Bikini Scientific Resurvey. Three of the ten seminars in the series covered topics pertaining to radiological safety (Reference C.8.1, pp. 33 through 41). The first, "Effects of Radiation on Man," summarized what was known in this field and identified potential hazards on Bikini Atoll. The remaining two seminars outlined the operation plan for radiological safety at Bikini (Reference C.8.1, pp. 39 and 40).

While Chilton was en route from Pearl Harbor to Bikini Atoll, several series of experiments bearing on radiological safety were conducted. In one group of tests, samples of seawater were analyzed for radioactive content to establish a background figure for comparison with the lagoon water at Bikini Atoll. In a separate test, a container of radium was hidden on board Chilton and monitors with Geiger counters attempted to identify its location. The monitors detected not only the radium container but also x-ray equipment in the dental office. The purpose of this test was to ensure that the Geiger counters were in good operating condition before the initial landing at Bikini Atoll (Reference C.8.1, p. 44).

During the trip to Bikini Atoll, work proceeded on the scientific laboratories. As a consequence, by 15 July 1947 all of the programmed onboard laboratories were ready for use. These facilities included (Reference C.8.1, p. 29):

- Two radiochemistry laboratories and a counting room aboard Chilton that were capable of determining beta, gamma, and alpha radiation levels in samples

- A radiobiology laboratory (aboard Chilton)
- A photography laboratory to support scientific operations, which had an associated activity devoted to photographic dosimetry, including the processing and examination of film badges aboard Chilton.

Subsequently, other laboratories were established on Bikini Island to support the scientific activities of onshore research personnel.

Medical examinations were the final preoperational component of the radsafe program. All TG 10.12 military and civilian personnel who were to be engaged in the resurvey operations were required to complete a special physical examination and detailed laboratory tests. Later, personnel who had been actively engaged in resurvey activities were reexamined following the operation. Appendix E of the operation plan detailed the medical tests and criteria employed (Reference C.8.1, p. 100).

OPERATIONS

Initial landing operations commenced on 15 July 1947. Coucal and Chilton passed through Eneu Channel at 1030. Coucal anchored in the vicinity of the sunken Saratoga; Chilton anchored off Bikini Island (Reference C.8.1, p. 47).

At 1145 a radiological monitoring team landed on Bikini Island to monitor the beach, being the first party ashore. Radsafe officers obtained beta and gamma readings along the beach and at a number of inland locations. Readings inland from the beach were uniformly at the same general levels as normal background. The lagoon side of the beach area had radioactivity concentrated in old life rafts, fenders, and similar materials. It was believed that these items might have washed ashore from target ships sunk during CROSSROADS. Samples were obtained from all areas and returned to Chilton for alpha counts (Reference C.8.1, p. 47 through 51).

All members of the initial landing party were required to wear long-sleeved shirts, full-length trousers, and heavy work shoes. On return to Chilton they were monitored to assure necessary decontamination of personnel (a change station was established for this purpose) and prevent ship contamination. All personnel wore film badges designed to record both beta and gamma radiation and monitors carried pocket dosimeters (Reference C.8.1, p. 51).

Evaluation of the pocket dosimeters and examination of developed film badges indicated that no individuals in the landing party had been exposed to tolerance levels of beta or gamma radiation (Reference C.8.1, p. 51).

Immediately after the initial landing, a second landing team went ashore on Eneman Island where monitoring operations were also carried out (Reference C.8.1, p. 51).

Evidence collected by these two landing parties indicated that landing operations could be safely conducted.

Based on the results of the initial surveys, the Radiological Health Officer reported in a memorandum dated 16 July 1947 (reproduced in Appendix B) that (Reference C.8.1, p. 119):

- The preliminary survey of Bikini Island indicated that radiation intensities were on the order of 0.004 R/24 hours and were well below the established tolerance levels.
- Reconnaissance of Bikini Island indicated that all of the low-intensity radiation encountered in the central sector of the island was confined to the sand beaches along the lagoon side of the island and to debris that had washed up on the beaches.
- The survey of the northwestern tip of the island indicated intensities of approximately 0.03 R/24 hours in algal beds and other scattered locations in that sector. In the remainder of the surveyed areas, only background counts were observed.
- Observed intensities on Eneman Island were not above background, with the exception of scattered pieces of debris that produced readings somewhat above background count.

As soon as the radiological safety of various areas on Bikini Island was assured, offloading of material from Chilton commenced. Working on a dawn-to-dark schedule between 15 July 1947 and 22 July 1947, the offloading schedule specified in Annex K of the operation plan was met (Reference C.8.1, pp. 53 and 54).

Scientific activity commenced on 16 July. On 17 July, diving operations from Coucal were initiated. The initial target was Saratoga, which had been sunk by shot BAKER almost a year before. On the same day, LCI(L)-615 arrived with additional supplies. This vessel was used to support submarine geology studies. On July 18, drilling operations commenced (Reference C.8.1, p. 54).

Radsafe officers accompanied all scientific working parties during the initial landings on islands and reef areas and continued to accompany these groups over the period 15 July to 28 August 1947 until it had been determined that the specific areas to be visited were free from contamination by radioactive materials (Reference C.8.2, p. 94).

Victoreen Model 263 survey meters were used in all field and personnel monitoring operations. These devices were capable of detecting both gamma and beta-plus-gamma radiation through the approximate range of 0.001 to 0.6 R/24 hours. Model 356 alpha meters were also included in the equipment of the Radiological Safety Section but proved to be of no value in general terrain monitoring and of only limited value in the monitoring of underwater samples because of their comparatively low sensitivity (Reference C.8.2, p. 94).

While no major problems were encountered with the Victoreen Model 263 survey meters, these devices were a continuous repair and maintenance problem. They also proved to be too heavy and cumbersome to transport by hand over long distances. Hence, web straps were improvised. Canvas cases were also improvised

to protect the meters from water damage during rubber boat landings (Reference C.8.2, p. 95).

Between 15 July and 28 August, two members of the Radiological Safety Section were assigned to Coucal on a full-time basis. Duties included monitoring of divers, diving dress, and associated gear immediately following return aboard the ship after a dive; preliminary monitoring of all samples brought to the surface by the divers; and periodic monitoring of the ship itself to ensure that no unnecessary accumulation of radioactive materials occurred (Reference C.8.2, p. 95).

Two types of underwater survey meters/probes were tested during deep-water diving operations conducted from Coucal (Reference C.8.2, p. 94).

The initial equipment set consisted of a brass-cased Geiger tube, approximately 120 feet (37.6 meters) of shielded extension cable, and a Victoreen Model X-325 counting rate meter. Tests conducted before the initial dive on Saratoga showed that this equipment was inadequate because the survey cable was too short to survey the bottom in the vicinity of the target ship's position. Hence, the probe could not be used throughout the target area (Reference C.8.2, p. 94).

On 28 July, an experimental underwater radiological survey meter probe was received aboard Chilton from the Naval Research Laboratory. It consisted of a brass cylinder containing seven Geiger tubes, electrical circuitry and recording meters, and 225 feet (69 meters) of shielded extension cable. This device had a sensitivity range between (approximately) 0.00005 and 0.005 R/24 hours for gamma radiation only. Limited tests of this equipment were made during the latter part of August (Reference C.8.2, pp. 94 and 95).

Both probes were of limited utility because of their high sensitivities and because they required alternating current (Reference C.8.2, p. 95).

In addition to radiological reconnaissance, one of the missions of the original landing parties was to search for signs of human activity on Bikini following the conclusion of CROSSROADS. During both the initial survey and subsequent operations, no indications of human occupation before the arrival of the resurvey team were found (Reference C.8.1, p. 59).

The operation plan prohibited the consumption of fish, fruits or other materials grown in or around Bikini Lagoon, the drinking of water from any island source, and swimming. On 19 July CTG 10.12 opened limited recreation areas on Bikini Island. Certain beach areas were opened to swimming on 21 July, and the ban on consumption of edible fruits was lifted on 24 July. The prohibition of the consumption of fish and other marine organisms remained in effect and all personnel were cautioned to avoid unnecessary contact with barges and other objects in Bikini Lagoon and with the debris found on the beaches. CTG 10.12 initiated these actions on the advice of the Radiological Health Advisory Board established by Annex J of the operation plan (Reference C.8.1, p. 59; Reference C.8.2, p. 95). This annex is reproduced in Appendix B.

After it had been determined that the general level of radiation throughout Bikini Atoll was well within the tolerance limit of 0.1 R/24 hours, all members

of the Radiological Safety Section, except the radsafe officer and the two officers assigned to Coucal, were assigned collateral duties as planning officers for the major scientific groups of the resurvey staff. These reassigned officers continued to be primarily responsible for monitoring and for protecting personnel from radiation. One officer served as both radsafe officer and planning officer for LCI(L)-615 throughout the period of bottom sampling and coring operations. Another officer acted in the same capacity during shallow diving operations conducted from an LCM (Reference C.8.2, p. 95).

Monitoring data were collected by radsafe officers accompanying scientific teams and by independent radiological reconnaissance teams between 15 July and 28 August from all of the major islands and from representative islands in each group except the sector at the western end of Bikini Lagoon (Bokdrolul, Bokaetoktok, and Oroken islands). A complete reconnaissance of the latter islands was regarded as unnecessary because of their distance from the anchorage of Chilton and their lack of significance for the resurvey operation (Reference C.8.2, p. 96).

The survey indicated that while certain isolated areas and accumulations of waterborne debris found on the lagoon beaches continued to produce beta and gamma radiation in excess of the established tolerance limit of 0.1 R/24 hours, the general level of beta and gamma radiation throughout the atoll was well below this limit. Debris along the beach that continued to produce radiation was almost entirely material that was assumed to have been blown overboard from target ships during CROSSROADS or thrown into the lagoon by reboarding and damage control teams following BAKER (Reference C.8.2, p. 96).

On 25 July, CTG 10.12 forwarded two requests to CINCPACFLT, asking that LCI(L)-615 be retained for the duration of the resurvey and that an LSM be assigned for use in resurvey operations and for the transport of scientific specimens to San Diego. On 30 July, Commander Service Force, Pacific, ordered LSM-382 to report to CTG 10.12 as soon as practicable. LSM-382 reported to Bikini Lagoon on 5 August (Reference C.8.1, pp. 59 through 61).

On 11 August, LSM-382 with a number of scientific staff members on board visited Rongerik Atoll. This radiologically uncontaminated atoll was studied to obtain comparative data for the Bikini analyses (Reference C.8.1, p. 62).

OTHER UNITS AND PERSONNEL

Other personnel and units, not formally or originally assigned to TG 10.12, visited Bikini during the resurvey.

The first of these contacts occurred on 15 and 16 July when two Navy Catalina (PBY) aircraft flew up from Kwajalein. The Atoll Commander, Kwajalein, arrived to confer with CTG 10.12 on 16 July. Courier aircraft operated on the Kwajalein-Bikini route throughout the operation (Reference C.8.1, p. 51).

On 28 July USS Latona (AF-35) arrived in Bikini Lagoon. It transferred supplies to Chilton and departed the same day (Reference C.8.1, p. 59).

Between 31 July and 2 August, three technical specialists from Cornell Aeronautical Laboratory joined the resurvey to assist in the installation and operation of underwater television equipment (Reference C.8.1, p. 59).

From 6 to 8 August, a representative from the Office of the Secretary of the Navy arrived via courier plane. He visited the sites ashore at which resurvey operations were being conducted (Reference C.8.1, pp. 61 and 62).

From 6 to 11 August, four natives of Bikini Atoll were returned by courier plane. They toured the atoll to observe changes. The only change detected was the presence of a new species of fruit-bearing plant -- the papaya. The seeds of this plant apparently reached Bikini during CROSSROADS. This group departed by aircraft (Reference C.8.1, p. 61).

One representative from Geo-Technical Corporation joined the scientific team on 15 August to assist in seismographic research (Reference C.8.1, p. 62).

A representative from the Navy Hydrographic Office reached the survey site on 20 August to participate in analyses of seawater chemistry. Two additional Navy officers joined the task group on August 25 to assist in scientific experiments (Reference C.8.1, pp. 62 and 63).

ROLLUP OPERATIONS

In a dispatch to CINCPACFLT on 13 August, CTG 10.12 recommended that operations be terminated on 30 August 1947. An affirmative response from CINCPACFLT directing that operations cease on that date was received by CTG 10.12 on 14 August (Reference C.8.1, p. 62).

Active preparations for the end of the resurvey operation began on 22 August 1947 (Reference C.8.1, p. 71). Before leaving Bikini Lagoon, all ships in TG 10.12 were instructed to dispose of all lines and other equipment exhibiting radiation in excess of the final clearance limits specified by the Bureau of Ships and the Bureau of Medicine. In the absence of specific directives covering the final clearance limits established for diving dress and associated gear, Coucal was instructed to retain all such equipment pending return to Pearl Harbor, since monitoring had indicated that the contamination present was of a low order and presented no significant radiation hazard (Reference C.8.2, p. 96).

On 25 August, the securing of shore establishments and loading of ships was begun. LSM-382 completed operations and departed for Kwajalein, Pearl Harbor, and San Francisco on 26 August. Coucal was scheduled to complete diving operations on 27 August and, after offloading some special equipment to Chilton, departed Bikini. LCI(L)-615 departed for Kwajalein on 29 August (Reference C.8.1, p. 63).

Monitoring of Chilton's hull at the waterline immediately before departure from Bikini Lagoon on 29 August resulted in readings of background and slightly above background level. Monitoring of Chilton's small boats and deck gear between 29 and 31 August failed to indicate radiation levels above background. Samples of scale taken from Chilton's No. 2 evaporator on 1 September showed a

beta plus gamma count of 1.7 times background and a gamma count of 1.25 times background in scale taken from the second stage of the evaporator, and a beta plus gamma count of 2.3 times background and a gamma count of 1.3 times background in scale taken from the first stage. External monitoring of Chilton's evaporators, condensers, and other saltwater systems produced no evidence of radiation above normal background levels (Reference C.8.2, p. 96 and 98).

Chilton was loaded and ready for sea at 1000 on 29 August. A final inspection of secured installations ashore was made and ship musters were held to ensure that all personnel were properly accounted for. The last courier plane for Kwajalein embarked passengers and loaded mail. Chilton then departed for Pearl Harbor, arriving there on 3 September 1947 (Reference C.8.1, p. 63).

TG 10.12 was dissolved at Pearl Harbor on 4 September 1947 (Reference C.8.1, p. 73).

During the concluding phase of the operation, the Medical Legal Board submitted a report to the project officer. The report began by summarizing the radiological situation. Consistent with the foregoing account, only certain isolated areas and accumulations of debris were found to produce beta and gamma radiation in excess of the tolerance limit of 0.1 R/24 hours (Reference C.8.1, p. 123).

The maximum radioactivity observed during the resurvey was found on a deposit of tar or oil residue on a ledge of rock on a sandspit extending west of Bikini Island. This area produced a beta plus gamma reading of 0.6 R/24 hours and a gamma reading of 0.18 R/24 hours (Reference C.8.1, p. 123).

Concerning the operational phase of the resurvey, the report noted that (Reference C.8.1, pp. 123 and 124):

- Radsafe and health procedures specified in the operation plan were observed throughout the operation.
- Radsafe officers accompanied all scientific work parties during initial landings and continued to accompany these parties until it had been determined that the area in question was free from any hazardous concentrations of radioactive materials.
- Each diver returning to Coucal was initially hosed down with seawater while still on the stage and before being taken aboard. Following removal of the diving suit, divers and gear were monitored with Model 263 survey meters to detect any gamma and beta radiation.
- Personnel monitoring was carried out aboard Chilton until it was determined that this procedure was no longer required.
- Personnel decontamination stations were established on both Chilton and Coucal in the event that monitoring indicated presence of excessive radiation on either individuals or clothing.

- All members of the scientific teams wore individual film badges during the initial stages of the operation and until such time as it had been determined that this procedure could be modified or dispensed with entirely in areas that presented no radiological hazards.
- Since deep diving and underwater inspection operations were considered to pose the greatest potential hazard, film badges and pocket dosimeters were carried by each diver throughout the course of the underwater work. Three film badges, each enclosed in a waterproof covering, were attached to the inner clothing of the diver before descent -- one at waist height, one at chest height, and one in a shoe. During the early phases of the operation, these film badges were delivered to the Photodosimetry Unit for developing and analysis at the conclusion of each dive. Later, when it had been determined that hazardous concentrations of radioactive materials were not being encountered, badges were analyzed at weekly intervals.
- A total of 517 film badges were processed by the Photodosimetry Unit of the Radiological Health Section. No badge carried during the course of the operation gave evidence of exposure to beta or gamma radiation in excess of the daily specified tolerance limit of 0.1 R/24 hours.
- Biological analyses conducted during the resurvey indicated the presence of varying amounts of radioactivity in marine life in Bikini Lagoon, though not in sufficient concentrations to pose an external radiation hazard. Instructions issued by the task group commander on the recommendation of the Radiological Health Advisory Board directed that no marine life would be consumed by personnel involved in the operation.
- Recreational swimming at designated beaches on Bikini Island was allowed only after chemical analysis of lagoon water indicated a plutonium content of less than 10^{-11} grams per liter of water. A gross analysis of the fission products present in the water indicated a content of less than 10^{-12} curies per liter of water.
- On the basis of radiochemical analysis of edible fruits, the original ban on the consumption of such fruits was lifted on 24 July by the task group commander acting on the recommendation of the Radiological Health Advisory Board.

The Statement of Findings of the Medical Legal Board noted that (Reference C.8.1, p. 124):

> In view of the data obtained and the observations made during the period 15 July 1947 through 26 August 1947, the undersigned members of the Medical Legal Board, Bikini Scientific Resurvey, attest, that to the best of their knowledge and belief, no individual assigned to, attached to, or participating

in the Bikini Scientific Resurvey during the same period of time was exposed to radiation in excess of the established standards.

PERSONNEL EXPOSURE LEVELS

The photographic dosimetric equipment that was employed consisted of (Reference C.8.2, p. 101):

- An Ansco-Sweet densitometer for reading densities of films exposed in film badges
- Type K film badges (500) obtained from the Radiation Laboratory, San Francisco Naval Shipyard
- Holders and DuPont film packets obtained from the Atomic Energy Commission at Oak Ridge, Tennessee (300 holders and 5,000 packets).

Both types of film badges were exposed to a standard radium source for calibration. Each type had an approximate sensitivity range of 0.02 to 2 R.

Project reports differ as to the number of badges used during the operation. The Report of Findings of the Medical Legal Board stated (Reference C.8.1, p. 124):

> Of the total of 517 [emphasis added] film badges processed by the Photodosimetry Unit of the Radiological Health Section, no badge carried during the course of the Resurvey Operations gave evidence of exposure to beta or gamma radiation in excess of the tolerance limits referred to in Paragraph A.1., above.

On the other hand, the section entitled "Radiological Health at Bikini" presented in Volume II of the Report of the Technical Director states (Reference C.8.2, p. 101):

> During the period from 15 July to 29 August 1947, a total of 572 [emphasis added] film badges were developed, and the exposures interpreted. None of these badges was found to have been exposed to sufficient radiation to acquire computable density. From film-badge data it was determined that there were no personnel exposures in excess of the daily tolerance limit of 0.1R, beta plus gamma. All developed badges were alphabetically filed, and will be permanently stored at the Radiation Laboratory, San Francisco Naval Shipyard, as a permanent exposure record for personnel connected with this Resurvey Operation.

While these two sources differ as to the number of badges examined, both reach the same conclusion regarding badge readings -- no personnel exposures in excess of specified daily tolerance limits occurred; however, neither the badges nor any listing of the readings have been located.

RESURVEY CONCLUSIONS

The Bikini resurvey concluded that the atomic detonations caused only minor, transient disturbance to the plant and animal populations in the area. Some plants and animals in the immediate area of the underwater detonation were killed and some highly radioactive plants, fish, and invertebrates of impaired vitality were found during the 3 weeks following Test BAKER. One year later, a careful search of the islands, reefs, and lagoon revealed no changes in populations, number, or composition. No physiological damage could definitely be attributed to the detonation. Some dying coral on a reef between Bikini and Aomen islands provided the closest case of damage from the test. The corals (Heliopora) were in fine condition a few weeks before Test BAKER. At the time of the detonation, the tops of the coral clumps were about 1 foot (0.3 meter) underwater and the tide was rising. They may have been killed by the radioactive fission products that washed over the reef after raining down from the radioactive cloud. More probable causes of the corals' death were contamination from oil from the sunken ships or by heavy rain during one of the low tides. The question of what caused the death of the corals remained unsolved (Reference A.4, pp. 74 and 75).

One of the most discussed effects of the radioactivity was the possibility of producing genetic changes. At Bikini, more than 1,000 species of organisms were exposed to radioactivity, and many of them had reproduced at least once. A careful search of tens of thousands of specimens in the area failed to show definite evidence of aberrant forms. Since mutations produced by radiation almost invariably do not survive, the result was not unexpected (Reference A.4, p. 76). No scientific investigations found evidence of radiation-induced genetic effects during the 6 weeks of work in the atoll (Reference A.4, p. 77).

The Radiological Safety Section, which monitored most of the islands, found few places where beta-gamma readings exceeded the tolerance limit of 0.1 R/24 hours. The studies of sea urchins and other invertebrates led to the observation that the specimens examined in the shipboard laboratories were healthy, abundant, and reproducing normally.

Occasionally there were reports of situations in which radioactivity may have played a part in generating ecological anomalies, although other, non-radiological, factors could have been present. The Technical Director of the resurvey stated that the level of residual radioactivity was low and not dangerous (Reference A.4, p. 61). While there was no doubt that decay and dilution had reduced residual radioactivity to a low level, questions persisted (Reference A.4, p. 67).

For example, there remained the question of the unexplained turbidity of the eastern lagoon waters near Bikini Island and the target area. Before Test BAKER, the waters had been clear and transparent. However, in 1947 Chilton noted the lagoon waters were opaque. The most likely cause for the increased opacity was an increase in plankton (Reference A.4, pp. 66 and 67). Hypotheses for the increased plankton growth included seasonal effects (later rejected) and the discharge of untreated sewage by personnel at CROSSROADS in 1946. While the scientists agreed the turbidity was unique, they were unwilling to conclude that the atomic detonations had set up conditions that would encourage an increase in plankton (Reference A.4, p. 68).

Studies of radioactivity made in the vicinity of the target ships indicated that there were "large amounts of radioactive material" on the lagoon bottom, particularly in the vicinity of the target array (Reference A.4, p. 70). The radioactivity made its way into the food chain as sea cucumbers and worms ingested and excreted the mud. The plants took up some of the excreted radioactivity. The plants were eaten by small fish, which were preyed upon by larger fish. While the animals excreted most of the radioactive material, a small amount was retained, particularly by the liver, spleen, kidneys, and gonads. Furthermore, the ingestion of radioactive material resulted in a very widespread distribution of radioactivity in the lagoon. The radioactivity detected at Bikini was low, yet it was traceable in food chains. Fission products were found occurring in fish and invertebrates such as clams, snails, oysters, corals, sponges, octopods, crabs, sea urchins, sea cucumbers, spiny lobsters, and shrimp. They were also represented in the algae found in the lagoon (Reference A.4, p. 73).

CHAPTER 7
U.S. ARMY GROUND FORCES PARTICIPATION

INTRODUCTION

Approximately 3,300 Army personnel were assigned to Operation CROSSROADS (Reference C.9.206, p. III-(A)-3). Of the total number of Army personnel, approximately 350 were assigned to Task Group (TG) 1.4 (Army Ground Group) and 2,500 to TG 1.5 (Army Air Group). The forces that were to become the U.S. Air Force in 1947 were still part of the Army in 1946. A summary of Army Air Forces participation is discussed in Chapter 8. In addition to the 71 Army officers assigned to TG 1.4, another 70 Army ground officers have been identified on the Joint Task Force 1 (JTF 1) Officer Roster. Fifty of these were assigned to the Radiological Safety Section. Approximately 380 Army ground personnel remain without positive unit identification. Some of these probably were assigned to JTF 1 Hq staff. Others were probably assigned to TU 1.5.5 (Air Service Unit) at Kwajalein as engineers and military police.

TASK GROUP 1.4 (ARMY GROUND GROUP)

TG 1.4 had two assigned missions: to determine damage to selected Army equipment exposed at varying distances from the point of detonation and to measure the bombs' radii of effectiveness. CTG 1.4 maintained close liaison with various agencies operating under the Director of Ship Material and was assigned the operating code designation 014B. Senior representatives of each of the technical services under TG 1.4 were at the same time in command of a task unit and also a member of the technical staff (Reference C.9.149, p. 3).

TG 1.4 was berthed aboard the support ship USS Wharton (AP-7) and consisted of a headquarters and the following six operating task units (TU):

- TU 1.4.1 (Engineer Unit)
- TU 1.4.2 (Signal Unit)
- TU 1.4.3 (Ordnance Unit)
- TU 1.4.4 (Chemical Unit)
- TU 1.4.5 (Quartermaster Unit)
- TU 1.4.6 (Air Unit).

Headquarters was composed of Command, Technical, and Administrative sections. The functions of Command and Administrative sections were the normal ones implied by their respective designations. The Technical Section was composed of representatives of six branches, i.e., Corps of Engineers, Chemical Warfare Service, etc. Its members planned, correlated, and supervised test procedures; prepared reports covering test items; and assisted the commanding officer in preparation of the test. The provisional headquarters was activated on 22 March 1946 with an operating strength of five officers and eighteen

enlisted personnel. Four officers and nine enlisted headquarters personnel have been identified, none of whom were badged.

Each operating task unit was under the command of a technical staff officer and was composed of a staff and a group of inspection teams. These teams were assigned to target ships and were responsible for loading, securing, maintaining, and inspecting test items. Teams were to reboard target ships after each detonation after the ships had been radiologically cleared and declared safe for boarding.

Task Unit 1.4.1 (Engineer Unit)

TU 1.4.1 conducted tests to determine the radii of damage to typical items of Corps of Engineers equipment and to discover weaknesses that might be corrected by improved design. Items such as construction tractors, crawlers, caterpillars, floating bridges, and firefighting and water-supply equipment were exposed aboard the target attack transports USS Gilliam (APA-57) at 800 yards (732 meters), USS Dawson (APA-79) at 1,500 yards (1.37 km), and USS Butte (APA-66) at 2,200 yards (2.01 km) for Test ABLE. During Test BAKER, water purification units and other equipment were exposed aboard USS LST-545 4,100 yards (3.75 km), and USS LST-125 and LCM-5 5,700 yards (5.21 km) away on Bikini Island (Reference C.9.150, p. 15). TU 1.4.1 operating strength called for 12 officers, 53 enlisted personnel, and 2 civilians (Reference C.9.150, Appendix E, p. 1). Six officers, four enlisted personnel, and one civilian have been identified, but none can be positively identified as badged.

Task Unit 1.4.2 (Signal Unit)

Signal Corps participation in Tests ABLE and BAKER was to determine the effects of damage versus distance on Signal Corps equipment such as switchboards, generators, batteries, wires, and installations. Equipment was exposed aboard USS Nevada (BB-36), USS Arkansas (BB-33), USS Independence (CVL-22), Prinz Eugen, USS Saratoga (CV-3), USS New York (BB-34), USS Gasconade (APA-85), and on Bikini Island for Test ABLE. For Test BAKER, items were exposed aboard Arkansas, Nevada, Saratoga, and Prinz Eugen. The unit operating strength called for nine officers and twenty-seven enlisted personnel as well as nine civilians from Signal Corps Engineer Laboratory. Seven officers, twenty-six enlisted men, and nine civilians have been identified. Two individuals can be identified as having been badged. One had a badge he carried from 30 June to 7 July 1946; it read zero. The other was badged on 19 August, and his badge read 0.130 R (gamma). He may also have had a badge showing zero exposure on 14 August.

Task Unit 1.4.3 (Ordnance Unit)

To facilitate control and preclude duplication it was agreed that the Ordnance Unit would handle all explosives and demolition materials for the Corps of Engineers. Objectives of the TU 1.4.3 tests were to determine whether changes in design of ordnance materials, ammunition, and packaging were necessary to minimize the effects of a nuclear detonation and to collect technical data that might aid in future designs. Items were placed on Arkansas, Nevada, USS Pennsylvania (BB-38), Saratoga, YOG-83, USS LST-52, USS LST-661, USS LST-220, and LST-545 for both tests; some test items were also located on Bikini Island. Operating strength called for 17 officers and 72 enlisted personnel.

Only 15 officers and 38 enlisted personnel have been identified and none were badged. It was not until 31 July that ordnance inspection teams were allowed to inspect the Army equipment after Test BAKER (Reference B.5.3; Reference C.9.155, p. 1).

Task Unit 1.4.4 (Chemical Unit)

Chemical Warfare Service personnel conducted tests to expose selected items of chemical warfare equipment and fillings to the effects of a nuclear detonation. The tests had two objectives: first, to determine the effects of heat, blast, and radiation on packaging, chemical composition, and functioning; second, to determine whether changes in design and chemical composition of these items were necessary to ensure their effective use during and after exposure. Items were displayed during Test ABLE on the following six target ships (distances from Nevada, center of target array, in parentheses) YOG-83 (1,000 yards [914 meters]), LCT-818 (1,200 yards [1.10 km]), LST-52 (1,500 yards [1.37 km]), LCT-874 (2,000 yards [1.83 km]), LST-661 (2,300 yards [2.10 km]), and LST-220 (3,200 yards [2.93 km]). The Chemical Warfare Service did not participate in Test BAKER. The operating strength of this unit called for six officers, seventeen enlisted personnel, and one civilian. Except for one enlisted man, all have been identified. Only one person was badged and he had a zero reading (Reference B.5.3; Reference C.9.151, p. 1-2, Appendix F).

Task Unit 1.4.5 (Quartermaster Unit)

The objectives for TU 1.4.5 tests were to determine the effects of a nuclear detonation on quartermaster supplies and prepare recommendations for future implementation. This unit was composed of a technical staff of four officers and five enlisted men and 11 test teams consisting of one officer and six enlisted men each. TU 1.4.5 was activated from 1 February through 10 August 1946. Test ABLE tested the effects on quartermaster supplies in open storage from an airburst, and Test BAKER tested the effects on quartermaster supplies in various stages of an amphibious invasion operation from an underwater explosion.

Test items for ABLE were displayed on the following 13 target ships: New York, Arkansas, Nevada, Pennsylvania, USS Pensacola (CA-24), Saratoga, USS Carteret (APA-70), USS Fallon (APA-81), USS Cortland (APA-75), USS Bladen (APA-63), USS Niagara (APA-87), USS Catron (APA-71), and ARDC-13. USS Rockwall (APA-230) was used as a supply ship. After each target vessel was declared radiologically safe, test teams reboarded their assigned vessels and prepared inspection reports on damage sustained by test items.

After Test ABLE, TU 1.4.5 was divided into three groups. The first group consisted of three officers, three enlisted personnel, three test teams, and a security detachment to guard supply dumps on Bikini. Each test team had one officer and fourteen enlisted personnel, and the security detachment consisted of one officer and twelve enlisted personnel. The second group was composed of chemists and chemical engineers who departed for Honolulu before BAKER to compile data from ABLE. Members of the third group were relieved from further duty with TU 1.4.5 and proceeded to their normal duty stations. The latter two groups departed Bikini on 13 July aboard USS Chilton (APA-38) for Hawaii and the mainland.

Three displays were used for Test BAKER: aboard LST-545, 4,000 yards (3.66 km) from the blast, LST-125, beached on shore of Bikini, and Bikini Island beachhead. On BAKER D+6, TU 1.4.5, accompanied by radsafe monitors, inspected three displays. In all, 16 officers and 78 enlisted personnel have been identified from this unit, but only 7 were badged; the highest badge reading was 0.21 R (References B.5.3, C.9.155, and C.9.154).

Task Unit 1.4.6 (Air Unit)

The objectives of TU 1.4.6 were to test nuclear effects on representative items of Army Air Forces equipment at varying distances from Test ABLE. Navy target ships used to expose items were Nevada, Independence, and New York. After radsafe personnel declared each target ship safe, Army Air Forces inspection teams went aboard. Reboarding was as follows:

	Time	Date	Hours after Detonation
New York	1145	2 July	25
Nevada	0830	4 July	71
Independence	0930	5 July	93

The operating strength of this unit called for seven officers and nine enlisted personnel. Reboarding teams were composed of ships' personnel and Army personnel. Seven officers and six enlisted personnel have been identified; none were badged (Reference B.5.3; Reference C.9.156, p. 218).

CHAPTER 8

U.S. ARMY AIR FORCES PARTCIPATION

About 2,500 U.S. Army personnel in the Army Air Forces* served in CROSSROADS and were assigned to Task Group (TG) 1.5, Army Air Group. The air units of TG 1.5 operated from Kwajalein and Enewetak islands. A small number of personnel (13 have been identified) were assigned to Task Unit (TU) 1.4.6 (Air Unit). This unit is discussed in Chapter 7, "U.S. Army Ground Forces Participation."

In January 1946, the 58th Bombardment Wing of the U.S. Army Fourth Air Force was designated TG 1.5 for CROSSROADS activities. Roswell Army Air Field, New Mexico, was selected as the center for preparations in the continental United States. The 509th Composite Group at Roswell formed the nucleus of the various task units needed for the tests. A large part of the headquarters staff of the 58th Wing at March Army Air Field, California, was transferred to Roswell to form Headquarters, TG 1.5. (Reference C.9.206, Part VIIE). Other units that furnished significant manpower included the 320th Troop Carrier Squadron, 329th Bomb Squadron, 330th Bomb Squadron, 393rd Bomb Squadron, and 1027th Air Materiel Squadron. Table 12 lists all units known to have supplied personnel to TG 1.5.

Functions performed by TG 1.5 included airdropping the shot ABLE nuclear weapon, collecting samples of nuclear debris from the radioactive clouds, weather reconnaissance and prediction, communications support, operation of the airbase at Enewetak Island, photography and air transport support for men and material. It also assisted in some effects experiments associated with measuring blast, heat, and radiation aboard aircraft.

Table 13 lists the task units in TG 1.5. The table shows number of persons in each unit, number badged, and dosimetry breakdown. The information was obtained using May 1946 task unit rosters and the Reynolds Electrical and Engineering Company's (REECo) printout of radiation exposure by name. Rosters for June and July 1946 could not be located, and there is some evidence that more personnel were assigned to the various task units during June and July. An undated chart showing task unit totals for Hq TG 1.5 and TU 1.5.1 through TU 1.5.5 was located at Brooks AFB, Texas. Totals for Hq TG 1.5, TU 1.5.1, TU 1.5.2, and TU 1.5.3 are quite close to those on the May rosters (as shown in Table 13). However, the total for TU 1.5.4 is 309 versus 55 in Table 13; and for TU 1.5.5 it is 995 versus 686 in Table 13. Since TU 1.5.4 included personnel who ferried men and equipment to the Pacific, the roster may have included only those assigned on Kwajalein. However, no such explanation is available for the difference in TU 1.5.5.

*In 1946 the Air Forces were still part of the U.S. Army.

Table 12. Participating Army Air Forces units, Operation CROSSROADS.

Unit	Home Station	Task Unit
1st Ordnance Squadron	Roswell AAF, New Mexico	1.5.1
6th Aircraft Repair Unit (Floating)	SS Brig. Gen. Alfred J. Lyon	Unknown
40th Bomb Group (VH)	Davis Monthan AAF, Arizona	1.5.8
44th Bomb Group	Smoky Hill AAF, Kansas	1.5.2
58th Bomb Wing	March AAF, California	Hq TG 1.5
59th Weather Recon Squadron	Castle AAF, California	1.5.7
71st AACS Group	Hickam AAF, Hawaii	1.5.5
93rd Bomb Group	Clovis AAF, New Mexico	1.5.3
107th AACS Squadron	Robins AAF, Georgia	1.5.5
110th Army Air Force Base Unit	Mitchel AAF, New York	1.5.5
112th Army Air Force Base Unit	Grenier AAF, New Hampshire	1.5.2
123d Army Air Force Base Unit	Seymour-Johnson AAF, North Carolina	1.5.3
136th Army Air Force Base Unit	Myrtle Beach AAF, South Carolina	1.5.2
139th Army Air Force Base Unit	Shaw AAF, South Carolina	1.5.5
146th Army Air Force Base Unit	Selfridge AAF, Michigan	1.5.5
201st Army Air Force Base Unit	Peterson AAF, Colorado	1.5.5
233d Army Air Force Base Unit	Ft. Worth AAF, Texas	1.5.3
234th Army Air Force Base Unit	Clovis AAF, New Mexico	1.5.3
243rd Army Air Force Base Unit	Great Bend AAF, Kansas	1.5.2
245th Army Air Force Base Unit	McCook AAF, Nebraska	1.5.5
247th Army Air Force Base Unit	Smoky Hill AAF, Kansas	1.5.5
263rd Army Air Force Base Unit	Peterson AAF, Colorado	1.5.5
311th Reconnaissance Wing	Buckley AAF, Colorado	1.5.7
316th Troop Carrier Squadron	Pope AAF, North Carolina	1.5.1
320th Troop Carrier Squadron	Roswell AAF, New Mexico	1.5.4
326th Army Air Force Base Unit	MacDill AAF, Florida	1.5.5
329th Bomb Squadron	Clovis AAF, New Mexico	1.5.3
330th Bomb Squadron	Clovis AAF, New Mexico	1.5.3
337th Army Air Force Base Unit	Venice AAF, Florida	1.5.5
390th Air Service Group	Roswell AAF, New Mexico	1.5.5

(continued)

Table 12. Participating Army Air Forces units, Operation CROSSROADS (continued).

Unit	Home Station	Task Unit
393d Bomb Squadron	Roswell AAF, New Mexico	1.5.1
400th Army Air Force Base Unit	San Francisco AAF, California	1.5.2
420th Army Air Force Base Unit	March AAF, California	1.5.2
427th Army Air Force Base Unit	Roswell AAF, New Mexico	1.5.2
439th Troop Carrier Squadron	Roswell AAF, New Mexico	1.5.4
444th Bomb Group	Davis-Monthan AAF, Arizona	1.5.3
448th Bomb Group	Ft. Worth AAF, Texas	1.5.2
462d Bomb Group	MacDill AAF, Florida	1.5.2
466th Air Service Group	Sedalia AAF, Missouri	1.5.5
466th Army Air Force Base Unit	Sedalia AAF, Missouri	1.5.5
467th Army Air Force Base Unit	Salt Lake City AAF, Kearns, Utah	1.5.5
468th Bomb Group	Roswell AAF, New Mexico	Hq TG 1.5
477th Air Service Group	Pope AAF, North Carolina	1.5.5
509th Composite Group	Roswell AAF, New Mexico	Hq TG 1.5
519th Air Services Group	Smoky Hill AAF, Kansas	1.5.2
603d Air Engineering Squadron	Roswell AAF, New Mexico	1.5.5
702d Army Air Force Base Unit	Mitchel AAF, New York	1.5.5
719th Air Materiel Squadron	Pope AAF, North Carolina	1.5.5
454th Army Air Force Base Unit	McCord AAF, Washington	1.5.5
775th Army Air Force Base Unit	Hickam AAF, Hawaii	1.5.5
789th Bomb Squadron	Clovis AAF, New Mexico	1.5.3
790th Bomb Squadron	Clovis AAF, New Mexico	1.5.3
804th Army Air Force Base Unit	Greenville AAF, South Carolina	1.5.5
811th AAB FU	Ft. Benning, Georgia	1.5.5
812th Army Air Force Base Unit	Pope AAF, North Carolina	1.5.5
902d Army Air Force Base Unit	Orlando AAF, Florida	1.5.2
1027th Air Materiel Squadron	Roswell AAF, New Mexico	1.5.5
1395th Military Police Squadron	Roswell AAF, New Mexico	1.5.5
1503rd Army Air Force Base Unit	Hamilton AAF, California	1.5.5
2135th Army Air Force Base Unit	Tyndall AAF, Florida	1.5.2
2140th Army Air Force Base Unit	Smyrna AAF, Tennessee	1.5.2

(continued)

Table 12. Participating Army Air Forces units, Operation CROSSROADS (continued).

Unit	Home Station	Task Unit
2530th Army Air Force Base Unit	Selman AAF, Louisiana	1.5.2
2533th Army Air Force Base Unit	Goodfellow AAF, Texas	1.5.2
2621st Army Air Force Base Unit	Barksdale AAF, Louisana	1.5.2
2622th Army Air Force Base Unit	Mather AAF, California	1.5.2
3010th Army Air Force Base Unit	Williams AAF, Arizona	1.5.2
3501st Army Air Force Base Unit	Boca Raton AAF, Florida	1.5.2
3705th Army Air Force Base Unit	Lowry AAF, Colorado	1.5.2
4000th Army Air Force Base Unit	Patterson AAF, Ohio	1.5.2
4121st Army Air Force Base Unit	Kelly AAF, Texas	1.5.2
4135th Army Air Force Base Unit	Hill AAF, Utah	1.5.4
4136th Army Air Force Base Unit	Tinker AAF, Oklahoma	1.5.2
Air Material Command	Wright AAF, Ohio	1.5.2 1.5.3 1.5.8

Source: Reference C.13.5.

Table 13. U.S. Army Air Forces personnel exposure, CROSSROADS.

Element	No. of Persons Listed	No. of Persons Badged	Exposure Ranges (R)		
			0	0.001-0.5	0.5-1
Hq TG 1.5	139	20	17	3	
TU 1.5.1	367	48	42	6	
1.5.2	412	149	143	6	
1.5.3	450	117	30	87	
1.5.4	55	8	8		
1.5.5	686	2	0	2	
1.5.7	56	0			
1.5.8	27	15	14	1	
1.5.9	48	8	2	5	1
Others	249	0			

Sources: References C.13.4, B.5.3, and B.5.4.

Eleven personnel listed in the REECo exposure data as being on Enewetak on 25 July are not on any TG 1.5 roster. Five of these have sequential badge numbers. This strongly implies that they were an aircraft crew in TU 1.5.3. Since there were no other units on Enewetak, these 11 individuals have been counted with TU 1.5.3. It is not possible to arbitrarily group otherwise unidentified personnel on Kwajalein since numerous units were there besides Army Air Forces units.

The REECo data (taken from original source documents) shows last name only (no first name or initials) in about 60 percent of the listings, so for the more common names such as Smith, Jones, and Williams it is very difficult to match the right name. In some cases, e.g., aircraft crews, men were given sequential badge numbers and it was possible to match common names positively. In general, however, whenever there was doubt it was assumed that there was no match. In addition to name, the REECO list shows badge number, location (Enewetak, Kwajalein, ships by name, etc.), badge dates, and badge exposure. It does not identify an individual with a particular organization, only his location. Thus the task unit rosters have to be used along with the dosimetry list.

TU 1.5.6 and TU 1.5.10 are not shown in Table 13. TU 1.5.6 was consolidated with TU 1.5.3 in June 1946. TU 1.5.3 totals reflect personnel from both units. TU 1.5.10 is synonymous with Hq TG 1.5 and the latter designation is used in Table 13.

HEADQUARTERS TASK GROUP 1.5

This group was made up primarily of personnel from Hq 58th Wing and Hq 509th Group. The listing in Table 13 includes personnel assigned to Hq TG 1.5 and Hq 509th Composite Group on Kwajalein. Why these two units are listed separately is unknown. It may be that the personnel in Hq 509th Composite Group were recent arrivals at Kwajalein and were pending assignment to one of the task units. Only 20 of 139 personnel were badged and no exposures exceeded 0.5 R. Three civilians are included in the totals.

Task Unit 1.5.1 (Tactical Operations Unit)

Personnel from the 393rd Bombardment Squadron of the 509th Group Roswell AAF, New Mexico, made up the majority of TU 1.5.1. This unit operated seven B-29 aircraft from Kwajalein including the bomb drop aircraft, two command-and-control aircraft, two pressure-gauge drop aircraft, and two spare aircraft. Of 367 personnel associated with TU 1.5.1, 48 were badged, and all exposures were less than 0.5 R. Almost all the badged personnel were aircraft crews; 27 of the 48 were officers. There were no civilians in this task unit.

Task Unit 1.5.2 (Army Air Photographic Unit)

Personnel drawn from several units in the Air Materiel Command formed this task unit. This unit was responsible for a large part of the technical photography program during CROSSROADS. It operated two C-54s and eight F-13s (modified B-29s) from Kwajalein, which were equipped with very-high-speed and normal-speed motion picture cameras and 35-mm still cameras. Table 13 provides dosimetry information for the 149 personnel out of 412 who were badged. All

but 15 of the badged personnel were aircraft crewmembers. This unit had 55 civilians assigned, several of whom were cameramen on the aircraft and were badged. The highest exposure, 0.05 R, was recorded by a civilian.

Task Unit 1.5.3 (Instrumentation and Test Requirements Unit)

Personnel drawn from several units within the Air Materiel Command made up this task unit. TU 1.5.3 was consolidated with the Drone Aircraft Unit, TU 1.5.6, and was one of two organizations based on Enewetak Island for the CROSSROADS operation. The aircrews that flew the B-17 drones came from the 329th and 330th Bomb Squadrons, Clovis AAF, New Mexico. TU 1.5.3 operated the airfield and flew and maintained the seven B-17 drone controllers and ten B-17 drone aircraft used for cloud sampling. It also operated all base support functions at Enewetak including mess facilities, post exchange, special services, rations, fuel, signal and engineer support, and the message center (Reference B.5.1). There were 117 personnel badged out of a total of 450. All recorded exposures were less than 0.5 R. The vast majority of those badged were members of aircraft crews flying the B-17 controller aircraft. However, several firefighters and sheetmetal workers were also badged. The badging of firefighters is understandable since they may have had to fight a fire on contaminated aircraft. Perhaps the sheetmetal workers performed duties associated with the gaseous or particulate filter boxes on the drone B-17s, which were of sheetmetal construction.

Task Unit 1.5.4 (Air Transport Unit)

Personnel for TU 1.5.4 came primarily from the 320th Troop Carrier Squadron of the 509th Composite Group at Roswell Army Air Field, New Mexico. This unit provided airlift to and from the United States to Enewetak-Kwajalein, and performed air support missions in the Enewetak-Kwajalein-Bikini area. Although documents reflect TU 1.5.4 had 20 C-46s and 10 C-54s, there were not sufficient personnel for this many aircraft. In fact, the 20 C-46s were manned by the 439th Troop Carrier Squadron, Roswell Army Air Field, New Mexico, and were used to ferry men and materiel to and from the Pacific area. These personnel were never assigned to the joint task force. Only eight personnel were badged, four of whom were officers. None of the eight recorded any exposure.

Task Unit 1.5.5 (Air Service Unit)

Personnel for this unit came primarily from the 603rd Air Engineering Squadron, 1027th Materiel Squadron, 1395th Military Police Squadron, and the 390th Headquarters and Service Squadron. All were part of the 509th Composite Group at Roswell, New Mexico. TU 1.5.5 provided the supply and maintenance functions to Army Air Forces units on Kwajalein. In addition, it operated a mess facility, the special services office, a post exchange, rations breakdown point, fuel dump, signal and engineer supply point, and a message center for the Army Air Forces needs. It also had weather forecasting personnel and military policemen assigned to it. Of 686 personnel on the roster only 2 were badged. Their exposures were less than 0.10 R.

Task Unit 1.5.6 (Army Drone Unit)

This unit was combined with TU 1.5.3 before ABLE and BAKER tests.

Task Unit 1.5.7 (Army Air Weather Reconnaissance Unit)

Personnel for this task unit came primarily from the 59th Reconnaissance Squadron at Castle Army Air Field, California. This unit operated three WB-29s from Kwajalein to monitor weather around Bikini before the tests. On days before each shot, its planes monitored the weather at long ranges. Just after midnight the morning of each shot, its planes took off and monitored the weather in the Bikini area. Records indicate that none of these personnel were badged.

Task Unit 1.5.8 (Air Orientation Unit)

Personnel and aircraft for TU 1.5.8 came from units in the Air Materiel Command. Stationed at Kwajalein, it was responsible for aiding and transporting observers, visitors, news broadcasters, and the press. It furnished facilities for broadcasting and news releases on Kwajalein and provided two B-29s and two borrowed C-54s for media representatives to view the detonations and their results. Although no roster could be located for TU 1.5.8, a Letter Order from the 40th Bomb Group provided the names of 27 personnel assigned to TU 1.5.8. More personnel were probably in this unit, but they cannot be identified. Of the 27 personnel identified, 15 were badged and only one recorded any exposure, 0.06 R.

Task Unit 1.5.9 (Air-Sea Rescue Unit)

This unit was stationed on Enewetak with TU 1.5.3, and, in fact, was part of TU 1.5.3 until June 1946. It was made a separate task unit by Change No. 4 to the JTF 1 Op Plan 1-46 dated 30 May 1946. It operated two B-17 air-sea rescue aircraft equipped to support air-sea rescue operations for downed aircraft crews. It patrolled the area between Enewetak and Bikini, which was the flight path of the B-17 drones and B-17 controllers flying out of Enewetak. Although no roster for TU 1.5.9 personnel could be located, a set of orders marked "VOCG Mid Pac, eff 6 May 46" (Verbal Order Commanding General Mid-Pacific, effective 6 May 1946) was located, assigning 40 personnel from the 4th Emergency Rescue Squadron, APO 244, to TG 1.5. The remaining eight on Table 13 were identified from a TU 1.5.3 roster made up before TU 1.5.9 broke away from TU 1.5.3. Only eight personnel were badged, all of whom were officers. Four of these eight are also listed as radsafe monitors in the Radsafe Group of the Instrumentation Division (see Chapter 3). They were badged and received exposures in August as well as on both shot days. Two other officers in TU 1.5.9 appear to have performed radsafe monitoring duties as well since they were also badged and received exposures in August and on both shot days. These latter two may have been assigned to radsafe duties after the 20 April 1946 edition of the Instrumentation Division roster was formulated.

It is unusual that six officers from this unit received exposures on 1 July and 25 July (shot days), while no one else in the unit did. Furthermore, the location for all six on both dates is shown as "Eniwetok." They obviously were not members of a B-17 air-sea rescue crew since no one else was badged. They may have monitored returning drones for radiation at Enewetak on those dates and then went on to other radsafe monitoring duties in August. The highest exposure of the six was 0.77 R, recorded by an Army Air Forces captain. He was badged three times in August for a total of 0.47 R and on both shot days when

he recorded a total of 0.30 R. As mentioned above, his location on shot days was "Eniwetok;" however, his locations in August were target ships in Bikini Lagoon. His name is so unusual that it is unlikely that these were two different individuals, although it remains a possibility since the REECo exposure list shows no initials for this name.

OTHERS

Unit orders were located that identify the 6th Aircraft Repair Unit (Floating) as being aboard SS Brigadier General Alfred J. Lyon at Kwajalein during CROSSROADS. Lyon was a U.S. Army aircraft repair ship. Names of assigned personnel do not appear on other TG 1.5 rosters. None of the personnel assigned this unit has a record of being badged during CROSSROADS.

CHAPTER 9
U.S. NAVY PARTICIPATION

Operation CROSSROADS was popularly perceived as a Navy operation. The Deputy Task Force Commander for Aviation, an Army Air Forces officer, observed that (Reference C.9.206, pp. II-(B)-3 and II-(B)-4):

> Despite all efforts to the contrary on the part of the Task Force Commander and his officers in charge of public relations, news releases and publicity in the majority of cases tended to create, in the mind of the public, the impression that the tests were primarily a naval activity rather than a joint effort in which all services were participating and in which they were equally entitled to praise or censure.

That this was the case is not surprising. From every point of view except the organizational, CROSSROADS was predominantly a U.S. Navy operation. The primary mission of the test was to determine the effects of nuclear detonations on naval vessels. Commander Joint Task Force 1 (CJTF 1) was a Navy officer, and the majority of his joint staff were Navy personnel. In all, over 37,000 Navy personnel participated in CROSSROADS, approximately 90 percent of the total combined military and civilian population of the operation. There were 45 Navy aircraft and 237 Navy ships involved as full-time participants.

The ships were in two categories: support ships and target ships. In the support group were 153 large and small ships, which provided the berthing, messing, laboratory, and office space for the task force. In the target group were 93 vessels for Test ABLE and 92 vessels for Test BAKER, ranging from battleships to small amphibious craft. Of the target ships only 12 were remanned by their crews after the tests, 13 were sunk after ABLE or BAKER, 8 were towed to Pearl Harbor or the United States for inspection, and the remainder were sunk at Bikini or Kwajalein. The target ships that were later remanned were those with low radioactive contamination and no significant structural damage. Support ships evacuated the lagoon before each shot and took all personnel, including target ship crews, to a safe distance outside Bikini Lagoon. Tables 14 and 15 summarize the Navy vessels' participation in CROSSROADS. Ship histories, largely extracted from the ships' deck logs, which present information pertinent to potential personnel exposure, make up Appendix A to this report.

In the remainder of this chapter, the other Navy components of JTF 1 are discussed. For each unit, except small support ships, detailed information is given on the events in which they were involved during CROSSROADS. Discussed are Navy air units, diving units, and other Navy units that had some potential for radiological exposure.

Table 14. CROSSROADS target vessels and their disposition.

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure[a]	Destination and Arrival[a]	Decontamination Location	Disposition/Remarks	
						Date	Location
USS Anderson (DD-411)						1 Jul 46	Sunk at Bikini, shot ABLE
USS Apogon (SS-308)						25 Jul 46	Sunk at Bikini, shot BAKER
ARDC-13						6 Aug 46	Sunk at Bikini, shot BAKER
USS Arkansas (BB-33)						25 Jul 46	Sunk at Bikini, shot BAKER
USS Banner (APA-60)	27 Aug 46	29 Aug 46				16 Feb 48	Scuttled off Kwajalein
USS Barrow (APA-61)	26 Aug 46	27 Aug 46				11 May 48	Scuttled off Kwajalein
USS Bladen (APA-63)	20 Aug 46	21 Aug 46[b]	30 Aug 46	Pearl Harbor San Francisco 13 Sep 46	San Francisco	3 Aug 53	Remanned; transferred to Maritime Commission[c]
USS Bracken (APA-64)	19 Aug 46	21 Aug 46				10 Mar 48	Scuttled off Kwajalein
USS Briscoe (APA-65)	20 Aug 46	22 Aug 46[b]				6 May 48	Scuttled off Kwajalein
USS Brule (APA-66)	28 Aug 46	29 Aug 46				11 May 48	Scuttled off Kwajalein (8°47'N, 167°18'E)
USS Butte (APA-68)	28 Aug 46	30 Aug 46[c]				12 May 48	Scuttled off Kwajalein (8°40'N, 167°15'E)
USS Carlisle (APA-69)						1 Jul 46	Sunk at Bikini, shot ABLE
USS Carteret (APA-70)	25 Aug 46	27 Aug 46				19 Apr 48	Sunk by gunfire, Kwajalein (8°42'N, 167°5'E)
USS Catron (APA-71)	26 Aug 46	28 Aug 46				6 May 48	Sunk at Kwajalein (9°2'N, 167°17'E)
USS Conyngham (DD-371)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor San Francisco 17 Oct 46	San Francisco	July 1948	Remanned; scuttled, southern California (31°33.5'N, 118°27'W)[c]
USS Cortland (APA-75)	19 Aug 46	20 Aug 46	30 Aug 46	Pearl Harbor San Francisco Norfolk December 1946	San Francisco	31 Mar 48	Remanned; transferred to Maritime Commission[c]

Notes:

[a] Target vessels that were sunk or scuttled at Kwajalein have no entry in this column.

[b] Inferred from various sources.

[c] Operational and final radiological clearance dates for remanned target vessels can be found in Appendix A.

(continued)

Table 14. CROSSROADS target vessels and their disposition (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure[a]	Destination and Arrival[a]	Decontamination Location	Disposition/Remarks	
						Date	Location
USS Crittenden (APA-77)	24 Aug 46	26 Aug 46	1 Dec 46	San Francisco 1 Jan 47	San Francisco	5 Oct 48	Sunk off southern California (32°05'N, 115°05'E)
USS Dawson (APA-79)	19 Aug 46	21 Aug 46				19 Apr 48	Sunk by gunfire, Kwajalein (8°47'N, 167°20'E)
USS Dentuda (SS-335)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor San Francisco October 1946	Mare Island Naval Shipyard	20 Jan 69	Remanned; sold for scrap[b]
USS Fallon (APA-81)	1 Sep 46	3 Sep 46				10 Mar 48	Scuttled near Kwajalein
USS Fillmore (APA-83)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor Norfolk January 1947	San Francisco	1 Apr 48	Remanned; transferred to Maritime Commission[b]
USS Gasconade (APA-85)	24 Aug 46	26 Aug 46	Jan 47[c]	San Francisco 27 Jan 47	San Francisco	21 Jul 48	Sunk off southern California (31°35'N, 118°33'W)
USS Geneva (APA-86)	24 Aug 46	25 Aug 46	13 Oct 46	Pearl Harbor Norfolk January 1947	San Francisco	2 Nov 66	Remanned; transferred to Maritime Commission[b]
USS Gilliam (APA-57)						1 Jul 46	Sunk at Bikini, shot ABLE
USS Hughes (DD-410)	26 Aug 46	28 Aug 46	May 47[c]	Bremerton 31 May 47	Bremerton	16 Oct 48	Sunk off southern California (31°47'N, 118°40'W)
USS Independence (CVL-22)	25 Aug 46	27 Aug 46[c]	Jun 47	San Francisco 16 Jun 47	San Francisco	26 Jan 51	Sunk off southern California (37°20'N, 123°04'W)
USS Lamson (DD-367)						1 Jul 46	Sunk at Bikini, shot ABLE
LCI-327	1 Sep 46	3 Sep 46				30 Oct 47	Destroyed at Kwajalein
LCI-329	24 Aug 46	25 Aug 46				16 Mar 48	Sunk at Kwajalein
LCI-332	1 Sep 46	3 Sep 46				30 Sep 47	Sunk at Kwajalein
LCI-620						10 Aug 46	Sunk at sea off Bikini

Notes:

[a]Target vessels that were sunk or scuttled at Kwajalein have no entry in this column.

[b]Operational and final radiological clearance dates for remanned target vessels can be found in Appendix A.

[c]Inferred from various sources.

(continued)

Table 14. CROSSROADS target vessels and their disposition (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure[a]	Destination and Arrival[a]	Decontamination Location	Disposition/Remarks	
						Date	Location
LCI(L)-549	24 Aug 46	25 Aug 46	June 1948	San Francisco	San Francisco	19 Aug 49	Remanned; sold to private purchaser[b]
LCI(L)-615	4 Sep 46	5 Sep 46	June 1948	San Francisco	San Francisco	19 Aug 49	Remanned; sold to private purchaser[b]
LCT-412[c]	4 Sep 46	6 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-414						After 25 Jul 46	Sunk at Bikini, demolition
LCT-705	2 Sep 46	4 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-812						30 Aug 46	Sunk at Bikini, demolition
LCT-816	Unknown	Unknown				June 1947	Sunk at Kwajalein
LCT-818	1 Sep 46	3 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-874	4 Sep 46	6 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-1013	2 Sep 46	4 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-1078	4 Sep 46	6 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-1112	1 Sep 46	3 Sep 46				Sept 1947	Sunk at Kwajalein
LCT-1113	Unknown	Unknown				June 1947	Sunk at Kwajalein
LCT-1114						30 Jul 46	Sunk at Bikini, demolition
LCT-1115	Unknown	Unknown				Sept 1947	Sunk at Kwajalein
LCT-1175						After 25 Jul 46	Sunk at Bikini, shot BAKER
LCT-1187						29 Aug 46	Sunk at Bikini, shot BAKER
LCT-1237						After 25 Jul 46	Sunk at Bikini, shot BAKER
LSM-60						25 Jul 46	Sunk at Bikini, shot BAKER

Notes:

[a]Target vessels that were sunk or scuttled at Kwajalein have no entry in this column.

[b]Operational and final radiological clearance dates for remanned target vessels can be found in Appendix A.

[c]Shot BAKER target only.

(continued)

Table 14. CROSSROADS target vessels and their disposition (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure[a]	Destination and Arrival[a]	Decontamination Location	Disposition/Remarks	
						Date	Location
USS LST-52	26 Aug 46	27 Aug 46				Apr 1948	Sunk by gunfire, Kwajalein (8°47'N, 167°25'E)
USS LST-125[b]						11 Aug 46	Sunk at sea off Bikini (11°25'N, 165°25'E)
USS LST-133	29 Aug 46	30 Aug 46				11 May 48	Sunk at Kwajalein (8°48'N, 167°10'E)
USS LST-220	28 Aug 46	30 Aug 46				12 May 48	Sunk at Kwajalein (8°44'N, 167°25'E)
USS LST-545	28 Aug 46	30 Aug 46				12 May 48	Sunk at Kwajalein (8°48'N, 167°21'E)
USS LST-661	25 Aug 46	27 Aug 46				25 Jul 48	Sunk at Kwajalein (8°51'N, 167°20.3'E)
USS Mayrant (DD-402)	28 Aug 46	29 Aug 46				4 Apr 48	Sunk by gunfire, Kwajalein (8°49'N, 167°23'E)
USS Mugford (DD-389)	19 Aug 46	21 Aug 46				22 Mar 48	Scuttled, Kwajalein
USS Mustin (DD-413)	28 Aug 46	30 Aug 46				28 Apr 48	Sunk by gunfire, Kwajalein (8°47.8'N, 167°11.5'E)
Nagato (Japanese battleship)						30 Jul 46	Sunk at Bikini, shot BAKER
USS Nevada (BB-36)	19 Aug 46	22 Aug 46	May 1947[c]	Pearl Harbor 15 May 1947	Pearl Harbor	31 Jul 48	Sunk by gunfire, near Pearl Harbor (20°58'N, 159°17'W)
USS New York (BB-34)	22 Aug 46	24 Aug 46	March 1947[c]	Pearl Harbor 15 Mar 1947	Pearl Harbor	8 Jul 48	Sunk 40 nmi (74 km) southwest of Pearl Harbor
USS Niagara (APA-87)	21 Aug 46	23 Aug 46	30 Aug 46	Pearl Harbor San Francisco Norfolk	San Francisco	1950	Remanned; sold for scrap to Northern Metals Co., Philadelphia[d]
USS Parche (SS-384)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor San Francisco 14 Oct 46	Mare Island Naval Shipyard, San Francisco	July 1970	Remanned; sold for scrap[d]
USS Pennsylvania (BB-38)	21 Aug 46	24 Aug 46				10 Feb 48	Sunk at Kwajalein

Notes:

[a]Target vessels that were sunk or scuttled at Kwajalein have no entry in this column.

[b]Shot BAKER target only.

[c]Inferred from various sources.

[d]Operational and radiological clearance dates for remanned target vessels can be found in Appendix A.

(continued)

Table 14. CROSSROADS target vessels and their disposition (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure[a]	Destination and Arrival[a]	Decontamination Location	Disposition/Remarks	
						Date	Location
USS Pensacola (CA-24)	24 Aug 46	27 Aug 46[b]	April 1947[b]	Bremerton 21 Apr 1947	Bremerton	10 Nov 48	Sunk off Washington coast (48°12'N, 127°01'W)
USS Pilotfish (SS-386)						25 Jul 46 16 Oct 48	Sunk, shot BAKER; raised and inspected; resunk at Bikini
Prinz Eugen (German cruiser)	20 Aug 46	22 Aug 46				22 Dec 46	Sank at Kwajalein
USS Ralph Talbot (DD-390)	26 Aug 46	29 Aug 46				March 48	Sunk at Kwajalein
USS Rhind (DD-404)	30 Aug 46	1 Sep 46				22 Mar 48	Scuttled, Kwajalein
Sakawa (Japanese cruiser)						2 Jul 46	Sunk at Bikini, shot ABLE
USS Salt Lake City (CA-25)	23 Aug 46	25 Aug 46	July 1947[b]	Bremerton 28 Jul 47	Bremerton	25 May 48	Sunk off southern California (31°57'N, 119°54'W)
USS Saratoga (CV-3)						25 Jul 46	Sunk at Bikini, shot BAKER
USS Searaven (SS-196)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor San Francisco 14 Oct 46	Mare Island Naval Shipyard, San Francisco	11 Sep 48	Remanned; sunk off southern California (31°42.3N, 118°26.4'W)[c]
USS Skate (SS-305)	23 Aug 46	24 Aug 46	28 Aug 46	San Francisco 22 Oct 46	Mare Island Naval Shipyard, San Francisco	1948	Sunk off southern California (32°00'N, 119°04'W)[c]
USS Skipjack (SS-184)	5 Sep 46	7 Sep 46	11 Sep 46	San Francisco	Mare Island Naval Shipyard, San Francisco	11 Aug 48	Sunk off southern California (32°22'N, 118°53'W)
USS Stack (DD-406)	19 Aug 46	20 Aug 46				24 Apr 48	Sunk at Kwajalein
USS Trippe (DD-403)	20 Aug 46	22 Aug 46				3 Feb 48	Sunk at Kwajalein
USS Tuna (SS-203)	22 Aug 46	23 Aug 46	28 Aug 46	Pearl Harbor	Mare Island Naval Shipyard, San Francisco October 1946	24 Sep 46	Remanned; sunk off southern California (31°40'N, 118°30'W)[c]
USS Wainwright (DD-419)	23 Aug 46	25 Aug 46[b]				5 Jul 48	Sunk at Kwajalein
USS Wilson (DD-408)	19 Aug 46	21 Aug 46				8 Mar 48	Scuttled, Kwajalein
YO-160						25 Jul 46	Sunk at Bikini, shot BAKER
YOG-83	5 Sep 46	7 Sep 46				16 Sep 48	Sunk at Kwajalein

Notes:

[a]Target vessels that were sunk or scuttled at Kwajalein have no entry in this column.

[b]Operational and final radiological clearance dates for remanned target vessels can be found in Appendix A.

[c]Inferred from various sources.

Table 15. CROSSROADS support ships and decontamination locations.

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Achomawi (ATF-148)	29 Aug 46	30 Aug 46	1 Sep 46	Pearl Harbor San Francisco 4 Oct 46	San Francisco	6 Dec 46	13 Dec 46
USS Ajax (AR-6)	23 Aug 46	24 Aug 46	28 Aug 46	Pearl Harbor San Pedro 27 Sep 46	San Diego	By 1 Jan 47	Unknown
USS Albemarle (AV-5)[a,b]	25 Jul 46	26 Jul 46	30 Jul 46	Pearl Harbor San Pedro 12 Aug 46	Not required		By 22 Nov 46
USS Allen M. Sumner (DD-692)	10 Aug 46			Pearl Harbor San Diego San Francisco Puget Sound 30 Oct 46	Puget Sound	19 Nov 46	10 Jan 47
APL-27	24 Aug 46	26 Aug 46	July 1947	Los Angeles	Kwajalein	25 Feb 47	10 Mar 47[c]
USS Appalachian (AGC-1)[a]	29 Jul 46	30 Jul 46	30 Jul 46	Pearl Harbor San Francisco 16 Aug 46	Not required	2 Oct 46	3 Oct 46
USS Appling (APA-58)	8 Aug 46			Pearl Harbor San Francisco 22 Aug 46	San Francisco	By 22 Nov 46	13 Dec 46
ARD-29	25 Aug 46	26 Aug 46	16 Sep 46	Pearl Harbor 3 Oct 46	Pearl Harbor	18 Feb 47	18 Feb 47
USS Artemis (AKA-21)	18 Aug 46			Pearl Harbor 24 Aug 46	San Francisco	20 Nov 46	27 Dec 46
ATA-124[b]	25 Aug 46	26 Aug 46	9 Sep 46	Pearl Harbor Puget Sound 25 Nov 46	Puget Sound	Unknown	18 Dec 46

Notes:

[a]Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

[b]Shot BAKER only

[c]Inferred from various sources.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
ATA-180	1 Sep 46	3 Sep 46	8 Sep 46	Pearl Harbor Puget Sound 25 Nov 46	Puget Sound	24 Feb 47	Unknown
ATA-185	5 Sep 46	7 Sep 46	8 Sep 46	Pearl Harbor 20 Sep 46	Pearl Harbor San Diego	13 Dec 46	18 Jan 47
ATA-187	24 Aug 46	25 Aug 46	11 Sep 46	Pearl Harbor San Francisco 9 Oct 46	San Diego	6 Nov 46	By 22 Nov 46
ATA-192	2 Sep 46	4 Sep 46	8 Sep 46	Pearl Harbor San Francisco 12 Oct 46	San Francisco	14 Nov 46	10 Feb 47
ATR-40	23 Aug 46	25 Aug 46	8 Sep 46	Pearl Harbor 21 Sep 46	San Francisco	17 Dec 46	21 Dec 46
ATR-87	1 Sep 46	3 Sep 46	8 Sep 46	Johnston Island Pearl Harbor Bremerton 27 Nov 46	Puget Sound	13 Dec 46	By 4 Jan 47
USS Avery Island (AG-76)	7 Aug 46			San Francisco 21 Aug 46	San Francisco	3 Dec 46	By 4 Jan 47
USS Barton (DD-722)	10 Aug 46			Pearl Harbor San Diego 22 Aug 46	San Francisco	2 Nov 46	18 Dec 46
USS Bayfield (APA-33)	3 Aug 46	4 Aug 46	8 Aug 46	Pearl Harbor San Francisco Puget Sound August 1946	Puget Sound	7 Dec 46	10 Feb 47
USS Begor (APD-127)	3 Aug 46			Pearl Harbor 8 Aug 46	San Diego	30 Sep 46	25 Jan 47
USS Benevolence (AH-13)	25 Aug 46	26 Aug 46	29 Aug 46	Pearl Harbor San Francisco 8 Sep 46	San Francisco	24 Sep 46	April 1947
USS Bexar (APA-237)	23 Aug 46	24 Aug 46	29 Aug 46	Pearl Harbor San Pedro 10 Sep 46	San Diego	24 Jan 47	1 Feb 47

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Blue Ridge (AGC-2)[a]	30 Jul 46			Pearl Harbor 6 Aug 46	Not required		By 22 Nov 46
USS Bottineau (APA-235)	10 Aug 46			Pearl Harbor San Francisco 21 Aug 46	San Francisco	19 Dec 46	27 Dec 46
USS Bountiful (AH-9)[a]	27 Jul 46			Pearl Harbor 4 Aug 46	Not required	27 Sep 46	27 Sep 46
USS Bowditch (AGS-4)[b]	27 Sep 46	28 Sep 46	30 Sep 46	Pearl Harbor 8 Oct 46	San Francisco	20 Nov 46	20 Nov 46
USCG Bramble (WAGL-392)	24 Aug 46	25 Aug 46	Unknown	Pearl Harbor[c]	Pearl Harbor	Unknown	By 22 Nov 46
USS Burleson (APA-67)	5 Aug 46			Pearl Harbor San Pedro 22 Aug 46	Norfolk	Unknown	By 14 Oct 46
USS Cebu (ARG-6)	23 Aug 46	24 Aug 46	29 Aug 46	Pearl Harbor San Diego[c]	San Francisco	16 Dec 46	21 Dec 46
USS Charles P. Cecil (DD-835)[a]	25 Jul 46	25 Jul 46	28 Jul 46	Pearl Harbor San Diego 9 Aug 46	Not required	Unknown	By 22 Nov 46
USS Chickasaw (ATF-83)	26 Aug 46	28 Aug 46	7 Sep 46	Guam	San Francisco	13 Jan 47	18 Jan 47
USS Chikaskia (AO-54)	23 Aug 46	24 Aug 46	24 Aug 46	Pearl Harbor San Francisco 17 Sep 46	Puget Sound	31 Dec 46	4 Jan 47
USS Chowanoc (ATF-100)	28 Aug 46	30 Aug 46	16 Sep 46	Pearl Harbor 3 Oct 46	Pearl Harbor	Unknown	1 Feb 47
USS Clamp (ARS-33)	28 Aug 46	30 Aug 46	5 Sep 46	Pearl Harbor San Francisco 22 Oct 46	Los Angeles	Unknown	By 22 Nov 46

Notes:

[a]Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

[b]Shot BAKER only

[c]Inferred from various sources.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Coasters Harbor (AG-74)	15 Aug 46	16 Aug 46	17 Aug 46	Pearl Harbor San Diego	Los Angeles	7 Dec 46	13 Dec 46
USS Conserver (ARS-39)	5 Sep 46	7 Sep 46	12 Feb 47	Wake Island Pearl Harbor 22 Feb 47	Pearl Harbor	4 May 47	11 May 47
USS Coucal (ASR-8)	4 Sep 46	6 Sep 46	11 Sep 46	Pearl Harbor 22 Sep 46	San Diego	10 Jan 47	18 Jan 47
USS Creon (ARL-11)	21 Aug 46	23 Aug 46	11 Sep 46	Pearl Harbor San Pedro	Los Angeles	23 Jan 47	1 Feb 47
USS Cumberland Sound (AV-17)	1 Aug 46			San Pedro	Los Angeles	3 Dec 46	13 Dec 46
USS Current (ARS-22)	25 Aug 46	27 Aug 46	2 Dec 46	Pearl Harbor 18 Dec 46	Pearl Harbor	6 Feb 47	17 Feb 47
USS Deliver (ARS-23)	20 Aug 46	22 Aug 46	8 Sep 46	Pearl Harbor 23 Sep 46	San Francisco	20 Dec 46	27 Dec 46
USS Dixie (AD-14)	25 Aug 46	26 Aug 46	9 Sep 46	Pearl Harbor San Francisco 22 Sep 46	San Francisco	2 Oct 46	By 22 Nov 46
USS Dutton (AGS-8)	14 Sep 46	15 Sep 46	25 Sep 46	Pearl Harbor 4 Oct 46	Los Angeles	18 Dec 46	10 Jan 47
USS Enoree (AO-69)	24 Aug 46	25 Aug 46[a]	7 Sep 46	San Francisco 20 Sep 46	San Francisco	3 Dec 46	Unknown
USS Etlah (AN-79)	27 Aug 46	29 Aug 46[a]	2 Sep 46	Pearl Harbor 12 Sep 46	Puget Sound	18 Dec 46	21 Dec 46
USS Fall River (CA-131)	4 Sep 46	5 sep 46	9 Sep 46	Pearl Harbor 14 Sep 46	Los Angeles	23 Dec 46	27 Dec 46
USS Flusser (DD-368)	4 Sep 46	5 Sep 46	9 Sep 46	Pearl Harbor 14 Sep 46	Pearl Harbor	By 22 Nov 46	13 Dec 46
USS Fulton (AS-11)	25 Aug 46	26 Aug 46	28 Aug 46	Pearl Harbor San Francisco	San Francisco	24 Dec 46	10 Jan 47

Notes:

[a]Inferred from various sources.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Furse (DD-882)[a]	28 Jul 46	29 Jul 46	30 Jul 46	Pearl Harbor San Pedro	Not required	Unknown	By 22 Nov 46
USS George Clymer (APA-27)	20 Aug 46			Pearl Harbor San Pedro 3 Sep 46	San Diego	By 22 Nov 46	7 Feb 47
USS Gunston Hall (LSD-5)	25 Aug 46	26 Aug 46	2 Sep 46	Pearl Harbor 1 Sep 46	Los Angeles	8 Jan 47	10 Jan 47
USS Gypsy (ARSD-1)	5 Sep 46	7 Sep 46	10 Sep 46	Pearl Harbor 16 Sep 46	Pearl Harbor Los Angeles	9 Jan 47	19 Jan 47
USS Haven (AH-12)	25 Aug 46	26 Aug 46	10 Oct 46	Pearl Harbor 15 Oct 46	Los Angeles	14 Feb 47	Unknown
USS Henrico (APA-45)	16 Aug 46			Pearl Harbor San Francisco 27 Aug 46	San Francisco	28 Jan 47	1 Feb 47
USS Hesperia (AKS-13)	23 Aug 46	24 Aug 46	31 Aug 46	Pearl Harbor 12 Sep 46	Pearl Harbor	28 Dec 46	4 Jan 47
USS James M. Gilliss (AGS-13)	20 Aug 46			Pearl Harbor 1 Sep 46	San Francisco	13 Nov 46	13 Nov 46
USS John Blish (AGS-10)	20 Aug 46			Pearl Harbor 1 Sep 46	San Francisco	15 Oct 46	22 Nov 46
USS Ingraham (DD-694)	10 Aug 46			Pearl Harbor San Diego	Puget Sound	19 Nov 46	21 Nov 46
USS Kenneth Whiting (AV-14)	14 Aug 46			Pearl Harbor 19 Aug 46	Los Angeles	11 Dec 46	21 Dec 46
USS Laffey (DD-724)	10 Aug 46			Pearl Harbor San Diego 22 Aug 46	San Francisco	2 Nov 46	18 Dec 46
LCI(L)-977	22 Aug 46	23 Aug 46	11 Sep 46	Guam	Guam/Marianas	Unknown	7 Mar 47

Note:

[a]Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
LCI(L)-1062	22 Aug 46	23 Aug 46	11 Oct 46	Guam Pearl Harbor	Pearl Harbor	Unknown	By 4 Jan 47
LCI(L)-1067	22 Aug 46	23 Aug 46	9 Sep 46	Guam 16 Sep 46	Guam	24 Feb 47	Unknown
LCI(L)-1091	25 Aug 46	26 Aug 46	9 Sep 46	Guam 16 Sep 46	Guam	Unknown	11 Dec 46[a]
USS Limestone (IX-158)[b]		15 Apr 46	8 Sep 46	Pearl Harbor 23 Sep 46	Not required	Unknown	By 22 Nov 46
USS Lowry (DD-770)	10 Aug 46			Pearl Harbor San Diego 22 Aug 46	San Francisco	6 Nov 46	By 4 Jan 1947
USS LST-388	25 Aug 46	26 Aug 46	Unknown	Caroline Islands	San Francisco	5 Dec 46	13 Dec 46
USS LST-817	23 Aug 46	24 Aug 46	31 Aug 46	Pearl Harbor Port Hueneme 5 Oct 46	San Francisco	21 Nov 46	22 Nov 46
USS LST-861	24 Aug 46	25 Aug 46	2 Sep 46	Pearl Harbor 12 Sep 46	San Francisco	6 Dec 46	13 Dec 46
USS LST-871[b]	25 Jul 46	27 Jul 46	9 Aug 46	Pearl Harbor 30 Aug 46	Not required	Unknown	By 22 Nov 46
USS LST-881	22 Aug 46	27 Aug 46	31 Aug 46	Pearl Harbor 10 Sep 46	San Francisco	13 Dec 46	23 Dec 46
USS LST-989[b]	25 Jul 46	9 Aug 46[c]	9 Aug 46	Pearl Harbor 20 Aug 46[a]	Not required	19 Nov 46	22 Nov 46
USS Mender (ARSD-2)[d]	4 Sep 46	6 Sep 46	8 Sep 46	Pearl Harbor 19 Sep 46[a]	Los Angeles	3 Jan 47	Unknown

Notes:

[a] Inferred from various sources.

[b] Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

[c] From Enewetak.

[d] Shot BAKER only.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Moale (DD-693)	10 Aug 46			Pearl Harbor San Diego 22 Aug 46	San Francisco	19 Nov 46	11 Dec 46
USS Mount McKinley (AGC-7)	10 Aug 46			Pearl Harbor 16 Aug 46	San Diego	20 Dec 46	29 Jan 47
USS Munsee (ATF-107)	28 Aug 46	30 Aug 46	2 Sep 46	Pearl Harbor	San Francisco	18 Nov 46	April 1947
USS Newman K. Perry (DD-883)	4 Aug			Pearl Harbor 9 Aug 46	San Diego	17 Jan 47	25 Jan 47
USS O'Brien (DD-725)	8 Aug 46			Pearl Harbor 15 Aug 46	San Francisco	6 Nov 46	19 Dec 46
USS Oneota (AN-85)	26 Aug 46	29 Aug 46	6 Sep 46	Guam 13 Sep 46	Pearl Harbor	11 Dec 46	Unknown
USS Orca (AVP-49)	12 Aug 46	13 Aug 46	14 Aug 46	Guam	Pearl Harbor	11 Dec 46	13 Dec 46
USS Ottawa (AKA-101)	2 Aug 46			Port Hueneme 14 Aug 46	Pearl Harbor	13 Sep 46	13 Sep 46
USS Palmyra (ARS[T]-3)	5 Sep 46	6 Sep 46	11 Sep 46	Pearl Harbor San Francisco 9 Oct 46	San Francisco	By 22 Nov 46	By 4 Jan 47
USS Panamint (AGC-13)[a]	27 Jul 46	28 Jul 46	29 Jul 46	Honolulu San Francisco 12 Aug 46	Not required	22 Nov 46	22 Nov 46
PGM-23	25 Aug 46	26 Aug 46	9 Sep 46	Pearl Harbor 16 Sep 46	Pearl Harbor	Unknown	Unknown
PGM-24	25 Aug 46	26 Aug 46	9 Sep 46	Pearl Harbor 16 Sep 46	Pearl Harbor	13 Feb 47	Decommissioned 13 Mar 47
PGM-25	10 Aug 46	11 Aug 46	12 Aug 46	Guam 17 Aug 46	New Orleans	Unknown	28 May 47

Note:

[a]Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
PGM-29	10 Aug 46	11 Aug 46	12 Aug 46	Guam 17 Aug 46	New Orleans	Unknown	28 May 47
PGM-31	10 Aug 46	11 Aug 46	12 Aug 46	Guam 17 Aug 46	Pearl Harbor	17 Jan 47	25 Jan 47
PGM-32	10 Aug 46	11 Aug 46	12 Aug 46	Guam 17 Aug 46	Philippines	10 Oct 46	10 Oct 46
USS Phaon (ARB-3)[a]	23 Aug 46	24 Aug 46	3 Sep 46	Pearl Harbor 12 Sep 46	Los Angles	26 Dec 46	4 Jan 47
USS Pollux (AKS-4)	19 Aug 46	20 Aug 46	20 Aug 46	Pearl Harbor 29 Aug 46	Puget Sound	29 Nov 46	25 Jan 47
USS Preserver (ARS-8)	28 Aug 46	30 Aug 46	1 Sep 46	Pearl Harbor	Los Angeles	8 Dec 46	4 Jan 47
USS Presque Isle (APB-44)	19 Aug 46	20 Aug 46	2 Sep 46	Pearl Harbor 12 Sep 46	Los Angeles	12 Dec 46	21 Dec 46
USS Quartz (IX-150)	22 Aug 46	23 Aug 46	3 Sep 46	Pearl Harbor 15 Sep 46	Puget Sound	12 Dec 46	13 Dec 46
USS Reclaimer (ARS-42)	1 Sep 46	3 Sep 46	6 Sep 46	Pearl Harbor 25 Sep 46	Los Angeles	24 Dec 46	By 4 Jan 47
USS Robert K. Huntington (DD-781)	10 Aug 46			Pearl Harbor San Diego 27 Aug 46	Puget Sound	19 Nov 46	4 Jan 47
USS Rockbridge (APA-228)	23 Aug 46	24 Aug 46	29 Aug 46	Pearl Harbor San Francisco 12 Sep 46	San Francisco	6 Dec 46	13 Dec 46
USS Rockingham (APA-229)	24 Aug 46	25 Aug 46	29 Aug 46	Pearl Harbor San Francisco 12 Sep 46	San Francisco	4 Dec 46	18 Dec 46
USS Rockwall (APA-230)	19 Aug 46			Pearl Harbor Port Hueneme 13 Sep 46	San Francisco	17 Dec 46	27 Dec 46

Notes:

[a]Shot BAKER only.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Rolette (AKA-99)	26 Aug 46			Enewetak Port Hueneme 13 Sep 46	San Diego	28 Jan 47	1 Feb 47
USS Saidor (CVE-117)	4 Aug 46			Pearl Harbor 9 Aug 46	San Diego	28 Jan 47	1 Feb 47
USS Saint Croix (APA-231)	2 Aug 46			Pearl Harbor Port Hueneme	San Diego	22 Nov 46	10 Jan 47
USS San Marcos (LSD-25)	25 Aug 46	26 Aug 46	30 Aug 46	Pearl Harbor 6 Sep 46	San Francisco	24 Oct 46	18 Jan 47
USS Severn (AO-61)[a]	24 Aug 46			Pearl Harbor	Los Angeles	Unknown	3 Nov 46
USS Shakamaxon (AN-88)	27 Aug 46	28 Aug 46	6 Sep 46	Guam	Pearl Harbor	12 Dec 46	4 Jan 47
USS Shangri-La (CV-38)[a]	25 Jul 46	25 Jul 46	28 Jul 46	Pearl Harbor San Diego	Not required	Unknown	By 22 Nov 46
USS Sioux (ATF-75)	25 Aug 46	26 Aug 46	3 Sep 46	Pearl Harbor	Los Angeles	28 Nov 46	4 Dec 46
USS Sphinx (ARL-24)	19 Aug 46	20 Aug 46	14 Dec 46	Wake Island Pearl Harbor	Los Angeles	14 Feb 47	23 Apr 47
USS Suncock (AN-80)	30 Aug 46	1 Sep 46	2 Sep 46	Pearl Harbor 12 Sep 46	Puget Sound	12 Dec 46	13 Dec 46
USS Sylvania (AKA-44)	25 Aug 46	26 Aug 46	27 Aug 46	Pearl Harbor 7 Sep 46	Puget Sound	7 Dec 46	Unknown
USS Telamon (ARB-8)[b]	15 Aug 46			Pearl Harbor San Francisco 7 Sep 46	Los Angeles	12 Dec 46	21 Dec 46
USS Tombigbee (AOG-11)[c]	21 Aug 46	22 Aug 46	5 Sep 46	Pearl Harbor	Los Angeles	31 Dec 46	4 Jan 47
USS Turner (DD-834)[a]	25 Jul 46			Pearl Harbor 30 Aug 46	Not required	Unknown	By 22 Nov 46

Notes:

[a]Ship not present at Bikini for sufficient period after BAKER test to be radiologically suspect.

[b]Shot BAKER only.

[c]Shot ABLE only.

(continued)

Table 15. CROSSROADS support ships and decontamination locations (continued).

Vessel	Bikini Departure	Kwajalein Arrival	Kwajalein Departure	Destination and Arrival	Decontamination Location	Operational Clearance	Final Clearance
USS Walke (DD-723)	10 Aug 46			Pearl Harbor San Diego 22 Aug 46	San Francisco	Unknown	23 Oct 46
USS Wenatchee (ATF-118)	18 Aug 46	19 Aug 46	28 Aug 46	Pearl Harbor 5 Sep 46	San Francisco	13 Nov 46	13 Nov 46
USS Wharton (AP-7)	25 Aug 46	26 Aug 46	28 Aug 46	San Francisco After 3 Sep 46	Puget Sound	10 Feb 47	Unknown
USS Widgeon (ASR-1)	5 Sep 46	7 Sep 46	11 Sep 46	Pearl Harbor 22 Sep 46	San Francisco	13 Dec 46	10 Jan 47
USS Wildcat (AW-2)	19 Aug 46	20 Aug 46	28 Aug 46	Pearl Harbor 9 Sep 46	Puget Sound	9 Jan 47	10 Jan 47
YMS-354	14 Sep 46	15 Sep 46	21 Oct 46	Guam/Subic Bay	Guam/Marianas	20 Dec 46	10 Feb 47
YMS-358	14 Sep 46	15 Sep 46	21 Sep 46	Guam/Subic Bay	Guam/Marianas	20 Dec 46	10 Feb 47
YMS-413	14 Sep 46	15 Sep 46	21 Oct 46	Guam/Subic Bay	Guam/Marianas	20 Dec 46	10 Feb 47
YMS-463	14 Sep 46	15 Sep 46	21 Oct 46	Guam/Subic Bay	Guam/Marianas	20 Dec 46	10 Feb 47

Sources: References A.3, A.5, C.0.23, A.13.9, C.13.10, C.13.11, C.11.27.

JOINT TASK FORCE 1 STAFF

The Joint Chiefs of Staff (JCS) directive establishing JTF 1 stated that it would be organized with adequate representation of land, sea, and air forces, and that it would include civilian scientists. Implementation of adequate representation reflected the dominant naval flavor of the operation. The JTF 1 roster of officers dated 1 July 1946 shows 501 Navy officers, 8 Marine Corps officers, 141 Army ground officers, and 21 Army Air Forces officers. Of the 501 Navy officers, 444 were assigned to various ships at Bikini. The remainder filled billets in other locations: 39 were in the JTF 1 rear echelon at Washington, D.C.; 1 each was at Pearl Harbor and Oak Ridge, Tennessee; and 16 were assigned to Kwajalein Atoll.

DISPATCH BOAT AND BOAT POOL

The Dispatch Boat and Boat Pool was designated Task Unit (TU) 1.8.3 (Dispatch Boat and Boat Pool) under Task Group (TG) 1.8 (Service Group). The mission of TU 1.8.3 was to provide dispatch and mail service, interatoll freight and passenger service, and general boat pool services, e.g., ship-to-ship and ship-to-shore. Special boat operations were also a mission, which included operating a flag pool as required for use of distinguished persons and visiting flag and general officers and providing craft for radiological safety (radsafe) work and boats for the target array.

A large number of personnel, ships, and boats were assigned to TU 1.8.3. These totals varied throughout the operation as personnel were discharged from the naval service or transferred to other task force activities, and as boats were damaged or sunk, or released for special missions. Originally 313 personnel were assigned to operate and maintain the boat pool. By 10 June this number had been reduced to 228 due to discharges and transfers. Some replacements were obtained from TG 1.7 (Surface Patrol Group) and from new personnel arrivals. However, personnel deficiencies were never made up. The loss of personnel, as enlistments from World War II lapsed, continued to be a problem throughout CROSSROADS. For the most part, replacement personnel were untrained and great difficulty was experienced in keeping boats operating. For example, a maximum number of boats assigned to TU 1.8.3, 152, was reached on 19 June. By 31 July, a time of high boat pool need, only 93 boats were in operating condition.

Units assigned to TU 1.8.3 were two dock landing ships, USS San Marcos (LSD-25) and USS Gunston Hall (LSD-5), one self-propelled barracks ship, USS Presque Isle (APB-44), and a variety of small boats. The two LSDs provided boat maintenance facilities and along with the APB quartered and messed boat pool personnel. A landing craft repair ship, USS Sphinx (ARL-24), from TG 1.8 also assisted in boat repairs. The number and types of boats assigned varied. On 19 June there were six motor gunboat patrol vessels (PGM-23, PGM-24, PGM-25, PGM-29, PGM-31, and PGM-32), used almost exclusively for by the Radiological Safety Group; four large infantry landing craft (LCI(L)-1062, LCI(L)-1067, and LCI(L)-1091 at Bikini and LCI(L)-977 at Kwajalein; 38 LCMs (mechanized landing craft); 34 LCVPs (vehicle and personnel landing craft); 44 LCP(R)s (ramped personnel landing craft); 1 LCP(L) (large personnel landing craft); 30 PPBs (24-foot boats); 3 PBs (45-foot boats); 1 LCC (control landing craft); and 1 MB (35-foot boat).

All ships and most of the boats of TU 1.8.3 cleared the lagoon for both tests. San Marcos and the six PGMs used for radiological monitoring soon after both shots were stationed about 12 nmi (22 km) from the lagoon entrance. The remainder of the task unit evacuated to Rongelap Atoll for shot BAKER (Reference C.9.206, pp. VII-(A)-77 and VII-(F)-29 through VII-(F)-31).

In order to meet pressing demands, the boat pool was augmented by boats and personnel from various ships and TU 1.3.1 (Transport Unit) and TG 1.2 (Target Vessel Group). Despite these arrangements, at no time during the course of the operation did the boat pool have sufficient operable boats to meet all requirements. The situation was very much aggravated by the damage, beaching, and sinking of 42 boats in the vicinity of Aomen Island during Queen Day (ABLE shot rehearsal) evacuation. The loss was caused by a combination of heavy weather, inadequate moorings, and an LCT breaking loose and drifting through the boat moorings (Reference C.9.206, p. VII-(A)-79).

DIVERS

Following both tests, experienced salvage and diving officers took teams of divers down to inspect wrecks and to obtain comprehensive descriptions of conditions encountered (Reference C.9.207, pp. VII-(I)-87-B and VII-(I)-75-B; Reference A.2, p. 75; Reference C.2.9). The ships sunk during the operation carried with them precisely the type of information CROSSROADS was set up to obtain, the type and degree of damage caused by a nuclear detonation. Divers communicated information to the surface and took many underwater photographs. The Technical Director requested services of divers to recover instrumentation from a number of target ships. These operations were carried out when it was radiologically safe. Diving operations included recovery of (Reference C.9.207, p. VII-(I)-83-B):

- Nine vertical stations
- Pressure-time recorders from USS Arkansas (BB-33), USS Saratoga (CV-3), and USS Pilotfish (SS-386)
- Two hydrophones
- Diaphragm gauge and 5-gallon (18.93-liter) cans attached to raft on Nagato
- Radiation intensity film on Arkansas, Nagato, Saratoga, USS Apogon (SS-308), and Pilotfish
- Underwater pressure gauges on USS Bracken (APA-64) and USS Briscoe (APA-65)
- Bottom pressure recorders and possibly gamma meters attached to a cable near the center of BAKER detonation site.

Divers from the submarine rescue vessel USS Coucal (ASR-8) reported on 2 August (eight days after shot BAKER) that it was moored over the target submarine USS Skipjack (SS-184) and ready to start diving operations as soon as radiological conditions permitted. Inspection dives in preparation to salvage Skipjack were done that day (Reference C.9.207, p. VII-(I)-75-B).

In order to alert divers to radiation exposure levels, a long watertight Geiger tube was carried by them on dives when radiological conditions were uncertain. This instrument transmitted to a counter aboard the tending diving ship. When high radiation levels were detected, the crew on board communicated to the divers to stand clear (Reference A.2, p. 75).

UNDERWATER DEMOLITION TEAM 3 (UDT-3)

In March, Los Alamos scientists decided that the analysis of a sample of water from the immediate vicinity of the nuclear detonation was essential if the tests were to be properly evaluated. After consideration of several proposals to accomplish this, it was finally decided to employ drone boats of the type used in World War II by Naval Combat Demolition Units in southern France. In April, the Drone Boat Unit was designated TU 1.1.3, composed of USS Begor (APD-127), Underwater Demolition Team Easy (later renamed UDT-3), 6 LCVP drone boats (with 2 boats in reserve), and control TBM-3Es from TG 1.6 (when assigned) stationed aboard USS Saidor (CVE-117). On 27 April, Begor reported that 7 officers and 51 enlisted men boarded for transfer from Port Hueneme to Bikini for UDT operations (Reference A.3, Begor, 27 April). It is assumed that this was the composition of UDT-3. UDT-3 personnel were responsible for operation and maintenance of the drone boats and provided airborne control officers for the TBM flights. The LCVP drones were directed to desired sample areas and, when an adequate Geiger reading was transmitted back to the controllers, a water sample was taken. Upon completion of the mission, each drone was directed back to Begor where it was washed down with hoses from Begor and boarded by a safety officer. After being declared safe, a UDT-3 boat crew took over and a radiochemist boarded to transfer the collected water samples.

Successful sample operations were carried out for both shots. On BAKER day, two LCVP drones were monitored by boarding parties and were found to be highly radioactive. Water samples were left in the drones and were recovered 2-1/2 hours later (Reference C.9.207, p. VII-(R)-30). Forty 5-gallon (18.93-liter) water samples were collected on BAKER day (Reference C.9.207, p. VII-(R)-39).

53rd NAVAL CONSTRUCTION BATTALION (53rd NCB)

An advance contingent of the 53rd NCB (Seabees) arrived at Bikini Atoll on 5 March 1946 aboard USS Saint Croix (APA-231) for an initial survey by Seabees to plan the construction of facilities for CROSSROADS. On 13 March, 550 personnel of the 53rd NCB arrived at Bikini Atoll from Guam on USS Randall (APA-224). They were later transferred to Saint Croix, where most of the Seabees were berthed throughout the operation. On 14 March, USS LST-881 delivered 175 stevedores from Pearl Harbor who were to be responsible for handling cargo, assembling moorings for the target array, assisting in the installation of instruments, and assembling sonobuoys and life rafts. During CROSSROADS, the stevedores were berthed on Saint Croix, USS Ottawa (AKA-101) and USS Rolette (AKA-99). On 19 March, USS LST-817 arrived with 75 Seabees. On 20 March, Rolette and Ottawa brought 200 more Seabees from Port Hueneme (Reference C.9.206, pp. VII-(A)-20 and VII-(A)-91). The maximum strength of the battalion from 20 March to mid-May was 1,006 (Reference C.9.206, p. VII-(A)-92(d)).

Construction on Bikini Atoll was limited to that necessary for essential test instrumentation and recreational facilities. The structures built were instrument towers, radio beacons, magazines, photo reference crosses, observation towers, seismic huts, bombing targets, and a recreational area for 7,000 personnel. All of this was to be completed by 1 May 1946 (Reference C.9.206, pp. VII-(A)-2, VII-(A)-42, and VII-(A)-43).

Early in May, 200 men were released from the 53rd NCB, and an additional 522 were released early in June when all originally planned construction was essentially complete. Twenty-one officers were released late in May. They were replaced by six ensigns. By 19 June all remaining naval reserve personnel were released and replaced by regular enlisted personnel. During July, 6 officers and 240 enlisted men remained in the battalion to maintain installations at Bikini Atoll (Reference C.9.206, pp. VII-(A)-93 and VII-(A)-94).

For shot ABLE, the Seabees evacuated part of their construction equipment by LST. The equipment that remained ashore was not damaged by Test ABLE. For shot BAKER most of the equipment was left; again, there was no damage (Reference C.9.206, pp. VII-(A)-50 through VII-(A)-52).

On 3 August, the 53rd NCB was dissolved and personnel were transferred to Construction Battalion Detachment 1156 (CBD-1156), which was activated the same date, for the rollup phase at Bikini Atoll (Reference C.9.206, p. VII-(A)-99).

The majority of the 53rd NCB had completed their construction tasks and departed Bikini before shot ABLE. Those who remained were evacuated from Bikini prior to both shots.

CONSTRUCTION BATTALION DETACHMENT 1156

CBD-1156 was activated on 3 August 1946 when the 53rd NCB was dissolved. Two hundred forty enlisted men were transferred directly from the 53rd NCB to CBD-1156. Two officers were then assigned to take command (Reference C.9.206, p. VII-(A)-99). CBD-1156 prepared Bikini Atoll for rollup operations. The fleet recreation area was closed, dynamite disposed of, and security measures taken to protect equipment left behind. A complete survey and report on the conditions of Bikini Atoll was taken before its departure to Enewetak aboard Rolette. One ensign remained at Bikini and made reports on the condition of the equipment (Reference C.11.13). On 26 August, the battalion transferred from Bikini Atoll to Enewetak Atoll after closing off areas in the atoll. On 11 September, 30 Seabees flew to Bikini from Enewetak to assist in the transportation of usable and repairable equipment on board USS LST-388. This equipment went to Pearl Harbor for further evaluations (Reference C.9.206, p. VII-(A)-99). The ensign then completed another survey and reported on the condition of the equipment left behind on 27 September (Reference C.11.13). It is unknown when CBD-1156 left Enewetak Atoll.

TRANSIENT SHIPS

Several transient ships visited Bikini Atoll during CROSSROADS. All of them were stores ships (AF) or attack transports (APA). These ships and their dates at Bikini Atoll are listed below:

USS Pickaway (APA-222) -- 2 July, 21 July

USS Chilton (APA-38) -- 10-15 July

USS Graffias (AF-29) -- 15-16 July and 21-23 July

USS Hyades (AF-28) -- 19-22 August

USS Lavaca (APA-180) -- 23 August.

NAVY AIR GROUP (TASK GROUP 1.6)

Composed of ships and aircraft, TG 1.6 was involved in a variety of support missions during CROSSROADS. Elements of the task group were operated from two aircraft carriers and from two island bases, Roi and Ebeye at Kwajalein. Table 16 gives TG 1.6 composition.

Task Unit 1.6.1 (Drone Carrier Unit)

This unit was based on USS Shangri-La (CV-38). It was responsible for training personnel, preparing equipment for atomic bomb tests, conducting aircraft operations for drones engaged in collecting air and water samples in target areas on ABLE and BAKER days. It operated the carrier and plane guard destroyers as necessary to carry out air operations of embarked units (Chapter 4) (Reference C.9.206, p. VII-(E)-14).

Personnel and equipment of the Drone Carrier Unit (TU 1.6.14), the Drone Boat Control Unit (TU 1.6.15), and the Field Recovery Unit (TU 1.6.13) were transported overseas aboard Shangri-La. An extensive program of takeoffs and recoveries was initiated while en route from Hawaii to Roi Island, Kwajalein. The units arrived at Dyess Field, NAB Roi, on 5 June. Training was given en route in navigation, homing, fighter direction, general communications, and the ABLE day Air Operation Plan (Reference C.9.206, p. VII-(E)-118).

Practice for ABLE day using the drones occurred on 10, 20, and 24 June. The practices included all Navy and Army aircraft. For each of these joint rehearsals, 4 drone F6Fs, 16 control F6Fs, and 2 air-sea rescue TBMs were launched from Shangri-La near Orbit Point Tare (40 nmi [74 km] from the center of Bikini Island). Orbit points for ABLE are summarized in Table 8. During each rehearsal, the carrier drones operated as follows (Reference C.9.206, pp. VII-(E)-119 and VII-(E)-120):

- Four primary drone-control flights (Red, White, Blue, Yellow) of two F6Fs each were launched and rendezvoused over Shangri-La to await the launching of four F6F drones (Red, White, Blue, Yellow)
- As each of the four F6F drones were launched (each carrying a safety pilot for the rehearsals only), the corresponding color-coded flight of the primary drone-control aircraft assumed control of the aircraft and directed it to its station over Bikini Lagoon.
- Four secondary drone-control flights (Red, White, Blue, Yellow) of two F6Fs each then took off and proceeded to their stations opposite the point where it was expected

Table 16. Units in Task Group 1.6, CROSSROADS.

Task Unit 1.6.1 -- Drone Carrier Unit

- Task Unit 1.6.11 -- USS Shangri-La (CV-38)
- Task Unit 1.6.12 -- Commander Destroyer Division 5
- Destroyer Division 51
  - USS Turner (DD-834)
  - USS Charles P. Cecil (DD-835)
- Task Unit 1.6.13 -- Field Recovery Unit (NAB Roi)
- Task Unit 1.6.14 -- Carrier Drone Air Unit (detachment from Air Development Squadron-2 (VX-2)
  - 26 F6F-3K drones
  - 31 F6F-5 drone control planes
- Task Unit 1.6.15 -- Drone Boat Control Air Unit[a]
  - 6 TBM-3E

Task Unit 1.6.2 -- Photographic Carrier Unit

- Task Unit 1.6.21 -- USS Saidor (CVE-117)
- Task Unit 1.6.22 -- Photographic carrier plane guard destroyers
  - USS Furse (DD-882)
  - USS Newman K. Perry (DD-883)
- Task Unit 1.6.23 -- 5 F6F-5P photo aircraft
- Task Unit 1.6.24 -- 5 TBM-3P photo aircraft
- Task Unit 1.6.25 -- 4 HOS-1 helicopters

Task Unit 1.6.3 -- Seaplane Unit

- Task Unit 1.6.31 -- Naval Air Base (Ebeye)
- Task Unit 1.6.32 -- Patrol Seaplane Squadron 32 (VPB-32) (9 PBM-5s)
- Task Unit 1.6.33 -- Air-Sea Rescue Squadron 4 (VH-4) (6 PBM-5s)

Task Unit 1.6.4 -- Seaplane Tender, Bikini

- Task Unit 1.6.41 -- USS Orca (AVP-49)

Note:

[a]Transferred to Saidor on 10 June.

Source: Reference C.9.206, p. VII-E-Appendix III.

that the drones would be directed into the atomic cloud on ABLE day by the correspondingly color-coded primary control aircraft

- Each of the secondary drone-control flights then took control its drone after its passage through the area of the expected cloud column and guided it approximately 175 nmi (324 km) to Roi Island, where the drones were landed by the Field Recovery Unit
- The primary control aircraft returned to the carrier, and the secondary control aircraft landed on Roi Island.

The drone unit was not successful in carrying out all the details of the plan for the first two rehearsals, but the Queen Day rehearsal was almost perfect (Reference C.9.206, p. VII-(E)-120). The control aircraft were equipped with Geiger counters to enable the pilot to detect the presence of radiation.

SHOT ABLE. On 30 June at 1625 Shangri-La, accompanied by plane guard destroyers USS Turner (DD-834) and USS Charles P. Cecil (DD-835), departed Roi Island to take station within 15 nmi (28 km) of reference Point Tare (bearing 135°T, 40 nmi [74 km] from the center of Bikini Island) (Reference C.9.206, p VII-(E)-162). Earlier, final inspection of aircraft and special equipment had been initiated. At 1005, the drone unit in Shangri-La began a deck checkout of each drone and drone-control aircraft and bench checkouts of all identification, friend or foe (IFF) equipment on them. In addition, all special equipment on the aircraft, such as Geiger-Mueller counters, air filters, cameras, and recording devices, was given final tests. By 2130 all aircraft to be launched the next morning for ABLE were on the deck ready to be launched (Reference C.9.206, p. VII-(E)-163).

Between 0714 and 0717 on 1 July, two F6Fs from each of the four primary drone-control flights took off from Shangri-La. The eight primary control F6Fs rendezvoused over the carrier in position to intercept the drones. The Red, White, Blue and Yellow drones took off, in that order, between 0725 and 0745. The primary control flight established control over each airborne drone. By 0828 all drones were at their respective stations, bearing 312°T, 20 nmi (37 km) from target center, flying at the following altitudes: Red at 28,000 feet (8.5 km), White at 20,000 feet (6.1 km), Blue at 15,000 feet (4.6 km), and Yellow at 10,000 feet (3.0 km). Meanwhile, the four secondary drone-control flights of two F6Fs each were launched between 0747 and 0750. By 0830 all were on station, bearing 135°T, 20 nmi (37 km) from the target center at altitudes corresponding to the drones and primary drone-control flights across the center of the target axis (Reference C.9.206, p. VII-(E)-167). Two air-sea rescue TBMs (Dagger-1 and Dagger-2) were launched at 0757 from Shangri-La and stood by over the carrier until 1150 (Reference C.9.206, pp. VII-(E)-167 and VII-(E)-168).

No problems in launching the drones or in controlling them to station occurred. However, after the Red drone arrived on station, a stuck aileron caused it to go out of control and it crashed in the sea at 0850. Consequently, the Red primary and secondary drone-control flights were ordered to return to base at 0900 (Reference C.9.206, pp. VII-(E)-167 and VII-(E)-168).

All pilots in the controlling planes had adjusted their darkened goggles to shield their eyes from the blinding flash of light at the instant of detonation. Since the pilots had expected a much stronger flash than actually occurred, they were momentarily unsure whether the burst had occurred on schedule. However, no serious delay resulted. The primary control flights commenced controlling the drones toward the cloud column, entering as follows: at 0906 the Yellow drone at 10,000 feet (3.0 km), at 0909 the White drone at 20,000 feet (6.1 km), and at 0910 the Blue drone at 15,000 feet (4.6 km). As the drones passed through the cloud column, the White drone increased altitude from 20,000 feet to 26,000 feet (6.1 to 7.9 km), probably due both to the strong upward currents within the cloud and to the White drone having a slight nose-up altitude when the primary drone-control flight released it. The secondary drone-control flights successfully completed the interceptions as follows: Yellow at 0923, Blue at 0924, and White at 0953. The control aircraft recaptured the White drone over Wotho Atoll and returned it to Roi without damage. All drones landed safely at Roi between 1028 and 1046, and all control aircraft returned to the base aboard Shangri-La or to Roi between 0957 and 1056 (Reference C.9.206, pp. VII-(E)-171 and VII-(E)-172). All 16 pilots wore film badges, and 16 were readable. The average exposure was 0.02 R (gamma), with a maximum of 0.03 R (gamma).

Following completion of drone flight operations, radiological samples were removed from the F6F drones after they landed at Roi. Soon after, all other drone and drone-control aircraft from Shangri-La were flown to Roi Island where they were later checked and flight-tested. On 9 July one drone and its safety pilot were lost on a routine test flight off Roi Island when the drone, under the control of the field unit, rolled over at a very low altitude and spun into the sea (Reference C.9.206, p. VII-(E)-188).

Between 0910 and 0918 four drone boat control TBMs (Bucko-1, Bucko-2, Bucko-3, and Bucko-4) of TU 1.6.15 were launched from Saidor. Immediately after takeoff, Bucko-1 and Bucko-3 proceeded to their stations 5 nmi (9.3 km) upwind from the drone boats Factory-1 and Factory-3. Bucko-2 and Bucko-4 stood by circling the carrier as replacements. When Bucko-1 reported a hydraulic leak shortly after takeoff, Bucko-2 replaced it. At 1015 Bucko-4 replaced Bucko-3, which had developed generator trouble. The TBMs remained about 5 nmi (9.3 km) upwind from the drone boats. The TBMs controlled the drone boats' courses as they moved through the radioactive target area. The TBMs also reported on the levels of radiation in the area in which they were flying. Bucko-2 and Bucko-4 completed their missions and were out of the area by 1238 (Reference C.9.206, p. VII-(E)-172).

SHOT BAKER. The air operation plan for shot BAKER provided for the active use of only three drones with twelve control aircraft: Red drone at 14,000 feet (4.3 km) at B+6 minutes, White drone at 9,000 feet (2.7 km) at B+10 minutes, and Blue drone at 5,000 feet (1.5 km) at B+12 minutes. The Yellow control flight remained in readiness as a replacement in case any control flights developed trouble. The primary drone-control aircraft were at Orbit Point Victor, bearing 315°T, 20 nmi (37 km) from the target center. The secondary drone control aircraft were at Orbit Point Sugar, bearing 135°T, 20 nmi (37) from target center (Reference C.9.206, p. VII-(E)-213).

Some safety restrictions were relaxed since airborne radiation from the underwater shot would be less than for ABLE, and the control group was brought closer to the target area. One flight in each group was positioned to be in sight contact of the drone at all times. The amber shield over the cockpit greenhouse and the blue goggles were discarded (Reference C.9.206, p. VII-(E)-187). The White drone had been modified to include the installation of a Mitchell camera, and a K-17 type aerial camera had been installed on the Red drone.

On 13 July all drones and drone-control airplanes were transported by barge from Roi to Shangri-La, which then proceeded to Bikini to participate in the first air rehearsal on 14 July. A second air rehearsal on 19 July was cancelled because of foul weather (Reference C.9.206, p. VII-(E)-188).

At 1610 on 24 July, Shangri-La, accompanied by destroyers Turner and Cecil, left Roi Island to assume their positions 40 nmi (74 km) from the center of Bikini Island (Reference C.9.206, p. VII-(E)-208). On 25 July at 0723, launching of the three F6F drones and twelve F6F drone-control aircraft began. By 0814, the three drone groups were on station. First the two F6Fs of each primary drone-control flight were launched, followed by the drones and the secondary drone-control flights. All aircraft rendezvoused over Shangri-La before proceeding to their assigned stations. At H-hour the primary drone-control flights were orbiting with their drones at Orbit Point Victor, bearing 315°T, 20 nmi (37 km) from the target center at the following altitudes: Red at 14,000 feet (4.3 km), White at 9,000 feet (2.7 km), and Blue at 5,000 feet (1.5 km). The secondary drone-control flights took up their positions on the opposite side of the target axis at Orbit Point Sugar, bearing 135°T, 20 nmi (37 km) from the target center, at altitudes corresponding to the other elements of their respective groups (Reference C.9.206, pp. VII-(E)-212 and VII-(E)-213). Orbit points for BAKER are summarized in Table 10 (Chapter 4).

The primary drone-control flights and the drones moved toward the target array after the detonation. The Red drone entered the cloud column at 0841 from 14,000 feet (4.3 km), the White drone at 0845 from 9,000 feet (2.7 km), and the Blue drone at 0847 from 5,000 feet (1.5 km). The secondary drone-control flight reported the drones at approximately the same altitudes as follows: Red at 0850, White at 0847, and Blue at 0849. Since the cloud of water and steam did not reach the altitude expected, the Red and White drones at the higher altitudes passed over the top of the cloud, and the Blue drone at 5,000 feet (1.5 km) flew through the upper portion of the column (Reference C.9.206, p. VII-(E)-216). Radioactivity was detected on the Blue drone only. Maximum reading was 7 R/24 hours (Reference C.7.6). All drones were guided to Roi Island and landed without damage between 0950 and 1006. All air filters, cameras, and other special installations operated satisfactorily except the camera installation in the Red drone (Reference C.9.206, p. VII-(E)-217). All pilots wore film badges. The 12 badges averaged 0.05 R (gamma) and the maximum was 0.08 R (gamma).

At detonation, the four drone boat control TBMs (Bucko-1, Bucko-2, Bucko-3, and Bucko-4) were standing by aboard Saidor ready for launching. All four took off between 0846 and 0849. Bucko-2 and Bucko-4 stood by in the air over the carrier as replacements while Bucko-1 and Bucko-3 proceeded to a position upwind from drone boats Factory-1 and Factory-3. Remaining approximately 5 nmi

(9.3 km) upwind of the drone boats, Bucko-1 at 2,300 feet (701 meters) and Bucko-3 at 2,600 feet (792 meters) conned the courses of Factory-1 and Factory-3 by voice radio as the boats moved through the radioactive waters near the target area (Reference C.9.206, pp. VII-(E)-217 and VII-(E)-218). Bucko-1 completed its conning assignment at 1055 and Bucko-3 at 1105. In the afternoon between 1508 and 1574, similar conning assignments were carried out by Bucko-2 and Bucko-4. Bucko-3 stood by in the air over Saidor as a replacement (Reference C.9.206, p. VII-(E)-218). The three F6F drones and half the control aircraft landed at Roi after the test and radiological samples were removed. On 26 July, two drones were returned by barge to Shangri-La. The following day the remaining F6Fs were transferred to Shangri-La.

Task Unit 1.6.2 (Photographic Carrier Unit)

TU 1.6.2 was based on Saidor. Its mission was to train crews and prepare equipment for atomic bomb tests during ABLE and BAKER and:

- Conduct photographic operations
- Operate helicopter aircraft for radiological reconnaissance, photography, and photographic utility flights
- Conduct conning of drone boats
- Operate photographic carrier and plane guard destroyers as necessary to carry out air operations of embarked units
- Provide pre- and postshot mapping and other photography.

The F6F photographic aircraft were equipped with cameras to provide stills, sonne-strip photos, and a limited amount of motion-picture coverage. Their primary duty was to obtain photographs of the target array just before the detonation. In addition, they were to make mosaics of the target area and strip photos of Bikini Beach before and after the tests (Reference C.9.206, p. VII-(E)-38). One F6F was to obtain motion pictures of the target array and cloud phenomenology after detonation.

Personnel and equipment of the F6F Photo Unit (TU 1.6.23), the TBM Photo Unit (TU 1.6.24), and the Helicopter Unit (TU 1.6.25) were transported overseas in Saidor. The Drone Boat Control Unit (TU 1.6.15) also joined the carrier on 10 June at Bikini (Reference C.9.206, p. VII-(E)-122). TU 1.6.23 had eight F6F and seven F6F-5P pilots. TU 1.6.24 had five TBM and five TBM-3E pilots (Reference C.9.206, p. VII-(G)-22).

After the photographic units arrived at Bikini, the training of the two photographic carrier units (TU 1.6.23 and TU 1.6.24) consisted primarily of three air rehearsals on 10, 20, and 24 June. In addition, they completed various preshot photographic assignments (Reference C.9.206, p. VII-(E)-123).

At Bikini, the Helicopter Unit (TU 1.6.25) observed the target array and inspected target installations. Considerable difficulty was experienced in operating the HOS-1 helicopters. One helicopter was irreparably damaged on a test landing on 30 May and another force-landed in Bikini Lagoon on 3 June (Reference C.9.206, pp. VII-(E)-123, and VII-(E)-124).

SHOT ABLE. The aircraft carrier was the first element of the group to begin moving to ABLE day stations. At 1400 on 30 June, Saidor, accompanied by destroyers USS Furse (DD-882) and USS Newman K. Perry (DD-883), left Bikini Lagoon for its position bearing 0°T, 40 nmi (74 km) from the center of Bikini Island (Point Auto) (Reference C.9.206, p. VII-(E)-162).

On 1 July between 0712 and 0715, six F6Fs (Queen flight of four and Sugar and Roger flights) were launched from Saidor to obtain still photographs of the Bikini target area immediately before detonation. The F6Fs flew directly from the carrier to positions 5 nmi (9.3 km) east of Bikini Atoll. All reported on station at 0725, but the first photographic run was delayed to allow time for the dissipation of the low stratus and cumulus clouds. After making photographic runs at 0747 and 0826, the Queen flight left the target area and landed aboard Saidor by 0840 (Reference C.9.206, p. VII-(E)-165).

Meanwhile, F6F Sugar had made a calibration run over Bikini Atoll at 0725 from 3,500 feet (1.1 km) and then returned to make three photo flights over the target array at 0742, 0750, and 0800, maintaining an altitude of 3,500 feet (1.1 km) for each run. Sugar made a final calibration run at 0810 before returning to Saidor at 0839. F6F Roger, meanwhile, had made a calibration run at 0729 and a photo run over the target array. F6F Roger then proceeded to its assigned station at Orbit Point Able, 20 nmi (37 km) from the target center and was in position at 0827 (Reference C.9.206, pp. VII-(E)-165 and VII-(E)-166).

Two TBMs, Nan and Oboe, of the photographic unit were launched from Saidor at 0734 and 0736. At 0800 they were on station, 20 nmi (37 km) from the target center. At h-hour TBM Nan was orbiting at 9,000 feet (2.7 km), and Oboe orbited at 4,000 feet (1.2 km) (Reference C.9.206, p. VII-(E)-166).

By H-hour, five photographic F6Fs had completed preshot photography of the target array and returned to Saidor (Reference C.9.206, p. VII-(E)-168). Roger was the only photography F6F still airborne at detonation, approximately 12 nmi (22 km) away and flying directly toward the target center at 10,000 feet (3.0 km). Roger took motion pictures of the burst and other photographs of the cloud column and the target ships until 0927 (Reference C.9.206, p. VII-(E)-70).

TBM Oboe was orbiting at 4,000 feet (1.2 km), 20 nmi (37 km) from the target center at H-hour. It moved in as close as 8 nmi (15 km) during the first 6 minutes following the burst, made oblique angle photographs of the cloud column, and at 0906 returned to its carrier base. TBM Nan was approximately 12 nmi (22 km) from target center at 0900. Immediately following the burst, it began circling the cloud column counterclockwise and took photographs of the cloud and of other aircraft in the area. Six minutes after the detonation, Nan began to fly a 270° arc at a minimum radius of 8 nmi (15 km) from the target, reversing its direction away from the area whenever necessary to avoid radioactivity. Motion picture photography had been started immediately preceding the burst and continued until 0933 when Nan left the area (Reference C.9.206, p. VII-(E)-170).

At 1013 the photographic carrier unit was directed to prepare two F6F photographic aircraft for a special oceanographic survey in Bikini Lagoon. The F6Fs, Sonar-1 and Sonar-2, were launched from Saidor at 1615 and proceeded

immediately over the lagoon. They made their strip color photographic runs from bearings 180° and 0° between 250 and 400 feet (76 and 176 meters) altitude over the target area. The aircraft landed on Saidor by 1715 (Reference C.9.206, p. VII-(E)-175).

Although not actually employed on ABLE day, the Helicopter Unit (TU 1.6.25) was standing by for air-sea rescue and miscellaneous missions as they arose. Moreover, its employment on D-1, when a helicopter delivered repair parts to Aomen Island, ensured operation of the photographic towers there on D-day (Reference C.9.206, p. VII-(E)-175). The ABLE Air Operation Plan called for a TU 1.6.25 helicopter to recover dirt samples from Bikini Island (Reference B.0.1, p. F-II-14), but there is no evidence that this mission took place.

SHOT BAKER. The mission of the units aboard the photographic carrier Saidor remained almost unchanged for BAKER. Seven F6Fs and four TBMs carried out special photographic missions over the Bikini target area on 5 July. Four TBM drone boat control aircraft practiced their BAKER assignments with Begor on the same day. The aircraft rehearsed successfully on 14 July. Two F6Fs were involved in accidents between 2 July and 24 July. One plane and its pilot were lost on 5 July when it spun into the sea while approaching the carrier. Another plane was badly damaged on 19 July when the tail wheel gave way in landing (Reference C.9.206, p. VII-(E)-189).

The first elements of the Navy air group to begin movement to BAKER stations were the aircraft carrier and its plane guard destroyers. At 0930 on 24 July, Saidor, accompanied by destroyers Furse and Perry, departed Bikini Lagoon to take up position in area Paige. Six F6F photographic aircraft were launched from Saidor between 0655 and 0704. The mission of the group was primarily to obtain still photographs of the target array immediately before the detonation. All six F6Fs flew directly from the photographic carrier to positions 5 nmi (9.3 km) east of Bikini Atoll, reporting on station between 0710 and 0716. One flight made photomapping runs of the target array at 0742 and 0820 and left the target area at 0825 to return to Saidor. At 0710, F6F Sugar made a camera calibration run over Bikini Island at 500 feet (152 meters), then climbed to 3,500 feet (1.1 km). It made photography runs of the target array beginning at 0725 before returning to Saidor at 0835. F6F Roger made a pass over Bikini Island from 600 feet (183 meters) at 0750 and took up station 10 nmi (18.5 km) northeast of the target array while awaiting the detonation (Reference C.9.206, pp. VII-(E)-211 and VII-(E)-212).

Three TBMs (Nan-1, Nan-2, and Oboe) were launched from Saidor between 0650 and 0710. By 0745 all were on station. The Nan TBMs were 7 nmi (13 km) from the target center at 10,500 feet (3.2 km). Oboe, however, proceeded first to Nam Island at Bikini Atoll and flew counterclockwise around the target center at 4,000 feet (1.2 km) so the turret photographer could make oblique angle photographs of the target array. At 0745 Oboe was on station 1 nmi (1.9 km) southeast of the south tip of Eneu Island. At H-hour, Oboe was again circling the target center at 4,000 feet (1.2 km) (Reference C.9.206, p. VII-(E)-212).

Roger, the only photographic F6F still airborne at detonation, was orbiting at 11,000 feet (3.4 km), 10 nmi (18.5 km) northeast of the target center. It immediately approached within 5 nmi (9.3 km) of the cloud column, taking motion

pictures and other photographs of the cloud column and aircraft in the vicinity. The mission was completed by 0900 when Roger returned to the photographic carrier (Reference C.9.206, p. VII-(E)-215).

Nan-1 and Nan-2 were orbiting in loose formation 7 nmi (13 km) from the target center at H-hour. After detonation, they circled the cloud column counterclockwise at approximately 5 nmi (9.3 km) from its center and photographed the cloud and the aircraft. Oboe moved from the southeast of the south tip of Eneu Island to within approximately 5 nmi (9.3 km) of the cloud column, where it took photographs of the cloud and the aircraft in the vicinity. Their missions were completed between 0905 and 0908 and the three planes returned to Saidor (Reference C.9.206, p. VII-(E)-215).

Helicopters flew to some of the islands after BAKER to recover instruments (Reference C.9.206, p. VII-(E)-222).

Task Unit 1.6.3 (Seaplane Unit)

Based at Ebeye, Kwajalein Atoll, the seaplane unit conducted (Reference C.9.206, p. VII-(E)-14):

- Photographic, radiological reconnaissance, air-sea rescue, and patrol operations
- Provided air shuttle service between Ebeye and Bikini
- Provided air facilities
- Serviced and maintained seaplanes of the Navy air group.

Carrier Aircraft Service Unit (Fleet) 34 performed maintenance on the unit.

TU 1.6.3 was composed of patrol bombers (PBM-5), converted to transport and air-sea rescue aircraft, from Patrol Seaplane Squadron 32 (VPB-32) and Air-Sea Rescue Squadron 4 (VH-4). Six VH-4 aircraft arrived at Ebeye Island from Saipan, Marianas Islands, on 10 March, and nine VPB-32 aircraft arrived between 16 and 22 March. On 20 March, elements of both squadrons reported to CTG 1.6 as TU 1.6.3 (Reference C.9.206, p. VII-(E)-25).

One PBM carried radiometric equipment to measure intensity of radiant energy as a function of time. The two PBM radiological reconnaissance aircraft carried equipment to determine the safe time for reentry into the lagoon. All aircraft carried normal communications equipment (Reference C.9.206, p. VII-(E)-39).

Two PBM radiological reconnaissance aircraft also carried equipment to record the observations made by the ship observer, photographic equipment, special gas masks, and other equipment. The PBMs for photographic wave measurement also carried special transmitters for actuation of cameras, sonobuoy receivers with scope cameras, and television receivers (Reference C.9.206, p. VII-(E)-39). Two PBM photographic aircraft took high-angle oblique photographs before, during, and after the blast for documentary purposes and for possible radio phototransmission. Three PBM photographic aircraft were specially equipped to obtain motion pictures of the blast for blast analysis and to obtain still

photos for photogrammetric analysis, documentary records, and possible radio phototransmission (Reference C.9.206, p. VII-(E)-38).

TU 1.6.3 training was carried out at Ebeye Naval Air Base (TU 1.6.31). Since the Patrol Seaplane Squadron (TU 1.6.32) was actively engaged in flight operations, its training for ABLE was limited almost exclusively to the three rehearsals. The unit was responsible for a minimum of one roundtrip flight daily from Ebeye to Bikini. Including the three rehearsals, the nine PBMs of TU 1.6.32 flew 1,139.8 hours during the period from 16 March to 30 June, transporting 1,521 passengers, 184,104 pounds of mail, and 73,469 pounds of freight (Reference C.9.206, p. VII-(E)-125).

VH-4 (TU 1.6.33) was also actively engaged in flight operations. It was directed to maintain one PBM each on the water at Ebeye and Bikini for air-sea rescue missions from 2 hours after sunrise to 2 hours before sunset. The unit assisted the patrol seaplane unit with overflow CROSSROADS passengers and freight transportation. A total of 714.3 hours was flown by the six PBMs of TU 1.6.33 between 11 March and 30 June (Reference C.9.206, p. VII-(E)-126).

SHOT ABLE. On 30 June the last seaplane cleared Bikini Lagoon at 1534. The first group of Navy aircraft to be airborne on ABLE day were nine seaplanes from Ebeye. They took off between 0503 and 0620 and reported at their respective stations off Bikini Lagoon between 0639 and 0730 (Reference C.9.206, p. VII-(E)-163). Each plane carried a radsafe officer with a Geiger counter.

The radiometry seaplane took off at 0503. It was the first Navy aircraft to depart, and at 0710 it was on its ABLE day station 15 nmi (28 km) bearing 15° from the target center. Two radiological reconnaissance seaplanes Charlie and Dog took off at 0514 and 0515 and reported on station at 0730, 30 nmi (56 km) from the target center. Three photographic seaplanes (Tare, Uncle, and William) were next off the water between 0519 and 0529. By 0658 all had reported on station, 15 nmi (28 km) from the target center at orbit points Charlie, King, and Dog (Reference C.9.206, p. VII-(E)-164).

The first air-sea rescue seaplane (Dumbo-2) of TU 1.6.33 was airborne at 0505 and at 0639 arrived at its station at Orbit Point Uncle. Dumbo-1 was off the water next at 0510 and at 0642 was on station at Orbit Point Love. Both seaplanes were stationed 30 nmi (56 km) from the target center. Dumbo-3 was the last to take off at 0620 and at 0710 reported on station at 7,000 feet (2.1 km) over Wotho Atoll, 90 nmi (167 km) from the target center (Reference C.9.206, pp. VII-(E)-164 and VII-(E)-165).

The radiometry seaplane was orbiting 15 nmi (28 km) northeast of the target center at the time of detonation. Equipped with special radiometry instruments to photograph and measure the infrared and visible electromagnetic radiation of the blast, the plane remained on station only 6 minutes making its recording of blast phenomena (Reference C.9.206, p. VII-(E)-168).

Three TU 1.6.32 seaplanes (Tare, Uncle, and William) measured the waves resulting from the burst. They were also instructed to monitor readings of the sonobuoys placed in the target array and to obtain the receiver scope photographs. These attempts were unsuccessful because of the distance away from

the target array required by the air plan. Uncle was also charged with radioactuation of the synchronized cameras in the photography towers on Eneu, Bikini, and Aomen islands as well as those in PBMs Tare and William. At 0900 all three seaplanes were on station 15 nmi (28 km) from the target center. At the instant of detonation the three seaplanes carried out the following missions:

- Tare started from Orbit Point Charle and flew track 349°T for 4 nmi (7.4 km), and then changed track right to 37°T for 20 nmi (37 km), maintaining a ground speed of approximately 150 knots (278 km/hr).
- Uncle started from Orbit Point King and flew track 0°T for 20 nmi (37 km) maintaining a ground speed of approximately 150 knots (278 km/hr)
- William started from Orbit Point Dog and flew track 309°T for 16 nmi (30 km), maintaining a ground speed of approximately 135 knots (250 km/hr).

Photographic and television equipment was turned on either immediately before or at the instant of the flash, and pictures and recordings were made throughout the runs and until approximately 0923 (Reference C.9.206, p. VII-(E)-169).

The radiological reconnaissance seaplanes, Charlie and Dog, were on station at 2,000 feet (610 meters), 30 nmi (56 km) bearing 30° from the target center at the time of burst. Leaving their stations shortly after H-hour, Charlie and Dog moved to positions approximately 5 nmi (9.3 km) upwind from the detonation points, where they awaited voice radio instructions from the Radiological Safety Officer to begin measuring radioactivity over the target area. While Dog orbited on its new station, Charlie at 0952 approached within approximately 3 nmi (5.6 km) of the target center. It then began traversing the target area in a series of parallel sweeps, flying normal to the wind direction, and covering a rectangle roughly 6 by 5 nmi (11 by 9 km) whose center was the target area.

The path of the sweeps along the rectangle were not regular, however, since the seaplane was also instructed to reduce progressively the distance of the sweeps from the radioactive area. Also, if high levels of radioactivity were encountered, the PBM was to turn abruptly, circle upwind, and turn back from the next sweep along the rectangular course. On completion of the runs at 2,000 feet (610 meters), Charlie dropped down to 1,000 feet (305 meters) at 1045 and carried through a series of similar sweeps at the new altitude. At 1126 the altitude was lowered to 500 feet (152 meters) and the pattern of radiological sweeps again was repeated.

As soon as Charlie had completed its sweeps at one altitude, Dog moved in and carried through the same pattern of operation. Dog commenced its 2,000-foot (610-meter) sweeps at 1055, its 1,000-foot (305-meter) sweeps at 1140, and its 500-foot (152-meter) sweeps at 1231. On completion of these flights, both seaplanes made radiological runs over the target area. At 1310 Dog flew directly over the target center at 3,000 feet (914 meters). Additional sweeps over the target area at varying altitudes were continued until 1402 when Charlie departed for Ebeye and until 1427 when Dog departed (Reference C.9.206, pp. VII-(E)-173 and VII-(E)-174).

The three Dumbo seaplanes of TU 1.6.33 continued to stand by for air-sea rescue calls. At 0806, Dumbo-3 reported its Geiger-Mueller counter was out of order. When Dumbo-4, the standby PBM at Ebeye, was ordered as a replacement, it reported having no counter. Nonetheless, Dumbo-3 was ordered to return to Ebeye. Dumbo-2 was shifted to the position over Wotho, and Dumbo-1 was transferred to Orbit Point Uncle. The seaplanes remained on station until 1425 at Uncle and 1455 over Wotho (Reference C.9.206, p. VII-(E)-174).

In addition to providing air transportation between Ebeye and Bikini in the period between the two tests, TU 1.6.32 prepared six PBMs to perform assignments similar to those executed on ABLE day. It also prepared two new seaplanes for participation in shot BAKER, namely Charlie-2 (a radiological reconnaissance PBM) and Eagle Eye (a special observation PBM) (Reference C.9.206, VII-(E)-190).

TU 1.6.33 continued its air-sea rescue and transportation mission between the two tests. For BAKER its mission was altered to provide two PBM air-sea rescue standby aircraft, Dumbo-4 and Dumbo-5, in addition to the three air-sea rescue seaplanes that had participated in ABLE (Reference C.9.206, p. VII-(E)-190).

SHOT BAKER. On 24 July the final seaplane from Bikini landed at Ebeye at 1614 (Reference C.9.206, p. VII-(E)-208).

A VPB-32 radiological reconnaissance seaplane (Dog) taking off at 0501 was the first Navy aircraft to depart from Ebeye for Bikini on 25 July for BAKER operations. It was followed at 0516 by a second radiological reconnaissance seaplane (Charlie-1). By 0655 both Dog and Charlie-1 were orbiting on their assigned stations at Orbit Point Able, bearing 45°T, 20 nmi (37 km) from the target center. Meanwhile three photographic seaplanes (Tare, Uncle, and William) were airborne between 0527 and 0542. By 0705 all had reported on station at Orbit Points Charlie, King, and Dog, respectively, each 9 nmi (17 km) from the target center. Tare and Uncle orbited in loose formation at 12,000 feet (3.7 km) bearing 180° and 215°, respectively, and William at 3,000 feet (914 meters) bearing 325°. The radiometry seaplane departed at 0505 and at 0645 was on station at Orbit Point Yoke bearing 45°T, 7 nmi (13 km) from the target center. The observation PBM (Eagle Eye) had replaced one of the Army C-54s that had performed a similar mission in shot ABLE. Eagle Eye was off the water at 0545 and at 0713 was at its station approximately 10 nmi (18.5 km) from the target center, bearing 285°T at 8,000 feet (2.4 km) (Reference C.9.206, p. VII-(E)-20).

Three air-sea rescue seaplanes also took off from the lagoon at Ebeye during the same interval. Dumbo-1 was airborne at 0510 and at 0646 arrived at its station at Orbit Point Love, bearing 315°T, 30 nmi (56 km) from the target center at 3,000 feet (914 meters). Dumbo-2 departed at 0513 and at 0647 assumed its position at Orbit Point Able, bearing 45°T, 20 nmi (37 km) from the target center at 3,000 feet (914 meters). Dumbo-3 departed last at 0617 and at 0709 was on station at 7,000 feet (2.1 km) over Wotho Atoll, 90 nmi (167 km) from the target center (Reference C.9.206, p. VII-(E)-210).

The radiometry seaplane at 0833, from its orbit point at 9,500 feet (2.9 km), 7 nmi (13 km) from the target center, took up a course heading 335°T so that the point of detonation was within 5° of the bore-sighted axis of the radiometric equipment. Remaining at the same altitude, successful operation of the radiometric, photometric, and spectrographic equipment was accomplished before its departure from the area at 0852 (Reference C.9.206, p. VII-(E)-214).

One minute before the detonation, three seaplanes (Tare, Uncle, and William) moved from their orbit points to positions tangent to a circle approximately 8 nmi (15 km) from the target center. Tare and Uncle then flew a counterclockwise course from 12,000 feet (3.7 km), generally along the periphery of the circle. Each plane flew at approximately 135 knots (250 km/hr) taking synchronized photographs of the waves and water column thrown up by the explosion. Seaplane Tare at 0834 and 0845 also transmitted synchronized signals in order to induce simultaneous operation of the airborne and ground tower cameras. The three PBMs completed their runs by 0907 and immediately departed for Ebeye (Reference C.9.206, p. VII-(E)-214).

The observation seaplane (Eagle Eye) was on course 285°T at 7,900 feet (2.4 km), approximately 10 nmi (18.5 km) from the target center at the time of detonation. It orbited the same general position until 0908 when it returned to Ebeye (Reference C.9.206, p. VII-(E)-216).

Two radiological reconnaissance seaplanes (Charlie-1 and Dog) were orbiting at 2,000 feet (610 meters), 20 nmi (37 km) from the target center at H-hour. Immediately after the explosion, Charlie-1 proceeded to a position 5 nmi (9.3 km) upwind from the target center and then approached within approximately 3 nmi (5.6 km) at 4,000 feet (1.2 km). At 0915 it began traversing the radioactive area in a series of sweeps along parallel tracks normal to the wind direction, covering a rectangle roughly 6 by 5 nmi (11 by 9 km). The paths of the sweeps were not regular because the course was shifted each time a radioactive area was encountered. Charlie-1 made sweeps at 3,000, 2,000, 1,000, and 500 feet (914, 610, 305, and 152 meters). It then orbited the target array at 500 feet (152 meters) from 4 nmi (7.4 km) before departing for Ebeye at 1304 after being relieved by Charlie-2 (Reference C.9.206, p. VII-(E)-218).

PBM Dog in the meantime had first made sweeps over the area occupied by the JTF 1 vessels northeast of Bikini Atoll and reported on the radioactivity encountered. As Charlie-1 reported completing each sweep over the target area, Dog came in at 1008 and flew four similar flight patterns at the same altitudes. After completing its radiological sweeps at 1214, Dog orbited over the target area and photographed the damaged and sinking Saratoga between 1215 and 1319 and then departed for Ebeye. Charlie-2 relieved Charlie-1 at 1258. At 1330 and 1334 it made photographic runs over Saratoga and at 1400 began the first of two photographic runs over the target array at 1,500 feet (457 meters). After descending to 1,000 feet (305 meters), Charlie-2 made eight radiological reconnaissance surveys over the radioactive area between 1425 and 1506. It executed a sonar run 2 nmi (3.7 km) west of the target area between 1535 and 1545 at 400 feet (122 meters). From 1,000 feet (305 meters), photographs of the sinking of Saratoga were taken between 1552 and 1610. Charlie-2 departed for Ebeye at 1615 (Reference C.9.206, p. VII-(E)-219).

No rescues were necessary. The air-sea rescue seaplanes left the area as follows: Dumbo-3 at 0952, Dumbo-2 at 1120, and Dumbo-1 at 1243. Dumbo-4, which relieved Dumbo-1 at 1243, remained on station until 1619 (Reference C.9.206, p. VII-(E)-219).

Task Unit 1.6.4 (Seaplane Tender Unit, Bikini)

The mission of TU 1.6.4 was to provide tender and air transport terminal services for seaplanes at Bikini Atoll. It was based from the seaplane tender USS Orca (AVP-49).

Orca arrived at Bikini Lagoon on 7 May 1946 to assume its assigned duties. It was felt, however, that provision should be made for air-sea rescue units both at Bikini and Kwajalein in case of takeoff accidents. By 15 June an AVR air-sea rescue boat had been obtained for Bikini Lagoon. During operating hours the boat was stationed at the seaplane runway. Once in the morning and again in the late afternoon it made sweeps of the area to be sure the takeoff space was clear. About this time Commander, Marianas, requested Commander in Chief, Pacific (CINCPAC) to furnish two destroyers for air-sea rescue service at Kwajalein, one to be stationed within the lagoon and the other in the ocean near the runway. CINCPAC replied that the destroyers were not available in the Pacific Fleet. It was necessary to assign vessels from JTF 1 to patrol the entrance to Kwajalein Lagoon for air-sea rescue duty (Reference C.9.206, p. VII-(E)-26). LCI(L)-977 from TU 1.8.3 (Dispatch and Boat Pool Unit) was assigned this duty.

SHOT ABLE. On 30 June the last seaplane cleared Bikini Lagoon at 1534. At 1648 Orca moved from the lagoon to its station in area Paige near reference Point Nan, bearing 0°T, 20 nmi (37 km) from the center of Bikini Island.

SHOT BAKER. On 24 July the last seaplane from Bikini Island landed at Ebeye at 1614 (Reference C.9.206, p. VII-(E)-208).

Other Navy Air Groups

Carrier Aircraft Service Unit (Fleet) 34 (CASU[F]-34). Located on Ebeye, CASU(F)-34 performed maintenance for aircraft of the Seaplane Unit (TU 1.6.3) (Reference C.9.206, p. VII-(E)-190).

VPW-1. This unit sent at least four Navy PB4Y-2s under Commander, Kwajalein Atoll, to assist in weather reconnaissance and air-sea rescue missions (Reference C.9.206, p. VII-(E)-190). The detachment at Kwajalein was recalled to Agana, Guam, on 12 August 1946. This unit was airborne on shot days, but flew weather reconnaissance flights well away from the test area.

VPB-116. With VPW-1, VPB-116 assisted in weather reconnaissance and air-sea rescue missions using 12 PB4Y-2 aircraft under Commander, Kwajalein Atoll (Reference C.9.206, p. VII-(E)-190). This unit was not airborne on shot days.

Carrier Aircraft Service Unit 8 (CASU-8). This unit performed aircraft maintenance on the PB4Y-2s from VPW-1 and VPB-116 at NAB Kwajalein (Reference C.9.206, p. VII-(E)-190).

CHAPTER 10

U.S. MARINE CORPS PARTICIPATION

Approximately 580 Marines participated at Bikini and Kwajalein during Operation CROSSROADS. Participation by the U.S. Marine Corps primarily involved photographic duties and security guard duties. They provided security on Aomen, Bikini, and Eneu islands at Bikini Atoll, on Kwajalein Island, and aboard certain task force ships. Approximately 155 Marines were aboard USS Saidor (CVE-117). According to a CROSSROADS participant there were three different Marine units/groups aboard the ship (Reference C.12.5):

- A detachment of Marine Fighter Squadron (VMF-513), based out of San Diego, California. Primarily, this was an aircraft maintenance detachment that was responsible for the aircraft of a Navy photographic detachment aboard Saidor.
- Marines who were part of the ship's air department.
- Twenty-eight enlisted Marines who were listed as Marine photographic personnel and who were transported by Saidor. Some were administratively assigned to VMF-513 and some to USS Wharton (AP-7).

Saidor was part of Task Unit 1.6.2 (Photo Carrier Unit), which trained air crews for the bomb tests. This unit conducted aerial photo operations, operated helicopters for radiological reconnaissance, conducted aerial control of drone boats, and operated a photo laboratory on board (Reference C.9.206, p. VII-(E)-14; Reference C.12.5). Movie crews aboard Saidor also filmed the target array and provided documentary coverage of the fleet and the visit of Commander Joint Task Force 1 to Rongerik Atoll (Reference B.7.1).

A Marine guard detachment at Bikini Atoll was furnished by Marine Ground Forces. A total of 36 Marine guards were stationed on Bikini Island, 6 each were on Aomen and Eneu islands.

A provisional Marine detachment at Enewetak had a total of 107 Marines. This unit was a heavy antiaircraft detachment whose duties were not directly related to CROSSROADS (Reference C.11.14).

Provisional detachments and normal Marine detachments were on a number of task force ships (Table 17) (Reference C.13.8). Duties primarily involved ship security.

Badge readings have not been located for Marine Corps personnel who participated in Operation CROSSROADS.

Table 17. Provisional and U.S. Marine Corps detachments aboard CROSSROADS vessels.

Ship	No. of Marines	Ship	No. of Marines
USS Albemarle (AV-5) (MD)	28	USS Mt. McKinley (AGC-7) (MD)	47
USS Bayfield (APA-33) (TQM)	1	USS Ottawa (AKA-101) (TQM)	1
USS Bexar (APA-237) (TQM)	2	USS Rockbridge (APA-228) (TQM)	2
USS Bottineau (APA-235) (TQM)	2	USS Rockingham (APA-229) (TQM)	1
USS Cumberland Sound (AV-17) (MD)	20	USS Rockwall (APA-230) (TQM)	1
USS Fall River (CA-131) (MD)	48	USS Rolette (AKA-99) (TQM)	4
USS George Clymer (APA-27) (TQM)	2	USS St. Croix (APA-231) (TQM)	2
USS Henrico (APA-45) (TQM)	2	USS Shangri-La (CV-38) (MD)	77
		USS Wharton (AP-7) (MD)	30

Legend: MD -- Marine Detachment, TQM -- Transport Quartermaster

CHAPTER 11

PARTICIPATION OF OTHER GOVERNMENT AGENCIES, CONTRACTING FIRMS, AND UNIVERSITIES

Many civilians from government agencies, contracting firms, and universities assisted the military personnel in Operation CROSSROADS. Civilians had played the major role in the development of atomic weapons during the war and civilian assistance at CROSSROADS was an important element in the scientific aspects of the tests. CROSSROADS occurred during a time of massive demobilization following World War II. There was also an acute shortage of specialists, including radiological safety (radsafe) monitors, who had to be recruited from universities with promises made that they would be returned before the start of the school year. Operation CROSSROADS called upon many of the nation's leading civilian scientists. The educational background of some of these scientists serving in the Radiological Safety Section for Test ABLE are enumerated below (Reference C.9.206, p. VII-(C)-6):

Number	Area of Advanced Study
36	Medicine
20	Physics
19	Chemistry
7	Biology
12	Engineering
3	Anatomy

Roles played by the various participating government agencies, contracting firms and universities are discussed below.

GOVERNMENT AGENCIES

U.S. Army Manhattan Engineer District. This organization was officially established on 13 August 1942, although its organization had been in process for 2 months before. The Manhattan Project developed and produced the atomic bombs used in World War II and at CROSSROADS. After the passage of the Atomic Energy Act of 1946, the Manhattan Engineer District was dissolved at the end of 1946, and its contracts, facilities and management responsibilities were transferred by the Army to the Atomic Energy Commission, which was activated 1 January 1947 (Reference C.9.208, pp. 3.10 ff; Reference C.8.1, pp. 6 through 15).

After the formal creation of Joint Task Force 1 (JTF 1), Manhattan Engineer District assisted principally through the 013E Los Alamos Group and the 013H Radioactivity Group. It also supplied the Technical Director as well as 27 observers for shot ABLE and 21 for shot BAKER. These personnel were berthed aboard USS Cumberland Sound (AV-17). Two individuals were badged and had zero readings. Three of its laboratories participated in CROSSROADS and the 1947 Bikini Scientific Resurvey; these are discussed

immediately below. All Bikini Resurvey personnel had film badges and none recorded greater than the daily tolerance limit of 0.1 R.

Argonne National Laboratory. This laboratory, operated by the University of Chicago, provided one scientist for the 1947 Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products and to study the vertical distribution of radioactivity in rocks (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

Clinton Laboratories, Oak Ridge, Tennessee. On 20 May 1946, ten scientists from Clinton Laboratories were scheduled to attend CROSSROADS as part of the Radiological Safety Section. Eight personnel were badged, with a high of 0.30 R and and an average exposure of 0.10 R. Clinton Laboratories also provided a physicist for the Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products and to study the vertical distribution of radioactivity in rocks (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

Los Alamos Laboratory. This group was responsible for preparing timing and firing devices, assembling and delivering the bomb, measuring certain phenomena, and determining yield of weapons. It was responsible to three different groups: the Technical Director, the Director of Los Alamos Laboratory, and the Deputy Task Force Commander for Technical Direction. This group consisted of 124 personnel including civilian consultants from universities, three Army officers, and two Navy officers. They were berthed aboard Cumberland Sound and USS Albemarle (AV-5). Five senior scientists served on the Medico-Legal Board. In addition, 63 personnel were assigned to the Radiological Safety Section as of 20 May. Of this group, 38 were badged. Fifteen of these had exposures of zero, the high was 0.94 R, and the average was 0.17 R.

U.S. Department of Interior -- Fish and Wildlife Service. The Fish and Wildlife Service designated three scientists and three fishermen to assist in fish surveys at Bikini prior to the tests. The unit collected specimens and identified fish in the shallows of the reef and in the lagoon. The unit operated from YMS-413 (see Appendix A for details). After tests ABLE and BAKER, the unit caught live fish and recovered dead fish for studies. No one was badged. The three scientists, plus eight additional scientists, also participated in the Bikini Resurvey in 1947. All persons were badged during the resurvey (Reference C.9.208, p. 3.11; Reference C.8.1, pp. 6 through 15).

U.S. Geological Survey (USGS). USGS personnel worked with the Oceanography Group and investigated the physiography, geology, and ecology of Bikini Atoll. USGS provided four scientists for CROSSROADS and the 1947 Bikini Resurvey to study ecology of reef-building organisms such as algae and corals and the effects of radiation upon them. None were badged for CROSSROADS. Personnel participating in the resurvey were badged (Reference C.9.208, p. 3.11; Reference C.8.1, pp. 6 through 15).

Smithsonian Institute. Smithsonian Institute cooperated with the Oceanography Group studying biological and oceanographic phenomena at Bikini. The institute provided two scientists to make fish surveys and study littoral and land animals, reef, lagoon, fish, algae, seed plants, and plankton at Bikini Atoll. These two plus two additional scientists also participated in the Bikini Resurvey to study the possible radiological effects upon the development of invertebrates and physiology of marine and other plant life. None were badged at CROSSROADS. Personnel on the resurvey were badged (Reference C.9.208, p. 3.11; Reference C.8.1, pp. 6 through 15).

Federal Security Agency -- National Cancer Institute. An unknown number of personnel from the National Cancer Institute helped the Director of Ship Material (DSM) Medical Group by providing mice for radiation experiments (Reference C.9.208, p. 3.11; Reference C.8.1, pp. 6 through 15).

The National Institute for the U.S. Public Health Service. This organization assisted the DSM Group and provided three public health service officers to the 013 Radioactivity Group. The officers were berthed aboard USS Haven (AH-12) and served as radsafe monitors part of the time. Two were badged; one had zero reading and the other had 0.06 R (Reference C.9.208, p. 3.10 ff; Reference C.4.1).

Department of Commerce -- National Bureau of Standards (NBS). NBS personnel assisted the Remote Measurements Group in attempts to detect nuclear detonations from remote locations in Projects 11, 12, and 16 of Program VIII (see Appendix C). Individual field groups were located at Honolulu, Hawaii; Kwajalein Island; Enewetak Atoll; Wake, Guam and Midway islands; Manila, Philippines; Nome, Sitka, Juneau, and Anchorage, Alaska; Bozeman, Montana; Santa Ana, San Francisco, and San Leandro, California; Seattle, Washington; Portland, Oregon; Tuscon, Arizona; Kingsville, Texas; Grand Island, Nebraska; Rapid City, South Dakota; St. Louis, Missouri; Chicago, Illinois; Australia; Peru; San Juan, Puerto Rico; Germany; and Washington, D.C. The total number of personnel involved is unknown (Reference C.9.208, p. 3.45; Reference B.2.1).

U.S. Coast & Geodetic Survey (USCGS). USCGS personnel supported the Oceanography Group by investigating tides and strong seismic disturbances. They made seismic measurements at Kwajalein, Wake, and Midway islands; Honolulu, Hawaii; Sitka, Alaska; San Juan, Puerto Rico; and Tuscon, Arizona. They also sent a party to survey the general layout of Bikini Atoll before CROSSROADS. The total number of personnel involved is unknown (Reference C.9.208, p. 3.12; Reference B.2.1).

Treasury Department -- U.S. Coast Guard. The Coast Guard furnished two vessels, USCG Bramble (WAGL-392) and USCG Red Bud (WAGL-398), and personnel. Bramble laid navigation buoys at Bikini and was to survey the effects of nuclear tests on fish and wildlife and to conduct oceonographic surveys to determine the characteristics of ocean currents inside and around the atoll. Red Bud assisted in a brief survey of western islands of Bikini Atoll before CROSSROADS. These vessels operated as part of Task Unit 1.8.5 (Survey Unit). Bramble had 49 crewmembers and operated at Bikini Atoll from 6 July through 24 August (Reference C.9.208, p. 3.12).

CONTRACTORS, UNIVERSITIES, AND OTHER DOMESTIC ORGANIZATIONS

In addition to military and nonmilitary Federal agencies, there were also private groups who participated in CROSSROADS. Their organizations and activities are described briefly below, along with industrial organizations that either participated directly or indirectly by supplying personnel and equipment.

American Red Cross. Three Red Cross representatives were assigned on the U.S. Army ship David C. Shanks (AP-180). None were badged (Reference B.2.1).

Bell Telephone Laboratories. Two people from this organization were attached to the Staff of the Electronics Coordinating Officer and assigned to USS Begor (APD-127). Neither was badged (Reference C.9.208, pp. 3.12; Reference B.0.18).

Carbide and Carbon Chemicals Corporation (C&C Co). Twenty-six employees of C&C Co. were selected to serve in the Radiological Safety Section at CROSSROADS. Of this group, 15 were badged. Four had recorded exposures of 0 R. The high exposure was 1.06 R, and the average for the group was 0.366 R.

Carnegie Institute. Personnel from Carnegie participated in Project VIII-9, Terrestrial Magnetism. Locations were Honolulu, Hawaii; Sitka, Alaska; Tuscon, Arizona; Cheltenham, Maryland; San Juan, Puerto Rico; Huancayo, Peru; and Watheroo, Australia. Number of personnel involved is unknown (Reference C.9.208, p. 3.45).

Columbia University. One professor from Columbia served in the Radiological Safety Section. His recorded exposure was 0 R.

Cleaver Brooks Co. This company provided a technician and an assistant to repair distillation units at Bikini. Neither was badged. (Reference C.9.206, p. VII-(A)-104).

Cornell Aeronautical Laboratory. This laboratory provided engineering services and telemetering equipment, plus electronics and four engineers for CROSSROADS and one engineer for the Bikini Resurvey's Underwater Photography and Television Group. Two were badged for CROSSROADS and had zero readings. Everyone in the Resurvey Group was badged (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

Eastman Kodak Co. Three scientists from Kodak were part of the Radiological Safety Section. One member of this group also served on the Medico-Legal Board. The recorded exposures for the three personnel were 0.15 R, 0.16 R, and 0.24 R.

Fairbanks Morse & Co., Beloit, Wisconsin. This company provided spare parts and a technician to repair main power plants at Kwajalein. It is unknown if this person was badged. (Reference C.9.206, pp. VII-(A)-96 ff.).

Fairchild Camera & Instrument Co., Jamaica, New York. This company was contracted to provide steel boxes for housing batteries of cameras to be installed on photographic towers. It is unknown if personnel from this company were at Bikini. (Reference C.9.206, p. VII-(A)-96).

Franklin Institute's Bartol Research Foundation. One physicist from the organization was in the Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products and to study the vertical distribution of radioactivity in rocks. He was badged (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

G.E. Failing Co. Under Navy contract for drilling operations at Bikini, this company also provided eight personnel for the Bikini Resurvey in 1947. Approximately nine individuals participated at Bikini during CROSSROADS. None were badged (Reference C.9.208, pp. 3.12 and 3.13; Reference B.2.1).

Geotechnical Corp., Dallas, Texas. This corporation made seismic measurements. It is unknown if any personnel were provided at Bikini (Reference C.9.208, pp. 3.12 and 3.13; Reference B.2.1).

Lenox Hill Hospital. An expert in radiological physics was sent from Lenox Hill Hospital in New York. He served in the Radiological Safety Section. His recorded exposure was 0 R.

Massachusetts Institute of Technology (MIT). Three scientists from MIT were assigned to the Radiological Safety Section at CROSSROADS. All were badged; two had exposures of 0 R, and one had an exposure of 0.36 R. MIT also provided three research associates for the Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products. All three were badged (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

Monsanto Corporation. One representative from Monsanto was selected to work in the Radiological Safety Section. He was not badged.

Princeton University. The university provided engineering services and telemetering equipment. Five personnel were assigned to USS Avery Island (AG-76). Two were badged. The highest reading was 0.10 R (Reference C.9.208, pp. 3.12 and 3.13; Reference B.0.18).

Raytheon Corp., Waltham, Massachusetts. Raytheon provided engineering services for sonar and radar electronic equipment. They also provided eight personnel assigned to Avery Island and attached to the Staff of the Electronics Coordinating Officer. All eight were badged. The highest reading among them was 0.35 R (Reference C.9.208, pp. 3.12 and 3.13; Reference B.0.18).

Scripps Institution of Oceanography. Scripps provided technical personnel, including one radsafe monitor during CROSSROADS. Two oceanographers were provided for the Bikini Resurvey. No one was badged during CROSSROADS (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

Stanford Research Institute (SRI). One physiologist to study radiological effects on developing invertebrates and other plants came from SRI. He was not badged (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

Stanford University. Four scientists from Stanford were involved in the Bikini Resurvey to investigate population studies of reef, lagoon, and pelagic

fishes. Everyone in the resurvey was badged (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

University of Chicago. Twenty-four professors and graduate students from the University of Chicago were selected to serve in the Radiological Safety Section. Of this group, 16 were badged, with a high exposure of 0.38 R. Nine individuals had exposures of 0 R, and the average recorded exposure was 0.072 R.

University of Minnesota. The university provided a physiological chemist for the Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products and to study the vertical distribution of radioactivity in rocks. Everyone in the resurvey was badged (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

University of Notre Dame. Notre Dame provided two chemistry professors for the Bikini Resurvey's Radiochemistry Group to investigate the presence and dispersal of plutonium and fission products. Both were badged (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

University of Rochester. Twenty professors and graduate students were selected to work in the Radiological Safety Section at CROSSROADS. Many in this group were medical doctors or dosimetry experts. Of the 22, 10 were badged. Six had recorded exposures of 0 R. The remaining exposures were 0.017 R, 0.04 R, 0.05 R, and 0.72 R.

University of Tennessee. This university provided one zoology professor and one agronomy professor for the Bikini Resurvey's Radiochemistry and Experimental Biology Group. Both were badged for the resurvey (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

University of Washington, Applied Fisheries, Seattle, Washington. This organization supplied three scientists on board Haven as radsafe monitors. Only one person was badged and he recorded an exposure of 0.4 R. In addition, Applied Fisheries also provided eight more scientists for the Bikini Resurvey to study the effects of radiation in living forms in and around the atoll. They also did comparative studies of radiation in different plants and animal groups and comparative studies on distribution of radioactive material in organs and tissues plus histological studies of various fish tissues. All personnel for the resurvey were badged; (Reference C.8.1, pp. 6 through 15; Reference C.9.208, p. 3.13).

University of Wisconsin. The university provided a research associate for the Bikini Resurvey's Radiochemistry and Radiophysics Group to investigate the presence and dispersal of plutonium and fission products and to study the vertical distribution of radioactivity in rocks. He was badged (Reference C.8.1, pp. 6 through 15; Reference B.0.18).

Victoreen Corporation. Victoreen manufactured Geiger counters. Three employees of Victoreen were asked to be part of the Radiological Safety Section. Two had recorded exposures -- one was 0 R and the other was 0.21 R.

Western Electric Co. This company provided one person to the staff of the Electronics Coordinating Officer. He was assigned to Avery Island and was not badged (Reference C.9.208, pp. 3.12 and 3.13; Reference B.0.18).

Westinghouse Co. Westinghouse provided two personnel attached to the staff of the Electronics Coordinating Officer. One was assigned to Avery Island, and the second is indicated as having assignment on the target ship USS Bracken (APA-64). Neither was badged (Reference C.9.208, pp. 3.12 and 3.13; Reference B.0.18).

Woods Hole Oceanographic Institute. Woods Hole provided one scientist who made physical field measurements at Bikini, Enewetak, Rongelap, and Rongerik atolls. He was not badged (Reference C.9.210, p. N-63).

OBSERVERS

A large number of military and civilian scientists, both foreign and domestic observers, witnessed CROSSROADS. The Transport Group, Task Group 1.3, provided facilities for observers and the press. Task Unit 1.3.2 (Press Unit) consisted of USS Appalachian (AGC-1) and Spindle Eye, an Army press ship operating out of Kwajalein Island. The majority of the press were transported to Bikini aboard Appalachian and were berthed aboard. Others were berthed on USS Mount McKinley (AGC-7), USS Panamint (AGC-13) (the observers ship), USS Saidor (CVE-117) (photographic headquarters ship), and at Kwajalein Island at the Press Branch Headquarters. The following is the breakdown of press observers for tests ABLE and BAKER (Reference C.9.208, p. 3.14):

	Number at ABLE	Number at BAKER
U.S. Press Representatives (radio, pictorial services, magazines, etc.)	114	75
Foreign Press	10	8

In November 1945 the British Admiralty Delegation requested that a small group of British scientists be permitted to participate in the planning and execution of CROSSROADS. The U.S. Joint Chiefs of Staff decided on 5 December 1945 to invite British scientists. A total of nine scientists participated in blast pressure phenomena, physiological effects, radiation measurements, and effects on electronic equipment. A total of five personnel were badged. The highest was reading 0.12 R (Reference C.9.208, p. 3.13).

Table 18 is a summary of the observers (Reference C.9.208, pp. 3.12 and 3.13; Reference B.0.18).

Table 18. CROSSROADS observers.

Group	ABLE	BAKER
Domestic		
U.S. Senate[a]	4	1
U.S. House of Representatives[a]	9	5
U.S. Army	61	55
U.S. Navy	26	14
Civilian scientists	22	19
Foreign		
Membership in UN AEC (Australia, Brazil, Canada, China, France, Egypt, Great Britain, Mexico, Netherlands, Poland, and USSR)	21	21
British	9	9
Canadian	4	4

Note:

[a]One was badged with zero exposure.

Source: Reference C.9.208, pp. 3.16 and 3.17.

CHAPTER 12
PERSONNEL EXPOSURES

The total exposure to ionizing radiation of participating personnel during atmospheric nuclear testing was the sum of their exposures resulting from activities that required them to undertake missions in radioactive areas or to deal with radioactive materials, and of exposures resulting from increased background radiation in normally nonradioactive areas. These latter might be created by fallout or as in CROSSROADS by a buildup of radioactivity in the support ships. This buildup resulted from radioactively contaminated lagoon water passing through the ships' saltwater plumbing systems where some radioactivity was retained and by radioactive material being retained by marine growth on the ships' hulls.

FILM BADGE DOSIMETRY PROGRAM

The device used to record individual exposures, the film badge, was used exclusively for personnel involved in missions that had radiation exposure potential. The Operation Plan defined the CROSSROADS personnel who were to wear badges and under what conditions. All radsafe monitors and assistant monitors were to wear them when entering potentially radioactive areas. Crewmembers of aircraft airborne within 20 nmi (37 km) of surface zero from H-2 until H+30 were all to wear badges. The Operation Plan also stated that monitors were to provide film badges to persons entering radioactive areas (Reference B.0.1, pp. E-II-1, E-II-8, and E-IV-2). Badges were to be collected daily, developed, read, and an exposure record maintained (Reference B.0.1, pp. E-X-2 and E-X-3). CROSSROADS film badges usually were issued for 1 day, but issue periods of 2, 3, or as many as 9 days have been noted.

In practice, badging for personnel other than the monitors and certain aircrews was more complete for personnel doing tasks with an obviously high potential for exposure, such as test-day surveys, initial boarding of target vessels, recovery of test animals, and early recovery of instruments, than for those engaged in other activities. For example, 50 percent of the crewmembers of PGMs and LCPLs on lagoon patrol (Program V, Project 3) were to be badged (Reference B.0.1, p. E-II-6). During early August, before decontamination of ships at Bikini was stopped, an average of about 100 unbadged personnel worked on USS Salt Lake City (CA-25) in three 2-hour shifts. Each shift was assigned two monitors who surveyed working areas to provide information concerning the time allowed in each area before a tolerance exposure was accrued (Reference C.11.16).

All personnel not badged on these missions were, however, accompanied in the potential exposure areas by monitors equipped with radiation detection instruments. The monitor's function was to guide the work parties away from radiologically "hot" areas and determine safe stay times in work areas. His pocket dosimeter or film badge recorded a representative exposure for the group he accompanied.

A total of 18,775 badges were issued during CROSSROADS at Bikini and at Kwajalein through 31 December 1946. Almost 11 percent of the badges were issued on ABLE-day and about 7 percent on BAKER-day, or the days immediately following each shot. About 38 percent were issued during August when target vessels were being reboarded for decontamination and damage inspection.

Through July and August, 10,431 personnel badges were issued. Most of the remaining 8,344 badges were issued during September and October. Because most badges were issued for only 1 day, some individuals received more than one badge. The number of individuals receiving badges is not presently available, but the Navy Department currently estimates that up to 15 percent of the personnel received at least one badge.

Badge-Recorded Exposures After ABLE

Due to the small amount of radioactive contamination as a result of Test ABLE, 47 of the target ships had been declared clear of radiation by the evening of 2 July. The lagoon was reported as less than 0.1 R/24 hours at 1008 on 2 July. By the end of 4 July most of the target ships had been remanned by their crews. As a consequence of this rapid clearing of residual radiation, the number of persons issued badges and recorded exposures decreased rapidly in the days after the detonation, even though much work was done in recovering test data and in readying the target fleet for BAKER. Post-ABLE exposures are summarized in Table 19. From 8 until 24 July, the day before BAKER, only nine badges were issued each day (Reference C.13.6). Ninety-three percent of all film badges issued between 1 and 7 July read 0 R (gamma).

Table 19. Badge issues and exposures following Test ABLE, CROSSROADS.

Date	No. of Badges Issued	No. of Badges With Zero Exposure	No. of Badges Exceeding 0.1 R[a]
1 July (ABLE Day)	1,627	1,501	6
2 July	274	264	2
3 July	107	105	1
4 July	90	85	0
5 July	16	15	0
6 July	18	18	0
7 July	0	--	--
Total	2,132	1,988	9

Note:
[a]0.1 R was daily tolerance dose.

Badge-Recorded Exposures after BAKER

After BAKER in late July and early August, while efforts were made to find an effective means of decontamination, task force personnel were severely restricted in reboarding target vessels by high and persistent levels of radioactivity in the lagoon water in the area of the target array and on the target vessels themselves. As a consequence, the number of badges issued was low during this period.

On 4 August the Director of Ship Material issued fairly detailed instructions for ship decontamination (Reference C.9.185, pp. 4 through 13). The decontamination effort then expanded and with it the number of men issued badges.

The number of badges issued then dropped abruptly after the decision on 10 August was made to end decontamination of the target vessels and limit activities aboard them to recovery of instruments, ship inspection, salvage work, and preparations for towing vessels from the area. However, the number of badges issued then increased as the number of personnel involved with ship inspections grew and towing activity increased. For the rest of the month, the trend of badges issued was downward as target ship and support ship crews departed Bikini. By the end of August most of the support ships had left Bikini. Table 20 summarizes the badge issues and recorded exposures during this period.

The CROSSROADS Bikini badge readings were entered into standard government ledger books, along with certain associated information. The data-recording had several shortcomings. Given names or initials were included with only about half of the last names, and therefore when several entries containing only the same last name are found, it cannot be determined whether they represent the badge reading of one person or several with the same last name. Poor penmanship and spelling on the part of the clerks making the entries further complicates identification. Although a ship's name was usually entered along with a person's name, it is not always clear whether the ship named was the one on which the man lived or the one on which he worked as he wore the badge. However, the target ships with few exceptions were not remanned, so if a target ship is named in the ledger it was the place where the exposure occurred.

Other information has been used to supplement the old dosimetry records. Ships' logs, muster rolls, and other personnel lists have been compared with the ledger records in an effort to identify all those who were badged and to accurately total each individual's recorded exposure. Use of these other sources has matched from 85 to 90 percent of the Navy badges with individuals.

Badge-Recorded Exposures at Kwajalein

During the ammunition off-loading and inspection phase of the operations at Kwajalein to the end of 1946, the recordkeeping on badge issues was improved. The ledgers were used to issue the badges to the men and to record the target vessel being worked on and the exposure, but a 5x8 card was used to cumulate the individual badge readings from the ledgers for each man. Because the recordkeepers of the time made these cumulations, the problems of handwriting interpretation and same-name confusion are not present.

Table 20. CROSSROADS badging after shot BAKER.

Date	No. of Badges Issued	No. of Badges With Zero Exposure	No. of Badges Exceeding 0.1 R (gamma)
25 July (BAKER day)	468	189	85
26 July	211	128	4
27 July	287	175	27
28 July	110	40	25
29 July	180	62	49
30 July	68	23	18
31 July	44	8	9
1 August	40	12	17
2 August	60	19	16
3 August	91	46	18
4 August	81	17	16
5 August	100	15	21
6 August	101	48	19
7 August	107	29	29
8 August	167	59	33
9 August	245	133	26
10 August	190	101	24
11 August	5	3	2
12 August	201	79	32
13 August	280	73	54
14 August	416	329	20
15 August	402	342	1
16 August	543	460	2
17 August	733	682	13
18 August	238	135	2
19 August	511	158	59
20 August	555	367	36
21 August	386	177	42
22 August	277	100	53
23 August	153	53	15
24 August	126	64	11
25 August	78	31	10
26 August	179	151	2
27 August	215	157	1
28 August	54	31	0
29 August	44	26	1
30 August	59	36	1
31 August	27	14	0

Source: Reference C.13.6.

Inspection of these cards on the microfilm record (Reference C.13.4) shows that 699 persons were badged at Kwajalein from 30 August to year end. Most were issued more than one badge, the highest number observed being 42, and many men had from 10 to 30 badges. Each badge, of course, represented a day's work off-loading ammunition from the contaminated targets or inspecting or mooring or otherwise servicing them.

The periods of heaviest issue were from early September until the end of October. After this time very few badges were issued. The distribution of the exposures recorded during this September through October period is as follows:

Total Exposure Recorded (R, gamma)	No. of Personnel With This Exposure	No. in Group With at Least One Missing or Unreadable Badge
0 R (gamma)	121	7
0.0001 - 0.4999	498	133
0.5 - 0.9999	68	30
1.0 - 1.4999	4	0
1.5 or greater	1 (1.52 R)	0

Seven of the men had unreadable badges.

Summary of Personnel with the Highest Badged Exposures for 1946

An examination of the personnel dosimetry records shows that radiation safety monitors, certain air unit personnel, radiological patrol boat crews, target ship crews, and JTF 1 initial boarding teams were groups with the highest exposures. Personnel from the scientific projects also had a high potential for exposure.

The group with the highest exposures was the radsafe monitors who accompanied all personnel into contaminated areas and were responsible for monitoring radiation intensity of the water and the target ships. This group was issued more film badges than any other single group during the Bikini phase of the operation. The monitors were badged an average of five times each (1,616 total badges). One monitor was badged 28 times (on 19 days), and forty-five were badged more than 10 times. The highest cumulative exposure recorded by a monitor was 3.72 R, the highest single day exposure was 2 R, and the mean cumulative exposure was 0.278 R per monitor.

Table 21 summarizes film badge issues and exposure for the monitors. Fifty-six percent of the 1,497 readable film badges had a zero reading. There were 213 readings, or 14 percent, that exceeded the maximum daily allowance of 0.1 R/24 hours. Except for one day, the daily average was below the maximum allowed exposure.

Air unit personnel exposures and patrol boat crew exposures are summarized in Tables 22 and 23. Summaries for target ship crew reboardings for USS New York (BB-34), USS Pennsylvania (BB-38), and USS Salt Lake City (CA-25) are shown in Tables 24, 25, and 26. JTF 1 initial boarding team exposures are

Table 21. Summary of film badge data for radiation safety monitors, CROSSROADS.

Date	No. of Badges Issued[a]	No. of Badges Readable[b]	No. of Badges With Zero Exposure	Average (R)	High (R)	No. of Badges Exceeding 0.1R[c]
1 July	191	177	156	0.019	2.000	5
2 July	89	80	76	0.006	0.130	1
3 July	18	17	13	0.008	0.050	0
4 July[d]	3	2	2	0.0	0.0	0
25 July	132	130	69	0.044	2.000	24
26 July	77	76	51	0.024	0.300	4
27 July	68	66	41	0.030	0.120	5
28 July	39	39	18	0.060	0.370	8
29 July	36	34	16	0.050	0.300	8
30 July	28	25	20	0.028	0.120	3
31 July	30	29	16	0.054	0.240	3
1 August	30	29	11	0.050	0.250	4
2 August	24	23	13	0.070	1.800	6
3 August	38	37	17	0.052	0.350	5
4 August	42	42	9	0.073	0.220	14
5 August	43	42	9	0.092	1.300	9
6 August	33	33	7	0.034	0.860	8
7 August	52	50	10	0.142	1.400	16
8 August	48	46	15	0.042	0.240	13
9 August	53	42	19	0.061	0.360	11
10 August	43	40	12	0.052	0.160	7
11 August	4	3	3	0.0	0.0	0
12 August	38	27	7	0.073	0.400	4
13 August	40	39	11	0.083	0.600	10
14 August	39	28	21	0.018	0.280	1
15 August	43	42	34	0.008	0.150	1
16 August	35	34	24	0.020	0.150	2
17 August	44	39	34	0.083	2.000	3
18 August	16	14	8	0.091	0.790	2
19 August	40	37	4	0.045	0.180	5
20 August	51	44	25	0.048	0.490	6
21 August	33	27	5	0.068	0.190	7
22 August	32	31	10	0.063	0.260	9
23 August	15	13	6	0.062	0.300	2
24 August	27	27	16	0.025	0.120	1
25 August	6	6	3	0.033	0.060	0
26 August	11	11	8	0.021	0.150	1
27 August	8	8	4	0.036	0.080	0
28 August	4	4	3	0.032	0.130	1
29 August	2	2	1	0.005	0.010	0
30 August	2	2	1	0.020	0.040	0
Totals	1,616	1,497 (100%)	836 (56%)			213 (14%)

Notes:

[a]Nineteen multi-day badges not included.

[b]Some badges that were issued were not readable when processed.

[c]0.1 R/day was the maximum allowable exposure for CROSSROADS.

[d]Less than 10 film badges were issued between 5 and 24 July.

Table 22. Film badge summaries (in roengtens) for air unit personnel, CROSSROADS.

Unit	ABLE				BAKER			
	No. of Readings[a]	Low	Average	High	No. of Readings[a]	Low	Average	High
F6F drone control pilots	15	0	0.020	0.030	12	0	0.050	0.080
PBM radiological patrols	29	0	0	0	1	0	0	0
B-17 drone control crews	40	0	0	0	75	0.060	0.145	0.350
Army F-13 photo aircraft	24	0	0	0	None Identified			

Note:

[a]Some badges that were issued were not readable and have been omitted from this display.

Table 23. Film badge summary (in roentgens) of radiological patrol boat crews, CROSSROADS.

Date	PGMs (6)				LCPLs (20)			
	No. of Readings[a]	Low	Average	High	No. of Readings[a]	Low	Average	High
ABLE								
1 July	82	0	0.016	0.190	82	0	0.018	0.120
2 July	21	0	0	0	74	0	0.003	0.060
BAKER								
25 July	53	0	0.076	0.180	81	0	0.037	0.240
26 July	28	0	0.045	0.310	92	0	0.018	0.080
27 July	36	0	0.024	0.250	89	0	0.049	0.150
28 July	14	0	0.122	0.380	36	0.060	0.085	0.180
29 July	11	0	0.029	0.090	20	0.050	0.065	0.130
30 July					13	0	0.083	0.270
31 July					5	0.090	0.094	0.100

Note:

[a]Some badges that were issued were not readable and have been omitted from this display.

Table 24. Post-BAKER film badge summary (roentgens) for USS New York (BB-34) reboarding parties.

Date	No. of Badges Issued	Low	Average	High
5 August	1	0	0	0
6 August	1	0.1	0.1	0.1
7 August	4	0.07	0.165	0.390
8 August	11	0	0.021	0.070
9 August	4	0.07	0.08	0.1
10 August	6	0	0.053	0.08
13 August	3	0	0.04	0.07
15 August	9	0	0.047	0.09
16 August	151	0	0.004	0.06
17 August	34	0	0.019	0.1
18 August	42	0	0.012	0.06
19 August	42	0	0.007	0.03
20 August	28	0	0.008	0.05
21 August	109	0	0.067	0.21

Source: Reference C.13.6.

Table 25. Post-BAKER film badge summary (roentgens) for USS Pennsylvania (BB-38) reboarding parties.

Date	No. of Badges Issued	Low	Average	High
7 August	1	0.06	0.06	0.06
8 August	3	0.04	0.063	0.08
9 August	2	0.07	0.105	0.13
10 August	5	0.0	0.063	0.07
12 August	1	0.05	0.05	0.05
16 August	24	0.0	0.001	0.03
17 August	46	0.0	0.002	0.05
19 August	130	0.0	0.03	0.1
20 August	40	0.0	0.067	0.17
21 August	19	0.05	0.07	0.09
25 August	8	0.0	0.036	0.11
26 August	42	0.0	0.008	0.12
27 August	43	0.0	0.023	0.6

Source: Reference C.13.6.

Table 26. Post-BAKER film badge summary (roentgens) for USS Salt Lake City (CA-25) reboarding parties.

Date	No. of Badges Issued	Low	Average	High
4 August	15	0	0.088	0.190
5 August	15	0	0.146	0.320
6 August	17	0.070	0.113	0.230
7 August	4	0	0.183	0.400
8 August	29	0	0.105	0.210
9 August	18	0	0.159	0.360
12 August	1	0.040	0.040	0.040
13 August	9	0.050	0.084	0.130
17 August[a]				
20 August	137	0	0.017	0.080
23 August[b]				
25 August[b]				

Notes:

[a]Boarded by 19 men for 2.5 hours to raise anchor. No film badge data.

[b]Boarded briefly by 6 men to rig and derig towed gear. No film badge data located.

Source: Reference C.13.6.

summarized in Table 27. Badged exposures for scientific personnel have been summarized in Tables 4 and 6 (Chapter 3).

Table 27. Summary of Joint Task Force 1 initial boarding team film badge readings.

Date	No. of Readings	No. of Zero Exposures	Average (R)	High (R)	No. of Readings Over 0.1 R
1 July	9	9	0.0	0.0	0
2 July[a]	68	66	0.001	0.050	0
25 July	4	0	0.055	0.080	0
26 July[b]	2	0	0.160	0.200	2
27 July[c]	5	0	0.075	0.160	3
28 July	6	0	0.108	0.160	2
29 July	2	0	0.130	0.150	2
30 July	11	0	0.106	0.150	7
31 July	4	0	0.247	0.720[d]	2
1 August	3	0	0.193	0.420	1
2 August	11	5	0.071	0.420	2
3 August	8	3	0.052	0.120	1
4 August	1	0	0.110	0.110	1
5 August	7	0	0.125	0.180	3
6 August	2	0	0.110	0.120	1
7 August	5	1	0.090	0.140	2
8 August	11	2	0.103	0.240	4
9 August	2	1	0.020	0.040	0
10 August	2	1	0.020	0.040	0
12 August	3	1	0.063	0.110	1
13 August	12	3	0.066	0.170	2
14 August	8	6	0.023	0.150	1
15 August	4	2	0.015	0.030	0
16 August	8	7	0.005	0.040	0
17 August	7	7	0.0	0.0	0
18 August	5	2	0.042	0.100	0
19 August	7	2	0.030	0.100	0
20 August	5	3	0.024	0.080	0
21 August	5	1	0.048	0.080	0
Totals	227 (100%)	122 (54%)			37 (16%)

Notes:

[a]All badges issued 1-2 July.

[b]Badges issued 25-26 July.

[c]Badges issued 25-27 July.

[d]Badge issued 29-31 July.

Badge-Recorded Exposures After 1946 Related to CROSSROADS

The Bikini Resurvey personnel were badged during their 1947 activities. For the over 300 personnel involved and crewmembers of the support ships, from 517 to 572 badges were issued. "There were no personnel exposures in excess of the daily tolerance of 0.1 R beta plus gamma" (Reference C.8.2, p. 101). This is discussed in Chapter 6 in more detail.

Exposures of personnel working primarily on CROSSROADS target ships were also monitored. Table 28 presents exposures at San Francisco Naval Shipyard. Of the recorded exposures at Kwajalein, where until July 1948 the ship security detail existed, the maximum exposure, accrued during 394 hours of work over 10 months, was 0.790 R (gamma), and the average exposure was 0.070 R (gamma) (Reference C.0.30). At Puget Sound Naval Shipyard, the maximum exposure, accrued during 563 hours of work, was 1.380 R (gamma). The average exposure was 0.137 R (gamma) and 0.287 rep (beta) during 20 months of work.

Table 28. Dosimetry for military and civilian personnel at San Francisco Naval Shipyard for 1947 and 1948.

	High (R)	Low (R)	Average (R)	Maximum Hours One Person Exposed	Average No. Hours of Exposure
Through December 1947 (128 personnel)				1,032	167
Gamma	4.230[b]	0	0.039[c]		
Beta	4.920	0	0.051		
1947 through 1948 (397 personnel)				2,169	278
Gamma	4.060[d]	0	0.004[e]		
Beta	4.630	0	0.006		

Notes:

[a] This exposure summary was compiled at the end of each year. Personnel who worked both years are included in the 1947-1948 data as well as the 1947 data. Therefore, the total number of personnel from 1947 and 1948 cannot be added to determine total personnel exposed.

[b] Individual averaged 0.081 rem gamma and 0.094 rem beta per day during 51.8 workdays.

[c] In 1947, 36 percent of the badges showed zero (gamma).

[d] Individual averaged 0.034 rem gamma and 0.039 rem beta per day during 119 workdays.

[e] In combined 1947-1948, 43 percent of the badges showed zero (gamma).

Sources: References C.11.25 and C.11.26.

PERSONNEL EXPOSURES NOT RECORDED ON FILM BADGES

Only a small portion of the CROSSROADS Bikini participants were badged and even these personnel were badged only during missions that might expose them directly to test instrumentation or test objects that were known or expected to be heavily contaminated with radioactive material. The exposure to the higher-than-normal radioactive background went largely unrecorded. The prime source of this elevated background was the contaminated lagoon water after the BAKER test. However, many participants had little or no exposure to this background. Some lived on islands distant from the tests and thus had no contact with the contaminated lagoon and received no fallout. Others were aboard ships that did not reenter the lagoon after BAKER, or did so only briefly.

Nearly 50 percent of the personnel did not reenter the lagoon after Test BAKER until it had been declared radiologically safe (less than 0.1 R/24 hours) at 0959 on 30 July. Table 29 summarizes the number of personnel and when they entered the lagoon after BAKER.

Forty-one percent of all participants were assigned to units involved with decontamination, inspection, towing, or salvage. However, only a portion of the crew on most ships would have been actively involved. Many Navy job ratings such as cooks, yeomen, engineers, signalmen, and radiomen would normally have remained aboard the support ship. The 8,463 target ship crewmembers were the most active in the reboarding and decontamination phase. Even then, as indicated in the Independence deck log, which lists the names of all boarding teams, only 50 men reboarded from the crew of 343. The USS Briscoe (APA-65) deck log indicates the boarding teams were limited to 29 men from the 112-man crew. Table 30 compares the ship's missions with their likelihood for contact with target ships for decontamination and inspection.

DOSE RECONSTRUCTION

To produce estimated doses for all CROSSROADS participants, a scientific dose reconstruction project has been completed. In this effort, three major sources of radiation were considered:

1. Radioactivity of lagoon waters due to weapon debris and neutron-activated radionuclides, such as sodium-24
2. Target ship contamination resulting from weapon debris and neutron-induced activity
3. Contamination buildup on the exterior hulls below the waterline and in the saltwater piping of ships operating in the low-level radioactive environment of Bikini Lagoon.

Reconstruction Model

Computer models were developed to combine the various radioactive sources with the movement of each support ship. Based upon recorded lagoon water and support ship hull readings, the radiological environment was reconstructed. Exposures were calculated for each ship as it operated in this environment. An integrated dose was determined up to the time that each ship was granted radiological clearance after CROSSROADS. Doses for personnel assigned to recovery

Table 29. Number of ships[a] and personnel[b] reentering Bikini Lagoon after Test BAKER.

	Support Ships	Target Ship Crews	Army[c]	Joint Task Force 1 Staff	Marine Corps	Other Units Aboard Ships	Total
25 July							
Ships	49						
Personnel	11,444	943	350	1,274	325	584[d]	14,920 (36%)
26 July							
Ships	9						
Personnel	2,709				155		2,864 (7%)
27 July							
Ships	1						
Personnel	280						280 (<1%)
28 July							
Ships	4						
Personnel	342				242		584 (1%)
29 July							
Ships	2						
Personnel	634	2,888					3,522 (9%)
30 July							
Ships	21						
Personnel	6,528	4,632					11,160 (27%)
31 July							
Ships	18						
Personnel	1,261						1,261 (3%)
1 August							
Ships	2						
Personnel	344						344 (1%)
After 1 August							
Ships	7						
Personnel	363						363 (1%)
Never Reentered[e,f]							
Ships	6						
Personnel	3,285		2,300		107	904	6,596 (16%)

Notes:

[a] See Appendix A for details of ship activities.

[b] Total CROSSROADS personnel, 41,894

[c] All Army personnel are assumed to have entered on July 25.

[d] Includes 372 personnel in small units. Entry date assumed to be July 25.

[e] Or on other atolls.

[f] About 525 aircrew members flew in the vicinity of Bikini on 25 July.

Table 30. Ship and unit missions and involvement with target ship decontamination and inspection after Test BAKER, CROSSROADS.

Frequent Contact			Not Directly Involved			Not at Bikini After 25 July	
	No. of Ships	No. of Personnel		No. of Ships	No. of Personnel		No. of Ships	No. of Personnel
Towing/ Salvage/ Repair	39	5,767	Command/ Transports	28	10,787	Ships	6	3,285
Target Ship Crews	92	8,463	Survey/ Destroyers	17	4,040	At Other Atolls		904
Army		350	Oilers/ Supply	13	1,610	Army Air Forces		2,300
Joint Task Force 1 Staff		1,274	Marines/ Seabees		722	Marines		107
Dispatch and Boat Pool	7	1,269	Radiological Safety[a]	9	1,016			
TOTALS	138	17,123 (41%)		67	18,175 (44%)		6	6,596 (16%)

Note:

[a]High potential for radiation exposure but not involved in decontamination.

parties or decontamination working parties, which boarded target ships, can be derived from the target ship radiological readings and specific boarding times, locations, and activities. These can be be added to the dose calculated by the models. An example of the methodology is presented in Appendix G.

Reconstruction Results

Among the support ships, the PGM crews generally received the highest calculated doses. These ships entered the lagoon shortly after shot BAKER and, for the next several days, helped establish the Red and Blue Lines around and within the target array. While in the radioactive water, their exterior hulls below the waterline became contaminated, which in turn raised intensity levels in the interior berthing spaces near the hull. This necessitated that crews sometimes evacuate their ships at night to sleep on other support ships that were not contaminated, although in most instances, skeleton crews remained on board the PGMs. This procedure was effected to preclude the crews from receiving doses in excess of their daily tolerance. By the morning of 29 July, the hull contamination on all of the PGMs had decreased to the point that the crews could remain on board continuously and the practice of evacuating at night was terminated.

Other ships with higher exposures were the tugs and salvage ships that worked among the target fleet. USS Barton (DD-722) crew had higher than average reconstructed doses because of that ship's radiological surveys in the contaminated lagoon waters following BAKER shot. The ships' movements and activities are outlined in Appendix A of this report

Table 31 presents the dose calculated by this model for crews of support ships at CROSSROADS. Table 32 presents the same information for crews of target ships. This latter is made up of exposures while the crews were berthed on support ships and times spent aboard the target ships. The number of personnel in these tables does not coincide in all cases with the crew size indicated in Appendix A because the numbers involved change as more information becomes available. The data in Tables 31 and 32 are more recent, but are subject to change.

CONTEMPORARY EVALUATIONS OF THE RADIOLOGICAL SAFETY PROGRAM

The chairman of the Medico-Legal Board that had advised the Chief of the Safety Section entered the following comments in the records after the operations (Reference C.0.5):

> [The CROSSROADS operations] were carried through without irradiation injury to any persons. I consider this conclusion well reasoned and founded on a sufficiently broad basis of measurements made by monitors sufficiently skilled and conscientious in their work . . . . [Because the board is scattered at the time of this writing,] the conclusion will have to stand as the opinion of the chairman.

In 1966, the former chief of the CROSSROADS Radiological Safety Section wrote a short overview of radiological safety and the operation. Depending upon recollection and records personally available to him (which subsequently have

Table 31. Reconstructed (calculated) dose for support ship crews, CROSSROADS.

Vessel Name/Identification	No. of Personnel	Bikini Departure Date	Bikini Reconstructed Dose (rem gamma)	Clearance Date	Total Reconstructed Dose (rem gamma)
USS Achomawi (ATF-148)	80	29 Aug 46	1.245	6 Dec 46	1.300
USS Ajax (AR-6)	753	23 Aug 46	0.191	1 Jan 47	0.220
USS Albemarle (AV-5)[a]	569	25 Jul 46	0	22 Nov 46	0
USS Allen M. Sumner (DD-692)	278	10 Aug 46	0.467	19 Nov 46	0.580
APL-27	23	24 Aug 46	0.131	25 Feb 47	0.220
USS Appalachian (AGC-1)	614	29 Jul 46	0.010	2 Oct 46	0.010
USS Appling (APA-58)	226	8 Aug 46	0.116	22 Nov 46	0.180
ARD-29	106	25 Aug 46	0.265	18 Feb 47	0.300
USS Artemis (AKA-21)	160	18 Aug 46	0.216	20 Nov 46	0.250
ATA-124	44	25 Aug 46	0.359	18 Dec 46	0.430
ATA-180	45	1 Sep 46	0.547	24 Feb 47	0.630
ATA-185	43	5 Sep 46	0.593	13 Dec 46	0.640
ATA-187	33	24 Aug 46	0.347	6 Nov 46	0.410
ATA-192	15	2 Sep 46	0.547	14 Nov 46	0.590
ATR-40	68	23 Aug 46	0.903	17 Dec 46	0.990
ATR-87	69	1 Sep 46	0.485	13 Dec 46	0.550
USS Avery Island (AG-76)	483	7 Aug 46	0.147	3 Dec 46	0.260
USS Barton (DD-722)	260	10 Aug 46	0.519	2 Nov 46	0.630
USS Bayfield (APA-33)	428	3 Aug 46	0.063	7 Dec 46	0.140
USS Begor (APD-127)	155	3 Aug 46	0.114	30 Sep 46	0.200
USS Benevolence (AH-13)	673	25 Aug 46	0.236	24 Sep 46	0.250
USS Bexar (APA-237)	293	23 Aug 46	0.231	24 Jan 47	0.280
USS Blue Ridge (AGC-2)	534	30 Jul 46	0.001	22 Nov 46	0.010
USS Bottineau (APA-235)	299	10 Aug 46	0.178	19 Dec 46	0.240
USS Bountiful (AH-9)[b]	585	25 Jul 46	0	27 Sep 46	0
USS Bowditch (AGS-4)	296	27 Sep 46	0.143	20 Nov 46	0.160
USCG Bramble (WAGL-392)	49	24 Aug 46	0.302	22 Nov 46	0.350
USS Burleson (APA-67)	244	5 Aug 46	0.066	14 Oct 46	0.110
USS Cebu (ARG-6)	357	23 Aug 46	0.229	16 Dec 46	0.270

Notes:

[a] In Bikini Lagoon only 4 hours after BAKER.

[b] Did not enter Bikini after BAKER.

(continued)

Table 31. Reconstructed (calculated) dose for support ship crews, CROSSROADS.

Vessel Name/Identification	No. of Personnel	Bikini Departure Date	Bikini Reconstructed Dose (rem gamma)	Clearance Date	Total Reconstructed Dose (rem gamma)
USS Charles P. Cecil (DD-835)[b]	287	25 Jul 46	0	22 Nov 46	0
USS Chickasaw (ATF-83)	78	26 Aug 46	0.400	13 Jan 47	0.480
USS Chikaskia (AO-54)	176	23 Aug 46	0.198	31 Dec 46	0.240
USS Chowanoc (ATF-100)	88	28 Aug 46	0.401	1 Feb 47	0.470
USS Clamp (ARS-33)	88	26 Aug 46	0.651	22 Nov 46	0.720
USS Coasters Harbor (AG-74)	195	15 Aug 46	0.195	7 Dec 46	0.240
USS Conserver (ARS-39)	86	5 Sep 46	0.919	4 May 47	0.985
USS Coucal (ASR-8)	117	4 Sep 46	0.556	10 Jan 47	0.610
USS Creon (ARL-11)	144	21 Aug 46	0.284	23 Jan 47	0.360
USS Cumberland Sound (AV-17)	540	1 Aug 46	0.061	3 Dec 46	0.130
USS Current (ARS-22)	94	25 Aug 46	0.885	6 Feb 47	0.970
USS Deliver (ARS-23)	84	20 Aug 46	0.952	20 Dec 46	1.030
USS Dixie (AD-14)	835	25 Aug 46	0.214	2 Oct 46	0.230
USS Dutton (AGS-8)	60	14 Sep 46	0.306	18 Dec 46	0.360
USS Enoree (AO-69)	152	24 Aug 46	0.198	3 Dec 46	0.240
USS Etlah (AN-79)	36	27 Aug 46	0.689	18 Dec 46	0.750
USS Fall River (CA-131)	817	4 Sep 46	0.204	23 Dec 46	0.220
USS Flusser (DD-368)	146	4 Sep 46	0.428	22 Nov 46	0.490
USS Fulton (AS-11)	733	25 Aug 46	0.267	24 Dec 46	0.300
USS Furse (DD-882)	293	28 Jul 46	0.002	22 Nov 46	0.010
USS George Clymer (APA-27)	270	20 Aug 46	0.248	22 Nov 46	0.270
USS Gunston Hall (LSD-5)	305	25 Aug 46	0.211	8 Jan 47	0.240
USS Gypsy (ARSD-1)	77	5 Sep 46	0.516	9 Jan 47	0.570
USS Haven (AH-12)	476	25 Aug 46	0.250	14 Feb 47	0.290
USS Henrico (APA-45)	424	16 Aug 46	0.226	28 Jan 47	0.270
USS Hesperia (AKS-13)	139	23 Aug 46	0.245	28 Dec 46	0.280
USS Ingraham (DD-694)	237	10 Aug 46	0.505	19 Nov 46	0.620
USS James M. Gilliss (AGS-13)	40	20 Aug 46	0.202	13 Nov 46	0.300
USS John Blish (AGS-10)	48	20 Aug 46	0.335	15 Oct 46	0.410
USS Kenneth Whiting (AV-14)	539	14 Aug 46	0.195	11 Dec 46	0.230
USS Laffey (DD-724)	251	10 Aug 46	0.332	2 Nov 46	0.440
LCI(L)-977	35	22 Aug 46	0.176	7 Mar 47	0.300

(continued)

Table 31. Reconstructed (calculated) dose for support ship crews, CROSSROADS.

Vessel Name/Identification	No. of Personnel	Bikini Departure Date	Bikini Reconstructed Dose (rem gamma)	Clearance Date	Total Reconstructed Dose (rem gamma)
LCI(L)-1062	35	22 Aug 46	0.362	4 Jan 47	0.470
LCI(L)-1067	34	22 Aug 46	0.093	24 Feb 47	0.220
LCI(L)-1091	35	25 Aug 46	0.380	11 Dec 46	0.480
USS Lowry (DD-770)	244	10 Aug 46	0.326	6 Nov 46	0.430
USS LST-388	80	25 Aug 46	0.277	5 Dec 46	0.330
USS LST-817	63	23 Aug 46	0.182	21 Nov 46	0.260
USS LST-861	80	24 Aug 46	0.326	6 Dec 46	0.380
USS LST-871[a]	81	25 Jul 46	0	22 Nov 46	0
USS LST-881	71	22 Aug 46	0.193	13 Dec 46	0.260
USS LST-989[a]	84	25 Jul 46	0	19 Nov 46	0
USS Mender (ARSD-2)	49	4 Sep 46	0.307	3 Jan 47	0.360
USS Moale (DD-693)	247	10 Aug 46	0.759	19 Nov 46	0.870
USS Mount McKinley (AGC-7)	824	10 Aug 46	0.193	20 Dec 46	0.250
USS Munsee (ATF-107)	63	29 Aug 46	0.368	18 Nov 46	0.420
USS Newman K. Perry (DD-883)	280	4 Aug 46	0.185	17 Jan 47	0.360
USS O'Brien (DD-725)	237	8 Aug 46	0.175	6 Nov 46	0.310
USS Oneota (AN-85)	45	26 Aug 46	0.582	11 Dec 46	0.650
USS Orca (AVP-49)	215	12 Aug 46	0.262	11 Dec 46	0.330
USS Ottawa (AKA-101)	67	2 Aug 46	0.063	13 Sep 46	0.130
USS Palmyra (ARS[T]-3)	299	5 Sep 46	0.378	22 Nov 46	0.420
USS Panamint (AGC-13)[b]	591	27 Jul 46	0	22 Nov 46	0
PGM-23	39	25 Aug 46	0.935	16 Jan 47	1.120
PGM-24	48	25 Aug 46	1.293	13 Feb 47	1.500
PGM-25	53	10 Aug 46	1.061	28 May 47	1.380
PGM-29	48	10 Aug 46	1.087	28 May 47	1.400
PGM-31	55	10 Aug 46	0.812	17 Jan 47	1.100
PGM-32	27	10 Aug 46	1.045	10 Oct 46	1.250
USS Phaon (ARB-3)	160	23 Aug 46	0.331	26 Dec 46	0.390
USS Pollux (AKS-4)	154	19 Aug 46	0.117	29 Nov 46	0.150

Note:

[a]Did not enter Bikini after BAKER.

[b]Not in Bikini Lagoon long enough to become contaminated.

(continued)

Table 31. Reconstructed (calculated) dose for support ship crews, CROSSROADS.

Vessel Name/Identification	No. of Personnel	Bikini Departure Date	Bikini Reconstructed Dose (rem gamma)	Clearance Date	Total Reconstructed Dose (rem gamma)
USS Preserver (ARS-8)	85	28 Aug 46	1.122	18 Dec 46	1.180
USS Presque Isle (APB-44)	194	19 Aug 46	0.280	12 Dec 46	0.340
USS Quartz (IX-150)	50	22 Aug 46	0.235	12 Dec 46	0.280
USS Reclaimer (ARS-42)	73	1 Sep 46	1.679	24 Dec 46	1.740
USS Robert K. Huntington (DD-781)	234	10 Aug 46	0.474	19 Nov 46	0.590
USS Rockbridge (APA-228)	206	23 Aug 46	0.334	6 Dec 46	0.400
USS Rockingham (APA-229)	297	24 Aug 46	0.241	4 Dec 46	0.280
USS Rockwall (APA-230)	288	19 Aug 46	0.208	17 Dec 46	0.250
USS Rolette (AKA-99)	151	26 Aug 46	0.241	28 Jan 47	0.280
USS Saidor (CVE-117)	854	4 Aug 46	0.068	28 Jan 47	0.100
USS Saint Croix (APA-231)	306	2 Aug 46	0.072	22 Nov 46	0.150
USS San Marcos (LSD-25)	631	25 Aug 46	0.249	24 Oct 46	0.280
USS Severn (AO-61)	145	24 Aug 46	0.137	3 Nov 46	0.170
USS Shakamaxon (AN-88)	38	27 Aug 46	0.643	12 Dec 46	0.700
USS Shangri-La (CV-38)[a]	1,935	25 Jul 46	0	22 Nov 46	0
USS Sioux (ATF-75)	66	25 Aug 46	0.301	28 Nov 46	0.370
USS Sphinx (ARL-24)	155	19 Aug 46	0.290	14 Feb 47	0.360
USS Suncock (AN-80).	43	30 Aug 46	0.664	12 Dec 46	0.730
USS Sylvania (AKA-44)	208	25 Aug 46	0.238	7 Dec 46	0.270
USS Telamon (ARB-8)	158	15 Aug 46	0.267	12 Dec 46	0.350
USS Tombigbee (AOG-11)	86	21 Aug 46	0.273	31 Dec 46	0.340
USS Turner (DD-834)[a]	313	25 Jul 46	0	22 Nov 46	0
USS Walke (DD-723)	242	8 Aug 46	0.210	23 Oct 46	0.330
USS Wenatchee (ATF-118)	99	18 Aug 46	0.301	13 Nov 46	0.380
USS Wharton (AP-7)	493	25 Aug 46	0.245	10 Feb 47	0.280
USS Widgeon (ASR-1)	86	5 Sep 46	0.637	13 Dec 46	0.690
USS Wildcat (AW-2)	128	19 Aug 46	0.172	9 Jan 47	0.230
YMS-354	28	14 Sep 46	0.457	20 Dec 46	0.500
YMS-358	31	14 Sep 46	0.468	20 Dec 46	0.520
YMS-413	32	14 Sep 46	0.444	20 Dec 46	0.500
YMS-463	17	14 Sep 46	0.441	20 Dec 46	0.500

Note:

[a]Did not enter Bikini after BAKER.

Table 32. Reconstructed (calculated) dose for target ship crews, CROSSROADS.

Ship	Crew Size	Support Ship Dose[a] (rem gamma)	Post-BAKER Target Ship Boarding Dose[b] (rem gamma)	Total Dose[c] (rem gamma)
USS Anderson (DD-411)	105	0.192	Sank at ABLE	f
USS Apogon (SS-308)	54	0.248	Sank at BAKER	f
ARDC-13	4	Unknown	Sank 4 Aug 46	
USS Arkansas (BB-33)	441	0.178	Sank at BAKER	f
USS Banner (APA-60)	104	0.262	0.297	0.580
USS Barrow (APA-61)	114	0.223	0.187	0.420
USS Bladen (APA-63)[e]	111	0.222	e	0.260
USS Bracken (APA-64)	108	0.263	0.177	0.440
USS Briscoe (APA-65)	112	0.202	0.389	0.650
USS Brule (APA-66)	111	0.234	0.635	0.890
USS Butte (APA-68)	126	0.231	0.422	0.670
USS Carlisle (APA-69)	104	0.005	Sank at ABLE	f
USS Carteret (APA-70)	119	0.219	0.932	1.160
USS Catron (APA-71)	116	0.260	0.850	1.110
USS Conyngham (DD-371)[e]	109	0.495	e	1.000
USS Cortland (APA-75)[e]	89	0.228	e	0.260
USS Crittenden (APA-77)	112	0.258	1.061	1.350
USS Dawson (APA-79)	110	0.270	d	d
USS Dentuda (SS-335)[e]	58	0.693	e	0.990
USS Fallon (APA-81)	127	0.232	d	d
USS Fillmore (APA-83)[e]	109	0.209	d	0.250

Notes:

[a]Includes time living aboard support ships at Bikini for ABLE and BAKER.

[b]Includes only those periods the ship was reboarded after BAKER when the ship was not remanned.

[c]Includes dose accrued during time living aboard target ship if it was remanned after ABLE and BAKER. Includes also Support Ship Dose as well as dose accrued during return to the United States aboard a support ship or remanned target ship. Calculation ends with the radiological clearance of the ship on which most of the crew was located.

[d]Post-BAKER boarding party analysis not completed at time of printing.

[e]Remanned target after BAKER.

[f]Crew splintered to several ships. Individual doses vary.

[g]Only 29 crewmembers reboarded after BAKER. Individual doses have been assigned.

(continued)

Table 32. Reconstructed (calculated) dose for target ship crews, CROSSROADS (continued).

Ship	Crew Size	Support Ship Dose[a] (rem gamma)	Post-BAKER Target Ship Boarding Dose[b] (rem gamma)	Total Dose[c] (rem gamma)
USS Gasconade (APA-85)	105	0.224	d	d
USS Geneva (APA-86)[e]	115	0.230	e	0.270
USS Gilliam (APA-57)	91	0.379	Sank at ABLE	f
USS Hughes (DD-410)	81	0.314	d	d
USS Independence (CVL-22)	343	0.200	0.195	0.420
USS Lamson (DD-367)	119	0.002	Sank at ABLE	
LCI-327	18	0.311	d	d
LCI-329[e]	16	0.208	e	0.260
LCI-332	17	0.311	d	d
LCI-620 (officers)	2	0.274	d	d
LCI-620 (crew)	14	0.249	d	d
LCI(L)-549[e]	22	0.205	e	0.250
LCI(L)-615[e]	16	0.644	e	0.760
LSM-60	44	f	Sank at BAKER	f
USS LST-52	63	0.240	d	d
USS LST-125	56	unknown	d	d
USS LST-133	78	0.207	d	d
USS LST-220	59	0.226	d	d
USS LST-545	47	0.224	d	d
USS LST-661	62	0.229	d	d
USS Mayrant (DD-402)	109	0.284	0.416	0.720
USS Mugford (DD-389)	126	0.255	1.639	1.920
USS Mustin (DD-413)	112	0.274	0.280	0.580

Notes:

[a] Includes time living aboard support ships at Bikini for ABLE and BAKER.

[b] Includes only those periods the ship was reboarded after BAKER when the ship was not remanned.

[c] Includes dose accrued during time living aboard target ship if it was remanned after ABLE and BAKER. Includes also Support Ship Dose as well as dose accrued during return to the United States aboard a support ship or remanned target ship. Calculation ends with the radiological clearance of the ship on which most of the crew was located.

[d] Post-BAKER boarding party analysis not completed at time of printing.

[e] Remanned target after BAKER.

[f] Crew splintered to several ships. Individual doses vary.

(continued)

Table 32. Reconstructed (calculated) dose for target ship crews, CROSSROADS (continued).

Ship	Crew Size	Support Ship Dose[a] (rem gamma)	Post-BAKER Target Ship Boarding Dose[b] (rem gamma)	Total Dose[c] (rem gamma)
Nagato	172	0.118	Sank 29/30 July 1946	f
USS Nevada (BB-36)	403	0.261	1.510	1.790
USS New York (BB-34)	536	0.331	0.908	1.270
USS Niagara (APA-87)[e]	271	0.197	e	0.230
USS Parche (SS-384)[e]	61	1.097	e	2.660
USS Pennsylvania (BB-38)	484	0.255	0.746	1.020
USS Pensacola (CA-24)	354	0.231	0.569	0.810
USS Pilotfish (SS-386)	52	0.209	Sunk at BAKER	f
Prinz Eugen	444	0.229	1.240	1.530
USS Ralph Talbot (DD-390)	132	0.267	d	d
USS Rhind (DD-404)	104	0.266	d	d
Sakawa	143	0.003	Sank at ABLE	f
USS Salt Lake City (CA-25)	335	0.330	1.004	1.350
USS Saratoga (CV-3)	589	0.072	Sank at BAKER	f
USS Searaven (SS-196)[e]	58	0.896	e	1.560
USS Skate (SS-305)	53	0.508	d	d
USS Skipjack (SS-184)	78	0.230	d	d
USS Stack (DD-406)	102	0.239	1.729	1.990
USS Trippe (DD-403)	135	0.224	0.118	0.380
USS Tuna (SS-203)[e]	57	1.489	e	2.360
USS Wainwright (DD-419)	148	0.218	0.533	0.760
USS Wilson (DD-408)	115	0.222	0.910	1.150
YO-160	10	unknown	Sank at BAKER	
YOG-83	10	unknown	d	d

Notes:

[a] Includes time living aboard support ships at Bikini for ABLE and BAKER.

[b] Includes only those periods the ship was reboarded after BAKER when the ship was not remanned.

[c] Includes dose accrued during time living aboard target ship if it was remanned after ABLE and BAKER. Includes also Support Ship Dose as well as dose accrued during return to the United States aboard a support ship or remanned target ship. Calculation ends with the radiological clearance of the ship on which most of the crew was located.

[d] Post-BAKER boarding party analysis not completed at time of printing.

[e] Remanned target after BAKER.

[f] Crew splintered to several ships. Individual doses vary.

been retired to the University of California, Los Angeles archives), he wrote (Reference A.6):

> On President Harry S. Truman's instructions to Admiral Blandy [I] was to safeguard what was eventually a 42,000-man operation from the "peculiar hazards" of the atomic bomb and was to devise a radiologic defense organization and pattern for both military and civilian operations. At the end of the JTF 1 operation, it could be said that no one had been injured by the "peculiar hazards" inherent in it.

REFERENCES

The references are organized in the following manner. Section A consists of references of general interest. Section B contains CROSSROADS planning documents. Section C is comprised of operational and postoperational documents.

In sections B and C, the number following the letter gives a general indication as the type of document. The headings for B and C are as follows:

B.0 JTF 1 documents (or no task group given)

B.2 Navy planning

B.5 Army-Army Air Force planning

B.11 Letters, memoranda

B.12 Newspapers and magazine articles

C.0 JTF 1 documents

C.1 Los Alamos Laboratory reports

C.2 Target ships

C.4 General Navy

C.6 Nontarget ships

C.7 Navy aircraft

C.8 Bikini resurvey

C.9 Reports in the CROSSROADS or XRD series

C.10 Navy messages

C.11 Memoranda, letters

C.12 Lectures, interviews, newspapers, magazines

C.13 Current interpretations of CROSSROADS.

Source documents bearing an NTIS availability code may be purchased at the following address:

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2753 S. Highland
P.O. Box 14100
Las Vegas, Nevada 89114
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C.2.17 Decontamination of USS Carteret (APA-70)††
Commanding Officer to Director of Ship Material
22 August 1946

C.2.18 Commanding Officers Report No. 11, USS Catron (APA-71)††
Commanding Officer to Director of Ship Material
11 July 1946

C.2.19 Report of Decontamination Procedures, USS Conyngham (DD-371)††
Commanding Officer to CTG 1.2
19 August 1946

C.2.20 Commanding Officers Report No. 11, USS Cortland (APA-74)††
Commanding Officer to Director of Ship Material
30 July 1946

C.2.21 Geiger Readings USS Crittenden (APA-77)††
Commanding Officer to CTG 1.2
23 August 1946

C.2.22 Damage Report (No. 5) and Commanders Report (No. 11), USS Dawson (APA-79)††
Commanding Officer to Director of Ship Material
3 July 1946

C.2.23 Report Five, Test Baker, USS Dawson††
Commanding Officer to Director of Ship Material
14 August 1946

C.2.24 Boarding Reports 27 July -- 17 August, USS Dentuda (SS-335)††

C.2.25 Report of Decontamination, USS Dentuda (SS-335)††
Commanding Officer to Director of Ship Material
21 August 1946

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††Undergoing Declassification Review; will be available from DOE CIC.

C.2.26 Preliminary Inspection, USS Gasconade (APA-85)††
Commanding Officer to Director of Ship Material
7 August 1946

C.2.27 Major Damage Report, USS Gasconade (APA-85)††
Commanding Officer to Director of Ship Material
20 August 1946

C.2.28 Decontamination Measures Carried Out on USS Gasconade (APA-85)††
Commanding Officer to Director of Ship Material
21 August 1946

C.2.29 Commanding Officer's Report -- CROSSROADS, Report No. 11††
Commanding Officer LCI(L)-549 to Director of Ship Material
7 July 1946

C.2.30 CROSSROADS Report No. 5††
Commanding Officer LCI(L)-549 to Director of Ship Material
11 August 1946

C.2.31 Report Number 11, LCI(L)-615††
Commanding Officer to Director of Ship Material
9 August 1946

C.2.32 Major Damage Resulting from Test ABLE, CROSSROADS Report Number 5††
Commanding Officer LCI(L)-615 to Director of Ship Material
3 July 1946

C.2.33 Commanding Officer's Report (Report Number 11)††
Commanding Officer USS LST-220 to Director of Ship Material
8 July 1946

C.2.34 Major Damage Report (Report 5)††
Commanding Officer USS LST-220 to Director of Ship Material
14 August 1946

C.2.35 Report Number 11, Commanding Officer's Report on Test ABLE††
Commanding Officer USS LST-545 to Director of Ship Material
4 July 1946

C.2.36 Major Damage Report (Report Number 5, Test BAKER)††
Commanding Officer Mugford to Director of Ship Material
13 August 1946

C.2.37 Major Damage Report (Report Number 5)††
Commanding Officer Nevada to Director of Ship Material
13 August 1946

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††Undergoing Declassification Review; will be available from DOE CIC.

C.2.38 Report of Decontamination Progress, USS New York (BB-36)††
Commanding Officer to Director of Ship Material
15 August 1946

C.2.39 Report on Decontamination††
Commanding Officer USS Niagara to Director of Ship Material
20 August 1946

C.2.40 Decontamination Work Done by Ship's Forces††
Commanding Officer USS Parche to Director of Ship Material
21 August 1946

C.2.41 Commanding Officer's Report (Report Number 11), Forwarding of††
Commanding Officer USS Pennsylvania to Director of Ship Material
12 July 1946 (ABLE)
n.d. (BAKER)

C.2.42 Major Damage, Test ABLE -- CROSSROADS Report Number 5††
Commanding Officer USS Pilotfish to Director of Ship Material
4 July 1946

C.2.43 Major Damage Report -- Report Number 5††
Commanding Officer Prinz Eugen to Director of Ship Material
5 July 1946

C.2.44 Sakawa -- Condition of and Sinking††
W.S. Maxwell to Director of Ship Material
2 July 1946

C.2.45 Report of Radiological Decontamination of the USS Salt Lake City (CA-25)††
Commanding Officer to Director of Ship Material
19 August 1946

C.2.46 Report of Decontamination Work, Submission of††
Commanding Officer Searaven to Director of Ship Material
23 July 1946

C.2.47 Report of Decontamination Work††
Commanding Officer Searaven to Director of Ship Material
20 August 1946

C.2.48 Decontamination Work, Report of††
Commanding Officer Skate to Director of Ship Material
20 August 1946

C.2.49 Boarding Reports, 28 July -- 21 August, Skipjack (SS-184)††

C.2.50 Procedure for All Target Vessels††
Commanding Officer Stack to Director of Ship Material

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††Undergoing Declassification Review; will be available from DOE CIC.

C.2.51 Tuna Boarding Reports, 27 July -- 15 August††

C.2.52 Decontamination Work Accomplished Aboard USS Tuna, Report of††
Commanding Officer to CTG 1.2
19 August 1946

C.2.53 Report of Decontamination Work††
Commanding Officer Wilson to CTG 1.2
18 August 1946

C.2.54 Radiological Decontamination Procedures, Prinz Eugen, August 4 to August 11, 1946††
Commanding Officer to CTG 1.2
13 August 1946

C.4.1 Rosters of Officers††
CJTF 1
1 July 1946

C.6.1 Comments on Results of the Investigations on the USS Rockbridge††
H. Scoville
Technical Analysis Section
21 November 1946

C.6.2 From Rockingham, CTG 1.2, to Director of Ship Material††
U.S. Naval Communications Systems Dispatch
3 August 1946

C.7.1 VX-2 Log††
Volume 1679 aboard Shangri-La

C.7.2 VPB-32 Squadron at CROSSROADS††
Ltr from William B. Lower to Capt A.G. Nelson, USN
Serial 981 T3J/1243
29 June 1979 (Privacy Act Restrictions)

C.7.3 Personal Flight Log of Durell Hyers††
VPB-32 Log (Privacy Act Restrictions)

C.7.4 VH-4 PBM Daily Flight Log††
Vol. 736

C.7.5 Smooth Log -- Submission of††
Commanding Officer U.S. Pacific Fleet, Air Forces Pacific Fleet to Chief of Naval Personnel
20 September 1946

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††Undergoing Declassification Review; will be available from DOE CIC.

C.7.6 Danger from Alpha Contamination on Drone Aircraft in Test BAKER
Memo from H. Scoville to S.L. Warren†
9 September 1946

C.8.1 Bikini Scientific Resurvey, Volume I, Operations
AFSWP
December 1947 NTIS AD A077 489*

C.8.2 Bikini Scientific Resurvey, Volume II, Report of the Technical Director
AFSWP
December 1947 NTIS AD A077 490*

C.8.3 Bikini Scientific Resurvey, Annex IV, Report of the Technical Director (Supplement to Volume II)
AFSWP
December 1947 NTIS AD A077 491*

C.8.4 Investigation of Gamma Radiation Hazards Incident to an Underwater Atomic Explosion††
Walmer E. Strope
BuShips
March 1948

C.9.2 Bureau of Ships Group Final Report, Test A and B, Volume I**
December 1946 XRD-2

C.9.3 Final Report of Test ABLE and Test BAKER, Volume II**
December 1946 XRD-3

C.9.149 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 1 -- General Report**
XRD-149

C.9.150 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 2 -- Report of CTU 1.4.1 (Engineer)**
XRD-150

C.9.151 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 3 -- Report of CTU 1.4.2 (Signal)**
XRD-151

C.9.153 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 5 -- Report of CTU 1.4.4 (Chemical)**
XRD-153

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*Available from NTIS; order number appears before the asterisk.

**Undergoing Declassification Review, will be available from NTIS.

†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

C.9.154 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 6, Part I -- Report of CTU 1.4.5 (Quartermaster)**
XRD-154

C.9.155 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 6, Part II -- Report of CTU 1.4.5 (Fuels and Lubricants)**
XRD-155

C.9.156 Final Report of Atomic Bomb Tests, January 17, 1946 to September 27, 1946, Volume 7 -- Report of CTU 1.4.6 (Air)**
XRD-156

C.9.157 Final Report for Tests ABLE and BAKER, Bureau of Aeronautics Group**
18 October 1946 XRD-157

C.9.185 Radiological Decontamination of Target and Nontarget Vessels, Volume 1
NTIS AD 473 906* XRD-185

C.9.186 Radiological Decontamination of Target and Nontarget Vessels, Volume 2
NTIS AD 473 907* XRD-186

C.9.187 Radiological Decontamination of Target and Nontarget Vessels, Volume 3
NTIS AD 473 908* XRD-187

C.9.189 Historical Report -- Atomic Bomb Tests ABLE and BAKER (Operation CROSSROADS), Volume I**
January 1946 XRD-189

C.9.190 Historical Report -- Atomic Bomb Tests ABLE and BAKER (Operation CROSSROADS), Volume II**
January 1947 XRD-190

C.9.191 Historical Report -- Atomic Bomb Tests ABLE and BAKER (Operation CROSSROADS), Volume III**
January 1947 XRD-191

C.9.206 Report on Atomic Bomb Tests ABLE and BAKER, Operational Report, Volume I
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C.9.207 Report on Atomic Bomb Tests ABLE and BAKER, Operational Report, Volume II**
January 1947 XRD-207

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C.9.208 Technical Report of Operation CROSSROADS
W.H. Shurcliff et al.
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C.9.209 Report on Instrumentation of Technical Staff**
December 1946 XRD-209

C.9.210 Report on Instrumentation of Technical Staff**
December 1946 XRD-210

C.10.1 Naval message 030445Z††
A.M. Sumner
4 August 1946

C.10.2 Naval message 120706Z††
CTG 1.2
12 August 1946

C.10.3 Naval message 032309Z††
CJTF 1
3 August 1946

C.10.4 Naval message 302200Z††
CNO
31 August 1946

C.10.5 Naval message 240111Z††
ComServPac
25 August 1946

C.10.6 Naval message 311521Z††
CJTF 1
31 July 1946

C.10.7 Naval message 020252Z††
CJTF 1
2 August 1946

C.10.8 Naval message 091244Z†
CTG 1.2
9 August 1946

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*Available from NTIS; order number appears before the asterisk.

**Available at DOE CIC.

†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

C.10.9 Naval message 142238Z†
CTG 1.2
16 August 1946

C.10.10 Naval message 050544Z††
CJTF 1
5 August 1946

C.10.11 Naval message 080303Z††
CJTF 1
11 August 1946

C.10.12 Naval message 102345Z††
CJTF 1
11 August 1946

C.10.13 Naval message 202354Z††
Safety Advisor
21 August 1946

C.10.14 Naval message 100648Z††
CJTF 1
11 August 1946

C.10.15 Naval message 150802Z†
Radsafe Section
15 August 1946

C.10.16 Naval message 100305Z†
Los Alamos Laboratory
Kwajalein
10 August 1946

C.10.17 Naval message 292336Z†
Burleson (APA-67)
30 July 1946

C.10.18 Naval message 180134Z††
CTG 1.2 to BuPers (ammunition dispersal CROSSROADS)
18 October 1946

C.11.1 Ltr: S.L. Warren to W.G. Myers†
31 December 1946

C.11.2 Messageform Sept 46 041649Z†
Washington Headquarters
4 September 1946

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†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

C.11.3 Notebook, Bikini, August 1946 (entry for 10 August)†
S.L. Warren

C.11.4 "Command Problems of Atomic Defense Warfare" (speech)††
F.T. Winant, Jr.
September 1947

C.11.5 Ltr: Task of Ammunition Inspection and Disposal on CROSSROADS Target Vessels, Report on††
LCDR S.W. McGovern to CTU 1.2.12
JTF 1
23 October 1946

C.11.6 Message: Serial T-346††
CTG 1.2 to JTF 1
29 August 1946

C.11.7 Ltr: Radiological Safety††
OIC Ammunition Disposal Unit to Chief BuMed
11 November 1946

C.11.8 Memorandum: Comments on Letter of Officer in Charge of Ammunition Disposal Unit of 11 November 1946††
Capt. G.M. Lyon, Safety Advisor
29 November 1946

C.11.9 Ltr: Safety Regulations for Work on Target Vessels Formerly JTF 1††
Chief BuMed
31 January 1947

C.11.10 Ltr: Serial 0169P36††
CNO to Chief NavPers
15 July 1947

C.11.11 Memorandum: Conference on Radiological Safety 22 November 1946, report on††
BuShips
10 December 1946

C.11.12 Message: September 462417482†
Kelley, USEO
24 September 1946

C.11.13 Memorandum††
CB 1156 to CJTF 1
1 October 1946

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††Undergoing Declassification Review; will be available from DOE CIC.

C.11.14 Memorandum: Security Guards on Amen, Bikini, Eneu Islands††
23 July 1946

C.11.15 Ltr: Ser 9E1 TD/2200†
W.H. Loeffler to S. Jones
Department of the Navy

C.11.16 Memorandum: Monitor Problems††
OIC Target Ship Monitors to Chief Radsafe Section
9 August 1946

C.11.17 Ltr: Ser X-000083††
University of California, Berkeley, to Capt. W.B. Walsh, USN
20 September 1946

C.11.18 Ltr: Ser 000096††
University of California, Berkeley, to Adm. T.A. Solberg
25 October 1946

C.11.19 Memorandum: Summary Report of Conditions of Target Ships as of 2000, 4 August 1946, Based on DSM Plot in Radiological Safety Control††
Radiological Safety Section
4 August 1946

C.11.20 Memorandum: Ammunition Disposal Unit Muster List††
Commanding Officer Geneva
22 September 1946

C.11.21 Memorandum: Ammunition Disposal Muster List††
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C.11.22 Ltr (Ser 040S): Radiological Safety Section, Weekly Chronological Report of Activities of Week Beginning 24 March 1947††
CINCPAC to Chief BuMed
March 1947

C.11.23 ALNAV #122: Blood Count for All Navy CROSSROADS Personnel††
19 May 1947

C.11.24 Message: ATCOMKWAJ to BuMed (160515Z)††
17 May 1947

C.11.25 Ltr: A9-4(49921) (390)/Kh††
Commander San Francisco Shipyard
22 January 1948

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†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

C.11.26 Ltr: A(-4/S99-(5) RAC:jll, Code 950††
Commander San Francisco Shipyard
1 December 1948

C.11.27 JTF-1 Letter to commanding officers of ships††
CJTF 1
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C.11.28 Letter from Wright Langham to Dr. Herbert Scoville†
5 Nov 1946

C.11.29 Telegram to CWSF from Radiological Safety Advisor AH 12 - Haven†
13 August 1946

C.11.30 Memorandum: Staff Commander JTF-1, Radiological Advisor to CTG 1.2†
13 August 1946

C.11.31 Memorandum: "Dust Samples Taken in Crew Spaces on Prinz Eugen 9 August 1946," Pill Country Lab to Col. Warren†
n.d.

C.12.1 National Geographic, "Operation CROSSROADS"
April 1947

C.12.2 Life, "After Year Ships are Radioactive"
11 August 1947

C.12.3 All Hands†
Bureau of Naval Personnel
1 July 1946

C.12.4 Lecture†
Stafford L. Warren
7 October 1947

C.12.5 Personal interview with Col. Gallentine††
11 November 1982 (Privacy Act Restrictions)

C.12.6 Washington Post, "New Blood Tests Ordered for Men Who Were at Bikini"
28 May 1947

C.13.1 History of USS Geneva (APA-86) during Operation CROSSROADS (1946)†
August 1981

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†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

C.13.2 Ltr: Beta Radiation Film Dosimetry†
J. Brady to W.H. Loeffler
Reynolds Electrical and Engineering Co., Inc.
18 March 1983

C.13.3 Ltr: Office of the Chief of Naval Operations to the Honorable Diane Feinstein, Mayor of San Francisco (includes attachment 1 and internal NTPR CROSSROADS working papers)†

C.13.4 CROSSROADS Personnel Dosimetry Records (printed list and microfilm source records)†
Reynolds Electrical and Engineering Corp.
1946-1947 (Privacy Act Restrictions)

C.13.5 Listing of Army Air Force Units Participating in CROSSROADS†
October 1982

C.13.6 Dosimetry Matrix Report, 1946 Pacific Records†
Reynolds Electrical and Engineering Co., Inc.
7 September 1982

C.13.7 Not Used

C.13.8 Marine Corps Nuclear Test Personnel Review File C†
[1983] (Privacy Act Restrictions)

C.13.9 CROSSROADS Radiological Clearance of Various Ships††
1 August 1982

C.13.10 NNTPR Ship Histories†
Various dates

C.13.11 Memorandum: Listing of the CROSSROADS Target Ships and Their Fate†
CNO
25 May 1978

C.13.12 "Plutonium Contamination on the USS SKATE, Operation CROSSROADS"††
Memorandum: J. Goetz (Science Applications Inc.) to D. Auton (DNA)
24 March 1984

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†Available from DOE CIC.

††Undergoing Declassification Review; will be available from DOE CIC.

APPENDIX A

ACTIVITIES OF PARTICIPATING NAVY VESSELS DURING OPERATION CROSSROADS

APPENDIX A
ACTIVITIES OF PARTICIPATING NAVY VESSELS DURING OPERATION CROSSROADS

This appendix lists the 153 support ships, 84 target ships, and other Navy craft that participated in Operation CROSSROADS. Their crew complements, the dates of their arrival at and departure from Bikini, their distances from the two shots, and their postshot dispositions are given. Crew sizes and Bikini departure dates may vary somewhat from data in Tables 31 and 32 (Chapter 12), which are based on somewhat more expanded research. Activities that are considered important to the conduct of the operation or that had radiological significance are included. Excluded was information on those days that the log entries reflected only routine operations. For example, all ships left Bikini Lagoon on July 18 and 19 for the test BAKER rehearsal, but reference to the rehearsal has been omitted in the ships' activity schedule in this appendix. The ships are listed alphabetically.

The information in this appendix has been extracted primarily from each ship's log (Reference 1)* but has been been supplemented by material from logs of other ships and other documents. Information given without citation to a reference may be assumed to be from the ship's own log. Among the other documents useful in compiling this Appendix were two specified in the CROSSROADS OpPlan for each target vessel. These were the Major Damage Report (often referred to as "Report No. 5") (Reference 2) and the Commanding Officers Report (often referred to as "Report No. 11") (Reference 3). In addition, the commanding officer of each target vessel wrote a report summarizing decontamination activities (Reference 4).

Throughout the description of the ships' movements, reference is made to the numbered berths and named lagoon-patrol sectors within Bikini Lagoon and named operating areas outside the lagoon. The berths were numbered from 1 in the northwestern portion of the anchorage area to 386 in the southeastern area. The berths were arranged in long, somewhat irregular west-to-east rows. There were in addition berths near Eneu Island designated by letters or their phonetic equivalent, e.g., Able for A, Jig for J, Oboe for O, etc. Figure A.1 shows the berths and their relationship to the islands of the atoll and the target fleet area.

The lagoon-patrol sectors within the lagoon important during reentry were designated with names of various countries. The sectors were centered on the surface zero point and are shown on Figure A.2.

The operating areas outside Bikini Lagoon used by the ships during the tests were designated with the names of historic automobile manufacturers. These are also shown in Figure A.2.

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*References are listed at the end of this Appendix (p. 448).

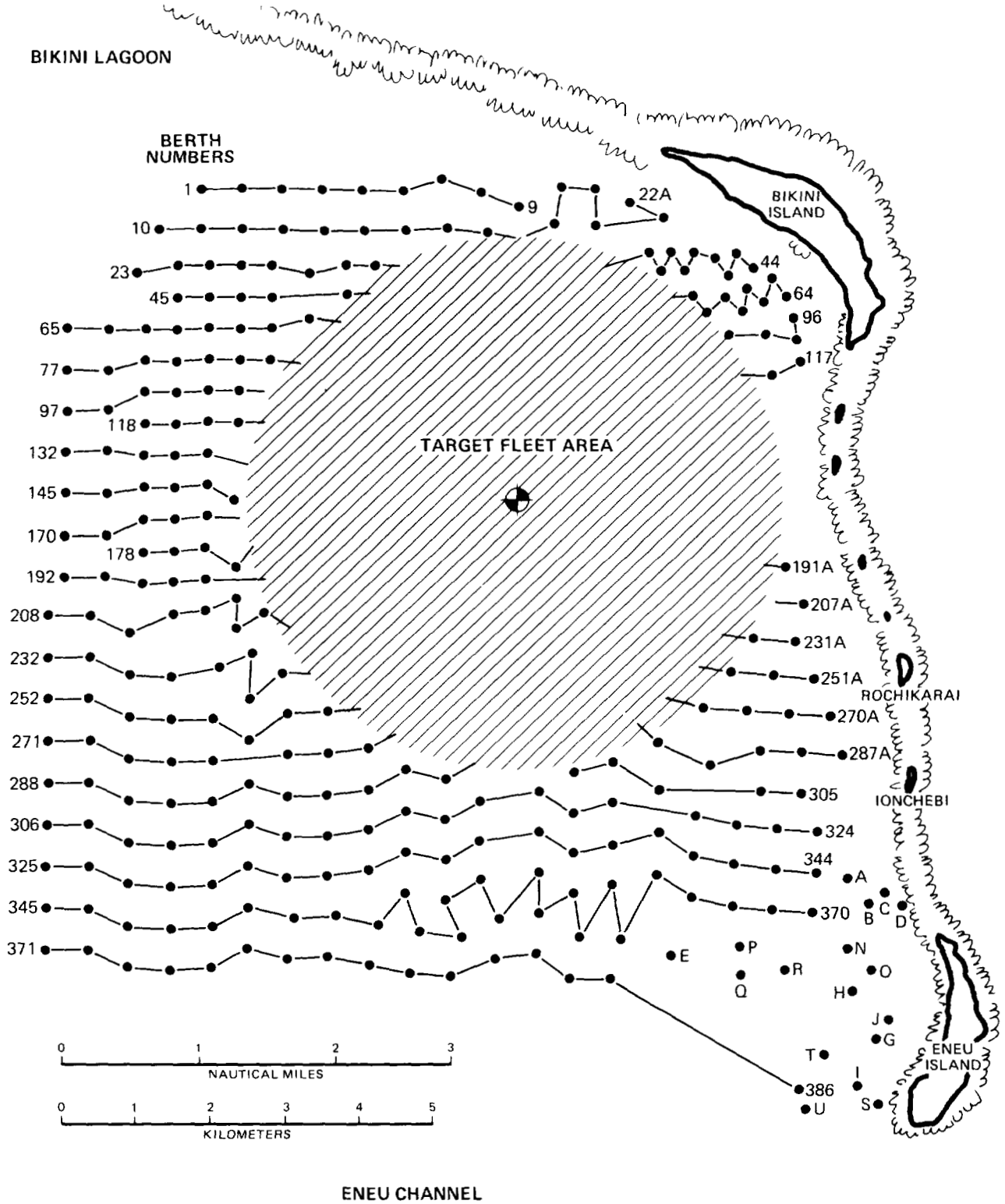


Figure A.1. Bikini anchorages and target ship area, CROSSROADS.

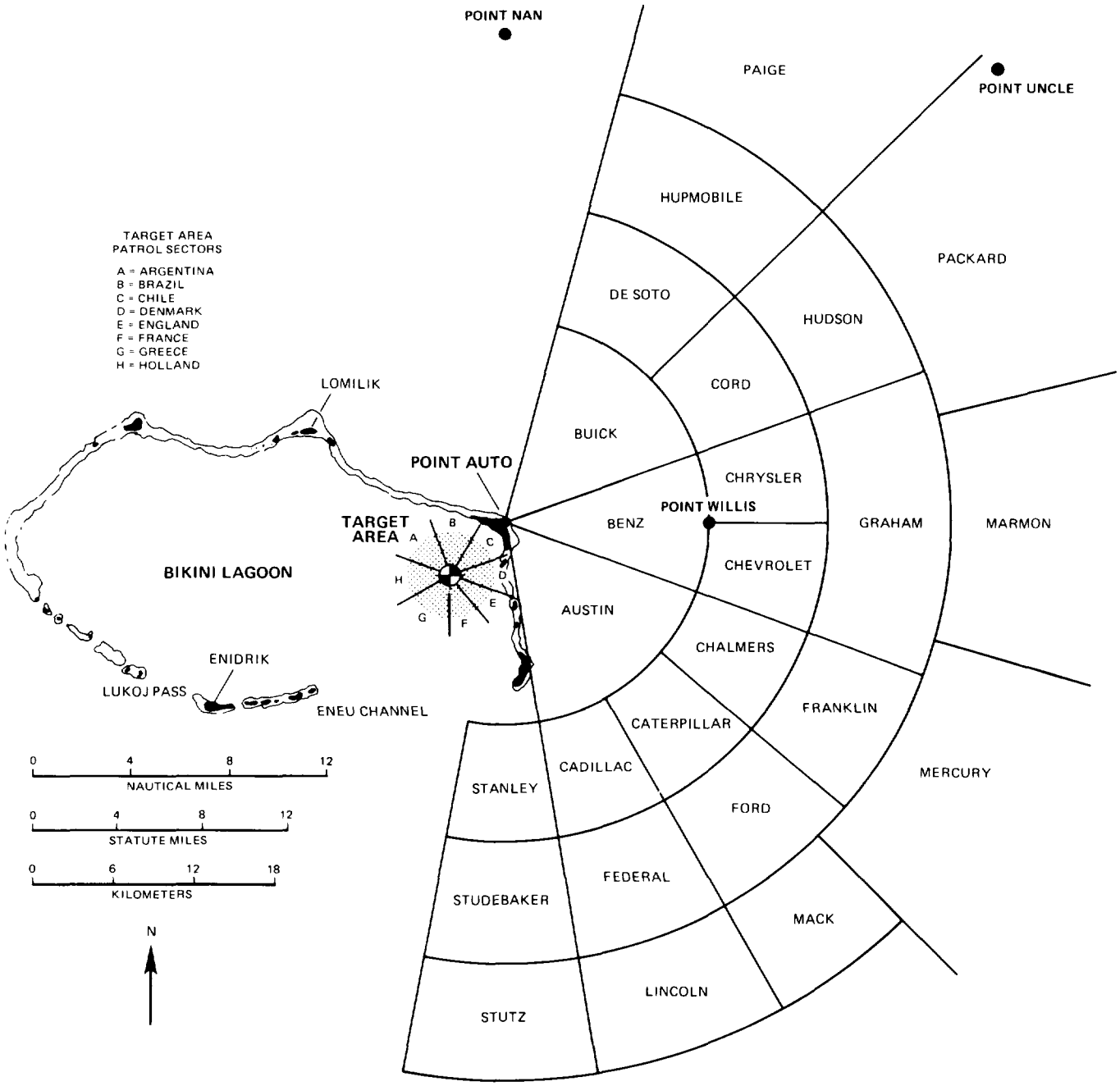


Figure A.2. Target area patrol sectors and ship operating areas for CROSS-ROADS. Target area patrol sectors shown are for ABLE. For BAKER, the Holland sector was eliminated and the England, France, and Greece sectors expanded to fill the area. The ship operating areas shown are in their nominal positions. Before each shot, the shot-time wind was predicted and the areas were rotated around Point Auto accordingly. For ABLE the areas were rotated counterclockwise 50°; for BAKER, clockwise 30°.

USS Achomawi (ATF-148)

USS ACHOMAWI (ATF-148)

Crew Size: 80
Bikini Atoll Arrival: 26 May 1946
Bikini Atoll Departure: 29 August 1946
Shot ABLE Location: 27 nmi (50 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Francisco
Operational Clearance: 6 December 1946
Final Clearance: 13 December 1946

Task Unit and Function

Achomawi, a fleet ocean tug, served as a support ship in TU 1.2.7 (Salvage Unit) under TG 1.2 (Target Vessel Group). Its function was to tow or salvage damaged target vessels after the shots and to fight fires and make ship repairs.

Shot ABLE (1 July, 0900)

30 June
- 1250 Underway for station outside lagoon.

1 July
- 1253 Entered Bikini Lagoon.
- 1340 Approached USS Palmyra (ARS[T]-3) to disembark the boarding party.
- 1425 Steered east of array to clear the target vessel array.
- 1802 Anchored in berth George.

2 July
- 0830 Arrived at USS Haven (AH-12) to bring aboard a salvage officer.
- 0840 Underway for target ship Sakawa.
- 0903 Arrived at Sakawa, which was found to be radiologically unsafe.
- 0905 Stood clear of Sakawa.
- 1025 Sakawa in tow but slowly sinking.
- 1040 Sakawa completely submerged.
- 1143 Tow wire to Sakawa cut.
- 1232 Anchored in berth George.

3 July
- 0936 Underway for target vessel ARDC-13.
- 1007 Arrived at ARDC-13.
- 1117 Towed ARDC-13 to vicinity of Eneu Island.
- 1345 Cast off tow wire from ARDC-13.
- 1445 Anchored in berth George.

6 July
- 0800-0925 Towed target ship USS Salt Lake City (CA-25) and anchored it in berth 164.
- 0950 Underway for target ship USS Pensacola (CA-24).
- 1233 Took Pensacola in tow to berth 286.
- 1347 Anchored Pensacola.
- 1515-1530 Towed Salt Lake City to a new anchorage.
- 1619-1630 Towed Salt Lake City to a new anchorage.
- 1708 Anchored in berth 76.

7 July
- 0830 Underway for target ship USS Crittenden (APA-77).
- 0918 Arrived at Crittenden.
- 1020 Assisted by ATR-87, took Crittenden in tow.
- 1129 Crittenden anchored.
- 1152 Anchored in berth 76.

8 July
- 1547 Underway for ARDC-13.
- 1731 Anchored ARDC-13 securely.
- 1820 Anchored in berth 76.

10 July
- Towed target vessel YO-160 to anchorage beside target ship USS Arkansas (BB-33).
- 1958 Anchored in berth 76.

11 July
- 0909-1105 In vicinity of Pensacola, while Pensacola shifted berths.
- 1120-1708 In vicinity of target ship USS Nevada (BB-36), while Nevada shifted berths.
- 1722 Anchored in berth 76.

12 July
- 0703-1132 In vicinity of target ship USS Saratoga (CV-3), assisting in towing and shifting berths.
- 1157 Anchored in berth 76.

15 July
- 0946-1013 Towed target vessel YOG-83 to new anchorage.
- 1110 Anchored in berth 76.

16 July
- 0800 Towed Saratoga to new berth.
- 0927 Anchored in berth 76.

17 July
- Moored beside YW-92, a radiologically suspect vessel, for 8-1/2 hours and towed it for 5 hours.

23 July
- 0600-0900 Cleared lines fouled while maneuvering target ship USS Briscoe (APA-65).
- 0948 Anchored in berth 76.

Shot BAKER (25 July, 0835)

24 July
- 1259 Underway for a station outside the harbor.

25 July
- 1006 Reentered the lagoon.
- 1119 Anchored in berth G.
- 1300 Underway for target ship USS Bladen (APA-63).
- 1320 Arrived in vicinity of Bladen, standing by awaiting orders.
- 1327 Proceeded to berth G.
- 1356 Anchored in berth G without conducting salvage activity.

26 July
- Stood clear of anchorage for about 2 hours to allow USS Reclaimer (ARS-42) and its tow through.

28 July
- Shifted to new anchorage, 1,375 yards (1.3 km) south of berth 377.

29 July
- 0749 Underway for target submarine USS Skate (SS-305).
- 0831-1307 Towed Skate to Ionchebi Island for mooring.
- 1544-1752 Conducted diving operations on Skate.
- 1819 Anchored Skate.
- 1850 Anchored in berth 377.

30 July
- 0745 Underway for target submarines Skate and USS Tuna (SS-203).
- 0836 Began washdown of Skate using monitors (fixed, high-pressure water nozzles) and firehoses.

USS Achomawi (ATF-148)

1027	Washed down Skate's bow with diesel fuel oil.
1125	Began washdown of Skate's portside.
1315-1327	Underway for Tuna.
1335	Began washing down Tuna.
1517	Washed down Tuna's portside.
1540	Washed down Tuna using lye solution under pressure.
1625	Completed washdown operations.
1705	Anchored in berth G.
31 July	
0745	Underway for further washdown operations.
0815-1130	Washed down Skate with saltwater using two monitors and two additional streams, and sprayed with lye and boiler compound solution.
1305-1603	Washed down Tuna with two monitors and two additional streams.
1654	Anchored in berth G.
1 August	
0753-0821	Underway for Skate.
0833	Began washdown of Skate.
1053	Used four streams of seawater on Skate.
1214	Skate washdown completed.
1225	Underway to target ship USS Stack (DD-406).
1316-1400	Washed down Stack with midship monitor.
1402-1420	Hose crew boarded Stack and washed it down with lye solution.
1537-1541	Lye solution sprayed on Stack.
1621-1643	Monitored Stack amidship and washed down its portside.
1652	Underway to berth 145 near USS Wharton (AP-7).
1705	Anchored in berth 145.
2 August	
0936	Underway for Stack.
1006-1009	Sprayed Stack with lye solution.
1017-1021	Two men boarded Stack.
1038-1043	Resprayed Stack with lye solution.
1223-1232	Stack boarded by the captain, a civilian, and members of the boarding team.
1314-1330	Sprayed Stack with lye and boiler compound solution.
1350-1352	Sprayed Stack with lye and boiler compound solution.
1420-1438	Washed down Stack's portside with saltwater.
1441-1504	A party took readings on Stack.
1515	Underway to berth 377.
1634	Anchored in berth 377.
3 August	
0731	Underway for Stack.
0840-0932	Washed down Stack with saltwater.
0957-1055	Concentrated on Stack's portside.
1207	Anchored in a berth 1,375 yards (1.3 km) south of berth 337.
5 August	
0850-1050	Underway for target ship USS New York (BB-34) with boarding team members.
1100	A civilian boarded New York.
1103-1122	Sprayed New York with lye solution.
1159-1201	Sprayed New York with lye solution.
1213-1221	Sprayed New York with lye solution.
1310-1356	Washed down New York with saltwater.
1358	A civilian boarded New York.
1405	Boarding team boarded New York.
1500	Boarding team and civilian returned to Achomawi.
1515-1530	Sprayed New York with lye solution.
1705	Anchored near berth 373.
6 August	
0755	Underway to New York.
0900-0905	Sprayed New York with lye solution.
0921	Resumed spraying New York.
0936	Boarding team No. 1 boarded New York with a hose to continue spraying with lye solution.
1020	Discontinued spraying New York; boarding team returned to Achomawi.
1051	Boarding team No. 2 boarded New York to spray with lye solution.
1135	Discontinued spraying New York; the boarding team returned to Achomawi.
1137	Departed area to conduct an inspection tour.
1535-1545	Sprayed target ship USS Pennsylvania (BB-38) with lye solution.
1607-1625	Sprayed Pennsylvania with lye solution.
1650	Departed the area.
1716	Anchored in berth 363.
7 August	
0951-1014	Underway for Pennsylvania with boarding teams and monitors.
1120-1155	Sprayed paint remover solution on Pennsylvania's superstructure.
1319-1355	Sprayed paint remover solution on Pennsylvania's portside.
1548	Anchored in berth 76.
8 August	
0748	Underway for target ship USS Trippe (DD-403).
1010-1038	Sprayed decontamination solution on Trippe.
1304-1543	Washed down Trippe with saltwater streams.
1640	Anchored in berth 76.
9-15 August	Anchored in berth 76.
16 August	
0839	Underway to Pennsylvania.
1645	Returned to berth 76.
1725	Anchored.
17 August	
0845	Went alongside Pennsylvania to pick up a boarding and working party of 7 officers and 37 men.
1118	Underway for anchorage.
1125	Arrived at anchorage.
1457	Underway to swing Pennsylvania around.
1526	Turned Pennsylvania around.
1630	Cast off line from Pennyslvania.
1701	Anchored in berth 76.
19 August	
1037	Took target ship USS Dawson (APA-79) in tow for Kwajalein Atoll.
21 August	
1050	Anchored Dawson in Kwajalein Lagoon.
1356	Underway for Bikini Atoll.
22 August	
1115	Anchored at Bikini Atoll.
1422	Departed for Kwajalein Atoll with New York in tow.

24 August
1008 Anchored New York at Kwajalein Atoll.
1425 Underway for Bikini Atoll.

25 August
0727 Arrived at Bikini Atoll.

26 August
1005 Underway with target ship USS Barrow (APA-61) in tow.

27 August
1307 Arrived at Kwajalein Atoll.
1703 Underway for Bikini Atoll.

28 August
0919 Arrived at Bikini Atoll.

29 August Left for Kwajalein Atoll with target ship USS LST-133 in tow.

30 August
1535 Anchored LST-133.

1 September
1616 Departed for Pearl Harbor.

USS AJAX (AR-6)

Crew Size: 753
Bikini Atoll Arrival: 1 May 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: 16 nmi (30 km) NNE
Shot BAKER Location: 15.5 nmi (29 km) ENE
Decontamination Location: San Diego
Operational Clearance: By 1 January 1947

Task Unit and Function
Ajax, a repair ship, was part of TU 1.8.1 (Repair and Service Unit). Its functions were salvaging, towing, and emergency repair work. It also was equipped with heating apparatus for rapid determination of the safe-life storage period of any questionable smokeless gunpowders.

Shot ABLE (1 July, 0900)

30 June
1417 Underway for station outside lagoon.

1 July
1912 Anchored in berth 270.

2 July Shifted to berth 207.

Personnel transfers occurred for several days after shot ABLE.

Shot BAKER (25 July, 0835)

24 July
1602 Underway for station northeast of Bikini Atoll.

25 July
1631 Anchored in Rongelap Lagoon in berth 31.

30 July
1811 Underway for Bikini Atoll.

31 July
0707 Anchored at Bikini Atoll in berth 207.

2 August Shifted to berth 385.

7 August Shifted to berth 207.

12 August Personnel from target ship USS Independence (CVL-22) came aboard Ajax for messing and berthing.

14 August Shifted to anchorage located between berths 93 and 114.

18 August Some Independence personnel transferred to USS Artemis (AKA-21) for transport to Pearl Harbor.

23 August
1150 Departed for Kwajalein Atoll.

24 August
1136 Arrived Kwajalein Atoll.

28 August
1543 Departed Kwajalein Atoll after embarking personnel for transport to Pearl Harbor.

6 September
1035 Arrived at Pearl Harbor.

USS ALBEMARLE (AV-5)

Crew Size: 569
Bikini Atoll Arrival: 4 May 1946
Bikini Atoll Departure: 25 July 1946
Shot ABLE Location: Anchored at Kwajalein Atoll
Shot BAKER Location: >8 nmi (15 km) ESE (Area Chalmers)
Decontamination Location: Los Angeles
Final Clearance: By 22 November 1946

Task Unit and Function
The seaplane tender Albemarle served in TU 1.1.1 (Laboratory Unit). It contained laboratory facilities for the technical group. It also transported the weapons and provided assembly facilities.

Shot ABLE (1 July, 0900)

1 July Anchored at Kwajalein Atoll.

4 July
1012 Anchored at Bikini Atoll in berth 40.

Shot BAKER (25 July, 0835)

25 July
0513 Underway to its operating area east of the lagoon.
1447 Anchored in berth 368, Bikini Atoll.
1835 Underway for Kwajalein Atoll.

26 July
0929 Anchored at Kwajalein Atoll.

30 July
1017 Underway for San Pedro, California, via Pearl Harbor.

USS Allen M. Sumner (DD-692)

USS ALLEN M. SUMNER (DD-692)

Crew Size: 278
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 19 nmi (35 km) E
Shot BAKER Location: 19 nmi (35 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 19 November 1946
Final Clearance: 10 January 1947

Task Unit and Function

The destroyer Sumner served as a support ship in Destroyer Division 72 in TG 1.7 (Surface Patrol). Its function was to patrol the area around the atoll and also aid in the oceanographic and radiological task unit.

Shot ABLE (1 July, 0900)

1 July
- 1348 En route to conduct radiological and oceanographic operation (Palmolive Operation).
- 1639 Anchored in Bikini Atoll between berths 93 and 114.

2 July
- 0940 Underway to relieve USS Fall River (CA-131) as Harbor Entrance Control Vessel (HECV).
- 1044 Anchored in berth 386, Bikini.

3 July
- 1819 Underway in search of an LCM with personnel aboard, adrift off Enidrik Island.
- 1839 Intercepted message from USS Avery Island (AG-76) to CJTF 1 to the effect that USS O'Brien (DD-725) had recovered personnel and LCM.
- 1917 Approached O'Brien 1,000 yards (914 meters) south of Enidrik Island.
- 1946 Laying to receiving passengers from O'Brien and securing LCM-C29 in tow.
- 2019 Underway with LCM-C29 in tow.
- 2240 All engines stopped, line towing LCM parted. Commenced maneuvering to recover LCM-C29.
- 2328 LCM-C29 recovered and recovery crew aboard for Bikini.

4 July
- 0733 Anchored at Bikini Atoll in berth 386.

6 July
- 1024 Underway to new anchorage.
- 1122 Anchored 200 yards (183 meters) north of berth 168, Bikini.

8 July
- 0851 Underway for Point Sugar oceanographic survey.
- 1033 Maneuvering to get on station for oceanographic tests.
- 1036 Laying to at Point Sugar.
- 1448 Underway and proceeding to regain station Point Sugar for oceanographic test.
- 1936 All engines stopped. Laying to at Point Sugar for oceanographic tests.

9 July
- 0824 Laying to, conducting oceanographic training.
- 1123 Set course and proceeded to resume station at Point Sugar.
- 1553 Laying to at Point Sugar.
- 1927 Proceeding to station at Point Sugar.

10 July
- 0950 Proceeding to rendezvous at 11°42'N; 165°48'E. Conducted tactical naval operations in this area in company with USS Ingraham (DD-694) and USS Robert K. Huntington (DD-781).

11 July
- 0955 Proceeded independently and stood into port.
- 1033 Moored to USS Enoree for refueling in berth 305.
- 1230 Underway for berth 147E.
- 1259 Anchored in berth 147E.

14 July
- 0615 Underway for Point Sugar.
- 1039 Anchored in berth 147E.

18 July
- 1057 Underway en route to HECV berth 386.
- 1208 Anchored in berth 386, after relieving USS Flusser (DD-386) as HECV.

19 July
- 0525 Underway, proceeding to Point Sugar.
- 1018 Returned to lee of Eneu Island; continued steaming as before to relieve Fall River as HECV at Bikini.
- 1424 Anchored in berth 386 and relieved Fall River as HECV.

21 July
- 1008 Underway after being relieved by Laffey (DD-724) as HECV. Proceeding to berth 147E.

22 July
- 1658 Underway for Kwajalein Atoll for personnel transfers.

23 July
- 0651 Anchored in anchorage berth C, Kwajalein.
- 1557 Underway to conduct tactical maneuver exercises along route to Bikini.

24 July
- 0609 Moored portside to Enoree in berth 324, Bikini, for refueling.
- 0747 Underway to berth 147E.
- 1010 Six military and civilian personnel reported aboard in accordance with verbal orders of Radiological Safety Section JTF 1.
- 1052 Underway to assume HECV duty.
- 1138 Anchored in berth 386, Bikini.

Shot BAKER (25 July, 0835)

25 July
- 0540 Underway from berth 386 to Point Sugar.
- 1647 Stopped all engines, laying to while taking deep-water samples for radiological tests outside Bikini Atoll.
- 1714 Set course and proceeded to Bikini Atoll for night monitoring.
- 1900 Anchored in Bikini Atoll, about 2-1/2 nmi (4.6 km) south of surface zero.
- 2250 Underway for new berth.

25 July

2309 Anchored in new berth.

26 July
0127 Underway to shift berths.
0146 Anchored in new berth.
0927 Underway to shift berth.
0948 Anchored in berth 313, Bikini.
1618 Underway to take deep-water soundings at various points in the atoll.
1635 Laying to while conducting oceanographic tests in position 11°32'N; 165°30'E.
1720 Laying to while conducting oceanographic tests in position 11°32'N; 165°31'E.
1730 Laying to while conducting oceangraphic tests.
1815 Completed tests, proceeding on various courses to 11°32'N, 165°32'E.
1829 Anchored at 11°32'N; 165°32'E for oceanographic tests.
1912 Underway to 11°32'N; 165°31'E.
1938 Anchored in Bikini Atoll to conduct oceanographic tests.
2013 Underway to radiological station 5.
2032 Anchored at station 5, Bikini Atoll, to conduct radiological tests.
2109 Completed radiological tests, made all preparations for getting underway.
2120 Underway to berth 369.
2135 Anchored in berth 369, Bikini.

27 July
1429 Underway to investigate oil slick about 11°40'N, 165°28.5'E.
1612 Laying to in oil slick, testing sample of water for radioactivity.
1634 Sample of water showed 80 times tolerance (8.0 R/24 hours).
1635 Leaving oil slick. Underway to entrance of Bikini Atoll.
1807 Anchored in berth 360, Bikini.

28 July
1550 Underway proceeding to berth 314N.
1612 Anchored in berth 314N, Bikini.
2348 Underway to shift berths due to radioactivity in excess of tolerance and to avoid excessive exposure to radiological activity.

29 July
0110 Anchored in berth 353E, Bikini.
0550 Underway to stand out of harbor.
1451 Anchored in berth 381, Bikini.
1523 Underway to shift berths.
1541 Anchored in berth D, Bikini.
1745 Five military and civilian personnel disembarked by verbal authority of the Radiological Safety Section, CJTF 1.

30 July
0649 Underway proceeding to Kwajalein Atoll.
1540 Anchored in berth K-16, Kwajalein.
1751 Underway from berth K-16, Kwajalein, to Bikini Atoll.

31 July
0811 Moored starboard side to USS Chikaskia (AO-54) in berth 250 for refueling.
0938 Underway from alongside Chikaskia proceeding to berth 147.
0956 Anchored between berth 147W and 145, Bikini.

2 August
0723 Underway to go alongside USS Dixie (AD-4).
0754 Moored starboard side to Dixie in berth 191, Bikini.
1445 Underway from alongside Dixie in berth 191, proceeding to berth G.
1515 Anchored in berth G, Bikini.

3 August
0728 Underway from berth G, Bikini, to go alongside Dixie.
0749 Moored starboard side to Dixie in berth 363, Bikini.

7 August
0747 Underway standing out of harbor to join USS Moale (DD-693) for offset firing practice off Eneu Island.
1445 Anchored in berth 147E, Bikini.

9 August
0716 Underway from anchorage berth 147E to fuel ship at berth 324.
0745 Moored starboard side to Enoree in berth 324, Bikini, for refueling.
0849 Underway from Enoree to berth 147E.
0917 Anchored in berth 147E, Bikini.

10 August
0750 Underway from berth 147E, Bikini, to join Ingraham, Moale, Huntington, Laffey, and USS Lowry (DD-770) to conduct firing runs, en route from Bikini to Pearl Harbor.

15 August Arrived Pearl Harbor.

USS ANDERSON (DD-411)

Crew Size: 105
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Rockbridge (APA-33)
USS Bayfield (APA-228)
Crew Location for Shot BAKER: USS Ajax (AR-6)
Shot ABLE Location: Berth 186, Bikini Anchorage, 750 yards (695 meters) S
Sunk 1 July 1946, Bikini Atoll

Task Unit and Function
The destroyer Anderson was a target vessel during CROSSROADS. Its crew was transferred before ABLE and was never returned. It served in Destroyer Division 1 in TU 1.2.3 (Destroyer Unit). Anderson was instrumented with microphones on its deck to pick up the sound of the explosions.

Shot ABLE (1 July, 0900)

Anderson's crew was transported to the above-noted ships, which were in area Marmon (21 nmi [39 km] east) of ABLE shot site. Shot ABLE sank Anderson. Diving operations were conducted later to examine the ship.

APL-27

Crew Size: 23
Bikini Departure: 24 August 1946
Decontamination Location: Kwajalein Atoll
Operational Clearance: 25 February 1947
Final Clearance: 10 March 1947

Task Unit and Function
APL-27, a non-self-propelled barracks ship, was a member of TU 1.2.12 (Kwajalein Maintenance Unit). It was used as a decontamination station at Kwajalein and was not at Bikini for either shot.

July-8 August At Kwajalein.

9 August — Taken in tow by USS Sioux (ATF-75) to Bikini.

10-23 August — Moored alongside target vessel USS Geneva (APA-86).

24 August — Taken in tow by ATR-87 for Kwajalein.

25 August — Anchored in Kwajalein, berth 27.

APL-27 remained at Kwajalein until July 1947.

USS APOGON (SS-308)

Crew Size: 54
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,000 yards (914 meters) SSE
Shot BAKER Location: 850 yards (777 meters) SSE
Sunk 25 July 1946, Bikini Atoll

Task Unit and Function
The submarine Apogon served in Submarine Division 112 of TU 1.2.4 (Submarine Unit) as a target vessel during CROSSROADS. Apogon carried special test torpedoes for studies of atomic blast effects on them.

Shot ABLE (1 July, 0900)

1 July — Anchored in assigned berth in target array (1,000 yards [914 meters] SSE of surface zero) in Bikini Lagoon. Crew evacuated to Bottineau 20 nmi (37 km) from shot site.

2 July
1500 — Reboarding teams A and B left Bottineau en route to USS Haven (AH-12).
1532 — Picked up radiological monitor from Haven.
1550 — Apogon boarded.
1554 — Topside reported radiologically safe.
1610 — Commenced reentry of boat through after engine room hatch. Began testing for hydrogen gas and other explosive mixtures. Hydrogen gas was the only gas found.
1752 — Below deck spaces testing completed: normal power and lighting restored.
1845-1850 — Engaged in maneuvering watch.

3 July
0740 — Boat trip to Bottineau to pick up Team Charlie.
0853 — Inspection of boat's safety film.
0920 — Inspection of instruments; film safety inspection party left.
0930 — "C" Party returned to boat from Bottineau.
1045 — Pressure gauge team aboard to inspect gauges; instrument party left.
1105-1130 — Party came aboard to inspect radioactivity.
1130 — Pressure gauge party left.
1500 — Party came aboard to inspect food and medical supplies.
1520 — Electronics party came aboard and medical party left.
1545 — Electronics party left the boat.
1650-1655 — Party came aboard to read foil gauges.

4 July
0805-0930 — Party came aboard to check instruments.
1000-1013 — Party came aboard to check instruments.
1010-1105 — Electronics party aboard to check instruments.

6 July
0900-0930 — Party came aboard for electronics inspection.
0957-1015 — Party came aboard to remove orientometers.

8 July
0935-1005 — Los Alamos Instrumentation Party aboard to check instruments.
1200-1600 — Party aboard to photograph blast gauges.

9 July
0810-0945 — Bureau of Ships Instrumentation Party aboard to install impulse velocity gauges.
1115-1200 — USS Kenneth Whiting (AV-14) instrumentation group came aboard to remove electronic instruments from forward bridge deck.
1357 — Moored portside to target submarine USS Parche (SS-384), alongside USS Fulton (AS-11), in berth 231.
1420 — Target submarine USS Skipjack (SS-184) came alongside to port.

10 July
0945-1019 — Party aboard to check torpedoes.
1110 — Skipjack got underway.
1243 — Anchored in berth 251, Bikini.
1302-1435 — Working party came aboard to check fire-control gear.

11 July
0830-1200 — Technician aboard.
1315-1635 — Party aboard to check torpedo data computer.
1405-1540 — Party aboard to remove instruments.

12 July
0908 — Moored starboard side to portside of Fulton.
0930-0945 — Transferred torpedoes from Fulton to Apogon.
1502 — Anchored in 29 fathoms (53 meters) of water in target array.

13 July
0940-0945 — Damage inspection group came aboard from USS Wharton (AP-7).
0945 — Sonar inspection party came aboard.
1120-1140 — Photographic party came aboard to take pictures of the topside.

14 July
1040-1045 — Party came aboard to deliver safety film.
1330-1625 — Party came aboard to inspect salvage fittings.

15 July
- 0811-0830 Party aboard to install deflection gauges in torpedo room.
- 1010-1110 Party aboard to work on blast gauges.

16 July
- 1330-1345 Party came aboard to pick up blast pots.
- 1440-1455 Party aboard to pick up paint patch.

17 July
- 0840-1150 Rigged special weight-suspension bridles for test BAKER.
- 1445-1540 Party aboard to install instruments.
- 1610-1620 Party aboard to post photographic films.

18 July
- 0900-1100 Working party came aboard to place Nord Unit 5120 topside for test BAKER.
- 1330-1425 Party came aboard to work on torpedo room gauges.

20 July
- 0645 Shoved first evacuation party off in preparation for test BAKER.
- 0807 Submerged at anchor.
- 0858 Surfaced.
- 1035-1052 Party came aboard to take motion pictures of topside.
- 1050-1115 Party boarded to check instruments.

21 July
- 0605 USS Gypsy (ARSD-1) moored alongside starboard; commenced work of suspending special weights for test BAKER.
- 0805 Gypsy installed set of submerged weights aft and cleared starboard side.
- 1008 Gypsy moored to starboard side to install set of weights.
- 1225 Gypsy completed installation of weights and cleared starboard side.
- 1345-1405 Party came aboard to check instrumentation work.
- 1445-1700 Party from Haven came aboard to install instruments.

22 July
- 0500 Began rigging submarine in accordance with special submerged condition bill.
- 0640 Rigging of boat completed and all hands determined to be topside. Secured final opening, the after engine room hatch; stood by for submergence.
- 0930 Commenced rigging hoses to salvage lines from USS Coucal (ASR-8). Evacuated crew to Bottineau.
- 0950 Boat rigged for dive. "A" and "B" parties evacuated to Bottineau. Coucal commenced submerging the submarine for test BAKER.

Shot BAKER (25 July, 0835)

25 July — Submerged at anchor in assigned position in target array (850 yards [777 meters] SSE of surface zero) in Bikini Lagoon. Crew evacuated to Bottineau 20 nmi (37 km) from BAKER detonation site. Apogon sank as a result of BAKER.

1 August — Geiger readings near Apogon at 165 feet (50.3 meters) depth 50 R/24 hours; 4 feet (1.22 meters) above bottom 1 R/24 hours.

8 August — Apogon's crew transfered to remanned target ship USS Fillmore (APA-83).

10 August — Diving operations started.

11-12 August — Diving operations continued; recovered torpedo ordnance.

13 August — Blast damage reported to main ballast tanks 6A, 6B, 6C, and 6D; tank 7 had large leaks near top on vent risers. Diver reported that tank top around 6B main ballast tank vent riser was ruptured; after torpedo room full of water; hatch found to be loose on its seat and it was believed that dog mechanism had failed. Maneuvering room contained water that was being blown out. The after battery hatch was found loose on its seat with bubbles escaping. It was made tight by turning hand wheel. Meanwhile diving operations continued.

14 August — Continued work on repairing the after torpedo room hatch. Blew water from control room despite large air leak in vicinity of forward torpedo-loading hatch. Forward engine room and after battery could be partially blown despite large leak from each within after end of conning tower fairwater.

15 August — Continued salvage operations. Removed badly damaged after torpedo room hatch.

16 August — Continued salvage operations. Continued fitting blow connections to the fuel ballast tanks and making the after torpedo room tight. Approximately 45 percent of the buoyancy required to lift boat was available within the boat's structure.

17 August — Continued salvage operations.

19 August — Attempts to install blow connection in the after fuel ballast and fuel tanks proceeding slowly.

20 August — Continued salvage operations.

21 August — Continued salvage operations. All fuel ballast and fuel tanks aft of the conning tower fitted with blow connection. Starting from aft all tanks being tested and made air tight.

22 August — Continued salvage operations.

24 August — Staff inspections completed and made available to CTG 1.2 for disposition.

USS APPALACHIAN (AGC-1)

Crew Size: 614
Bikini Atoll Arrival: 29 June 1946
Bikini Atoll Departure: 29 July 1946
Shot ABLE Location: 18 nmi (33 km) NNE
Shot BAKER Location: 9.5 nmi (18 km) ESE
Decontamination Location: San Francisco
Operational Clearance: 2 October 1946
Final Clearance: 3 October 1946

Task Unit and Function
Appalachian, an amphibious force flagship, served in TU 1.3.2 (Press Unit). Its functions were communications support, messing, berthing, and transportation for newspaper and radio reporters.

Shot ABLE (1 July, 0900)

30 July
1604 Underway for an area outside of the lagoon.

1 July
1409 Army patrol boat P-696 came alongside to pick up press films.
1609 Anchored in berth 251, Bikini Atoll.

4 July
1707 Underway for Kwajalein Atoll to disembark press correspondents.

5 July
1030 Anchored at Kwajalein Atoll.

6 July
1633 Underway for Pearl Harbor.

12 July Anchored Pearl Harbor.

14 July
1055 Left Pearl Harbor after picking up press personnel.

21 July Arrived at Kwajalein Atoll and immediately left for Bikini Atoll.

22 July
0843 Arrived at Bikini Atoll and anchored in berth 92, Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July
0555 Underway for an area outside the lagoon.

25 July
1748 Anchored in berth 363.

26 July
1634 Underway for Kwajalein Atoll.

27 July
0946 Arrived Kwajalein Atoll.
1752 Underway for Bikini Atoll.

28 July
0902 Arrived Bikini Atoll.

29 July Departed for Kwajalein Atoll en route to Pearl Harbor.

USS APPLING (APA-58)

Crew Size: 226
Bikini Atoll Arrival: 3 June 1946
Bikini Atoll Departure: 8 August 1946
Shot ABLE Location: >13 nmi (24 km) SE (area Federal)
Shot BAKER Location: >10 nmi (19 km) SE (area Chalmers)
Decontamination Location: San Francisco
Operational Clearance: By 22 November 1946
Final Clearance: 13 December 1946

Task Unit and Function
Appling was an attack transport that served in Transportation Division 94 in TU 1.2.6 (Merchant Type Unit). Its function was to house personnel from target vessels for shots ABLE and BAKER. It also was a base for LCPLs and radiological reconnaissance personnel.

Shot ABLE (1 July, 0900)

30 June
1359 Left the lagoon with USS Henrico (APA-45) for steaming area, after taking on transfers from target ship USS Geneva (APA-86) and other personnel.

1 July
1116-1123 Lowered seven radiological patrol boats into the water and left the lagoon.
1758 Anchored in berth 278, Bikini Atoll.

2 July
0615 Lowered all radiological boats for patrol purposes.
1030 Began disembarking Teams A and B from Geneva.
1335 Geneva Team C disembarked.

Shot BAKER (25 July, 0835)

24 July
1429 Underway for area off of the atoll with various transfers.

25 July
1017 Maneuvered near harbor entrance and lowered radiological boats.
1033 Left lagoon.
1530 Anchored in berth T, Bikini Atoll.

28 July Shifted to unidentified berth.

30 July Shifted to berth 263.

1 August Shifted to berth 56.

2 August
1731 After transferring four LCPLs (apparently used during the operation) to USS Haven (AH-12), underway for Enewetak Atoll to pick up cargo.

3 August
0854 Arrived at Enewetak Atoll.

7 August
1605 Underway for Bikini Atoll.

8 August
0851 Anchored at Bikini Atoll to pick up personnel for transportation.
1717 Underway for Pearl Harbor.

ARD-29

Crew Size: 106
Bikini Atoll Arrival: 26 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 94 nmi (174 km) SSE
Shot BAKER Location: Rongelap Atoll
Decontamination Location: Pearl Harbor
Operational Clearance: 18 February 1947
Final Clearance: 18 February 1947

Task Unit and Function
ARD-29, a non-self-propelled auxiliary floating drydock, was a support vessel in TU 1.8.1 (Repair and Service Unit). Its functions included salvaging, supplying provisions, repairing, and carrying target vessels. It also served as Fleet Post Office, and provided recreation, legal, and welfare facilities.

Shot ABLE (1 July, 0900)

30 June
1315 Carrying 22 LCVPs, YF-582, and a pontoon, underway in tow by USS Sioux (ATF-75).

2 July
0930 Moored to buoy in berth 270-A, Bikini Atoll.

Shot BAKER (25 July, 0835)

23 July
1840 Carrying 20 LCVPs, YF-582, and a pontoon, underway in tow by Sioux for Rongelap Atoll.

24 July
1615 Anchored at Rongelap Atoll.

30 July
1315 Underway for Bikini Atoll.

31 July
1043 Anchored in berth 43, Bikini Atoll, for loading.

3 August Shifted to berth 270A.

7 August Shifted to berth 43.

25 August
0538 Departed Bikini Atoll towed by Sioux.

26 August Arrived Kwajalein.

16 September Departed Kwajalein towed by USS Chowanoc (ATF-100).

5 October Arrived Pearl Harbor.

ARDC-13

Crew Size: 4
Bikini Atoll Arrival: Before 30 June 1946
Shot ABLE Location: 827 yards (756 meters) W
Shot BAKER Location: 1,250 yards (1.1 km) NNE
Sunk 6 August 1946, Bikini Atoll

Task Unit and Function
ARDC-13, a concrete auxiliary floating drydock, was a target vessel during CROSSROADS. It served in the Miscellaneous Group in TU 1.2.5 (Landing Craft Unit) and sank as a result of flooding after shot BAKER.

Shot ABLE (1 July, 0900)

Upon arriving at Bikini Atoll ARDC-13 anchored and remained there for shot ABLE.

1 July
2400 Reported to still be radioactive (Reference 5, p. 6-B-17).

2 July
1308 A boarding team came aboard for an unspecified period of time (Reference 6, pp. VII-1-30-A and VII-I-32-A).

3 July
1500 Beached in shallow water to prevent sinking (Reference 5, p. 6-B-18).

Shot BAKER (25 July, 0835)

Sank as a result of shot BAKER.

USS ARKANSAS (BB-33)

Crew Size: 441
Bikini Atoll Arrival: 29 May 1946
Crew Location for Shot ABLE: USS Rockbridge (APA-228)
Crew Location for Shot BAKER: Rockbridge
Shot ABLE Location: 110 yards (101 meters) SSE
Shot BAKER Location: 620 yards (588 meters) N
Sunk 25 July 1946, Bikini Atoll

Task Unit and Function
The battleship Arkansas was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Battleship Division 7 in TU 1.2.1 (Battleship and Cruiser Unit). Arkansas was equipped with ball-crusher and free-piston recording gauges for the Ordnance Group; it also carried test aircraft.

Shot ABLE (1 July, 0900)

30 June Crew evacuated to Rockbridge. Three Congressmen visited during evacuation.
1515 Ship closed.
1525 Captain departed.

2 July
1545-1625 Initial boarding and salvage team (Team A) aboard. Ship was reported still radioactive.
1644 Three fires put out (Reference 5, p. 6-B-17).

3 July
1441 The captain, two radsafe monitors, and Team A reboarded for a radiological inspection of topside, gasoline storage area, ammunition lockers, and turrets 3 and 4.
1530 Inspection completed and dangerous areas marked. Ammunition lockers and turrets 3 and 4 found radiologically safe. Inspection of second deck begun.
1711 Group left ship.

4 July
0757 Captain and Teams A and B boarded to begin opening compartments below decks.
0945 All turrets inspected and found radiologically safe.
1645 All parties left ship for Rockbridge.

5 July
0810 Captain and Teams A and B reboarded.
1705 All parties departed except for a six-man security detail.

6 July
0830 Captain and Teams A, B, and C reboarded.

1655	All parties departed except for a six-man security detail.

7 July

0810	Captain and Teams A, B, and C reboarded.
1630	All parties departed except for a six-man security detail.

8 July

0800	Captain and Teams A, B, and C reboarded.
1645	All parties departed except for a six-man security detail.

9 July — Reboarding teams A, B, and C boarded and remained aboard.

10 July — Entire crew reboarded.

Shot Baker (25 July, 0835)

24 July

0900	Evacuation plan put into effect.
1550	The ship was empty and closed.

Arkansas sank as a result of the detonation. On 6 August, the crew was transferred to various units. A 21 August diver's report states there was damage to plating and on the starboard side of the ship there were many rips.

USS ARTEMIS (AKA-21)

Crew Size: 160
Bikini Atoll Arrival: 27 May 1946
Bikini Atoll Departure: 18 August 1946
Shot ABLE Location: >13 nmi (24 km) SE (Area Federal)
Shot BAKER Location: >10 nmi (19 km) SE (Area Federal)
Decontamination Location: San Francisco, California
Operational Clearance: 20 November 1946
Final Clearance: 27 December 1946

Task Unit and Function
Artemis was an attack cargo ship that served in Transportation Division 94 in TU 1.2.6 (Merchant Type Unit). It served as a base for radiological LCPLs and crews and also as an ammunitions store ship.

Shot ABLE (1 July, 0900)

30 June — Artemis left the lagoon for an area outside of the lagoon.

1 July

1129	Lowered six radiological survey boats into the lagoon and returned to position outside the lagoon.
1752	Anchored in berth 296, Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July

1423	Underway for an area outside the lagoon.

25 July

1018-1020	Lowered six radiological survey boats into the channel and left.
1531	Anchored in berth 385, Bikini Atoll.

9 August — Dumped all its ammunition outside of the harbor and anchored in berth 34, Bikini Atoll.

17 August — Five members of radiological section boarded to inspect. All areas and spaces except one were pronounced "perfectly safe from a radiological point of view." Army Engineer equipment from target ship USS LST-545 in Hold 1 and two small crates there were found to be reading 0.112 R/24 hours and were recommended to be secured and marked as dangerous.

18 August

1720	Underway for Pearl Harbor.

ATA-124

Crew Size: 44
Bikini Atoll Arrival: Before 25 June 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: Approximately 120 nmi (222 km) SSE
Shot BAKER Location: 17 nmi (32 km) SSE
Decontamination Location: Puget Sound
Final Clearance: 18 December 1946

Task Unit and Function
ATA-124 was an auxiliary ocean tug used as a support ship in TU 1.8.1 (Repair and Service Unit). Its functions were towing, repairing, and salvaging damaged target vessels.

Shot ABLE (1 July, 0900)

30 June

1200	Anchored in berth 191-A, Bikini.
1430	Underway from Bikini Atoll to Kwajalein Atoll.

1 July

1702	Moored to YW-92 in berth K-20, Kwajalein, 155 nmi (287 km) southeast of Bikini.

2 July

0742	Underway from Kwajalein Atoll to Bikini Atoll with YW-92 in tow.

3 July

1142	Anchored in berth 191-A, Bikini Atoll.
1428	Underway to moor alongside target vessel LCI-329 to deliver water.
1445-1637	Moored to LCI-329.
1637	Underway to go alongside USS Wildcat (AW-2).
1715	Underway to go to berth 191-A.
1815	Anchored in berth 191-A.

4 July

0750	Underway to go alongside target submarine USS Parche (SS-384) in berth 231.
0832-1226	Moored to Parche to deliver freshwater.
1246-1745	Moored to target submarine USS Apogon (SS-308) to deliver freshwater.
1745	Underway to berth 191-A.
1825	Anchored off bow of USS Fulton (AS-11) in vicinity of berth 231.

5-11 July — Engaged in routine tasks.

12 July

0729	Underway.
0750-0830	Moored to target ship USS New York (BB-34) to receive ammunition.
0830	Underway from New York to target ship USS Pensacola (CA-24).
0845	Moored to Pensacola to load boxes aboard.

0935	Underway to go alongside target submarine USS Skate (SS-305).
0957	Moored to Skate to load ammunition.
1037	Underway from Skate to ammunition dumping area, 10 nmi (18.5 km) off Eneu Island.
1503	Anchored between berths 147 and 169 after completing dumping mission.

13 July

0725	Underway
0745-0756	Moored to LCT-1377.
0756	Took LCT-1377 in tow.
0905	Anchored in berth 270-M(N).
1334	Underway with LCT-1377 in tow.
1355	Underway from LCT-1377 having completed mooring mission.
1440-1530	Moored to LCT-1268.
1530	Underway with LCT-1268 in tow.
1545	Successfully moored LCT-1268 to USS San Marcos (LSD-25) in target array.
1555	Underway from San Marcos.
1615-1715	Moored to target vessel LSM-60 to transfer freshwater.
1715	Underway from alongside LSM-60.
1738	Moored to USS Severn (AO-61).
1830	Anchored in berth 191-A, Bikini.

14 July

0945	Underway for YF mooring to pick up three camels for delivery to target ship USS Nevada (BB-36).
1045-1100	Moored to Nevada.
1100	Underway throughout target area to check ships for location of camels.
1320	Anchored in vicinity of berth 191-A.
1550	Underway to pick up LCT-1132.
1709	Moored to LCT-1132.
1715	Underway with LCT-1132 in tow to moor LCT to USS Gunston Hall (LSD-5).
1810	Moored to LCT-1268, which was moored to San Marcos.
1817	Underway with LCT-1268 in tow to LCT moorings.
1847	Underway, having moored LCTs.
1905	Laying to off USS Chilton (APA-38).
1920	Underway with LCT-1415 to San Marcos.
2015	Underway to anchorage, having moored LCT-1415 to San Marcos.
2030	Anchored in berth 191-A.

15 July

0903	Underway from berth.
0925	Moored to YF-733 to receive steel plate for Nevada.
1330	Underway from YF-733.
1350-1530	Moored to San Marcos to assist in docking LCT.
1530	Underway from San Marcos.
1555	Anchored in berth 64, preparing to take LCMs from beach.
1610	Underway from berth.
1705	Moored to Nevada to transfer angle iron beams.
1712	Underway.
1730-1735	Moored to LCT-1132.
1756	Underway from alongside LCT-1132.
1810	Moored to ATA-187.
1847	Underway to berth 191-A.
1900	Anchored in berth 191-A.

16 July

0731	Underway from berth 191-A.
0835	Moored to LCT-1132 to take vessel in tow.
0910	Underway.
0920	Moored to LCT-1268.
1205	Underway with LCT-1132 in tow to Rongelap Atoll.

17 July

0757	Anchored in berth 4, Rongelap Atoll, after mooring LCTs.
0931	Underway to Bikini Atoll.
1656	Anchored in berth 191-A, Bikini.

18 July

0820	Underway, after taking on water from Severn, to target submarine USS Skipjack (SS-184).
0836-0934	Moored to Skipjack.
0945-1059	Moored to target submarine USS Dentuda (SS-335).
1107-1230	Moored to Skate.
1300-1428	Moored to YF-733.
1428	Underway to Rongelap with YF-733 in tow.

19 July

1343	Moored to YF-733.
1452	Underway to Bikini.

20 July

0643	Anchored in berth 191-A, Bikini; refueled throughout day.

22 July

0858	Underway.
0940-0955	Moored to target ship USS Arkansas (BB-33).
0955	Underway with camels in tow.
1013-1015	Moored to Nevada.
1024-1030	Moored to target ship Nagato.
1030	Underway from Nagato; moored to ARD-29.
1112	Left camels with ARD-29.
1124	Underway to tow target ship Prinz Eugen.
1510-1555	Moored to Prinz Eugen.
1630	Anchored in berth 191-A, Bikini.

23 July — Routine activities.

Shot BAKER (25 July, 0835)

24 July

1430	Underway in column formation for Rongelap Atoll.

25 July

1530	Anchored at Rongelap Atoll, berth 9.

27 July

0729	Underway for Bikini Atoll in company with LCT-1361.

28 July

0810	Anchored at berth 4, Bikini Atoll.
1030	Underway to Rongelap Atoll.
2341	Moored to ATA-187 in berth 10, Rongelap.

30 July

1530	Underway for Bikini Atoll.
1934	Anchored in berth 231-A, Bikini.

31 July — Worked in vicinity of Aomen Island throughout day, including transporting a pontoon causeway.

1757	Anchored in berth 191-A, Bikini.

2 August

1521-1612	Moored to YF-990.

ATA-124

1737	Underway from YF-990.
1854	Anchored west of Eneu Island.
3 August	Assisted ARD-29 to assigned berth.
1122	Anchored west of Eneu Island.
4 August	Assisted in mooring and towing whale boats to San Marcos.
1450	Anchored in area west of Eneu Island, Bikini.
6 August	Towed USS Rolette (AKA-99) to Seabee landing and towed pontoon bridge to Bokaetoktok Island.
2055	Anchored 1,500 yards (1.4 km) northeast of Bokaetoktok Island.
7 August	
1227	Anchored in berth 191-A, Bikini.
8 August	Towed YO-132; transported camel from USS Bottineau (APA-235) to YF mooring.
1635	Anchored in berth 191-A.
9 August	
1655	Underway.
1710	Standing off target ship USS Cortland (APA-75) to assist in clearing Cortland from alongside USS Dixie (AD-14).
1720	Moored alongside Cortland.
1758	Underway with Cortland to anchor Cortland in assigned berth.
1827	Underway from alongside Cortland to vicinity of LST landing.
1855	Anchored off LST landing, Bikini, to assist in salvaging beached target ship USS LST-125.
10 August	
1035	Underway to Bokaetoktok Island with pontoon causeway and LCMs in tow.
1256	Arrived at anchorage off Bokaetoktok Island.
1325	Underway to boat pool area off Bikini Island with LCM in tow.
1512	Anchored in berth 169, Bikini, in boat pool area.
12 August	
0946	Underway.
1044	Moored to target submarine USS Tuna (SS-203) to deliver freshwater.
1153	Underway to Wildcat to take on freshwater.
1320	Anchored in berth 161, Bikini, after taking on water.
13 August	
0919-1025	Delivered water to PGM-24.
1043	Anchored in vicinity of berth 169.
14 August	Towed YF-733 to berth 190 and spent the rest of the day moored to USS Pollux (AKS-4).
1515	Anchored in berth 147, Bikini.
15 August	Shifted to vicinity of berth 59.
16 August	Delivered water to PGM-24.
1647	Anchored in vicinity of berth 63.
17 August	
0557	Anchored south of Aomen Island.
1436	Underway to secure pontoon float to buoy in vicinity of Seabee landing.
1610	Underway from pontoon float.
1636	Anchored in vicinity of berth 60, Bikini.
18 August	Spent day in vicinity of ATA-187, YW-92, and Wildcat.
2240	Anchored in vicinity of berth 230.
19 August	Spent morning in vicinity of YW-92, Severn, and Dixie.
1011	Anchored in vicinity of berth 60.
20 August	Spent day in vicinity of ATA-187, YF-733, and YW-92.
1700	Anchored in vicinity of berth 60.
21 August	
1424	Underway to go alongside Tuna.
1448	Moored to Tuna to deliver freshwater.
1541	Underway with Tuna to go alongside Severn.
1551	Moored to Severn to take on freshwater.
1643	Anchored in berth 60, Bikini.
22 August	
0910	Underway to ARD-29.
1114	Underway to assist in undocking target ship USS Hughes (DD-410) from ARD-29.
1140	Moored to Hughes for towing.
1159	Underway with Hughes in tow to buoy between berths 160 and 141.
1412	Underway from alongside Hughes.
1457-1540	Moored to USS Enoree (AO-69) for towing.
1551	Anchored in vicinity of berth 59.
23 August	
0617	Underway with YF-733 in tow to Kwajalein.
24 August	
1145	Moored to YTB-553 at Kwajalein, having moored YF-733 to USS Quartz (IX-150).
1403	Underway from Kwajalein to Bikini.
25 August	
0730	Moored to PGM-24, berth 57, Bikini.
0757	Underway with PGM-24 in tow.
0900	Underway for Kwajalein with PGM-24 in tow.
26 August	
0655	Moored to ATA-187 at Kwajalein Atoll after mooring PGM-24.
27 August	Moored various nontarget ships at Kwajalein.
28 August	
1420-1500	Radsafe inspection party aboard to inspect for radioactivity; declared clear of radioactivity.
29 August-7 September	Operated at Kwajalein; not involved with target ships.
8 September	
0757-0814	Moored next to target submarine Skipjack.
9 September	Underway to Pearl Harbor with YF-385 in tow.
18 September	Moored at Able Docks, Pearl Harbor.

ATA-180

ATA-180

Crew Size: 45
Bikini Atoll Arrival: Before 25 June 1946
Bikini Atoll Departure: 1 September 1946
Shot ABLE Location: 20 nmi (37 km) SE (area Mercury)
Shot BAKER Location: >14 nmi (26 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 24 February 1947, Puget Sound

Task Unit and Function

ATA-180, an auxiliary ocean tug, was a support ship in TU 1.2.7. (Salvage Unit). Its functions were to fight fires and repair and salvage damaged target vessels.

Shot ABLE (1 July, 0900)

1 July
- 0530 Underway for area outside the harbor.
- 1750 Anchored in berth Queen, Bikini Atoll.

2 July
- 0920 Took radiological party aboard from USS Haven (AH-12) to target ship USS Independence (CVL-22).
- 0925-1312 Towed Independence.
- 1645-1735 Aided USS Chickasaw (ATF-83) towing Independence.
- 1858 Anchored in berth Roger, Bikini Atoll.

3 July
- 0945-1505 Towed target vessel ARDC-13 to beaching area.
- 1512 Anchored in berth Queen.

6 July
- 0750-1125 Conducted towing operation and assisted in mooring target ship USS Nevada (BB-36).
- 1320 Underway to pick up instruments from Chickasaw to take them to USS Kenneth Whiting (AV-14).
- 1620 Anchored in berth 52.

7 July
- 1005-1250 Towed target ship Nagato.
- 1310-1312 Alongside LSM-60.
- 1326 Anchored in berth 52.

8 July
- 0700-0905 Towed LSM-60 to USS Albemarle (AV-5).
- 1520-1717 Towed LSM-60 to mooring buoy.
- 1730 Anchored in berth 52.

9 July
- 0800-0805 In vicinity of Nagato.
- 0820 Anchored in berth 52.

11 July
- 0520-0700 Towed LSM-60 to a buoy and moored it; then got underway.
- 1105-1405 Towed ARDC-13 to deep water, then got underway.
- 1615-1855 Towed LSM-60 to berth 54.
- 1902 Anchored in berth 52, Bikini Atoll.

12 July
- 1355-1615 Remoored LSM-60 in the target array.
- 1630 Anchored in berth 52.

13 July
- 0750-1957 Towed ARDC-13 to the target array.
- 1957 Port anchor fouled on Nevada's mooring buoy; remained anchored at berth 143.

14 July
- 0803 Anchor cleared by diver from USS Clamp (ARS-33).
- 0918 Anchored in berth 52.

15 July
- 0830-1216 Moored target vessels LCI-332 and LCI-327 in target array.
- 1240 Anchored in berth 52.

16 July
- 0700-0733 Towed LSM-60 to Albemarle; then proceeded to anchorage.
- 1207-1320 Towed LSM-60 to mooring buoy.
- 1340-1415 Alongside target ship USS Fillmore (APA-83) to pick up APA hook.
- 1500 Anchored in berth 52.

17 July
- 0700-1745 Moved Independence to area with 22 fathoms (40 meters) of water.
- 1817 Anchored in berth 52.

18 July
- 0510-0900 Towed and moored LSM-60.
- 0915 Anchored in berth 52.

20 July
- 0715-0905 Towed and moored LSM-60, then got underway.
- 1300 Anchored in berth 52.

Shot BAKER (25 July, 0835)

24 July
- 0505-0902 Remoored LSM-60 in the target area after towing it to Albemarle several times before shot BAKER.
- 0917 Anchored in berth 52.
- 1300 Underway for area outside of lagoon.

25 July
- 1145 Anchored in special assigned berth J.
- 1240 Underway to target ship USS Bladen (APA-63).
- 1300-1310 Standing by Bladen.
- 1333 Returned to Berth J.

28 July
- 1350 Underway to assist ATA-192 in beaching target submarine USS Dentuda (SS-335).
- 1440-1710 Assisted in beaching Dentuda.
- 1806 Anchored south of berth 379.

30 July
- 0753 Underway to Kenneth Whiting.
- 0830 Stood off Kenneth Whiting while radiological instrument party went aboard.
- 0850 Underway to inspect vessels in target array and pick up radiological instruments.
- 0900-0946 Alongside Nevada.
- 1020-1055 Alongside target ship USS Pensacola (CA-24).
- 1100 Radiological monitors reported that the ATA-180 crew had reached maximum tolerance of radioactivity (0.1 R/24 hours maximum allowed).
- 1125 Underway to Kenneth Whiting to transfer instruments taken from target ships.
- 1623 Anchored in berth J.

31 July
0702 Underway to vicinity of Kenneth Whiting.
0745 Standing off Kenneth Whiting to receive radiological party, then underway for target ships.
0804-0810 Standing by target ship USS Gasconade (APA-85).
0814 Underway for target ship USS Catron (APA-71).
0825 Returned instruments from Catron.
0845-0903 Alongside target ship USS Brule (APA-66).
0920 Arrived at Kenneth Whiting and USS Haven (AH-12) to pick up Geiger monitor who had received maximum amount of radioactivity.
0926 Underway for Brule.
0945-0949 Alongside Brule.
0949 Underway for target ship USS Dawson (APA-79).
1000-1008 Alongside Dawson to pick up instruments.
1008 Underway for target ship USS Crittenden (APA-77).
1015-1035 Alongside Crittenden.
1050-1056 Standing by Kenneth Whiting to pick up instruments.
1056 Underway to Haven to pick up Geiger monitor.
1104-1111 Standing by Haven, then underway for berth.
1223 Anchored in berth J, Bikini.

2 August Shifted to anchorage south of berth 379.

3 August
0830 Steamed around Gasconade taking monitor readings.
0843-0940 Washed down Gasconade.
0952-1000 Alongside target ship USS Briscoe (APA-65).
1007-1045 Resumed washdown procedures.
1140 Anchored south of berth 379.

6 August
1010 A working party of one officer and six enlisted men from target ship USS Stack (DD-406) came aboard to assist in its decontamination.
1110 Anchored off Stack.
1235-1430 Washed down Stack with decontamination compound.
1430-1500 Geiger monitors took readings of Stack.
1537 Anchored south of berth 379.

7 August
0802 Underway for target ship USS Wilson (DD-408).
0920-1050 Washed down Wilson.
1205-1325 Washed down Wilson.
1327-1345 Geiger monitors took readings of Wilson.
1407 Underway for Haven.
1632 Disembarked monitor to Haven.
1644 Anchored in berth 52, Bikini Atoll.

9 August Shifted to berth 50.

10 August
1045 Underway for Pensacola.
1100-1107 Stood by Pensacola.
1107 Underway to sink rafts.
1245 Anchored alongside rafts.
1345 Underway for USS Benevolence (AH-13).
1430 Underway for USS Wharton (AP-7).
1435-1456 Stood by Wharton to transfer a passenger and fight fires on small boat.
1515 Anchored in berth 50.

14 August
0752 Underway to target ship USS Geneva (APA-86) to take APL-27 in tow.
0810-0840 Stood off APL-27.
0840 Underway for berth.
0850 Anchored in berth 50.
1240 Anchored 350 yards (320 meters) south of berth 53.

19 August
0937 Anchored near Wilson.
1157 Underway with Wilson in tow, steering out of the lagoon toward Kwajalein Atoll.

21 August
0855 Anchored Wilson at Kwajalein Atoll.
1024 Anchored at Kwajalein Atoll.

22 August
0815-1120 Assisted USS Preserver (ARS-8) in towing Nevada.
1120 Departed Kwajalein Atoll for Bikini Atoll.

23 August
0630 Anchored in berth 92, Bikini Atoll.
1215 Underway to take target ship USS Wainwright (DD-419) in tow for Kwajalein.
1500 Departed Bikini Atoll for Kwajalein Atoll with Wainwright in tow.

25 August
0550 Arrived Kwajalein Atoll and began to anchor Wainwright.
0820 Underway from Wainwright.
1206 Left for Bikini Atoll.

26 August
0650 Arrived Bikini Atoll.
1243 Took target ship USS Hughes (DD-410) in tow.
1252 Left Bikini Atoll with Hughes in tow.

28 August Arrived at Kwajalein Atoll and anchored Hughes.
1215 Left for Bikini Atoll.

29 August
0606 Anchored in berth 188, Bikini Atoll.

1 September
1345 Left Bikini Atoll for Kwajalein Atoll towing LCI-327 and LCI-332.

3 September Arrived Kwajalein and anchored LCI-327 and LCI-332.
0858 Anchored in berth A.

8 September Departed for Pearl Harbor with YF-733 in tow.

19 September Arrived at Pearl Harbor.

ATA-185

Crew Size: 43
Bikini Atoll Arrival: Before 25 June
Bikini Atoll Departure: 5 September 1946
Shot ABLE Location: Approximately 27 nmi (50 km) E
Shot BAKER Location: 18 nmi (33 km) ESE
Decontamination Location: San Diego
Operational Clearance: 13 December 1946
Final Clearance: 18 January 1947

ATA-185

Task Unit and Function

ATA-185 was an auxiliary ocean tug used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, repairing, and firefighting.

Shot ABLE (1 July, 0900)

1 July	Steamed in company with TU 1.2.7.
1731	Anchored in berth Roger, Bikini Atoll.
2 July	
0730	Laying to in vicinity of USS Haven (AH-12) to pick up radsafe monitor.
0855	Laying to in vicinity of target ship Sakawa.
1042	Sakawa sank.
1110	Underway to target ship USS Independence (CVL-22).
1115-1442	Transferred radiological equipment from Independence to USS Kenneth Whiting (AV-14).
1522	Anchored in berth Roger.
5 July	
0730	Underway to USS Wharton (AP-7).
0812	Laying to in vicinity of berth 89.
0845	Took aboard boarding party from Wharton.
0847	Underway to Haven.
0852	Laying to in vicinity of Haven.
0854	Boarding party aboard.
0855	Underway to place boarding team aboard target vessel YO-160.
0930	Moored portside to YO-160; boarding team aboard.
1035	Boarding team returned aboard; underway to await further orders.
1105	En route to Wharton.
1122	Laying to in vicinity of Wharton; boarding team disembarked.
1210	Anchored in berth 73.
6 July	
1115	Arrived at target ship Nagato, laying to awaiting instructions.
1415	Moored to Nagato's starboard side.
1430	Passed main wire to Nagato to assist in lifting Nagato's anchor. After trying unsuccessfully to lift Nagato's anchor with towing machine, commenced heaving on beach tackle with stern capstan, chain coming in slowly.
1738	Secured lifting Nagato's anchor.
1812	Underway from alongside Nagato.
1830	Anchored in berth 73.
7 July	
0530	Underway, proceeding to Nagato.
0600	Passed main tow wire to Nagato through its stern chocks.
1007	Nagato cut loose from mooring buoy.
1010	Commenced towing Nagato to newly assigned berth.
1151	Nagato let go starboard anchor.
1155	Standing by Nagato to prevent swinging.
8 July	Moored to stern of Nagato by main tow wire in berth 162.
9 July	
0735	USS Current (ARS-22) commenced towing Nagato forward, ATA-185 standing by Nagato's stern and assisting Current as necessary.
0812	Nagato anchored.
0840	Cast off tow wire from Nagato, proceeding to anchorage.
0854	Anchored in berth 73.
10 July	
0715	Underway, proceeding to target ship USS Arkansas (BB-33).
0745	Passed main towing wire to Arkansas through its stern chocks, let go mooring lines.
0910-1435	Commenced shifting Arkansas to new berth.
1445	Underway to berth 73.
1505	Anchored in berth 73.
11 July	
0925	Underway en route to target ship USS Nevada (BB-36).
0950	Laying to in vicinity of Nevada, awaiting instructions.
1300	Underway, standing by to assist ATR-87 towing Nevada.
1500	Secured main tow wire to stern of Nevada.
1515	Cast off main tow wire from Nevada.
1525	Secured bow line to port quarter of Nevada.
1700	Cast off bow line from Nevada.
1710	Underway to anchorage.
1725	Anchored in berth 73, Bikini.
12 July	
0630	Underway, proceeding to target ship USS Saratoga (CV-3).
0655	Arrived Saratoga, standing by to assist in shifting it to new berth.
0900	Passed main tow line to Saratoga and commenced maneuvering as necessary in placing it in a new berth.
1040	Cast off from Saratoga, laying to in vicinity.
1050	Proceeded to target ship USS Gasconade (APA-85) and stood by to assist ATA-192 as necessary in towing Gasconade.
1125	Secured from standing by duty with Gasconade.
1150	Anchored in berth 73, Bikini.
19 July	
0815	Observed explosion in vicinity of target vessel ARDC-13.
20 July	
0530	Underway and proceeded to target submarine USS Tuna (SS-203).
0600	Moored portside to portside of Tuna and began heaving in Tuna's port anchor.
0625	Tuna's anchor secured aboard ATA-185, proceeding with heaving in chain.
0805	Tuna underway to shift berths, with ATA-185 alongside assisting as necessary.
0820	Tuna anchored in new berth.
0920	Secured from assisting Tuna and got underway for USS Fulton (AS-11).
0945-1250	Received provisions from Fulton.
1400	Anchored in berth 73.
22 July	
0600	Underway, proceeding to target submarine Apogon (SS-308).
0620	Arrived at Apogon and lay to, awaiting instructions.
0701	Anchored 240 yards (220 meters) from Apogon.

0715 Passed 7-inch manila line to Apogon and commenced heaving around to bring its heading to 85°T prior to submerging.
1050 Apogon submerged.
1052 Buoyed line to Apogon and cast off from submarine.
1606 Underway for anchorage.
1629 Anchored in berth 73.

23 July
1615 Underway to Rongelap Atoll with LCT-1184 and LCT-1420 in tow.

24 July
1525 Underway for Bikini.

Shot BAKER (25 July, 0835)

25 July Rendezvoused with TU 1.2.7 in Mercury area before BAKER detonation.
1155 Anchored in Bikini Lagoon.
1830 Radiological monitors reported aboard.

29 July
0758 Proceeded to target array to retrieve radiological instruments from target ships Nagato (0820-0907), USS New York (BB-34) (1000), and USS Pensacola (CA-24) (1020). These instruments went to Whiting for study.

30 July
0852-0900 Recovered radiological instruments from target ship USS Banner (APA-60).
0910-0915 Recovered radiological instruments from target ship Prinz Eugen.
0940-0950 Recovered radiological instruments from target ship USS Pennsylvania (BB-38).
1000-1020 Recovered radiological instruments from target ship USS Catron (APA-71).
1023-1027 Recovered radiological instruments from Gasconade.
1038 Recovered radiological instruments from target ship USS Briscoe (APA-65).
1100 Recovered radiological instruments from target ship USS Salt Lake City (CA-25).
1118 Recovered radiological instruments from Nevada.
1144 Recovered radiological instruments from USS Brule (APA-68).
1223 Recovered radiological instruments from Independence.
1248-1315 Laying to in vicinity of Kenneth Whiting to transfer all instruments.
1318 Crew reached radiological tolerance.
1429 Anchored in berth King.

1 August
0730 Underway for Kenneth Whiting.
0815 Arrived at Kenneth Whiting.
0857 Recovered radiological instruments from Brule.
0912 Recovered radiological instruments from Independence.
0935 Recovered radiological instruments from target ship USS Barrow (APA-61).
0958 Recovered radiological instruments from Gasconade.
1017 Arrived vicinity of Kenneth Whiting and transferred radiological instruments to small boat.
1030 Ship and crew reached daily tolerance of radioactivity.
1108 Anchored in berth K, Bikini.

2 August Shifted to anchorage south of berth 378.

7 August Shifted to berth 73.

14 August Shifted to berth 231-A.

17 August
0935 Underway for Nevada.
0950 Arrived at Nevada.
0950-1600 Assisted USS Reclaimer (ARS-42) alongside Nevada.
1610 Anchored in berth 18, Bikini.

19 August
0747 Proceeded to Pennsylvania.
0840 Passed line to Reclaimer moored to portside of Pennsylvania.
0840-1620 Assisted Reclaimer.
1645 Anchored in berth 18, Bikini.

20 August
0927 Proceeded to Pennsylvania.
0955-1230 Passed line to Reclaimer; moored portside of Pennsylvania and Reclaimer.
1310 Made fast to USS Chowanoc (ATF-100) to assist in towing Pennsylvania's stern around.
1354 Released by Reclaimer and returned to anchorage.
1417 Anchored in berth 18, Bikini.

21 August
0752 Proceeded to vicinity of New York.
0840 Passed line to Reclaimer to assist in holding Reclaimer off side of New York.
1238 Cast off from Reclaimer.
1302 Anchored in berth 18, Bikini.

25 August
1330 Proceeded to vicinity of Eneu Island to assist USS Clamp (ARS-33) in towing target ship USS Fallon (APA-81).
1730 Moored portside to Fallon to recover Clamp's towing pendant.
1830 Released from duty by Clamp.
1845 Anchored in berth 53, Bikini.

3 September
1700 Underway to vicinity of target submarine USS Skipjack (SS-184).
1815 Anchored off Skipjack's starboard quarter keeping slight strain on line to Skipjack to keep it off side of USS Widgeon (ASR-1).

5 September
1005 Cast off from Skipjack.
1020 Underway for USS Conserver (ARS-39).
1228 Proceeding to target vessel YOG-83.
1540 Proceeding out of lagoon in tandem with Conserver towing YOG-83, LCT-1184, and LCT-1420 to Kwajalein.

7 September
1125 Entered Kwajalein anchorage and brought YOG-83 into position for anchoring in berth A-27.
1214 Cast off tow wire from Conserver.
1231 Anchored in vicinity of berth C, Kwajalein.

8 September
1115 Monitors from Haven came aboard to inspect for radioactivity.

1140	Monitors left after declaring ship radiologically safe.
1555	En route to Pearl Harbor.
20 September	Arrived Pearl Harbor.

ATA-187

Crew Size: 33
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 24 August 1946
Shot ABLE Location: 28 nmi (52 km) NE
Shot BAKER Location: 24 nmi (45 km) ENE
Decontamination Location: San Diego
Operational Clearance: 6 November 1946
Final Clearance: By 22 November 1946

Task Unit and Function

ATA-187 was an auxiliary ocean tug used as a support ship in TU 1.8.1 (Repair and Service Unit). Its functions were salvaging, towing, and emergency repair work on damaged target vessels.

Shot ABLE (1 July, 0900)

1 July	
1950	Anchored in berth 368, Bikini Atoll.
2 July	
0808	Underway to assist USS Sioux (ATF-75) in mooring ARD-29.
1222	Anchored in vicinity of YF mooring.
3 July	Recovered anchor and chain of USS Presque Isle (APB-44) and remained moored alongside overnight.
6 July	
0805	Moored alongside USS Ajax (AR-6) and commenced loading welding equipment.
0959	Cast off lines, underway for target ship USS Arkansas (BB-33) to deliver two camels obtained from USS Dixie (AD-14).
1030	Alongside Arkansas and delivered camels.
1035	Underway for target ship USS Pensacola (CA-24).
1047-1145	Moored alongside Pensacola and unloaded equipment.
1147	Cast off lines; underway for target ship USS Salt Lake City (CA-25).
1200-1305	Moored alongside Salt Lake City and unloaded equipment; after unloading equipment underway for target ship Nagato to pick up two camels.
1310	Picked up camels; underway for target ship Prinz Eugen to pick up two camels.
1409	Picked up two camels from Prinz Eugen; underway for target ship USS Pennsylvania (BB-38) to pick up one camel.
1500	Picked up one camel from Pennsylvania, underway for various ships to deliver camels.
1630	Delivered two camels to Pensacola.
1645	Delivered one camel to Salt Lake City.
1715	Delivered two camels to USS Nevada (BB-36).
1717	Underway to assigned anchorage.
1800	Anchored in berth 168, Bikini.
7 July	
1052	Underway for target submarine USS Skipjack (SS-184) to supply water.
1130	Moored alongside Skipjack and commenced supplying it with water.
1300	Secured from transferring water.
1347	Moored to LSM-60 and commenced transferring water.
1445	Secured transferring water.
1450	Cast off all lines.
1515	Dropped anchor in berth 198.
10 July	
0810-0910	Transferred water to target submarine USS Skate (SS-305).
0918	Underway to LSM-60.
0954-1048	Transferred water to LSM-60.
1405	Underway to target ship USS LST-545 searching for a piece of timber; unable to locate loose, drifting timber.
1550	Anchored in berth 168.
13 July	
0848-1109	Moored alongside target ship USS Fallon (APA-81).
1128	Anchored in berth 168.
16 July	
1212	Departed Bikini Atoll for Rongelap Atoll with LCT-1415 in tow.
17 July	
0800	Anchored at Rongelap Atoll.
0836	Departed Rongelap to return to Bikini Atoll.
1834	Arrived at Bikini Atoll.
23 July	
1254	Underway for Rongelap Atoll.
24 July	
1004	Arrived at Rongelap Atoll.
1640	Departed Rongelap Atoll.

Shot BAKER (25 July, 0835)

25 July	
0835	In Packard area.
1607	Moored at Rongelap Atoll.
30 July	
1613	Left Rongelap Atoll.
31 July	
0640	Arrived at Bikini Atoll; spent the day performing routine duties not involving target ships.
1900	Anchored in berth 117.
5 August	
0855-0946	Moored next to target ship USS Stack (DD-406) to pick up depth charges.
1121	Dumped depth charges overboard.
1337	Anchored near berth K.
9 August	
1428	Anchored near target vessel LCI-620 to tow it to the beach.
1505-1506	Hauled LCI-620 off beach.
1535	LCI-620 tied up alongside starboard side.
1545	Underway with LCI-620 alongside shifting berths.
1551	Anchored off Bikini Island near LCI-620.
10 August	
0637-0932	Assisted in sinking LCI-620.
1313	Anchored in vicinity of berth 168.

1700	Underway to target ship USS Geneva (APA-86) to deliver two camels.
1816	Anchored in berth 169.
12 August	
1549	Moored portside to target ship USS LST-125, remaining there until 14 August.
14 August	
0600	Underway from alongside LST-125 shifting positions.
0602	Moored starboard to portside of LST-125.
0610	USS Munsee (ATF-107) underway with LST-125 in tow.
0735	Underway from alongside LST-125, laying to to prepare to put bow line over to stern of LST-125.
0805	One bow line made fast to stern of LST-125 to assist Munsee in controlling tow.
0838	Munsee underway towing LST-125 and ATA-187 astern.
1108	Let go of bow line.
1158	USS Fall River (CA-131) opened fire on LST-125.
1404	Moored to USS Enoree (AO-69).
1624	Anchored in vicinity of berth 147.
15 July	
0850-1206	Anchored in berth 64.
1429	Anchored in berth 43.
18 August	
0840-1024	Anchored in berth 223.
1041	Anchored in berth 43.
22 August	
0920	Underway to assist ATA-124 in mooring target ship USS Hughes (DD-410).
0930	Laying to off ARD-29 waiting undocking of Hughes.
0952	Moored to starboard side of ATA-124.
1111	Underway, standing off ARD-29.
1135	Hughes clear of ARD-29.
1405	Hughes moored to mooring buoy.
1432	Underway from Hughes to assist Enoree.
1508	Anchored in berth 44.
1755	Underway to USS Wharton (AP-7) for pontoon camels.
1825	Received two camels from motor whaleboat.
1827	Received two more camels from motor whaleboat en route back to anchorage.
1846	Anchored in berth 44, Bikini.
24 August	
0739	Underway from alongside USS LST-861 with YF-990 in tow; standing out of Bikini Lagoon.
0930	Underway with YF-990 in tow for Kwajalein in company with YOG-70, YO-132, and YO-199.
25 August	
1550	YOG-70, YO-132, and YO-199 ordered to proceed independently and carry out previous anchorage instructions.
1635	Commenced taking tow alongside.
1655	Cast off main tow wire from YF-990.
1850	Anchored at Kwajalein Atoll.
28 August	
0930-1010	Radsafe monitors boarded ship to test for radioactivity -- "Results, vessel safe."
3 September	
0809	Underway to assist USS Current (ARS-22) to replace anchor on target ship USS Crittenden (APA-77).
1229	Let go all lines, underway for anchorage, assignment completed.
1303	Let go anchor in vicinity of K-19, Kwajalein.
5 September	
1000	Underway to go alongside target vessels LCI-327 and LCI-332.
1030	Moored to starboard side of LCI-332 and commenced dragging them to northwest corner of berth A43.
1133	Anchored in berth A-B, Kwajalein.
11 September	Departed Kwajalein for Pearl Harbor.
22 September	Arrived at Pearl Harbor.

ATA-192

Crew Size: 15
Bikini Atoll Arrival: 19 May 1946
Bikini Atoll Departure: 2 September 1946
Shot ABLE Location: Approximately 27 nmi (50 km) ESE
Shot BAKER Location: >14 nmi (26 km) SE
Decontamination Location: San Francisco
Operational Clearance: 14 November 1946
Final Clearance: 10 February 1947

Task Unit and Function

ATA-192 was an auxiliary ocean tug used as a support ship in TU 1.2.7 (Salvage Unit). Its functions included salvaging, firefighting, and repairing damaged target vessels.

Shot ABLE (1 July, 0900)

30 June	
1253	Underway for area outside of lagoon steaming with TU 1.2.7.
1 July	
1305	Entered the channel and proceeded to fight fires on target ships USS Niagara (APA-87), USS Bladen (APA-63), and USS Bracken (APA-64).
1416	Ordered to withdraw to east of target area.
1611-1629	Radiological officer with monitor aboard to inspect firefighting equipment for radioactivity.
1755	Anchored in berth Sugar, Bikini Atoll.
2 July	
0945-1000	Shooting water on target vessel YO-160.
1045-1254	Moored YO-160 to buoy.
1254	Stood by to assist mooring target ship USS Independence (CVL-22).
1528	Anchored in berth Sugar.
3 July	
1039-1433	Assisted in beaching target vessel ARDC-13 near Eneu Island.
1517	Anchored in berth Sugar.
5 July	
0920	Proceeded to target array to inspect target ships.
1145	Moored to target vessel LCI-332.

1227	Underway to inspect target ships.
1402	Completed inspection.
1539	Anchored in berth 74.

6 July

1122-1731	Reentered target area to assist in shifting target ship Nagato to another berth.
1830	Anchored in berth 74.

7 July

0528-1220	Reentered target area to assist in shifting Nagato to a new berth.
1329	Anchored in berth 230.

10 July

0725-1236	Assisted in shifting target ship USS Arkansas (BB-33) to new berth.
1624	Placed boarding party aboard YO-160 in order to tow it.
1850	Proceeded to anchorage.
1905	Anchored in berth 74.

11 July

1010-1705	Assisted in moving target ship USS Nevada (BB-36) to buoy in target array.
1719	Anchored in berth 74.

12 July

0641-1120	Assisted in moving target ship USS Saratoga (CV-3) to new berth.
1153	Anchored in berth 74.

15 July

0810-1040	Assisted in towing and moving target vessel YOG-83 to new berth.
1137	Anchored near berth 131-A.

16 July

0554-0837	Assisted in moving Saratoga to new berth.
0854	Anchored in berth 251.

17 July

0645-0950	Assisted in moving target ship USS Crittenden (APA-77) to new berth.
1059-1420	Assisted target ship USS Salt Lake City (CA-25) in shifting berths.
1539	Anchored in berth 74.

23 July

1727-1813	Moored to target ship USS Mayrant (DD-402).
1824-1901	Moored to USS Palmyra (ARS[T]-3).
1911	Anchored in berth 74.

Shot BAKER (25 July, 0835)

24 July

1255	Underway for area outside of lagoon, steaming with TU 1.2.7.

25 July

1150	Anchored in berth Item.
1249-1314	Assisted in attempted salvage of sinking Saratoga.
1333	Anchored in berth Item.

26 July

1735-1827	Assisted in beaching damaged target ship USS Hughes (DD-410).
1859	Anchored in berth Item.

28 July

1256-1545	Assisted in towing and beaching target submarine USS Dentuda (SS-335).
1717	Proceeded to anchorage.
1805	Anchored near berth 377.

29 July

0830-1210	Took inspection teams to various target ships.
1354	Anchored near berth 377.

30 July — Towed target vessel LCT-816 to beaching area off Eneu Island.

1154	Anchored in berth Item.

1 August

0838-1155	Washed down target ships Mayrant and USS Trippe (DD-403).
1155	Proceeded to USS Avery Island (AG-76).
1417	Anchored in berth Item.

2 August — Shifted anchorage 1,675 yards (1.5 km) south of berth 377.

3 August

0859-1023	Sprayed Mayrant.
1056	Proceeded to anchorage.
1143	Anchored near berth 377.

6 August

1305-1631	Sprayed Trippe.
1640	Proceeded to anchorage.
1717	Anchored near berth Item.

7 August

0946	Began assisting in decontaminating Mayrant.
1220	Radiological technicians boarded Mayrant, then returned.
1309-1341	Sprayed Mayrant.
1359	Anchored near target ship USS Stack (DD-406).
1522	Proceeded to Mayrant.
1532-1723	Washed down Mayrant with saltwater.
1725	Proceeded to anchorage.
1739	Anchored in berth 74.

9 August

1759-1827	Moored to target ship USS Cortland (APA-75).
1851	Anchored in southern edge of berth 5.

17 August

0805-1046	Assisted in turning target ship USS Gasconade (APA-85) around to clear fouled anchor chain.
1046	Proceeded to USS Wildcat (AW-2).
1554	Anchored in berth 18.

19 August

1028	Moored next to Stack.
1135	Departed for Kwajalein Atoll with Stack in tow.

21 August

0837	Anchored Stack at Kwajalein.
1005	Anchored in berth C, Kwajalein Atoll.

22 August

0838-1500	Assisted in towing and anchoring target ships Nevada and Prinz Eugen before departing Kwajalein Atoll for Bikini Atoll.

23 August — Arrived at Bikini Atoll.

24 August — Took Gasconade in tow for Kwajalein Atoll.

26 August
0830 Anchored Gasconade at Kwajalein.
0852 Proceeded to USS Bexar (APA-237).
1353 Departed for Bikini.

27 August
1019 Moored alongside target ship USS Banner (APA-60).
1326 En route to Kwajalein with Banner in tow.

28 August En route to Kwajalein.

29 August
0850 Anchored Banner in berth 51, Kwajalein.
1005 Moored in assigned anchorage.

30 August Departed for Bikini.

31 August
0736 Anchored in berth 220, Bikini Atoll.

2 September
0750 Moored next to target vessel LCT-1013.
1520 Left Bikini Atoll for Kwajalein Atoll with target vessels LCT-1013 and LCT-705 in tow.

4 September
0734-1007 Anchored LCT-1013 and LCT-705 at Kwajalein.
1047 Underway to anchorage.
1109 Anchored in assigned anchorage.

7 September
1345-1459 Towed target vessel LCT-1078 to berth.

8 September Left Kwajalein for Pearl Harbor.

21 September Arrived at Pearl Harbor.

ATR-40

Crew Size: 68
Bikini Atoll Arrival: 21 May 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: Approximately 27 nmi (50 km) E
Shot BAKER Location: 11 nmi (20 km) SE
Decontamination Location: San Francisco
Operational Clearance: 17 December 1946
Final Clearance: 21 December 1946

Task Unit and Function
ATR-40 was a rescue ocean tug used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, and repair work on damaged target ships.

Shot ABLE (1 July, 0900)

30 June
1257 Underway for area outside of lagoon, steaming with TU 1.2.7.

1 July
0904 Felt a distinct shock.
1313-1430 Entered the harbor and fought a fire on target ship USS Saratoga (CV-3).
1437 Observed an explosion on target ship USS Independence (CVL-22).
1537 Went alongside USS Current (ARS-22) for a Geiger check; results were negative.
1816 Anchored in berth Jig, Bikini Atoll.

2 July
0800-1200 Assisted in clearing damaged target ships from target array.
1133 Witnessed sinking of target ship Sakawa.
1420 Proceeded to anchorage after standing by in target array while ATA-192 moored target vessel YO-160.
1501 Anchored in berth Jig.

6 July
0723-0937 Towed target ship USS Salt Lake City (CA-25) to its new berth.
1032-1355 Assisted USS Achomawi (ATF-148) in towing target ship USS Pensacola (CA-24) to new berth.
1457-1641 Reanchored Salt Lake City twice.
1706 Anchored in berth 139.

7 July
1113-1251 Assisted in towing target ship USS Dawson (APA-79).
1310 Anchored in berth 139.

9 July
1343 Moored next to target ship USS Hughes (DD-410).

10-11 July Moored next to Hughes.

12 July
0834 Hughes underway.

17 July
0700-0917 Assisted ATA-192 in moving target ship USS Crittenden (APA-77) to new position.
1202-1413 Assisted in moving target ship Nagato.
1516 Anchored in berth 139.

20 July
0730-1045 Assisted in anchoring YO-160.
1111 Anchored in berth 139.

Shot BAKER (25 July, 0835)

24 July
1325 Underway for area outside of lagoon, steaming with TU 1.2.7.

25 July
1137 Anchored in berth Oboe, Bikini Atoll.
1627-1645 A radiological monitor came aboard.
1720 Another monitor came aboard under the direction of Director of Ship Materials.

26 July Underway to assist USS Reclaimer (ARS-42) beach Hughes, then anchored in unidentified special anchorage near Eneu Island.

27 July
0905-1115 Obtained Geiger readings and washed down Hughes.
1245-1414 Towed target ship USS Fallon (APA-81) to beaching area.
1528 Reanchored in berth Oboe.

28 July Shifted to unidentified special berth.

29 July
1125-1430 Washed down target ship USS New York's (BB-34) weather surfaces using three monitors.
1630 Anchored in unidentified special berth.

30 July
0731-1312 Washed down New York's weather surfaces.
1340 Anchored in unidentified berth.

31 July
1103 Disposed of all rubbish overboard at the lagoon's entrance.
1155 Obtained another reading of New York.
1215-1530 Foamed New York.
1752 Anchored in berth Oboe.

2 August
0953 Towed ATR-87 to a new berth and anchored next to it.

6 August
0720-1523 Took readings of target ship USS Pennsylvania (BB-38) and washed it down twice. Afterwards washed down New York.
1544 Anchored in unidentified berth.

7 August
0852-1110 Washed down Pennsylvania and Dawson.
1519-1713 Washed down Pennsylvania again.
1725 Anchored in berth 139.

8 August
0810-1400 Washed down target ship USS Nevada (BB-36).
1710 Anchored in unidentified berth.

9 August
0813-1618 Provided pumps to Pennsylvania to pump seawater through portable eductors.
1658 Anchored in unidentified berth.

10 August
0832-1634 Conducted pumping operations on Pennsylvania.
1705 Anchored in berth 6.

12 August
0935-1120 A diver inspected the bottom of USS Palmyra (ARS[T]-3).
1521 Anchored in unidentified berth.

14 August Shifted to berth 9.

19 August
0728 Moored next to target ship USS Muqford (DD-389).
0937 Underway for Kwajalein with Muqford in tow.

21 August
1025 Anchored Muqford at Kwajalein.
1158-1217 Proceeded to target ship USS Bladen (APA-63) to transfer working party.
1217 Departed for Bikini.

22 August
1444 Anchored in berth 20, Bikini.

23 August Towed target submarine USS Skate (SS-305) from Bikini Atoll to Kwajalein Atoll.

24 August
1931-1943 Anchored Skate at Kwajalein.
2016 Anchored in assigned berth.

25-27 August At Kwajalein; worked around Pennsylvania for about 3 hours on 25 August and about 7 hours on 26 and 27 August.

29 August
0825-0908 Three radsafe monitors aboard to check ship, ship cleared of radiological activity.

8 September Departed Kwajalein en route to Pearl Harbor via Johnston Island with YF-991 in tow.

21 September Arrived Pearl Harbor.

ATR-87

Crew Size: 69
Bikini Atoll Arrival: Before 13 June 1946
Bikini Atoll Departure: 1 September 1946
Shot ABLE Location: Approximately 27 nmi (50 km) E
Shot BAKER Location: 35 nmi (65 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 13 December 1946
Final Clearance: By 4 January 1947

Task Unit and Function
ATR-87 was a rescue ocean tug used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, repair work, and firefighting on damaged target vessels.

Shot ABLE (1 July, 0900)

30 June
1258 Underway for area outside of lagoon, steaming with TU 1.2.7.

1 July
1425-1446 Arrived at target ship USS Pennsylvania (BB-38) and began fighting fires.
1527 USS Current (ARS-22) alongside to port; checking firefighting equipment for radioactivity.
1645 Arrived at target ship USS Cortland (APA-75) and began fighting fire.
1805 Withdrew from the area.
1850 Anchored in berth King, Bikini Atoll.

2 July
0926-1017 Assisted in towing target ship USS Independence (CVL-22).
1230-1445 Standing off target ship USS Dawson (APA-79).
1544 Anchored in berth King.

5 July
0903-1332 Towed target vessel LCT-1114 and moored it next to target vessel LCT-1115.
1423 Anchored in berth 156.

6 July
0745-1128 Assisted towing target ship USS Nevada (BB-36) to new anchorage.
1202 Anchored in berth 155.

7 July
0845-1134 Shifted berths of target ships USS Rhind (DD-404) and USS Crittenden (APA-77).
1225 Anchored in berth 156.

9 July
0720-1115 Assisted moving Independence to new berth.
1129 Anchored in berth 155.

ATR-87

11 July
0744-1450 Assisted shifting berths of target ships USS Brule (APA-66) and USS Fallon (APA-81).
1814 Anchored in berth 156.

12 July
0800-0935 Standing by as target ship USS Hughes (DD-410) anchored.
1030 Underway to target ship USS Gasconade (APA-85).
1100 Proceeding to anchorage.
1120 Anchored in berth 114.

17 July
0923-1438 Assisted towing and shifting berths of target ships USS Salt Lake City (CA-25) and Nagato.
1452 Anchored in berth 156.

23 July
0600-0905 Anchored the stern of target ship USS Briscoe (APA-65).
1451-1740 Photographs were taken of target submarine USS Skate (SS-305) and Independence.
1818 Anchored in berth 156.

Shot BAKER (25 July, 0835)

24 July
1224 A radiological monitor reported aboard.
1248 Underway for area outside of lagoon, steaming with TU 1.2.7.

25 July
1139 Anchored at Bikini Atoll in berth Nan.

26 July
1541 Underway to stand clear of berth while USS Reclaimer (ARS-42) beached Hughes.
1824 Anchored near berth Jig.

28 July
1513-1531 Washed down Hughes with firefighting monitors, then stood by while ATA-180 beached target submarine USS Dentuda (SS-335).
1840 Anchored near berth 377.

29 July
1647-1727 Washed down Hughes and target submarine USS Dentuda (SS-335).
1840 Anchored in unidentified berth.

30 July
0855-1238 Washed down target ship USS Pensacola (CA-24) with firefighting monitors.
1238-1300 Took Geiger readings on Pensacola.
1458 Anchored in berth Nan.

31 July
0955-1105 Laid a blanket of chemical foam on Pensacola.
1500 Anchored in berth Nan.

2 August
0957-1505 Towed by ATR-40 to new berth How.

6 August
0818-0933 Washed down target ship USS Bracken (APA-64).
1220-1345 Washed down Gasconade.
1412-1422 Radiological monitors boarded Gasconade.
1424-1455 Resumed washing Gasconade.
1459-1512 Radiological monitors reboarded Gasconade.
1516-1543 Washed down Gasconade.
1549 Underway from Gasconade.
1631 Anchored in unidentified berth.

7 August
0805-0955 Washed down Brule and took Geiger readings.
1304-1528 Washed down Bracken.
1545-1612 Radiological monitors were on board Bracken.
1652 Anchored in berth 156.

8 August
1325-1500 Washed down Pensacola.
1835 Moored alongside ATR-40 in berth 6.

9 August
0832 Standing by in vicinity of Dawson.
0931 Proceeded to anchorage.
1227-1420 Washed down Dawson and took Geiger readings.
1443 Anchored in berth 16.

10 August
0824 Moored alongside Nevada.
0830 Connected firehoses to a forward monitor in order to wash down the decks of Nevada.
1601 Disconnected all hoses.
1655 Anchored in berth 16.

20 August
1020 Moored next to target ship USS Trippe (DD-403).
1120 Departed Bikini Atoll for Kwajalein Atoll with Trippe in tow.

22 August
1250 Anchored Trippe at Kwajalein and then got underway to assigned anchorage.
1532 Departed for Bikini.

23 August
1538 Returned to Bikini Atoll.

24 August Towed APL-27 to Kwajalein Atoll.

27 August
1116 Returned to Bikini Atoll.

28 August
1010 Moored next to target ship USS Mustin (DD-413).
1055 Underway for Kwajalein Atoll with Mustin in tow

30 August
0906 Anchored Mustin at Kwajalein, then proceeded to anchorage.
1303 Departed for Bikini.

31 August
1045 Returned to Bikini Atoll.

1 September
1507 Moored next to target vessel LCT-1112.
1553 Left Bikini Atoll for Kwajalein Atoll with target vessels LCT-1112 and LCT-818 in tow.

3 September
0814-1208 Anchored LCT-1112 and LCT-818 in Kwajalein.
1242 Moored next to ATR-40.

4 September
1345-1400 Radsafe inspection party boarded; ship declared radiologically safe.

8 September Departed Kwajalein for Pearl Harbor via Johnston Island.

20 September Arrived Pearl Harbor.

USS AVERY ISLAND (AG-76)

Crew Size: 483
Bikini Atoll Arrival: Spring 1946
Bikini Atoll Departure: 7 August 1946
Shot ABLE Location: 15 nmi (28 km) SE, Area Federal
Shot BAKER Location: 15 nmi (28 km) SE, Area Federal
Decontamination Location: San Francisco
Operational Clearance: 3 December 1946
Final Clearance: By 4 January 1947

Task Unit and Function
Avery Island, classified as a miscellaneous ship, was used as a support ship in TU 1.1.2 (Instrumentation Unit). Its primary function was furnishing laboratory and base facilities for the Instrumentation Unit and Electronics Group. It aided in still photography, telemetering equipment for measuring ionized clouds, and infrared measuring on target vessels.

Shot ABLE (1 July, 0900)

30 June
1658 Underway for area outside of lagoon.

1 July
1545 Anchored in berth 54, Bikini Atoll.

2 July
1251 Changed anchorage to berth 108-A.

3-23 July Routine activities.

Shot BAKER (25 July, 0835)

24 July
1657 Underway for area outside of lagoon.

25 July
1443 Anchored in berth B, Bikini Atoll.

28 July
1710 Underway for area Mercury by order of JTF 1.

29 July
1109 Anchored in berth King, Bikini Atoll.

30 July Shifted to berth 20.

2 August Shifted to berth Baker.

7 August
0935 Departed Bikini Atoll for San Francisco.

USS BANNER (APA-60)

Crew Size: 104
Bikini Atoll Arrival: 28 May 1946
Bikini Atoll Departure: 27 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,250 yards (1.1 km) SE
Shot BAKER Location: 2,049 yards (1.9 km) W
Scuttled 16 February 1948, near Kwajalein Atoll

Task Unit and Function
Banner, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It served in Transportation Division 91 in TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
1217 Completed abandoning ship.

2 July
1610 Commanding officer with four officers and sixten enlisted men returned to Banner to inspect for damage; declared radiologically safe.
1840 Twenty-two additional men returned aboard from Bottineau.

3 July
1135 Remainder of the crew returned to Banner.

A 4 July damage report stated there was no major damage warranting any special inspection (Reference 2).

9 July
1100 Jettisoned one FM-2 Navy aircraft.

Shot BAKER (25 July, 0835)

23-24 July Crew evacuated to Bottineau.

25 July Ship heavily contaminated from the detonation. Crew remained aboard Bottineau.

8 August Crew transferred to USS Bexar (APA-237).

9 August
0845-1000 Commanding officer, four officers, and nine enlisted men boarded Banner with Director of Ship Material representatives to inspect for damage; inspection party returned to Bexar.

Banner deck log gives no evidence that the crew reboarded after 9 August.

11 August Commanding officer reported no major damage or flooding that required special inspection.

17-19 August Crew dispersed to USS George Clymer (APA-27), USS Haven (AH-12), USS Fall River (CA-131), USS Dixie (AD-14), remanned target ship USS Geneva (APA-86), and Bexar for transportation to the U.S. West Coast for reassignment.

23 August Topside average 0.33 R/24 hours (Reference 7).

27 August — Decommissioned and towed to Kwajalein by ATA-192 for radiological tests.

29 August — Arrived at Kwajalein.

1 October — Topside average 0.21 R/24 hours (Reference 7).

USS BARROW (APA-61)

Crew Size: 114
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 26 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Bexar
Shot ABLE Location: 1,375 yards (1.3 km) N
Shot BAKER Location: 2,075 yards (1.9 km) W
Scuttled 11 May 1948, near Kwajalein Atoll

Task Unit and Function
Barrow, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It served in Transportation Division 92 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
1130 — Crew evacuated to Bexar.

2 July
1539 — The commanding officer with a Geiger monitor and Team A boarded and started the inspection.
1700 — The ship was declared free of radioactivity and Team B came aboard.

3 July — Teams C and D and the remainder of the crew came back on board.

8 July
1515 — Jettisoned an FM-2 airplane condemned by CROSSROADS air group.

9 July
1420 — Jettisoned another test plane.

13 July
0855 — An F6F aircraft was delivered for shot BAKER.

Shot BAKER (25 July, 0835)

24 July
1040 — Barrow was secured and all personnel were evacuated to Bexar.

25 July — Barrow sustained heavy radiological contamination. The crew remained aboard Bexar until reassigned to other units.

The ship was secured until an unknown date. There was one inspection on 9 August for 1 hour, according to an inspection report (Reference 2).

23 August — Topside average 0.30 R/24 hours (Reference 7).

26 August — Towed to Kwajalein by USS Achomawi (ATF-148) for radiological studies and observation.

27 August — Arrived at Kwajalein.

28 August — Decommissioned.

1 October — Topside average 0.22 R/24 hours (Reference 7).

USS BARTON (DD-772)

Crew Size: 260
Bikini Atoll Arrival: 15 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 10 nmi (19 km) ENE
Shot BAKER Location: 10 nmi (19 km), ENE
Decontamination Location: San Francisco
Operational Clearance: 2 November 1946
Final Clearance: 18 December 1946

Task Unit and Function
The destroyer Barton was a support ship in Destroyer Division 71, TG 1.7 (Surface Patrol). It functioned as a survey ship throughout the operation; therefore special oceanographic and radiological equipment was installed.

Shot ABLE (1 July, 0900)

1 July — Sighted various fires on unidentified target ships after detonation.
1027 — Commenced taking soundings.
1030 — Entered Bikini Atoll Channel.
1058 — Started taking oceanographic soundings.
1159 — Left the lagoon for area west of the atoll.

2 July
0601 — Anchored in berth 367-A, Bikini Atoll.
0744 — Changed anchorage to 251-A.

3 July
1815 — Received PGM-23 alongside to pick up oceanographic survey party and water samples.

8-14 July — Took oceanographic soundings.

14 July — Returned to berth 147-W, Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July
1210 — Underway for patrol area outside of lagoon.

25 July
0941 — Began the safety survey of the lagoon.
1112 — Departed the lagoon for a radsafe patrol station west of the atoll.

26 July
0348 — Anchored in berth 342, Bikini Atoll.

28-29 July — Took oceanographic soundings.

29 July
1135 — Anchored.
1433 — Shifted berths.

30 July
1431 — Underway to fuel, then anchored in berth 147W.

31 July — Shifted to berth 147E.

2 August — Shifted to berth E.

10 August
1112 Departed Bikini Atoll to rendezvous with Destroyer Squadron 7 en route to Pearl Harbor.

USS BAYFIELD (APA-33)

Crew Size: 428
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 3 August 1946
Shot ABLE Location: 25 nmi (46 km) NE
Shot BAKER Location: 15 nmi (28 km) ENE
Decontamination Location: Puget Sound
Operational Clearance: 7 December 1946
Final Clearance: 10 February 1947

Task Unit and Function
Bayfield, an attack transport, was a support ship in Transportation Division 31, TU 1.3.1 (Transport Unit). Its function was the evacuation and berthing of personnel from target vessels.

Shot ABLE (1 July, 0900)

30 June
1527 Underway to evacuate target vessel crews to area outside of lagoon with TG 1.3.

1 July
1728 Anchored in berth 298.

2 July Shifted to berth 217.

Shot BAKER (25 July, 0835)

24 July
1525 Underway with TG 1.3 with personnel from various target ships for area east-southeast of surface zero.

29 July
0625 Anchored in berth A, Bikini Atoll and started disembarking teams and personnel of target ships.

30 July Shifted to berth 279.

2 August Shifted to berth 378.

3 August
1600 Departed Bikini Atoll for Kwajalein Atoll.

4 August Arrived at Kwajalein.

8 August Departed Kwajalein for San Francisco.

USS BEGOR (APD-127)

Crew Size: 155
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 3 August 1946
Shot ABLE Location: 15 nmi (28 km) ESE
Shot BAKER Location: 15 nmi (28 km) SE, Area Franklin
Decontamination Location: San Diego
Operational Clearance: 30 September 1946
Final Clearance: 25 January 1947

Task Unit and Function
Begor was a high-speed transport used as a support ship in TU 1.1.3. (Drone Boat Unit). Its function was the support of drone boats that collected water samples from the lagoon after the detonations. LCVP drones were directed to desired sample areas to obtain water samples after an adequate Geiger reading had been transmitted to controllers. When the mission was completed, drones returned to Begor where they were washed down with hoses by Begor and boarded by a safety officer. When safe, Underwater Demolition Team 3 (UDT-3) boat crew took over and transferred water samples.

Shot ABLE (1 July, 0900)

1 July
0544 Underway en route to area Franklin.
0715 On station, Area Franklin, maneuvering to keep on station.
1015 Maintaining station off Bikini Atoll for drone boat operation.
1130 Underway for assigned anchorage off Eneu Island, Bikini.
1215 Anchored off Eneu Island.
1528 Underway to berth 38, Bikini.
1610 Anchored at Bikini Atoll in berth 37.

Shot BAKER (25 July, 0835)

25 July
0540 Underway to reach station (Area Franklin) designated for BAKER day.
0709 Arrived on station for BAKER day.
0840 Steaming to assigned station off Eneu Island, Bikini.
1054 Anchored in area off of Eneu Island.

Two LCVP drones were monitored by boarding parties after detonation and were found very radioactive. Water samples collected were left aboard drones and recovered 2-1/2 hours later. Forty water samples (5 gallons [18.9 liters] each) were collected on BAKER Day.

28 July
1630 Shifted to berth Jig.

30 July Shifted to berth 37.

2 August Shifted to berth D.

3 August
1012 Departed Bikini Atoll for Pearl Harbor.

USS BENEVOLENCE (AH-13)

Crew Size: 673
Bikini Atoll Arrival: 22 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 21 nmi (39 km) NNE
Shot BAKER Location: 16 nmi (30 km) E
Decontamination Location: San Francisco
Operational Clearance: 24 September 1946
Final Clearance: April 1947

Task Unit and Function
Benevolence was a hospital ship used as a support ship in TU 1.8.4 (Medical Unit).

Shot ABLE (1 July, 0900)

30 June
1519 Underway for area Graham, steaming with TG 1.8.

1 July
1845 Anchored in berth 268, Bikini Atoll.

2 July
1536 Anchored in berth 145.

Shot BAKER (25 July, 0835)

24 July
1518 Underway for area Packard outside of lagoon.

30 July
0751 Anchored in berth 145, Bikini Atoll.

2 August Shifted to berth Nan.

7 August Shifted to berth 145.

14 August Shifted to berth 34A.

25 August Departed for Pearl Harbor via Kwajalein Atoll.

USS BEXAR (APA-237)

Crew Size: 293
Bikini Atoll Arrival: 10 June 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: 25 nmi (46 km) NE
Shot BAKER Location: 15 nmi (28 km) ENE
Decontamination Location: San Diego
Operational Clearance: 24 January 1947
Final Clearance: 1 February 1947

Function and Task Unit
Bexar, an attack transport, was a support ship in Transportation Division 31 of TU 1.3.1 (Transport Unit). Its function was to house target vessel crews during the detonations.

Shot ABLE (1 July, 0900)

30 June
1530 Underway for area outside of lagoon after embarking target vessel personnel, steaming with TG 1.3.

1 July
1739 Anchored in berth 297, Bikini Atoll.

2 July
1218 Shifted to berth 140.
1900 Completed disembarking target ship personnel.

16 July
1320-1420 Target ship YOG-83 came alongside to fuel Bexar.

Shot BAKER (25 July, 0835)

24 July
1526 Underway after embarking target vessel personnel for area Franklin, steaming with TU 1.3.1.

30 July
0649 Anchored in berth 278, Bikini Atoll.

2 August Shifted to berth 351.

3 August Shifted to berth 355.

7 August Shifted to berth 278.

17 August
1310 Began personnel disembarkation from target ships USS Barrow (APA-61), USS Crittenden (APA-77), and USS Banner (APA-60), and support ship USS George Clymer (APA-27).

19 August Shifted berths.

23 August
1530 Underway for Kwajalein Atoll.

24 August Arrived at Kwajalein.

29 August Departed Kwajalein for San Pedro, California, via Pearl Harbor.

USS BLADEN (APA-63)

Crew Size: 111
Bikini Atoll Arrival: 31 May 1946
Bikini Atoll Departure: 20 August 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Henrico
Shot ABLE Location: 2,810 yards (2.6 km) SE
Shot BAKER Location: 2,480 yards (2.3 km) SW
Decontamination Location: San Francisco
Operational Clearance: 6 November 1946
Final Clearance: 21 December 1946
Decommissioned 26 December 1946, Norfolk, Virginia

Task Unit and Function
Bladen, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It served in Transportation Division 93 of TU 1.2.6 (Merchant Type Unit).

Shot Able (1 July, 0900)

1 July
1420-1433 ATA-192 fought a fire aboard Bladen.
1730 Bladen cleared for boarding.

2 July The ship's crew reboarded Bladen.

13 July
0900 The commanding officer commenced a personnel and upper decks inspection of the ship.

Shot BAKER (25 July, 0835)

24 July Crew evacuated to Henrico.

25 July
1137 Bladen cleared for boarding.
1230 Geiger readings showed Bladen at 0.0002 R/24 hours (Reference 6, p. I-7-B).

28 July
1552-1602 Medical research unit removed test animals to USS Conserver (ARS-39).

29 July The crew returned aboard ship.

30 July Shifted to berth 246.

2 August Shifted to berth 331.

7 August Shifted to berth 262.

20 August Departed for Kwajalein Atoll.

21 August — Arrived at Kwajalein.

27 August — Radiological clearance issued.

30 August — Departed for Pearl Harbor.

BLISH, JOHN; see USS JOHN BLISH (AGS-10)

USS BLUE RIDGE (AGC-2)

Crew Size: 534
Bikini Atoll Arrival: 29 June 1946
Bikini Atoll Departure: 30 July 1946
Shot ABLE Location: 18 nmi (33 km) NNE
Shot BAKER Location: 10 nmi (19 km) ESE
Decontamination Location: Los Angeles
Final Clearance: By 22 November 1946

Task Unit and Function
Blue Ridge, an amphibious force flagship, was a support ship in TU 1.3.3 (Observers Unit). Its function was to carry observers for the operation and to provide communications.

Shot ABLE (1 July, 0900)

30 June
1559 — Underway with TU 1.3.3 for area outside lagoon.

1 July
1559 — Anchored in berth 207, Bikini Atoll.

2 July
0930 — Shifted to berth 21.

5 July
1701 — Underway for Kwajalein Atoll.

6 July
1005 — Arrived at Kwajalein to detach several passengers.
1508 — Left for Majuro Atoll.

7 July
1134 — Anchored at Majuro Atoll.

8 July
1003 — Departed for Truk Island.

14 July — Arrived at Truk Island for a brief stay.

15 July
0621 — Departed Truk Island for Guam.

17 July
1017 — Arrived at Guam.

18 July
1806 — Departed for Kwajalein Atoll.

23 July
1118 — Anchored in berth K-20, Kwajalein Atoll.

Shot BAKER (25 July, 0835)

24 July
1030 — Underway for Bikini Atoll.

25 July
1741 — Anchored in berth 383, Bikini Atoll.

28 July
1552 — Anchored in berth 357, Bikini.

30 July
1000 — Underway for Pearl Harbor via Rongelap Atoll.

USS BOTTINEAU (APA-235)

Crew Size: 299
Bikini Atoll Arrival: 7 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: >21 nmi (39 km) ENE
Shot BAKER Location: 20 nmi (37 km) E
Decontamination Location: San Francisco
Operational Clearance: 19 December 1946
Final Clearance: 27 December 1946

Task Unit and Function
Bottineau, an attack transport, was a support ship in Transportation Division 31 of TU 1.3.1 (Transport Unit). Its function was to house target vessel crews during the operation.

Shot ABLE (1 July, 0900)

30 June
1452 — Underway for area outside of lagoon after embarking personnel from target vessels.

1 July
1730 — Anchored in berth 299, Bikini Atoll.

2 July
1421 — Shifted anchorage to berth 224.

Shot BAKER (25 July, 0835)

24 July
1450 — Underway for area Marmon, outside of the lagoon, steaming with Divisions One and Two of TG 1.3.

30 July
0633 — Anchored in berth 261, Bikini Atoll.

2 August — Shifted to berth 356.

7 August — Shifted to berth 261.

10 August
0528 — Departed Bikini Atoll for Pearl Harbor.

USS BOUNTIFUL (AH-9)

Crew Size: 585
Bikini Atoll Arrival: 18 June 1946
Bikini Atoll Departure: 27 July 1946
Shot ABLE Location: 23 nmi (43 km) NE
Shot BAKER Location: 19 nmi (35 km) E
Operational Clearance: 27 September 1946
Final Clearance: 27 September 1946

Task Unit and Function
Bountiful, a hospital ship, was a support ship in TU 1.8.4 (Medical Unit).

Shot ABLE (1 July, 0900)

30 June
1449 — Left the lagoon for area outside of the atoll, steaming with TG 1.8.

1 July
1857 Anchored in the lagoon.

Shot BAKER (25 July, 0835)

24 July
1530 Left Bikini Lagoon for area outside the atoll, steaming with TG 1.8.

27 July
1600 Departed Bikini Atoll en route to Pearl Harbor.

4 August
1040 Moored at Pearl Harbor.

13 September Decommissioned at Seattle, Washington.

USS BOWDITCH (AGS-4)

Crew Size: 296
Bikini Atoll Arrival: 5 March 1946
Bikini Atoll Departure: 27 September 1946
Shot ABLE Location: 23 nmi (43 km) NE
Shot BAKER Location: Rongelap Atoll
Decontamination Location: San Francisco
Operational Clearance: 20 November 1946
Final Clearance: 20 November 1946

Task Unit and Function
Bowditch was a surveying ship used as a support ship in TU 1.8.5 (Survey Unit). Before task force arrival, Bowditch made a survey of the atoll and lagoon to prepare anchorage charts to be used in the operation. Enewetak and Rongelap atolls were also surveyed. Its function during the operation was to survey the biological effects of the tests on fish and wildlife. It also conducted oceanographic surveys to determine the character of currents in and around the atoll.

Shot ABLE (1 July, 0900)

30 June
1601 Underway from Rongelap Atoll for area Packard.

1 July
0910 Joined TG 1.8.
1847 Anchored in berth 322, Bikini Atoll.

2 July Shifted to berth 230.

12 July
0841 Reported a fire on USS Cumberland Sound AV-17).
0855 Extinguished fire aboard Cumberland Sound.

17 July
0556 Underway.
1411 Anchored in Rongelap Atoll.

Shot BAKER (25 July, 0835)

25 July Anchored at Rongelap Atoll.

1 August
0558 Underway for Bikini Atoll where it anchored in berth 251.

3 August Shifted to anchorage between berths 385 and Item.

4-26 August Anchored at Bikini, conducting routine activities.

27 September Departed Bikini Atoll for Pearl Harbor via Kwajalein Atoll.

USS BRACKEN (APA-64)

Crew Size: 108
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Various units
Shot ABLE Location: 2,010 yards (1.8 km) S
Shot BAKER Location: 1,475 yards (1.3 km) SSE
Sunk 10 March 1948, off Kwajalein Atoll

Task Unit and Function
Bracken was an attack transport used as a target vessel during CROSSROADS. Its crew was evacuated before ABLE. It served in Transportation Division 93 of TU 1.2.6 (Merchant Type Unit). Bracken was equipped by the Electronics Group with Geiger counters coupled to radio transmitters. It also carried water-pressure-telemetering channels to measure ionized clouds.

Shot ABLE (1 July, 0900)

30 June
1145 Three officers and eighty-four enlisted men evacuated to Henrico. Last-minute detail of two officers and ten enlisted men remained on board.

1 July Remaining Bracken crew evacuated before ABLE.
1402 A fire was reported on Bracken (Reference 5, p. B-11).
1403-1435 ATA-192 alongside target ships USS Niagara (APA-87), USS Bladen (APA-63), and Bracken to fight fires caused by nuclear detonation (Reference 1, ATA-192).
1412 USS Oneota (AN-85) reported fire on Bracken (Reference 1, Oneota).
1435 ATA-192 started cooling down Bracken (Reference 6, I-12-A).
1535 Bracken not cleared for boarding (Reference 6, I-12-A).
1542 Oneota reported a small fire on afterdeckhouse of Bracken (Reference 1, Oneota).

2 July
0816-0854 Boarding party from Oneota on Bracken (Reference 1, Oneota).
0940 Cleared for boarding (Reference 5, p. B-16).

3 July Bracken crew resumed berthing aboard ship.

Shot BAKER (25 July, 0835)

25-26 July Ship abandoned before test BAKER. Personnel were aboard USS Rockbridge (APA-228), Henrico, USS Appling (APA-58), and USS Gunston Hall (LSD-5).

27 July
0940 Bracken showed a 30-minute tolerance level.

USS Bracken (APA-64)

27 July

1004-1020 A boarding team boarded Bracken to recover instruments after monitors declared Bracken Geiger sour (Reference 1, Conserver).

1022 Bracken reported Geiger sour (Reference 6, p. I-21-B).

1400 All Bracken personnel on Rockbridge were transferred to Henrico.

28 July

1340 Monitor boarded Bracken.

1341 NMRS team boarded Bracken.

1352 All animals instruments, and teams were placed back on board USS Conserver (ARS-39) (Reference 1, Conserver).

31 July

0930-1015 Conserver washed down Bracken.

1604-1641 Conserver sprayed foam on Bracken (Reference 1, Conserver).

1 August USS Current (ARS-22) washed down Bracken; a boarding team was aboard Bracken for 13 minutes (Reference 1, Current). After three hosings, Geiger sour, 2 to 4 R/24 hours.

3 August Current washed down Bracken; boarded Bracken for 30 minutes (Reference 1, Current).

6 August

0731 ATR-87 underway, approaching Bracken.

0818-0933 ATR-87 washed down Bracken (Reference 1, ATR-87).

1024-1056 USS Chickasaw (ATF-83) washed down Bracken (Reference 1, Chickasaw).

7 August

1023-1056 Sprayed with decontamination solution by Chickasaw.

1228 ATR-87 approached Bracken.

1304-1528 ATR-87 washed Bracken down.

1545 ATR-87 moored portside to Bracken; radiological monitor boarded Bracken.

1612 Radiological monitor returned aboard (Reference 1, ATR-87).

8 August

1555-1620 DSM boarding team from USS Deliver (ARS-23) on Bracken (Reference 1, Deliver).

9 August

1500 Ten Bracken crewmembers were transferred to remanned target ship USS Geneva (APA-86).

10 August

0900-1130 Party reboarded ship to open it and make inspection for DSM inspection party. No damage due to bomb explosion except radiological contamination and displacement of about a quarter of the upper deck hatch boards. Party departed ship, leaving DSM instrument salvage team on board. Although the ship's log does not indicate when the DSM boarding team departed, it is believed that they left later that day.

The weather decks on 10 August showed considerable contamination after various washes by tugs, radiating 0.4 to 0.5 R/24 hours, except in the canvas and cordage where the value rose to as much as 1.0 R/24 hours. Cargo nets on the deck on each side of the #2 hatch showed 2.0 and 2.5 R/24 hours, which may have been caused by soaking up water used to wash off the deck. Below deck there was an average radiation of 0.03 R/24 hours, except where water had entered the ship through the two main hatches partly opened by the explosion and through doors and ports left open by advance boarding parties. The highest reading was about 1.0 R/24 hours from water on the main deck near the #2 hold (Reference 2).

13 August

0900 Four men reboarded ship to assist DSM radiological monitor in collecting test equipment.

1000 Ship abandoned. All Bracken personnel on Henrico transferred to Rockbridge.

14 August Topside average 0.7 R/24 hours (Reference 7).

15 August Ship abandoned; crew on Rockbridge, Geneva, and Gunston Hall.

0900-1200 Party reboarded ship to take in the starboard anchor and close condenser sea valves; USS Etlah (AN-79) alongside to furnish power to the windlass. Ship abandoned with starboard anchor housed.

17-18 August Bracken crewmembers transferred to USS George Clymer (APA-27), Geneva, and Gunston Hall.

19 August

0900 Four Bracken crewmembers transferred to Chickasaw for temporary duty to anchor Bracken at Kwajalein.

1010 Port bow chain cut above waterline and taken into tow by Chickasaw. Anchor detail on board 25 minutes.

21 August Anchored at Kwajalein. Anchor detail was aboard 1 hour and 5 minutes.

28 August Bracken decommissioned.

30 September Topside average 0.20 R/24 hours (Reference 7).

USCG Bramble (WAGL-392)

USCG BRAMBLE (WAGL-392)

Crew Size: 49
Bikini Atoll Arrival: 6 July 1946
Bikini Atoll Departure: 24 August 1946
Shot ABLE Location: 630 nmi (1,167 km) E
Shot BAKER Location: 21 nmi (39 km) WSW
Decontamination Location: Pearl Harbor
Final Clearance: By 22 November 1946

Task Unit and Function

Bramble served as a support ship in TU 1.8.5 (Survey Unit). Its function was to survey the effects of the nuclear tests on fish and wildlife and to conduct oceanographic surveys to determine the character of the ocean currents around and inside the atoll.

Shot ABLE (1 July, 0900)

24 June Left Pearl Harbor for Kwajalein Atoll.

4 July
0816 Arrived at Kwajalein Atoll.

5 July
1010 Underway for Bikini Atoll.

6 July
1212 Arrived at Bikini Atoll and anchored in berth 150.

Shot BAKER (25 July, 0835)

24 July
1400 Departed Bikini Lagoon to sortie with TU 1.8.7 in area Packard.

25 July
0855 Changed course for Rongelap Atoll.
1545 Anchored at Rongelap Atoll.

30 July
1732 Underway for Bikini Atoll.

31 July
0719 Anchored in berth 250, Bikini Atoll.

2 August Moved to an anchorage off of Eneu Island.

7 August Returned to berth 250.

23 August
1320 A monitor from USS Haven (AH-12) came on board to measure any radioactivity on moorings that were to be loaded.
1330 Loaded small boat moorings.
1639 Monitor left having found no radioactivity on moorings; the ship then completed picking up moorings.

24 August
1203 Underway for Kwajalein Atoll.

USS BRISCOE (APA-65)

Crew Size: 112
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 20 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 1,656 yards (1.5 km) S
Shot BAKER Location: 920 yards (841 meters) WSW
Sunk 6 May 1948, near Kwajalein Atoll

Task Unit and Function
Briscoe, an attack transport, was a target vessel during CROSSROADS. It served in Transportation Division 93 in TU 1.2.6 (Merchant Type Unit). Its crew was evacuated before shot ABLE. Briscoe carried transmitters for the Electronics Group and was also equipped with water-pressure-telemetering channels to measure ionized clouds.

Shot ABLE (1 July, 0900)

30 June
1020 Crew evacuated to Bayfield except for seven crewmembers and two civilians left aboard as last-minute personnel.

1 July
0405 Last-minute personnel evacuated to USS George Clymer (APA-27).

1600 Last-minute personnel joined ship's company on Bayfield.
1630 USS Reclaimer (ARS-42) proceeded to investigate Briscoe and other target ships (Reference 1, Skipjack).

2 July
0901 Boarding team from USS Clamp (ARS-33) boarded Briscoe for inspection.
0905 Firefighting team aboard Briscoe.
0917 Fire aboard Briscoe extinguished.
0925 Firefighting party departed Briscoe.
0947 Boarding party departed Briscoe (Reference 1, Clamp).
0948 Briscoe reported Geiger sweet (Reference 6, p. I-25-A). Damage reported as negligible (Reference 3, p. 3).
1055 Briscoe team A left Bayfield.
1140 Picked up Geiger man on USS Haven (AH-12).
1155 Reboarding team A, Geiger man, and civilian technicians reboarded.
1158 Commenced inspecting and opening ship.
1245-1450 Technicians came aboard to read ordnance instruments.
1335 Team B reboarded.
1400 Technicians came aboard to read electronics.
1506-1535 Technicians came aboard to read instruments.
1510 Technicians came aboard to read instruments.
1645 Team C reboarded.
1705-1715 Technicians came aboard to read instruments.

3-23 July Technicians periodically boarded.

12 July
0900-1125 Diving party aboard to install underwater instruments.
0915-1015 Diving party underwater.
1040-1125 Diving party underwater.

14 July
0900-1115 Divers working from an LCM on CROSSROADS instrumentation engaged in operations on the portside.

15 July
0915 Bureau of Ships Instrumentation Group began working on underwater blasting to test installed gauges.

20 July
0805-1015 Diving operations conducted in connection with gauge installation and tests.

23 July
0615 USS Achomawi (ATF-148) and ATR-87 alongside to assist ship in dropping stern anchor.

Shot BAKER (25 July, 0835)

24 July
0815-0945 Crew evacuated ship for Bayfield with the exception of six crewmembers and two civilians conducting last-minute details.

25 July Last-minute detail evacuated to USS Rockbridge (APA-228) prior to BAKER.

27 July
1355-1440 Last-minute personnel from Briscoe departed Rockbridge to join the crew on Bayfield.

29 July
0952 Briscoe had a 30-minute tolerance level (Reference 6, p. I-39-B).
1455-1504 Naval Medical Research Service (NMRS) team boarded Briscoe to remove instruments and animals.
1510 Briscoe Geiger sour. All animals recovered. Average Geiger readings on main deck 30 R/24 hours.
1602 All animals, instruments, and NMRS personnel returned to USS Burleson (APA-67).

30 July
1027-1038 ATA-185 recovered instruments from Briscoe.

31 July
0822-0902 USS Conserver (ARS-39) washed down Briscoe with saltwater.
1146-1213 Conserver sprayed mechanical and chemical foams on Briscoe.
1414-1452 Conserver sprayed mechanical and chemical foams on Briscoe (Reference 1, Conserver).

1 August USS Current (ARS-22) washed down Briscoe; boarding team on board for 3 minutes. After a 3-hour hosing, Briscoe still Geiger sour. Spot reading from frame 100, upper deck, was 4 to 5 R/24 hours.

2 August Members from Current boarded Briscoe for 64 minutes for an inspection (Reference 1, Current).

3 August
0800 Transferred crew and officers to USS Rockwall (APA-230).
0946 ATA-180 underway to Briscoe.
0952-1000 ATA-180 alongside Briscoe (Reference 1, ATA-180).

10 August
0840 Commanding officer and inspection party of DSM personnel and 14 crewmembers boarded the ship for a survey of damage and material conditions.
1045 Commanding officer and inspection party left the ship; remained on board between 20 minutes and 1 hour.

13 August
1000 Four-man boarding party came on to take draft and soundings with one monitor accompanying the boarding party.
1115 Boarding party left the ship.

15 August
0750 Commanding officer and 22-man boarding party reboarded and inspected the ship in company with DSM representatives and radsafe monitors.
1120 Reboarding and inspecting party returned to Rockwall, having operated emergency diesel fire pumps.

16 August
1200 Commanding officer with radsafe monitor and 8 crewmembers reboarded Briscoe for the purpose of hoisting the starboard anchor and slipping the stern anchor.
1330-1410 USS Suncock (AN-80) alongside to take up the anchor. Briscoe topside average 0.7 R/24 hours (Reference 7).
1600 Special boarding detail returned to Rockwall.

17 August Some crewmembers transferred to other units.

18 August Majority of remaining crew transferred to remanned target ship USS Niagara (APA-87).

20 August
1330 Taken in tow by USS Deliver (ARS-23) for Kwajalein. A four-man anchor detail from Briscoe boarded Deliver.

22 August Anchored at Kwajalein. Four-man anchor detail returned to Niagara.

30 September Topside average 0.40 R/24 hours (Reference 7).

USS BRULE (APA-66)

Crew Size: 111
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Bexar
Shot ABLE Location: 1,005 yards (919 meters) SE
Shot BAKER Location: 867 yards (793 meters) NW
Sunk 11 May 1948 near Kwajalein Atoll

Task Unit and Function
Brule, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for both shots. It served in Transportation Division 91 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
1200 All personnel evacuated to Bexar.

2 July
1042 Brule declared Geiger sweet.
1518 Teams A and B began returning to ship and took soundings.
1620 The ship was pronounced free of radioactivity.

4 July Entire crew had reboarded.

13 July
1255 An F6F airplane was brought on board.

Shot BAKER (25 July, 0835)

24 July
1025 All personnel were aboard Bexar.

25 July Sustained only minor physical damage from BAKER, but it received a considerable amount of radiological contamination.

29 July Radiological readings indicated no change in Brule's condition; it was assigned a one-half hour radiological tolerance

level. Brule crewmembers remained aboard Bexar.

12 August — Personnel began being transferred from Brule to other units.

13 August — Brule was inspected by a party from USS Wharton (AP-7) (Reference 8); due to the low readings the inspection was brief.

23 August — Topside average 2.7 R/24 hours (Reference 7).

28 August — Personnel transfers completed; Brule decommissioned. Departed Bikini Atoll for Kwajalein Atoll in tow by USS Chowanoc (ATF-100).

29 August — Arrived Kwajalein.

30 September — Topside average 0.72 R/24 hours (Reference 7).

USS BURLESON (APA-67)

Crew Size: 244
Bikini Atoll Arrival: 14 June 1946
Bikini Atoll Departure: 5 August 1946
Shot ABLE Location: Approximately 11.5 to 15 nmi (21.7 to 28 km) ESE
Shot BAKER Location: 11.5 nmi (21 km) ESE
Decontamination Location: Norfolk, Virginia
Final Clearance: By 14 October 1946

Task Unit and Function
Burleson, an attack transport, was a support ship in TU 1.1.2 (Instrumentation Unit). Its function was to provide laboratory and base facilities for the Instrumentation Unit. It housed the test animals used in the operation, providing animal pens, feed bins, autopsy rooms, and pathology, hematology, radiobiology and biochemistry laboratories.

Shot ABLE (1 July, 0900)

30 June
1640 — Underway for area outside of the lagoon in area Graham.

1 July
1527 — Anchored in berth 33A, Bikini Atoll.
1618 — Anchored in berth 115, B-12.
1640 — Boats 10 and 14 were detached to target ships USS Niagara (APA-87), USS Geneva (APA-86), and LCI-327 to remove animals from only the topsides of the ships.
1820 — Boats returned.

2 July
1317 — Shifted to berth 107.

7 July
1705 — Underway for Kwajalein Atoll.

19 July
1638 — Left for Bikini Atoll.

20 July
0913 — Arrived Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July
1644 — Left Bikini Lagoon for area Graham.

25 July
1253 — Anchored in berth Uncle, Bikini Atoll.

26 July
1600 — Reported distilling plant clear of radiation and ready for use.

28 July
1410 — All evaporators were secured due to radioactivity in the water.
1531 — Ordered out of the lagoon to area Mercury to await the return of an LCVP with an animal-retrieving party aboard.
1740 — Animal party returned; Burleson steamed out of lagoon.

29 July
0905 — Anchored in berth 383.

30 July
1125-1330 — Conducted diving operations to release clothing caught in starboard condenser intake.
1711 — Underway for Kwajalein Atoll.

31 July
1045 — Anchored at Kwajalein Atoll.

3 August
1814 — Departed for Bikini Atoll.

4 August
0856 — Anchored in berth D, Bikini Atoll. Personnel came on board for transfer to the United States.

5 August
1440 — Departed for Pearl Harbor.

USS BUTTE (APA-68)

Crew Size: 126
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237), USS Rockbridge (APA-228)
Crew Location for Shot BAKER: Bexar, Rockbridge
Shot ABLE Location: 2,025 yards (1.9 km) NW
Shot BAKER Location: >2,400 yards (2.2 km) WSW
Sunk 12 May 1948 near Kwajalein Atoll

Task Unit and Function
Butte was an attack transport used as a target vessel during CROSSROADS. Its crew was evacuated for both shots of CROSSROADS. It served in Transportation Division 92 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
0910-1035 — Most crewmembers were evacuated to Bexar; a small contingent boarded Rockbridge.

1 July
1619 — Butte reported Geiger sweet by radsafe patrols.

USS Butte (APA-68)

1 July

2026 A fire was reported on board (Reference 6, p. I-14-A; Reference 5, p. B-14).

2 July
1600 An inspection team reboarded Butte.
1615-1945 Preliminary damage inspection conducted.

3 July
0845 All Butte personnel reboarded.

Shot BAKER (25 July, 0835)

24 July
1020 Ship's crew was again evacuated to Bexar; last-minute personnel boarded Rockbridge.

25 July
1444 Butte declared Geiger sour (Reference 6, p. I-12-B).

Butte's crew remained aboard Bexar and Rockbridge after BAKER.

31 July Washed down by USS Current (ARS-22) with high-pressure streams (Reference 6, p. I-58-B).

3 August USS Clamp (ARS-33) reported Geiger team inspected ship; Geiger sour.

7 August
0800-1100 Radsafe monitor and boarding team boarded Butte; inspection results unknown.

8-9 August Entire ship's company returned to Butte and conducted decontamination procedures for approximately 8 hours each day, returning to Bexar each night for berthing. Butte readings are given in Table A.1. Contaminated items were either washed with a high-pressure hose or thrown overboard. Scraping of the ship went below the waterline. Further decontamination ordered stopped by order of DSM.

Table A.1. USS Butte (APA-68) decontamination.

Date	Location	Reading (R/24 hrs)
7 August	Waterline Average	0.3
	Average Exterior	0.5
	Maximum Exterior	1.5
	Average Interior	0.05
	Maximum Interior	0.3
9 August	Waterline Average	0.09
	Average Exterior	0.08
	Maximum Exterior	0.6
	Average Interior	0.05
	Maximum Interior	0.08
12 August	Topside Average	0.12
1 October	Topside Average	0.02

Sources: References 4 and 7.

17-28 August Butte personnel transferred to various units of the task force.

28 August Towed to Kwajalein and decommissioned. Butte remained at Kwajalein for further radiological study until it was sunk.

USS Carteret (APA-70)

USS CARLISLE (APA-69)

Crew Size: 104
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Various units
Shot ABLE Location: 450 yards (411 meters) SW
Sunk 1 July 1946, Bikini Atoll

Task Unit and Function
Carlisle, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before ABLE and never returned to the ship. It served in Transportation Division 92 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

Carlisle sank due to test ABLE damage. Diving operations were conducted for examination of the ship after shot ABLE until about 14 July.

Shot BAKER (25 July, 0835)

By 25 July Carlisle's crew had been transferred to various units of the fleet for the remainder of CROSSROADS. The units included USS Coucal (ASR-8), USS Orca (AVP-49), CTG 1.2.6, CTU 1.2.7, ComSerDiv Eleven, and CTU 1.2.5.

USS CARTERET (APA-70)

Crew Size: 119
Bikini Atoll Arrival: Before 8 June 1946
Bikini Atoll Departure: 25 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for shot BAKER: Bexar
Shot ABLE Location: 1,710 yards (1.6 km) SE
Shot BAKER Location: >2,400 yards (2.2 km) WSW
Sunk 19 April 1948, Kwajalein Atoll

Task Unit and Function
Carteret was an attack transport used as a target vessel during CROSSROADS. Its crew was evacuated before each shot. It served in Transportation Division 91 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
0930 Commenced evacuating ship.
1214 Commanding officer evacuated ship; ship completely evacuated to Bexar.

2 July
1011 A boarding team from USS Clamp (ARS-33) boarded Carteret.
1012 Fire party from Clamp boarded Carteret after report of a fire.
1020 Fire aboard Carteret extinguished.
1050 Parties aboard Carteret returned to Clamp (Reference 1, Clamp).
1058 Carteret declared Geiger sweet (Reference 6, I-28-A).
1400 Commanding officer returned accompanied by radiologist and Team A of ship's crew to make preliminary investigation of the entire ship.
1410 Team B reboarded.

USS Carteret (APA-70)

1530	Radiologist departed, having reported Carteret to be free of radioactivity.
1652	All hands returned to Carteret.

6 July

0543	Underway to shift berths.
0621	Anchored between berths 185 and 197.
1055	YO-63 moored to starboard.
1110-1125	Took on fuel from YO-63.

Shot BAKER (25 July, 0835)

24 July

0915	Commenced evacuating personnel to Bexar.
1034	Commanding officer left Carteret; completed evacuating the ship.

25 July

1404	USS Suncock (AN-80) was advised that Carteret was clear for boarding and directed to place a team aboard.
1420	The water around Carteret was Geiger sour (5 R/24 hours); Suncock awaited further instructions.
1621	Suncock directed to proceed from Carteret to special anchorage (Reference 1, Suncock).

27 July

1217-1224	USS Conserver (ARS-39) recovered instruments from Carteret (Reference 1, Conserver).
1225	Ship reported Geiger sour, and it was not cleared for boarding (Reference 6, p. I-22-B).
1230	Carteret Geiger sour. Team not placed aboard; Geiger reading 0.25 R at 8-foot (2.44-meter) distance. Two instruments hanging over stern recovered.

29 July

1430	Carteret declared Geiger sour (1 R/24 hours).
1450	Carteret approved for reboarding for a limited time; monitor present to guard against exceeding tolerance.

USS Current (ARS-22) moored alongside Carteret for 15 minutes; boarding team aboard for 15 minutes (Reference 1, Current).

31 July

1101	USS Preserver (ARS-8) underway to Carteret to take Geiger readings and spray with foam.
1137	Preserver completed taking Geiger readings; commenced spraying Carteret with powdered chemical foam.
1255	Preserver completed spraying Carteret and proceeded to target vessel LCT-705 (Reference 1, Preserver).

1 August

0742	Preserver underway to wash down Carteret in target array.
0810-1004	Preserver washed down Carteret with two 5-inch water monitors.
1017-1027	Preserver monitor team on board Carteret to take Geiger readings (Reference 1, Preserver).
1054-1105	Radiological monitor from Clamp boarded Carteret (Reference 1, Clamp).
1115	Average radioactivity aboard Carteret 0.14 R/24 hours; boarding team returned to Clamp.

2 August

1345-1645	The captain and working party with a radiologist boarded to conduct decontamination operations; returned to Bexar.
1720	Decontamination crew boarded Carteret after instructions on target ship USS Mugford (DD-389). The survey by the Geiger men indicated that the ship was clear below deck. Diesel generators were started and the boiler lit off. Decontamination work was carried out on the weather deck and upper deck throughout the day (Reference 4).

The final Geiger readings that day were: upper deck 1.2 R/24 hours, cabin deck 0.15 R/24 hours, poopdeck 1.2 R/24 hours, bridge deck 0.3 R/24 hours, catwalk between stacks 1.2 R/24 hours, signal bridge 0.5 R/24 hours, forecastle 1.2 R/24 hours. Two monitors were required all day without relief (Reference 4).

3-11 August	Decontamination work continued. Working parties generally boarded at 0745, returning to Bexar about 1630. A radiologist accompanied the teams each day. From 3 August to 1000 on 11 August, the commanding officer and a skeleton crew of engineers remained aboard at night to operate the ship's boilers.

13 August

0930	Captain, accompanied by the radiologist, returned to ship to obtain chronometers. Captain and radiologist left the ship.

14 August

0905-1100	Captain and working party boarded ship with radiologist to receive paint stores.

16 August

0830	Captain boarded ship with radiologist and working party to rig ship for painting.
1630	Captain and working party returned to Bexar.

17 August

0830	Captain boarded ship with radiologist and working party and commenced painting outer deck and superstructure.
1730	Captain and working party returned to Bexar.

18 August

0814-1715	Captain, crew, and radiologist on board to complete painting.

19 August	Decontamination operations were ordered discontinued, and the crew was transferred to USS George Clymer (APA-27).
20 August	Crew transferred to other ships; captain and one petty officer continued to live on Bexar.
25 August	USS Chowanoc (ATF-100) prepared Carteret for towing; Chowanoc departed for Kwajalein with Carteret in tow.
26 August	Ship decommissioned.

27 August — Chowanoc arrived at Kwajalein; cast off tow.

Table A.2 lists the Geiger readings taken aboard Carteret.

Table A.2. USS Carteret (APA-70) radiation readings.

Date	Reading (R/24 hours) Maximum Topside	Average Topside	Maximum Inside	Average Inside
3 August	1.5	0.6	0.4	0.7
4 August	1.2	0.6	0.8	---[a]
5 August	1.0	0.5	0.8	---
6 August	0.9	0.4	1.2	0.06
7 August	0.75	0.3	0.6	0.06
8 August	0.45	0.13	0.55	---
9 August	0.45	0.215	0.6	0.06
10 August	0.6	0.098	0.6	0.04
11 August	0.6	0.098	0.6	0.04
20 August	---	0.1	---	---
29 September	---	0.014	---	---

Note:

[a] --- signifies no reading available.

Sources: References 4 and 7.

USS CATRON (APA-71)

Crew Size: 116
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 26 August 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Henrico
Shot ABLE Location: 1,840 yards (1.7 km) S
Shot BAKER Location: 1,275 yards (1.2 km) SSE
Sunk 6 May 1948 near Kwajalein Atoll, after being retained there for radiological studies.

Task Unit and Function
Catron, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for both shots. It served in Transportation Division 93 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
1015 — Crew was evacuated to Henrico.

1 July
1531 — Catron declared Geiger sour by USS Clamp (ARS-33) (Reference 6, p. I-12-A).

2 July
1345 — Catron radiologically cleared for boarding (Reference 5, p. B-16), crew reboarded.

An 11 July commanding officer's damage report stated that the damage was superficial. While the animals aboard the ship were exposed, there was no real influence on the ship's materiel from the test (Reference 3).

Shot BAKER (25 July, 0835)

24 July
1030 — Crew evacuated to Henrico.

27 July
0946 — Catron showed a 1-hour tolerance level from 30 feet (9 meters) (Reference 6, p. I-20-B).

28 July
1429-1436 — Half the test animals were removed while the ship was still Geiger sour.

29 July
1344-1357 — Remaining test animals were removed.

2 August — Clamp administered a coat of foam to Catron (Reference 6, p. I-71-B).

12 August — Ten men boarded for 3 hours to open and inspect ship.

13 August — Boarding team boarded for 45 minutes to recover casualty badges. Crew transferred from Henrico to USS Rockingham (APA-229).

14 August — All crewmembers who were in reboarding teams on Catron were examined, with their clothing, for radioactivity by radiological monitors. No personnel showed any radioactivity. The shoes of two men showed radioactivity and were disposed of.

16 August — Fifteen men boarded for 4 hours in the morning to pump out engine room; eight men boarded for 1 hour in the afternoon to continue pumping out the engine room.

17 August — Seven men boarded for 1-1/2 hours in the morning to pump out engine room. Nine men boarded in the afternoon for a 2-hour inspection.

19 August — Nine men boarded for 1 hour in the morning to conduct pumping operations; pumping continued for 2 hours 45 minutes in the afternoon.

20 August — Twelve men boarded for 2 hours in the morning to conduct pumping operations; pumping operations continued for 2 hours 15 minutes in the afternoon.

21 August — Ten crewmen boarded in the morning for 2 hours 30 minutes to conduct pumping operations; six men boarded for almost 3 hours in the afternoon to continue pumping.

22 August — Eleven crewmen pumped the ship for 2 hours 20 minutes.

26 August — Went to Kwajalein Atoll.

28 August — Arrived at Kwajalein.

29 August — Decommissioned.

Average topside intensities measured aboard Catron were as listed below (Reference 7):

Date	Reading (R/24 hours)
3 August	6.0
6 August	4.0
8 August	2.5
12 August	1.5
22 August	0.87
25 September	0.35

USS CEBU (ARG-6)

Crew Size: 357
Bikini Atoll Arrival: 20 May 1946
Bikini Atoll Departure: 23 August 1946
Location for Shot ABLE: Kwajalein Atoll
Location for Shot BAKER: 19 nmi (35 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 16 December 1946
Final Clearance: 21 December 1946

Task Unit and Function

Cebu was an amphibious ready group repair ship used as a support ship in TU 1.8.1 (Repair and Service Unit). Its functions were salvaging, towing, and emergency repair work.

Shot ABLE (1 July, 0900)

1 July
- 1151 Underway for Bikini Atoll from Kwajalein.

2 July
- 0913 Anchored in berth 251-A, Bikini Atoll.
- 1419 Shifted to berth 207-A.

18 July
- 1400 Left for Rongelap Atoll.

19 July
- 0730 Arrived at Rongelap Atoll.
- 0832 Departed for Bikini Atoll, completing transfers to USS Bowditch (AGS-4) before leaving.
- 1642 Anchored in berth 207-A, Bikini Atoll.

21 July
- 0940 PGM-32 came alongside for repairs.
- 1049 PGM-29 came alongside for repairs.

22 July
- 0400 PGM-31 came alongside for repairs.
- 0850 A diving party left to make underwater repairs on USS Creon (ARL-11).
- 1630 Diving party returned.

23 July
- 1532 All PGMs had cast off.

Shot BAKER (25 July, 0835)

24 July
- 1359 Departed lagoon for area Packard.

25 July
- 0835 Operating in area Graham.
- 0949 Left for Rongelap Atoll.
- 1604 Anchored at Rongelap Atoll.

30 July
- 0834 Underway for Bikini Atoll.
- 1500 Anchored in berth 207A, Bikini Atoll.

1 August
- 0908 YMS-413 came alongside for repairs.
- 0925 YMS-354 came alongside for repairs.

2 August
- 1504 Underway for berth Roger.
- 1601 Anchored.

7 August
- 0920 Anchored in preliminary berth 207-A.

14-23 August Target ship LCI(L)-549, which had been radiologically cleared after shots ABLE and BAKER, alongside for repairs.

16 August
- 0900 Monitors came aboard to check evaporators. Evaporator working spaces reported clear of radioactivity and safe for personnel.

22 August No radiological hazards found except for the auxiliary condenser of the evaporators. It was, however, safe to operate under standard watch conditions. A four-man Radiological Safety Clearance Board team came aboard to inspect the ship.

23 August
- 1400 Departed Bikini Atoll for Kwajalein Atoll and thence to Pearl Harbor.

10 September Arrived at Pearl Harbor.

13 September A radsafe representative issued a conditional radiological clearance for Cebu and recommended sinking two 36-foot (11-meter) motor launches and an LCVP that were considered unsafe. It was further recommended that camels, a boat weight, and a port gangway fender be sunk; that men working on the starboard anchor chain wear gloves; and that all saltwater system lines be opened or welded only under radiological monitoring supervision. The radsafe recommendations were followed.

14 September Left for San Diego.

USS CHARLES P. CECIL (DD-835)

Crew Size: 287
Bikini Atoll Arrival: 4 June 1946
Bikini Atoll Departure: 25 July 1946
Shot ABLE Location: 42 nmi (78 km) ESE
Shot BAKER Location: Approximately 48 nmi (89 km) SE
Final Clearance: By 22 November 1946

Task Unit and Function

The destroyer Cecil was a support ship in Destroyer Division 5, Commander Destroyer Squadron 5, of TG 1.6 (Navy Air Group). Its function was to provide support for the drone and photographic aircraft operations.

Shot ABLE (1 July, 0900)

30 June
- 1612 Underway for operating area.

1 July
1547 Anchored at Kwajalein Atoll.

2 July
1605 Left for Bikini Atoll.

3 July
0620 Arrived Bikini Atoll.
0616 Underway to join TU 1.6.1.
0945 Anchored in berth 269.
1616 Departed for Kwajalein.

4 July
0654 Anchored at Kwajalein Atoll; conducted aircraft-tracking runs, fighter direction exercises, and battle exercises.

13 July Left Kwajalein Atoll for operating area to conduct flight operations in company with USS Shangri-La (CV-38) and USS Turner (DD-408).

14 July
1334 Anchored at Bikini Atoll in berth 248.

15 July
1615 Underway for Kwajalein Atoll after transferring personnel from USS Chickasaw (ATF-83).

16 July
0816 Arrived Kwajalein Atoll.

Shot BAKER (25 July, 0835)

24 July
1610 Underway with TG 1.6 for area outside of Bikini Lagoon.

25 July
1722 Anchored at Kwajalein Atoll.

28 July
1640 Departed for Pearl Harbor.

USS CHICKASAW (ATF-83)

Crew Size: 78
Bikini Atoll Arrival: 31 May 1946
Bikini Atoll Departure: 26 August 1946
Shot ABLE Location: Approximately 24 nmi (44 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Francisco
Operational Clearance: 13 January 1947
Final Clearance: 18 January 1947

Task Unit and Function
The fleet ocean tug Chickasaw was a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, towing, and emergency repair work.

Shot ABLE (1 July, 0900)

1 July
0528 Underway for operating area for shot ABLE.
1305 Entered Bikini Harbor in formation.
1350 Laying to, awaiting orders.
1425 Laying to, clear and east of target ships; awaiting radiological clearance.
1815 Anchored in berth F, Bikini Atoll.

2 July
0900 Picked up radiological monitors from USS Haven (AH-12).
1104-1205 Alongside target ship USS Independence (CVL-22) to collect pressure instruments.
1738 Completed assisting ATA-180 in towing Independence.
1800 Anchored near berth 307, Bikini Atoll.

3 July
0855 Ordered to stay in the vicinity of Independence.
0953 Anchored in berth 292.

7 July
0844-1337 Assisted shifting target ship USS Dawson (APA-79) to new berth.
1403 Anchored in berth 289.

9 July
0718-1105 Towed Independence to berth 214.
1137 Anchored in berth 75.

10 July
0846-1328 Towed target ship USS Arkansas (BB-33) to berth 161.
1356 Anchored in berth 75.

11 July
1231-1645 Towed target ship USS Nevada (BB-36) to its position in the target array.
1713 Anchored in unidentified berth in Bikini.

12 July
0650-1100 Towed target ship USS Saratoga (CV-3) to its new mooring.
1145 Anchored in berth 75.

15 July
1310-1521 Towed target ship USS Crittenden (APA-77) to new berth.
1540 Anchored in berth 75.

16 July
0635-0829 Towed Saratoga to assigned mooring buoy.
1450-1758 Towed target ship USS Mayrant (DD-402) to new berth.
1820 Anchored in berth 75.

18 July
1156-1304 Towed ATA-185 to new berth.

Shot BAKER (25 July, 0835)

24 July
1252 Underway for area outside of lagoon with TU 1.2.7.

25 July
1116 Reentered lagoon.
1143 Anchored in berth H.

28 July
1248-1649 Underway towing target submarine USS Tuna (SS-203) to lee side of Rochikarai Island.
1725 Anchored near berth 378.

29 July
0905 Underway to spray foam on target ship USS Hughes (DD-410).
0940-1829 Anchored in vicinity of Hughes.
1902 Anchored in unidentified berth in Bikini.

30 July
1758 Underway for Rongelap Atoll.

31 July
0658 Anchored Rongelap Atoll.
1319 Underway to Bikini Atoll with LCT-1420 and LCT-1184 in tow.

1 August
0929 Anchored at Bikini Atoll in berth H, after casting off both LCTs.

2 August Shifted to anchorage near berth 378.

5 August
1447-1558 Washed down target ship USS Gasconade (APA-85).
1649 Anchored near berth 378.

6 August
0912-1012 Sprayed Gasconade with a special solution.
1024-1056 Washed down target ship USS Bracken (APA-64), then got underway.
1510 Anchored near berth 378.

7 August
1023-1056 Sprayed Bracken with decontamination solution, then got underway.
1327 Anchored in berth 75.

8 August
1300-1402 Lifted three boxes from target ship USS LST-545 to LCM-26.
1438 Anchored in berth 75.

9 August
0810-1013 Washed down target ship USS Brule (APA-66).
1027 Washed down Dawson.
1159 Anchored in berth 53.

13 August
1339-1427 Washed down target submarine USS Parche (SS-384).
1515-1628 Washed down target submarine USS Skate (SS-305).
1711 Anchored in berth 54.

19 August
1010 Underway to Kwajalein Atoll with Bracken in tow.

21 August
1204 Anchored Bracken at Kwajalein.
1724 Underway to Bikini.

22 August
1045 Anchored in berth 53, Bikini Atoll.

23 August
1059 Departed for Kwajalein Atoll with target ship USS Salt Lake City (CA-25) in tow.

25 August
1155 Anchored Salt Lake City at Kwajalein Atoll.
1617 Left for Bikini Atoll.

26 August
1147 Anchored Bikini Atoll.
1257 Underway for Kwajalein Atoll with target ship USS Catron (APA-71) in tow.

28 August
1239 Anchored Catron at Kwajalein, then proceeded to anchorage.

31 August
1423-1629 Moored Crittenden to Dawson.

7 September Departed Kwajalein for Guam.

USS CHIKASKIA (AO-54)

Crew Size: 176
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: 28 nmi (52 km) N
Shot BAKER Location: Kwajalein Atoll
Decontamination Location: San Francisco
Operational Clearance: 31 December 1946
Final Clearance: 4 January 1947

Task Unit and Function
Chikaskia, an oiler, was a support ship in TU 1.8.1 (Repair and Service Unit). Its function was to provide provisions, fuel, and water, to other support ships.

Shot ABLE (1 July, 0900)

1 July Steaming in column with seven other ships.
1835 Anchored in berth 324.

6 July
0848-1340 Refueled target ship USS Saratoga (CV-3).

10 July
0716-1155 Refueled target ship USS Pennsylvania (BB-38).
1632 Anchored next to target ship USS Nevada (BB-36). Remained anchored next to Nevada overnight.

11 July
0752 Underway from Nevada.

14 July
0739-1050 Fueled target ship USS Arkansas (BB-33).
1744 Anchored in berth 267.

21 July Departed for Kwajalein.

22 July Anchored at Kwajalein to replenish fuel supply.

Shot BAKER (25 July, 0835)

25 July
0952 Departed Kwajalein for Rongelap.

26 July
0825 Anchored at Rongelap.

30 July
1040 Departed Rongelap for Bikini after refueling ships.
1735 Anchored in berth 250, Bikini.

2 August
1629 Underway to discharge contaminated oil; believed to be contaminated from foreign material, not from radiation.

1832	Anchored 600 yards (549 meters) southwest of buoy 1).
3 August	Left Bikini for Kwajalein after refueling ships.
4 August	Anchored at Kwajalein.
5-12 August	Refueled and serviced ships at Kwajalein.
13 August	Departed Kwajalein for Bikini.
14 August	Returned and anchored at Bikini, berth 205.
20 August	
1150-1340	Fueled target vessel LCT-1115.
1430-1510	Radsafe party inspected ship; ship found free of radioactivity.
23 August	Underway for Kwajalein.
24 August	Arrived at Kwajalein. Departed for Pearl Harbor with barracks ship APL-34 in tow.
2 September	Arrived at Pearl Harbor.

USS CHOWANOC (ATF-100)

Crew Size: 88
Bikini Atoll Arrival: 28 May 1946
Bikini Atoll Departure: 28 August 1946
Shot ABLE Location: 94 nmi (174 km) SSE
Shot BAKER Location: 18 nmi (33 km) SSE
Decontamination Location: Pearl Harbor
Final Clearance: 1 February 1947

Task Unit and Function

The fleet ocean tug Chowanoc was a support ship in TU 1.8.1 (Repair and Service Unit). Its functions were salvaging, towing, and offloading supplies and equipment.

Shot ABLE (1 July, 0900)

30 June	
1532	Underway for Kwajalein Atoll with YO-132 in tow.
1 July	
0908	Reversed course and headed back to Bikini Atoll.
2 July	
0755	Anchored in berth 43, Bikini Atoll.
0843	Cast off YO-132 and underway to USS Bowditch (AGS-4) to discharge passengers.
0948	Underway for Kwajalein Atoll.
3 July	Arrived at Kwajalein.
1122	Left for Bikini Atoll with YF-753 in tow.
4 July	
1229	Anchored near berth 191A in Bikini Atoll.
5-9 July	Moored near USS Sioux (ATF-75) and USS Cebu (ARG-6) for repairs.
10 July	Anchored in berth 191A.
13 July	
0912-1226	Unloaded Army gear from target ship USS Pennsylvania (BB-38) to LCT-1415 and towed LCT to anchorage and YF to Sioux.
1800	Ordered to assist USS Safeguard (ARS-25), which was in trouble northeast of the lagoon.
1804	Underway to Safeguard.
14 July	En route to rendezvous with Safeguard.
15 July	Towed Safeguard to Enewetak Atoll.
16 July	Released Safeguard and departed for Bikini Atoll.
17 July	
1834	Anchored at Bikini Atoll. Went alongside target ship USS Independence (CVL-22) for about 5 minutes to moor YW beside it; moored to target ship USS Arkansas (BB-33) for 1 hour to unload cargo.
18 July	Alongside Independence for 10 minutes.
23 July	
0836	Departed for Rongelap Atoll with YF-990 in tow.
1952	Moored at Rongelap Atoll.
2142	Departed for Bikini Atoll after mooring YF-990 to USS Quartz (IX-150).

Shot BAKER (25 July, 0835)

24 July	
0618	Anchored at Bikini Atoll.
1610	Underway for area outside of lagoon.
25 July	
0905	Changed course for Rongelap.
1516	Anchored at Rongelap Atoll.
26-30 July	At Rongelap; routine activities.
30 July	Left Rongelap Atoll
31 July	
0815	Anchored in berth 207, Bikini Atoll.
1232	Shifted to berth 191A.
1-3 August	Scientific party attempted to recover recording equipment from Nam and Iroij islands, Bikini Atoll.
3 August	
1606	Anchored in berth 364.
6 August	Washed down target ship USS Ralph Talbot (DD-390) for about 4-1/2 hours.
7 August	Washed down target ship USS Rhind (DD-404) for 2 hours. Washed down target submarine USS Searaven (SS-196) for 1 hour.
8-9 August	Routine activities.
10 August	Pumped water from target ship USS Gasconade (APA-85) for an unspecified period of time.
11-13 August	Routine activities.

14 August — Alongside target ships USS Wilson (DD-408) (2-1/2 hours), USS Trippe (DD-403) (2 hours), and USS Mayrant (DD-402) (1 hour, 50 minutes) to retrieve torpedoes; all torpedoes were placed on LCT-1116.

15 August — Alongside target ship USS New York (BB-34) for 20 minutes to transfer torpedoes to LCT-1116.

16-19 August — Routine activities.

20 August — Alongside target ship USS Pennsylvania (BB-38) for 4 hours, 20 minutes, assisting in swinging it to remove twists in anchor chains.

21 August — Prepared Pennsylvania for tow and departed for Kwajalein.

22-23 August — En route to Kwajalein with Pennsylvania in tow.

24 August — At Kwajalein; cast off tow and set return course for Bikini.

25 August — At Bikini, prepared target ship USS Carteret (APA-70) for tow; departed for Kwajalein.

26 August — En route to Kwajalein with Carteret in tow.

27 August — At Kwajalein; cast off tow; underway for Bikini.

28 August — At Bikini. Prepared target ship USS Brule (APA-66) for tow; departed for Kwajalein with Brule in tow.

30 August — Arrived at Kwajalein, cast off tow, and proceeded to anchorage.

31 August — Assisted target ship USS Geneva (APA-86) for 25 minutes.

9 September — Assisted target submarine USS Skipjack (SS-184) in drydocking.

10 September — Radsafe monitors boarded Chowanoc for 40 minutes to test the ship's hull for radioactivity (results unknown).

16 September — Departed Kwajalein for Pearl Harbor with ARD-29 in tow. That evening heaved over five radioactive fenders.

3 October — Arrived at Pearl Harbor.

USS CLAMP (ARS-33)

Crew Size: 88
Bikini Atoll Arrival: 15 March 1946
Bikini Atoll Departure: 28 August 1946
Shot ABLE Location: 27 nmi (50 km) E
Shot BAKER Location: 12 nmi (22 km) NNE
Decontamination Location: Los Angeles
Final Clearance: By 22 November 1946

Task Unit and Function

Clamp was a salvage ship used as a support ship in TU 1.2.7 (Salvage Unit). Before the operation the ship was involved in towing, diving, demolition, and underwater photography functions in preparation for the arrival of the task force. During the operation its function was as a submarine rescue ship.

Shot ABLE (1 July, 0900)

30 June
- 1300 — Underway for area outside of lagoon, steaming with TU 1.2.7.

1 July
- 1443 — Ordered to put boarding team No. 2 aboard target ship USS Catron (APA-71) after receiving radiological clearance.
- 1450 — Underway from alongside Catron.
- 1510 — Moored next to Catron.
- 1515 — Boarding team returned; underway from alongside, laid to southwest side of target ship USS Saratoga (CV-3).
- 1632 — Underway, proceeded to target ship USS New York (BB-34).
- 1646 — Moored next to New York after receiving radiological clearance.
- 1648-1742 — Boarding team boarded New York.
- 1750 — Underway from New York to anchorage.
- 1905 — Anchored in berth Item.

2 July
- 0820-0850 — Boarding team boarded Catron for an inspection.
- 0901 — A boarding team boarded target ship USS Briscoe (APA-65) for an inspection.
- 0905 — A firefighting team was placed aboard Briscoe.
- 0917 — The fire aboard Briscoe was extinguished.
- 0925 — The firefighting party departed Briscoe.
- 0947 — The boarding party departed Briscoe.
- 1011 — A boarding team boarded target ship USS Carteret (APA-70).
- 1012 — A fire party boarded Carteret after a report of a fire.
- 1020 — The fire aboard Carteret was out.
- 1050 — The parties returned to Clamp.
- 1115-1150 — A boarding team boarded target ship USS Banner (APA-60) to inspect ship.
- 1242-1320 — A boarding team was placed on target ship USS Ralph Talbot (DD-390) for an inspection.
- 1415 — A boarding team boarded target ship Nagato.
- 1417 — A fire party boarded Nagato.
- 1509 — The fire aboard Nagato was out.
- 1525 — All parties returned to Clamp.
- 1541 — A boarding team boarded target ship USS Nevada (BB-36).
- 1545 — A fire party boarded Nevada.
- 1605 — The fire on Nevada was out and fire party returned to Clamp.
- 1647 — The boarding party returned to Clamp.
- 1827 — Moored near USS Deliver (ARS-23) after disembarking initial boarding team to USS Wharton (AP-7).

5 July
- 1321-1441 — Towed target ship USS Hughes (DD-410) to its new berth.
- 1850 — Moored alongside Nagato, remaining at that location overnight.

6 July — Alongside Nagato, conducting operations to hoist its anchor.

7 July
- 0619 — Underway from alongside Nagato.

USS Clamp (ARS-33)

0944	Anchored in berth 49.
8-10 July	Moored to buoy in target array. Installing assemblies on mooring buoys in target area for purpose of mooring target ships.
11 July	
1114-1633	Retrieved target vessel ARDC-13's anchor and took it in tow to its new berth.
1855	Anchored in berth 74.
12 July	
1035-1110	Conducted diving operations to clear fouled line from propeller shaft.
1430-2014	Worked in target area installing assemblies on mooring buoys.
13 July	
0925-2037	Towed ARDC-13 to target array.
2103	Anchored in berth 51.
14 July	
0637-0853	Conducted diving operations to retrieve ATA-180 anchor.
1135-1425	Conducted diving operations to retrieve ARDC-13 anchor.
1520	Anchored in berth 74.
15-16 July	Prepared mooring buoys in the target array.
16 July	
1845	Anchored in berth 74.
Shot BAKER (25 July, 0835)	
24 July	
1246	Underway for operating area after picking up a radsafe team.
25 July	
1207-1225	Boarding team boarded target ship USS Bladen (APA-63).
1304-1306	Boarding team boarded target ship LCI(L)-549.
1355	Anchored in berth Baker, Bikini Atoll.
1413	Underway for target vessel LCT-1013.
1451-1459	Boarding team boarded LCT-1013.
1500	Underway from LCT-1013.
1609	Observed the sinking of Saratoga.
1641	Returned to anchorage in berth Baker.
27 July	
0835	Underway for USS Kenneth Whiting (AV-14) to pick up members of the Instrumentation Group.
1019-1144	Alongside target ship USS Niagara (APA-87).
1200-1201	Alongside target ship USS Geneva (APA-86) to pick up instruments.
1209	Alongside Bladen.
1212-1317	Instrumentation Group boarded Bladen.
1330-1343	Boarded target ship USS Fillmore (APA-83) for an inspection.
1420	Instrumentation Group members returned to Whiting.
1623	Moored near USS Chickasaw (ATF-83).
28 July	Shifted to anchorage 1,450 yards (1.3 km) south of berth 380.
30 July	
0917-1017	Moored portside to instrument tank with the technical directors aboard to retrieve the tank, after which the directors returned to Whiting.
1352-1505	Covered target ship USS Conyngham (DD-371) with chemical foam.
1523-1543	Alongside target ship USS Mugford (DD-389) to cover it with foam.
1728	Anchored in berth Baker.
31 July	
1116-1235	Washed down target ship USS Salt Lake City (CA-25).
1241	Anchored off Bikini Island.
1422-1800	Alongside USS Tombigbee (AOG-11) and then USS Sylvania (AKA-44).
1843	Anchored in berth Baker.
1 August	
0911-0932	Washed down target ship USS Pensacola (CA-24).
1010	Investigated smoke on target ship USS Wainwright (DD-419).
1020-1031	Alongside target ship Prinz Eugen while a radiological monitor boarded.
1053-1106	Alongside Carteret while a radiological monitor boarded the target ship.
1123-1145	Washed down Pensacola.
1359	Moored next to USS Chickasaw (ATF-85).
2 August	
0740	Picked up boarding team from Wharton and proceeded to Catron.
0826-1056	Washed down Catron.
1100-1108	A boarding team conducted an inspection on Catron.
1120-1149	Applied foam to target vessel LCT-1013.
1405-1435	Sprayed LCT-1113.
1440-1447	A boarding team boarded LCT-1113.
1512-1557	Washed down LCT-1013.
1625-1630	Boarding team boarded LCT-1013.
1815	Anchored near berth 380.
3 August	
0835-0851	Boarding team from Wharton boarded target ship USS Butte (APA-68).
0925-0934	A boarding team boarded Talbot.
0950-1058	Washed down Talbot.
1104-1126	A boarding team boarded Butte.
1446	Moored next to Chickasaw.
7 August	
0845	Began washing down Nevada.
0914	A seven-man party boarded Nevada to assist decontamination operations.
1203	Decontamination operations on Nevada ceased.
1449-1531	Renewed decontamination operations aboard Nevada.
9 August	
0828	Began decontamination operations on target ship USS Dawson (APA-79).
0838	A party of six boarded Dawson to assist decontamination operations.
0914	Completed decontamination operations aboard Dawson.
1034-1155	Washed down target ship USS Brule (APA-68).
1350-1442	Washed down Brule.
1501	Anchored in berth 33.

13 August	
1459-1653	Conducted towing operations on Hughes. Moored Hughes to buoy 18 near Ionchebi Island and remained moored next to it.
14 August	
0933	Underway from alongside Hughes to anchorage.
0937	Anchored near Ionchebi Island.
15 August	
1015-1042	Conducted diving operations to repair damage on Hughes.
19 August	
0807-0900	Laying to near Geneva.
0923	Laying to in vicinity of target ship USS Independence (CVL-22).
1050-1140	Conducted pumping operations on Pensacola.
1154	Anchored in berth 219.
21 August	
0740-0832	Moored next to Salt Lake City.
0847-0914	Moored next to Pensacola.
22 August	
0752-0857	Moored to Pensacola.
1146	Anchored near Eneu Island, preparing to take target ship USS Fallon (APA-81) in tow.
23-24 August	Anchored near Fallon, which was beached off Eneu Island.
25 August	
1358-1700	Towed Fallon to mooring buoy.
1717-1840	Conducted diving operations on Fallon.
2101	Anchored in berth 218.
26 August	
1211	Left Bikini for Kwajalein with target ship USS LST-52 in tow.
27 August	
1630	Entered Kwajalein Atoll harbor and let go LST-52.
1926	Underway for Bikini Atoll.
28 August	
1402	Anchored at Bikini Atoll.
1834	Left for Kwajalein Atoll with target ship USS LST-545 in tow.
30 August	
1225	Anchored LST-545 at Kwajalein Atoll.
31 August	
1530-1600	Target ship LCI(L)-549 alongside.
5 September	Departed Kwajalein for Pearl Harbor.
16 September	Arrived Pearl Harbor.

CLYMER, GEORGE; see USS GEORGE CLYMER (APA-27)

USS COASTERS HARBOR (AG-74)

Crew Size: 195
Bikini Atoll Arrival: Prior to 1 June 1946
Bikini Atoll Departure: 15 August 1946
Shot ABLE Location: 23 nmi (43 km) N
Shot BAKER Location: 17 nmi (32 km) E
Decontamination Location: Los Angeles
Operational Clearance: 7 December 1946
Final Clearance: 13 December 1946

Task Unit and Function

Coasters Harbor was a survey ship used as a support ship in TU 1.8.1 (Repair and Service Unit). Its function was to aid in the repair of damaged target vessels.

Shot ABLE (1 July, 0900)

30 June	
1427	Underway for area Packard.
1 July	
1650	Reentered Bikini Lagoon.
1840	Anchored in berth 286, Bikini Atoll.
2-23 July	Shifted to berth 108. Engaged in routine activities.

Shot BAKER (25 July, 0835)

24 July	
1420	Underway for area Packard.
25 July	
1618	Anchored at Rongelap Atoll.
30 July	
0734	Departed for Bikini Atoll.
1557	Anchored in berth 9, Bikini.
1 August	
0725	Underway to sea to pump contaminated fuel oil (contamination believed to be from foreign matter and not from radiation).
0905-1235	Pumped contaminated oil overboard.
1435	Anchored in berth 269.
3 August	Shifted to berth Nan.
7 August	Shifted to berth 269.
14 August	
1350-1500	JTF-1 radsafe section boarded, inspected, and declared ship free of all radioactivity.
15 August	Departed for Kwajalein Atoll with crews of target ships USS Bracken (APA-64), USS Barrow (APA-61), USS Butte (APA-68), USS Carteret (APA-70), USS Nevada (BB-36), USS Pensacola (CA-24), and USS Wainwright (DD-419) aboard.
16 August	Arrived Kwajalein.
17 August	Departed Kwajalein for Pearl Harbor.
28 August	Arrived Pearl Harbor.

USS CONSERVER (ARS-39)

Crew Size: 86
Bikini Atoll Arrival: 29 March 1946
Bikini Atoll Departure: 5 September 1946
Shot ABLE Location: Approximately 27 nmi (50 km) E
Shot BAKER Location: >12 nmi (22 km) SE
Decontamination Location: Pearl Harbor

USS Conserver (ARS-39)

Operational Clearance: 4 May 1947
Final Clearance: 11 May 1947

Task Unit and Function

Conserver was a salvage ship used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, and emergency repairs.

Shot ABLE (1 July, 0900)

30 June
- 1255 Underway for area outside of the lagoon, steaming with TU 1.2.7.

1 July
- 1338 Anchored in berth Baker, Bikini Atoll.

2 July
- 1015-1115 Placed a boarding team on target ship USS Rhind (DD-404).
- 1115-1143 Boarding team on target ship USS Stack (DD-406).
- 1300-1310 A boarding team and fire party boarded target ship USS Dawson (APA-79) to extinguish a fire.
- 1322 Boarding and fire teams left Dawson.
- 1451 Inspected target ship Prinz Eugen.
- 1454 Proceeded to target ship USS Arkansas (BB-33).
- 1601 Extinguished fires aboard Arkansas.
- 1640 Boarding teams returned to Conserver.
- 1740 Reanchored in berth Baker.

4 July
- 0805-1055 Removed stack of target ship USS Salt Lake City (CA-25).
- 1350 Dropped stack of Salt Lake City in water.
- 1812 Anchored in berth 50.

6 July
- 1330-1712 Cleared damaged equipment from target ship USS Nevada (BB-36).

7 July — Continued salvage operations on Nevada.

9-10 July — Continued salvage operations on Nevada.

11 July — Removed heavy gear from Arkansas.

12 July
- 0744-1115 Removed a half-track and an armored car from Nevada and transferred them to LCT-1420.

13 July
- 0944-1144 Removed 155-mm guns from Arkansas.

14 July
- 0743-0825 Transferred 155-mm gun and carriage from Arkansas to LCT-1420.
- 0902-0945 Conducted salvage operations on Arkansas.
- 1030 Anchored in Bikini Lagoon.

15 July
- 0725-1340 Removed a half-track and an armored car from target ship USS Pennsylvania (BB-38) and transferred them to LCT-1420.
- 1559-1744 Engaged in other salvage operations on Pennsylvania and transferred equipment to LCT-1420.

16 July
- 0950-1132 Conducted operations to recover sunken LCVP.
- 1455-1645 Anchored off target ship USS Butte (APA-68).

20 July
- 1345-1715 Removed a 12-1/2-ton armor plate from Salt Lake City and transferred it to LCT-1420.

21 July
- 1012-1454 Removed 90-mm and 155-mm guns from Nevada and transferred them to LCT-1420.

22 July
- 1128-1335 Removed a tank turret from Arkansas and placed it aboard LCT-1420.
- 1355-1530 Removed a tank from Nevada and transferred it to LCT-1420.

23 July
- 1515-2127 Worked with USS Etlah (AN-79) in putting anchors on target submarine USS Skipjack.

Shot BAKER (25 July, 0835)

25 July
- 0455 Underway.
- 0530 Picked up target ship USS Gasconade (APA-85) personnel.
- 1125 Anchored off Eneu Island.
- 1402 Underway to place a boarding team on Butte.
- 1440 Butte found to be still radioactive and Conserver proceeded to southeast of array.
- 1638 Anchored off Eneu Island.

27 July
- 1004-1020 A boarding team boarded target ship USS Bracken (APA-64) to recover instrument. Boarding team declared sour.
- 1217-1224 Recovered instruments from target ship USS Carteret (APA-70).
- 1238 Recovered instruments from target ship USS Cortland (APA-75).
- 1239-1250 A boarding team boarded Cortland.
- 1410 All recovered instruments were transferred to USS Kenneth Whiting (AV-14).
- 1511 Anchored in unidentified berth.

28 July
- 1310 A Naval Medical Research Services (NMRS) team came aboard.
- 1340 A monitor boarded Bracken.
- 1341-1352 The NMRS team boarded Bracken and returned to Conserver with all animals, instruments, and monitor.
- 1429-1436 The animals and instruments were removed from target ship USS Catron (APA-71).
- 1508-1528 All instruments were retrieved from target ship USS Fillmore (APA-83).
- 1552 Teams boarded target ship USS Bladen (APA-63) to remove instruments.
- 1602 Recovered instruments aboard Bladen.
- 1618-1636 Retrieved instruments from target ship USS Geneva (APA-86).
- 1652 NMRS parties returned to USS Burleson (APA-67) with all instruments and animals for further studies.
- 1734 Anchored in unidentified berth.

29 July
1344-1357 NMRS team boarded Catron and removed instruments and animals.
1422 NMRS team at Gasconade to remove instruments and animals; too contaminated to board.
1455-1504 NMRS team boarded target ship USS Briscoe (APA-65) to remove instruments and animals.
1602 All animals, instruments, and NMRS personnel returned to Burleson.
1640 Anchored in unidentified berth.

30 July
1320-1405 Animals and instruments were retrieved from Gasconade.
1426 NMRS personnel and all animals transferred to Burleson.
1724 Anchored off Eneu Island.

31 July
0822-0902 Washed down Briscoe with saltwater.
0930-1015 Washed down Bracken.
1146-1213 Sprayed mechanical and chemical foams on Briscoe.
1414-1452 Sprayed mechanical and chemical foams on Briscoe.
1515-1524 Monitors boarded Salt Lake City.
1604-1641 Sprayed foam on Bracken.
1703 Anchored in unidentified berth.

1 August
0810-1348 Conducted salvage operations on Salt Lake City. Salt Lake City was declared very contaminated.
1430 Anchored in unidentified berth.

2 August
0815-1617 Continued salvage operations on Salt Lake City.
1755 Anchored in unidentified berth.

7 August
1751-1836 Retrieved Army equipment from target ship USS LST-545.
1854 Anchored.

8 August
0810-0826 Transferred Army equipment from LST-545 to LCT-1116.
1330-2025 Moored to YF buoys to conduct diving operations to recover Bureau of Ordnance instruments.

9-10 August Continued diving operations to recover Bureau of Ordnance instruments.

12-16 August Continued diving operations to recover Bureau of Ordnance instruments.

14 August Located target submarine USS Pilotfish (SS-386).

16-24 August Continued diving operations on Arkansas.

25 August
0900 Cast off lines to Arkansas buoy; moored to diving buoy.

26 August Shifted mooring over sunken target ship USS Saratoga (CV-3).

27 August-1 September
Conducted diving operations on Saratoga.

2 September
0801-1937 Prepared target vessel LCT-874 for towing.

3 September Conducted salvage operations on target submarine USS Skipjack (SS-184).

4 September
0734-0832 Alongside target vessel LCT-816, conducting operations to remove it from beach and sink it.
0907 Assisted USS Widgeon (ASR-1) with Skipjack.

5 September Left Bikini Atoll for Kwajalein Atoll towing target vessel YOG-83 and support vessels LCT-1420 and LCT-1184.

7 September
1207 Arrived at Kwajalein Atoll; remained until February 1947. Conducted salvage work on various target ships.

USS CONYNGHAM (DD-371)

Crew Size: 109
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 3,145 yards (2.9 km) ESE
Shot BAKER Location: 3,597 yards (3.3 km) WNW
Decontamination Location: San Francisco
Sunk July 1948, off southern California

Task Unit and Function
The destroyer Conyngham was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It served in Destroyer Divison 3 of TU 1.2.3.

Shot ABLE (1 July 0900)

30 June Crew evacuated to Bottineau.

1 July
1610 Conyngham declared radiologically clear.

2 July
1245 The captain, a monitor, and Team A returned to inspect for radioactivity and explosive gases.

Navy data indicate that Conyngham was found safe for reboarding and that remaining crewmembers returned on 2 July. Except for shifting anchorages on 7 July, Conyngham remained anchored in Bikini Lagoon.

Shot BAKER (25 July, 0835)

23-24 July
1110 Crew evacuated to Bottineau.

30 July
1040-1140 Washed down with seawater and foamite by USS Deliver (ARS-23).

31 July
1420 Washdown with foamite completed.
1502 Radsafe teams and monitors were placed aboard.

USS Conyngham (DD-371)
31 July

1907 — Radiological conditions were such that work parties could be put aboard for limited periods of time to carry out local, intensive decontamination work.

1 August — The decontamination party came on board Conyngham for the allowed 4 hours to scrub the top decks.

2 August — Conyngham scrubbed and hosed down. The hull and the waterline were slightly higher than average.

3 August — Scrubbing and hosing of Conyngham was continued, chipping rusted or flaked paint areas was begun, and its hull was scrubbed with lye water and diesel oil (Reference 4).

2000 — Boarded by the BuShips inspection parties and declared Geiger sweet (below 0.1 rem gamma/24 hours.

4 August — Marine growth from Conyngham's port waterline was scrubbed.

6 August — Took readings of ship (Reference 4).

7 August — Crew returned to Bottineau each night except for engineering watch (Reference 4).

Radiological readings for Conyngham (31 July through 7 August) are listed in Table A.3.

Table A.3. Radiological readings (R/24 hours), USS Conyngham (DD-371) (31 July through 7 August).

Date	Maximum Topside	Average Topside	Maximum Below	Average Below
31 July	0.5	0.3	0.15	0.05
1 August	0.35[a]	0.25[a]	---[b]	---
2 August	0.4	0.15	0.5	0.05
4 August	0.3	0.08	0.3	0.04
6 August	0.12	0.045	0.13	0.02
7 August	0.07	0.045	0.12	0.02

Notes:

[a]After decontamination efforts.

[b]No reading.

Source: Reference 4.

8 August — The radsafe inspection party declared Conyngham safe for reboarding; all personnel moved on board and painting of the ship began (Reference 4).

12 August — Clearance was revoked and all personnel were evacuated to USS Rockbridge (APA-228) on a 12-hour basis (Reference 4).

16 August — Interior and exterior painting of Conyngham was completed (Reference 4).

17 August — Conyngham declared radiologically safe for reboarding (Reference 4).

22 August — Left Bikini for Kwajalein Atoll.

23 August — Arrived at Kwajalein.

28 August — Departed for Pearl Harbor.

5 September
0921 — Arrived at Pearl Harbor.

11 October
1253 — Left for San Francisco.

17 October — Arrived at San Francisco.

USS Cortland (APA-75)

USS CORTLAND (APA-75)

Crew Size: 89
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS Artemis (AKA-21)
Crew Location for Shot BAKER: Artemis
Shot ABLE Location: 3,140 yards (2.9 km) WSW
Shot BAKER Location: 3,870 yards (3.5 km) WSW
Decontamination Location: San Francisco
Operational Clearance: 6 November 1946
Final Clearance: 16 December 1946
Decommissioned 30 December 1946, Norfolk, Virginia
Scrapped 31 March 1948

Task Unit and Function
Cortland, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Transportation Division 92 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

1 July
1402 — Fire was reported aboard ship (Reference 5, p. B-11).
1619 — Cortland reported Geiger sweet.

2 July
1440 — The initial boarding team returned to Cortland.
1831 — Remainder of the crew returned and normal routine on board was resumed.

A 16 July damage report stated that there was no major damage and no need for an examination by the technical staff of the Director of Ship Material.

Shot BAKER (25 July, 0835)

24 July
0950 — All personnel evacuated to Artemis.

25 July
1142 — Cortland cleared for boarding.
1309 — Reported Geiger sweet.
2312 — Declared radiologically free (Reference 5, pp. D-19 and D-12).

29 July
1305 — Teams A and B reboarded Cortland (Reference 5, p. V1-D-37).

30 July — Cortland crew returned; normal routine resumed.

A 30 July Commanding Officers Damage Report No. 11 stated that the ship was slightly over tolerance in radioactivity near the waterline (Reference 3).

2 August — Shifted to berth 349.

4-5 August — Went on a scheduled practice run.

18-19 August — Received aboard 19 officers and 305 enlisted men from target ship USS Nevada (BB-36).

19 August
1623 — Departed for Kwajalein Atoll.

20 August — Arrived at Kwajalein.

30 August — Departed Kwajalein for Pearl Harbor.

USS COUCAL (ASR-8)

Crew Size: 117
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 4 September 1946
Shot ABLE Location: 21 nmi (39 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Diego
Operational Clearance: 10 January 1947
Final Clearance: 18 January 1947

Task Unit and Function
Coucal, a submarine rescue vessel, was a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, and emergency repairs.

Shot ABLE (1 July, 0900)

30 June
1625 — Underway from Bikini Lagoon.
2100 — Proceeding to join TU 1.2.7, 5,000 yards (4.6 km) astern USS Reclaimer (ARS-42).

1 July
1255 — Entered Bikini Lagoon.
1735-1855 — Placed scientific parties on target ships USS Conyngham (DD-371) and USS Pennsylvania (BB-38).
1958 — Anchored in berth Love.

4 July
1430-1829 — Radiological survey group from USS Haven (AH-12) came aboard.
1525-1743 — Conducted diving operations.
1902 — Anchored in unidentified berth.

5-6, 8-10 July — Diving operations conducted around target ship USS Gilliam (APA-57).

12 July
1115 — Ran line from stern of target ship USS Brule (APA-66).
1400-1920 — Engaged in diving operations.

13 July — Ran two lines to Brule.
0745-1830 — Diving operations continued on Gilliam.

14 July
0800-1345 — Diving operations continued on Gilliam.
1355 — Took in tow and stern lines from Brule.

15 July
1050-1945 — Diving operations on target ship USS Lamson (DD-367). Ran a cable from port and bow to target ship USS Nevada's (BB-36) mooring buoy.

16-17 July — Continued diving operations around Lamson.

20 July — Ran a manila line to target ship USS Fallon (APA-81).
0830-1130 — Conducted diving operations on target ship Sakawa.
1400-1800 — Conducted diving operations on Sakawa.

21 July — Ran a manila line from port quarter to stern of target ship USS Arkansas (BB-33). Conducted diving operations.

22 July — Made a two-point mooring 100 feet (31 meters) off portside of target submarine USS Apogon (SS-308).
0950 — Began venting Apogon's ballast tanks. After Apogon was submerged, conducted diving operations.

23 July — Engaged in diving operations in the vicinity of Apogon.

24 July
0600-0645 — Flooded target submarine USS Pilotfish (SS-386).

Shot BAKER (25 July, 0835)

25 July
0400 — In formation with USS Conserver (ARS-39), USS Widgeon (ASR-1), and USS Etlah (AN-79).
0750 — Took position in formation of TU 1.2.7.
0800 — Underway.
1400 — Anchored in berth F, Bikini Lagoon.
1610 — Observed target ship USS Saratoga (CV-3) sink stern first.

26 July — Shifted to unidentified berth.

27 July
0815 — Underway to target submarine USS Tuna (SS-203), ran airhoses to Tuna.
1130 — Commenced blowing Tuna's ballast tanks.
1135 — Tuna broke surface.
1230 — Underway; tested all sea injections with Geiger counter, conditions found normal.
1340 — Shifted to unidentified berth.

28 July
0650 — Underway to go alongside target submarine USS Dentuda (SS-335).
1115 — Commenced blowing ballast tanks on Dentuda after engaging in diving operations.
1140 — Secured diving operations.
1617 — Anchored in unidentified berth.

29 July
0840 — Underway to come alongside target submarine USS Searaven's (SS-196) mooring buoy.
0945 — Commenced hooking airhoses to Searaven.
1030 — Commenced blowing Searaven's ballast tanks.
1130 — Underway.
1324 — Anchored in unidentified berth.

1650	Widgeon moored alongside to take on freshwater.
30 July	
1056-1155	Made a two-point mooring over submerged target submarine USS Skipjack (SS-184) and began blowing Skipjack's ballast tanks.
1306-1325	Conducted diving operations on Skipjack.
1331-1353	Blew ballast tanks on Skipjack.
1530-1550	Made a two-point mooring over submerged submarine Pilotfish and began blowing its ballast tanks.
1559	Broke two-point mooring.
1646	Anchored in unidentified berth.
31 July	
1306	Moored portside to Searaven.
1335	Began blowing Searaven's ballast tanks.
1355	Underway from alongside Searaven.
1406	Came alongside target submarine USS Parche (SS-384); sent a boat with a Geiger monitor to check radioactivity on Parche.
1418	Boat returned from Parche.
1746	Anchored near Eneu Island.
1 August	
1240	Underway to take soundings with Geiger meter over Pilotfish, Apogon, and Skipjack.
1615	Moored to USS Sylvania (AKA-44) to take on freight.
1830	Anchored in unidentified berth.
2 August	Engaged in diving operations to lay a four-point moor.
3 August	Moored over Skipjack; conducted salvage and diving operations.
4-9 August	Conducted diving operations on Skipjack.
10 August	
1015	Completed four-point moor over Apogon.
1230-1900	Conducted diving operations on Apogon.
11 August	
1015	Conducted diving operations on Apogon.
12 August	Made four-point mooring over Apogon and engaged in diving operations.
13 August-1 September	Diving and salvaging operations continued over Apogon.
2 September	Underway to Apogon to assigned anchorage.
3 September	Moored to Skipjack to aid Widgeon in salvaging Skipjack.
1200	Skipjack surfaced.
1438	Underway to anchorage.
4 September	
0650	USS Conserver (ARS-39) came alongside to bring target vessel LCT-874 alongside.
1000	USS Palmyra (ARS([T]-3) towed BAKER target vessel LCT-412 alongside; commenced rigging LCT-412 and LCT-874 for towing.
1630	Departed Bikini for Kwajalein with LCT-874 and LCT-412 in tow.
6 September	
0740	Entered Kwajalein Lagoon and anchored LCT-412 and LCT-874. Anchored in berth A-C.
7 September	
0830-1030	Radsafe inspection party, consisting of three officers from Haven, aboard to inspect for radioactivity. Results not recorded in log.
11 September	
1640	Departed Kwajalein for Pearl Harbor with Skipjack in tow.
22 September	
1500	Moored at Pearl Harbor after releasing Skipjack from its tow.

USS CREON (ARL-11)

Crew Size: 144
Bikini Arrival: 1 June 1946
Bikini Atoll Departure: 21 August 1946
Shot ABLE Location: Kwajalein Atoll
Shot BAKER Location: 17 nmi (31 km) ENE
Decontamination Location: Los Angeles
Operational Clearance: 23 January 1947
Final Clearance: 1 February 1947

Task Unit and Function

Creon, a landing craft repair ship, was a support ship in TU 1.8.1 (Repair and Service Unit). It served as a repair facility during CROSSROADS.

Shot ABLE (1 July, 0900)

1 July	
0915	Departed Kwajalein Atoll for Bikini Atoll.
2 July	
1125	Arrived at Bikini and anchored in berth 96.
13 July	LCT-412 alongside.
15 July	Target ship LCT-1187 alongside.

Shot BAKER (25 July, 0835)

24 July	
1131	Steaming in column with 11 other ships.
25 July	
0902	Departed for Rongelap Atoll.
1715	Anchored at Rongelap Atoll.
30 July	
1735	Underway for Bikini Atoll.
31 July	
1047	Arrived at Bikini Atoll and anchored in berth 96.
2 August	
1704	Shifted anchorage to area between berths Sail and Victor.
7 August	Returned to berth 96.
21 August	Left Bikini Atoll for Kwajalein Atoll.

23 August — Arrived Kwajalein.

11 September — Departed for Pearl Harbor.

USS CRITTENDEN (APA-77)

Crew Size: 112
Bikini Atoll Arrival: Before 30 July 1946
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Bexar
Shot ABLE Location: 675 yards (617 meters) NNW
Shot BAKER Location: 1,710 yards (1.7 km) WNW
Decontamination Location: San Francisco
Sunk 5 October 1948 off the southern California coast

Task Unit and Function

Crittenden, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Transportation Division 92 in TU 1.2.6 (Merchant Type Unit). Crittenden was equipped with a low-frequency radio beacon as a directional aid for the photographic aircraft.

Shot ABLE (1 July, 0900)

30 June

0916 — Crew evacuated to Bexar.

2 July

1600 — Crittenden reported Geiger sour, but reported safe to work on for short periods (Reference 6, p. I-36-A). Remained sour throughout the day (Reference 5, p. B-17).

4 July

0845 — Teams A and B reboarded.
1030 — Crittenden declared radiologically safe by the radiological team from USS Haven (AH-12).
1345 — Personnel began reboarding.
1412 — An oceanographic party came aboard to conduct an inspection; the Ship Measurement Group and Deck Survey Party came aboard to inspect damage.
1445 — Radiological Group came on board to inspect ship for radiological contamination.
1510 — All parties left the ship.
1600 — Samples of Crittenden's freshwater sent to Haven for radiological tests.
1815 — All officers and crew left for Bexar except gangway and security watch. Security watch made rounds and hourly reports of the material condition of the ship.

5 July

0800 — Officers and crew boarded from Bexar.
1115 — Food samples sent to Haven for radiological tests.
1400-1430 — The Ordnance Group came aboard for an inspection.
1710 — All officers and enlisted men returned to Bexar except gangway and security watch.

6 July

0815 — The crew returned to Crittenden.

Shot BAKER (25 July, 0835)

25 July

0355 — Crew evacuated to Bexar.

8 August — Boarding team 5 from USS Suncock (AN-80) boarded. Reported Crittenden Geiger sour. Upper deck average 4.0 R/24 hours; hot spots 10 R/24 hours; inside and main deck 0.5 to 1.5 R/24 hours. Evaporator room and forward engine room 0.15 R/24 hours.

12 August — Commanding officer, 5 officers, and 8 enlisted men boarded for opening the ship. Tolerance time 1 hour topside, 4 to 24 hours below decks.

13, 15, and 21 August — Ship was reboarded but number of personnel and time aboard not known.

22 August — Crittenden was reboarded. Its maximum portside topside reading was 4 R/24 hours, maximum starboardside topside 7 R/24 hours, and maximum inside 0.5 R/24 hours. The monitors returned to Bexar and the ship closed (Reference 9).

24 August — Left Bikini Atoll for Kwajalein towed by USS Reclaimer (ARS-42).

26 August — Arrived at Kwajalein. Topside average 0.75 R/24 hours (Reference 7).

28 August — Crittenden decommissioned.

1 October — Topside average 0.52 R/24 hours (Reference 7).

1 December — Crittenden departed Kwajalein towed by USS Cahuilla (ATF-152) en route to San Francisco.

USS CUMBERLAND SOUND (AV-17)

Crew Size: 540
Bikini Atoll Arrival: 3 May 1946
Bikini Atoll Departure: 1 August 1946
Shot ABLE Location: 19 nmi (35 km) SE
Shot BAKER Location: 13 nmi (24 km) SE
Decontamination Location: Los Angeles
Operational Clearance: 3 December 1946
Final Clearance: 13 December 1946

Task Unit and Function

The seaplane tender Cumberland Sound was used as a support ship in TU 1.1.2 (Instrumentation). Its function was to provide laboratory and base facilities throughout the operation.

Shot ABLE (1 July, 0900)

1 July

1421 — Reentered the lagoon and anchored in berth 56.
1705 — Shifted to berth 147.

2 July — Shifted to berth 56.

Shot BAKER (25 July, 0835)

25 July
- 0509 Underway for area outside the harbor (Reference 5, p. D-5).
- 1340 Reentered the harbor.
- 1425 Anchored in berth 384.

28 July — Departed the lagoon.

29 July — Returned to lagoon and anchored in berth G.

30 July — Shifted anchorages to berth 56.

1 August
- 0547 Underway for San Pedro.

USS CURRENT (ARS-22)

Crew Size: 94
Bikini Atoll Arrival: 3 June 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 27 nmi (50 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: Pearl Harbor
Operational Clearance: 6 February 1947
Final Clearance: 17 February 1947

Task Unit and Function

Current was a salvage ship used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, and repairing damaged target vessels.

Shot ABLE (1 July, 0900)

1 July
- 0942 Underway to Bikini Lagoon.
- 1214 Received orders to remain in reentry area until ordered forward, proceeding ahead with bare headway.
- 1256 Passed channel buoy 1 abeam to port; observed various fires and explosions in target area.
- 1415 Underway in company with ATR-87 to put out fire and place boarding party on target ship USS Pennsylvania (BB-38).
- 1443 Withdrawing from the area of Pennsylvania by order of CTU 1.2.7 due to heavy explosion from target ship USS Independence (CVL-22).
- 1525 Underway to go alongside ATR-87 to make Geiger counter test of firefighting equipment.
- 1535 ATR-87 underway from alongside.
- 1550 ATR-40 alongside to have Geiger counter test made of firefighting equipment.
- 1556 ATR-40 underway from alongside.
- 1604 Underway to place boarding team aboard Pennsylvania and extinguish fires on superstructure deck.
- 1624 Boarding party and firefighting party aboard Pennsylvania.
- 1708 Fires extinguished; firefighting party and boarding team aboard.
- 1711 Underway from alongside Pennsylvania, proceeding eastward awaiting instructions.
- 1744 Underway to berth H.
- 1825 Anchored in berth H, off Eneu Island, Bikini.

2 July
- 0739 Underway to complete inspection of target array.
- 0816 Boarding team member came aboard to resume duties with boarding team.
- 0850 Moored alongside target ship USS Fallon (APA-81) and placed boarding team on board, also firefighting team of three men aboard to extinguish smouldering fire on forecastle deck.
- 0920 Boarding party and firefighting party returned aboard from Fallon.
- 0923 Underway from alongside Fallon, proceeding to go alongside target ship USS Salt Lake City (CA-25).
- 0938 Moored alongside Salt Lake City.
- 0940 Placed boarding and firefighting parties on Salt Lake City.
- 1025 Observed target ship Sakawa sinking by the stern.
- 1035 Boarding team and firefighting party returned aboard from Salt Lake City.
- 1046 Underway from Salt Lake City, proceeding to target submarine USS Apogon (SS-308).
- 1125 Boarding team boarded Apogon.
- 1133 Boarding team returned to Current.
- 1135 Underway from alongside Apogon, proceeding to target submarine USS Skipjack (SS-184).
- 1152 Moored alongside starboard side of Skipjack and placed boarding team on board.
- 1200 Boarding team returned aboard.
- 1202 Underway from alongside Skipjack, proceeding to vicinity of Independence to follow it to new mooring and assist in mooring if necessary.
- 1323 Moored to Independence to keep Independence clear of vessels in area.
- 1412 Independence in tow by USS Chickasaw (ATF-83); cast off lines and stood clear, continued to follow Independence to new mooring.
- 1504 Withdrew from Independence, proceeding to USS Wharton (AP-7).
- 1559 Boarding team left the ship to return aboard Wharton.
- 1600 Proceeding to westward area with Independence to assist in mooring.
- 1730 Chickasaw completed mooring Independence.
- 1751 Dropped anchor in berth 310.

3 July
- 0910 Radiological team and boarding team III came aboard Current to conduct radiological and damage survey of Independence later.
- 0930 Underway to Independence.
- 1037 Inspection party and boarding teams left ship via boat to go aboard Independence.
- 1143 Anchored in berth 290.
- 1249 Boarding party and inspection party returned aboard.
- 1312 Underway to Wharton to discharge inspection and boarding parties.
- 1437 Laying to off Wharton, discharging inspection and boarding parties.
- 1448 Anchored in berth 75.
- 1706 Underway to new berth.
- 1720 Anchored in berth 31.

4 July
- 1052 Underway to go alongside target vessel ARDC-13.

1154	Anchored close to ARDC-13 off Eneu Island.
1359	Underway, maneuvering to go alongside ARDC-13.
1410	Moored alongside ARDC-13.
1430	Commenced rigging pumping equipment aboard ARDC-13.
1700	Started pumping afterpump room of ARDC-13.
1720	Afterpump room dry.
1740	Started pumping amidship compartments on C deck.
2130	Tank #8 and midship compartment dry, stopped pumps.
5 July	
1113	Disconnected all electrical leads to ARDC-13.
1128	Underway from ARDC-13 to target submarine USS Skate (SS-305).
1141	Moored alongside Skate.
1145	Started clearing wreckage on Skate.
1500	Transferred Skate's anchor to Current.
1635	Diver made dive for Skate's bow anchor.
1744	Skate underway to anchorage.
1747	Recovered stern anchor of Skate.
1753	Underway to accompany Skate to anchorage.
1830	Withdrew from accompanying Skate, proceeding to ARDC-13.
1847	Anchored off Eneu Island.
6 July	
0930	Underway to go alongside ARDC-13.
0944	Moored alongside ARDC-13.
1005-1240	Removed salvage equipment from ARDC-13 to ship.
1245	Underway.
1327	Dropped anchor in unspecified location.
1444	Underway to take target ship Nagato in tow.
1501	Dropped anchor alongside portside of Nagato.
1505	Ran line to mooring buoy on bow of Nagato.
1825	Dropped port anchor.
1830	Secured towing cable to Nagato's mooring buoy.
7 July	
1008	Underway for berth 162 with Nagato in tow.
1157	Released towing cable from Nagato.
1353	Maneuvering to go alongside Nagato.
1355	Moored portside to Nagato.
8 July	
0830	Underway, laying to in vicinity of Nagato.
1059	Moored portside to Nagato.
1423	Underway from alongside Nagato.
1510	Moored portside to starboard side of Nagato; commenced rigging towing wire to bow of Nagato.
1839	Commenced rigging towing wire; underway from alongside Nagato.
1901	Anchored to Nagato.
9 July	
0716	Underway with Nagato in tow.
0806	Nagato dropped anchor; Current cast off tow.
0934	Anchored in berth 31.
10 July	
1050	Anchored in berth 161.
1245	Commenced diving operations for mooring buoy riser.
1703	Dropped anchor south of berth 161.
1744-1905	Conducted search for mooring buoy riser.
11 July	
0722-1030	Conducted diving operations.
1157	Underway.
1233	Anchored in berth 32.
12 July	
1202	Underway to go alongside target ship USS LST-125.
1250	Moored alongside LST-125.
1340	Removed kedge anchor from LST-125.
1457	Moored portside to stern of LST-125.
1515-1523	Attached kedge anchor to stern of LST-125.
1526	Underway to berth.
1640	Anchored in berth 31.
13 July	Anchored in berth 31.
14 July	
0600	Underway to pick up hydrophone cable.
0637-0644	Anchored.
0840-1159	Conducted diving operations.
1205	Underway to anchorage.
1243	Anchored in berth 31.
15 July	Remained anchored.
16 July	
0632	Underway to go alongside Nagato.
0730	Moored portside to Nagato in berth 162.
0807-0817	Hoisted Nagato's stern anchor aboard Current.
0823	Moored starboardside to Nagato.
0938-0950	Hauled Nagato's stern anchor aboard Current, cleared lines and underway.
1029	Anchored close to target ship Prinz Eugen, in anchorage south of berth 141.
17 July	
0755	Underway for center of target array to lay instruments.
0859	Moored to mooring buoy in center of target array.
0936	Commenced laying anchors and cable with instruments attached to cable.
2030	Underway to pick up cable end attached to mooring buoy.
2051	Moored to mooring buoy in center of target array.
18 July	
0728-0807	Conducted diving operations to retrieve 1" cable.
0942	Instrument cable-laying operations completed, underway en route to berth 31.
19 July	
1300-1305	Circled target ship USS Geneva (APA-86).
1330-1336	Circled Fallon.
1355	Laying close aboard starboard of Wharton.
1404	Returning to berth 31.
1428	Anchored in berth 31.
20 July	
0823	Underway to recover anchor.

USS Current (ARS-22)

0937	Anchored close to starboard bow of target ship USS Saratoga (CV-3).
1155	Deep-sea divers underwater to search for anchor.
1432	Divers back on board.
1529-1815	Diver in deep-sea outfit searched for anchor.
21 July	Remained at anchor in berth 61 close to Saratoga.
0800	Commenced diving operations for recovery of hawk anchor.
1349	Continued to attempt to recover hawk anchor.
22 July	Anchored in center of target array.
0933	Underway en route to berth 31.
0950	Received orders to go alongside USS Kenneth Whiting (AV-14) to pick up pressure gauges.
1023-1155	Alongside Whiting, loading pressure gauges.
1203	Underway from Whiting to lay instrument buoys.
1232	Anchored in center of target array.
1340	Number one instrument buoy laid in position.
1434	Underway to lay instrument buoy #2.
1447	Anchored.
1510	Laid instrument buoy #2.
1541	Underway.
1548	Anchored.
1651	Laid instrument buoy #3.
1713	Made new anchorage.
1850	Laid instrument buoy #4.
1855	Underway to new anchorage to keep clear of mooring and instrument buoys in target array.
1922	Anchored 300 yards (274 meters) south of Prinz Eugen.
23 July	
0740	USS Mender (ARSD-2) came alongside to take aboard hawk anchor.
0840	Mender underway from alongside.
1241	Underway to conduct diving operations on instrument buoy.
1300	Secured line to target ship USS LST-133.
1415-1650	Conducted diving operations.
1735	Underway to anchorage berth 31.
1805	Anchored in berth 31.
24 July	
1207	Boarding party came aboard.
1230	Underway for BAKER day.
Shot BAKER (25 July, 0835)	
25 July	
1105	Entered the harbor.
1206-1219	Alongside Geneva.
1407	Near the north point of Eneu Island.
1450-1502	Alongside target vessel LCT-705.
1620	Anchored in berth D.
26 July	
1827	Shifted to anchorage off Eneu Island.
28 July	
1224-1553	Moored alongside target ship USS LST-545 for 9 minutes to place aboard and recover a boarding party. Moored alongside target ship USS LST-220 for 8 minutes to put over and recover boarding party. Moored alongside target vessel LCI-329 for 1 hour, 7 minutes; boarding party aboard LCI-329 for 57 minutes. After departing LCI-329, commenced washing down target vessel LCI-327, after which a boarding team was placed on board for 6 minutes.
1653	Anchored in unidentified berth in Bikini.
29 July	
0841-1620	Moored alongside LCI-327 for 1 hour, 28 minutes. First boarding party aboard for 36 minutes, after which LCI-327 was washed down; a second boarding party aboard for 7 minutes. Moored alongside target ship USS Wainwright (DD-419) for 11 minutes; boarding party aboard for 10 minutes. Circled seaplane for photographic purposes. Placed boarding parties aboard two seaplanes via the ship's motor whale boat. After recovering boarding parties and boat, moored alongside target ship USS Mugford (DD-389) for 38 minutes; boarding team aboard for 38 minutes. Moored alongside target ship USS Carteret (APA-70) for 15 minutes; boarding team aboard for 15 minutes. Circled and washed down Mugford for 1 hour. Alongside Mugford for 5 minutes; boarding party aboard for 3 minutes.
1714	Anchored in unidentified berth in Bikini.
30 July	
0901-2124	Washed down Mugford with front monitor for 1 hour, 48 minutes; placed boarding party aboard for 9 minutes to remove and bring back one instrument. Washed down Wainwright for 1 hour, 42 minutes; placed boarding party aboard for 16 minutes. Sent boating party to inspect target vessel LCT-1114; returned within 10 minutes. Boat left again with demolition team to place a dynamite charge on LCT-1114. Eighteen minutes later charge was fired. A second charge was placed and fired 25 minutes later. LCT-1114 sunk in close vicinity of obstruction buoy.
2319	Anchored off Eneu Island.
31 July	
1018-1726	Safety monitor came aboard from USS Haven (AH-12). Moored alongside Mugford for 3 hours, 9 minutes, washing it down with water from forward and auxiliary monitors; boarding party aboard for 7 minutes. Washed down target ship USS Butte (APA-68) for 2 hours, 28 minutes. Moored alongside Butte for 25 minutes; boarding party placed on board for 25 minutes. Lay to off USS Cumberland Sound (AV-17) for 25 minutes to transfer black box recovered from Mugford to Cumberland Sound.
1805	Anchored in lee of Eneu Island.
1 August	
0857-1622	Washed down target ship USS Briscoe (APA-65); boarding party aboard for 3 minutes. Washed down target ship USS Bracken (APA-64); boarding team aboard for 13 minutes.
1735	Anchored off Eneu Island.
2 August	
0925-1253	Boarded Briscoe for 64 minutes. Washed down LCT-705; boarded LCT for 7 minutes.

3 August	Washed down Bracken; boarded for 30 minutes. Washed down target ship USS Rhind (DD-404); boarded for 5 minutes.
1434	Anchored in Bikini.
7-12 August	Conducted diving operations over wreck of Apogon.
13-20 August	Conducted diving operations over wreck of target submarine USS Pilotfish (SS-386).
21 August	Continued diving operations over Pilotfish. Searched for sunken hull of Nagato.
22-24 August	Conducted diving operations over Nagato.
25 August	Completed diving operations over Nagato. Departed for Kwajalein with target ship USS LST-661 in tow.
27 August	Arrived Kwajalein Atoll. Anchored LST-661. Left Kwajalein for Wotho Island.
28 August	Proceeded to Wotho Island. Began towing target ship USS Mayrant (DD-402) to Kwajalein.
29 August	Anchored Mayrant in Kwajalein. Anchored off Ebeye Island, Kwajalein Lagoon.

Current remained at Kwajalein, assisting in towing, mooring, and salvaging vessels until it left for Pearl Harbor on 2 December. It returned to Kwajalein on 11 February 1947 and resumed salvage work on target ships. On 31 July 1947, Current returned to Pearl Harbor.

USS DAWSON (APA-79)

Crew Size: 110
Bikini Atoll Arrival: Before 1 June 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Henrico
Shot ABLE Location: 900 yards (823 meters) NW
Shot BAKER Location: 1,225 yards (1.1 km) WNW
Sunk 19 April 1948 near Kwajalein Atoll

Task Unit and Function

Attack transport Dawson was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Transportation Division 92 of TU 1.2.6 (Merchant Type Unit). Dawson carried Geiger counters and radio transmitters for the Electronics Group.

Shot ABLE (1 July 0900)

30 June	
1115	Crew evacuated to Henrico.
2 July	
1017	USS Clamp (ARS-33) reported a fire on board Dawson.
1027	Fire extinguished by ATR-87.
1148	Another fire reported (Reference 6, pp. I-29-A and I-30-A).
1322	Fire extinguished (Reference 6, pp. I-29-A and I-30-A).
1615	Commanding officer Teams A and B boarded to open ship and make radiological surveys.
1730	Dawson declared safe.
3 July	
0830	Teams C and D reboarded Dawson.

A 3 July damage report stated that the overall condition of the ship was good and that the radioactivity was negligible (Reference 2).

Shot BAKER (25 July, 0835)

24 July	
0950	Evacuation of Dawson's crew to Henrico began.
13 August	Crew transferred to USS Rockbridge (APA-228). Dawson was boarded for 2 hours by a monitor, select members of the ship's company, and a representative from DSM to reopen and inspect the ship (Reference 2).
14 August	Topside average 0.6 R/24 hours (Reference 7).
16 August	Dawson boarded by five personnel to lift anchor in preparation for towing.
19 August	Towed by USS Achomawi (ATF-148) to Kwajalein Atoll.
24 August	Arrived at Kwajalein Atoll.
28 August	Decommissioned.
1 October	Topside average 0.14 R/24 hours (Reference 7).

USS DELIVER (ARS-23)

Crew Size: 84
Bikini Atoll Arrival: 10 June 1946
Bikini Atoll Departure: 20 August 1946
Shot ABLE Location: Approximately 27 nmi (50 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Francisco
Operational Clearance: 20 December 1946
Final Clearance: 27 December 1946

Task Unit and Function

Deliver was a salvage ship used as a support ship in TU 1.2.7 (Salvage Unit). Its functions were salvaging, firefighting, and repair work on damaged target vessels.

Shot ABLE (1 July, 0900)

30 June	
1300	Underway for area outside of lagoon, steaming with TU 1.2.7.
1 July	
1340	Anchored in berth Dog, Bikini Atoll.
2 July	
0900	A party left the ship in small boats to inspect the landing craft on the beach.
0902	Anchored in berth 94.
1140-1230	Boarded target ship USS Crittenden (APA-77) for an inspection.
1301-1413	Inspected target vessel ARDC-13.
1442	Boarded target ship USS Pensacola (CA-24) for an inspection.
1448-1535	Extinguished two fires on Pensacola.
1622	Completed inspection of Pensacola.

USS Deliver (ARS-23)

1735	Reanchored in berth Dog.
5 July	
0840	Shifted to berth 32.
6 July	
1226	Underway in vicinity of Bikini to perform routine activities.
1618	Anchored off Adrikan Island.
11 July	
1415	Pulled LCM off Bokonejien Island.
2359	Moored in berth 32.
12 July	
0923	Pulled LCM off Adrikan Island.
1145	Anchored off Adrikan Island.
13-14 July	Anchored off Adrikan Island.
15 July	
1020	Underway to shift anchorages.
1157	Anchored in berth 32.
16 July	
0741	Underway to perform routine activities.
1047	Anchored in berth 32.
17 July	
0715-2009	Aided target ship USS Independence (CVL-22) in shifting berths.
2034	Anchored in berth 219.
20-21 July	Anchored in berth 32.
22 July	
1147	Underway to perform routine duties.
1753	Anchored in berth 36.
23 July	
0558	Underway to perform routine activities and shift berths.
1858	Anchored in berth 261.
Shot BAKER (25 July, 0835)	
24 July	
1349	Underway for area outside atoll, steaming with TU 1.2.7.
25 July	
1159	Anchored in berth Easy, Bikini Atoll.
26 July	
1537	Underway to clear area for USS Reclaimer (ARS-42), which was towing target ship USS Hughes (DD-410).
1600	Moored in berth B.
27 July	Anchored in Bikini.
28 July	
1310-1427	Towed target vessel LCT-818 to its new berth.
1548	Circling LCT-818, washing it down to dissipate radioactivity.
1652	Underway from alongside LCT-818.
1750	Anchored near berth 379.
29 July	
0802	Boarding team aboard.
0805	Underway to LCT-818.
0900	Moored to LCT-818 to inspect and hose down.
0959	Underway to target ship USS Conyngham (DD-371) to inspect and hose it down if necessary.
1037-1105	Moored to Conyngham.
1125-1145	Underway to USS Haven (AH-12) to take on new Geiger instruments.
1215	Underway to target vessel LCT-1013 to inspect.
1255	Moored to LCT-1013.
1315	Underway to inspect target vessel LCT-705.
1339	Moored to LCT-705.
1349	Underway to inspect and hose down Conyngham.
1410	Alongside Conyngham.
1544	Underway to USS Avery Island (AG-76) to transfer camera from Conyngham to Avery Island.
1739	Anchored near berth 379.
30 July	
0702-1010	Hosed down Conyngham.
1052-1210	Hosed down Conyngham.
1213-1258	Hosed down Conyngham's portside.
1313-1332	The boarding party boarded Conyngham.
1402-1420	Covered target ship USS Mugford (DD-389) with foam.
1426-1436	The boarding party boarded Mugford.
1435-1450	Sprayed foam on Mugford.
1451	Underway to anchorage.
1534	Anchored in berth E.
1800	Boarding team left Deliver.
31 July	
0618	Underway to receive foamite from USS Palmyra (ARS[T]-3).
0850	Underway to go alongside target ship USS Pennsylvania (BB-38).
0925-1338	Conducted operations [operations not specified in ship's log].
1418	Anchored in berth E.
1 August	
0812-0925	Sprayed foamite on Pennsylvania.
0945-1020	Inspected target ship USS New York (BB-34).
1035-1042	Inspected target ship USS Nevada (BB-36).
2 August	
0810	Received boarding party, then proceeded to target ship Prinz Eugen.
0832-1138	Washed down Prinz Eugen.
1147-1231	Boarding team inspected Prinz Eugen.
1245-1400	Washed down Nevada.
1513	Anchored in berth 379.
3 August	
0745	Underway to conduct routine duties.
1552	Anchored near berth 379.
4-6 August	Anchored in Bikini.
7 August	
0830	Moored next to YF-733 to pick up boiler compound and lye.
0931	Anchored in vicinity of Nevada.
1246	Underway to vicinity of target ship USS Mustin (DD-413).
1305-1355	Washed down Mustin.
1355	Laying to from Mustin to anchor in vicinity.
1358	Anchored in berth 165.
1552	Underway to Mustin to wash it down.
1557-1723	Washed down Mustin with saltwater.

USS Deliver (ARS-23)

1723	Proceeded to assigned anchorage.
1737	Anchored in berth 32, Bikini.
8 August	
0808	Underway to vicinity of USS Wharton (AP-7) to pick up working party, then proceeded to Pensacola.
1112	Completed washing down Pensacola.
1115	Anchored in berth 117, Bikini.
1214	Shifted to berth 32, Bikini.
1535	LCT-1186 came alongside to deliver boiler compound.
1545	LCT-1186 departed.
9 August	
0815	Director of Ship Material (DSM) boarding team came aboard.
0830	Proceeded to target ship USS Trippe (DD-403).
0902	Moored starboard side to Trippe to put boarding team aboard.
0902-0952	DSM boarding team on Trippe.
0952	Underway to Independence.
1005-1116	Continued unspecified operations.
1120	Anchored in berth 198, Bikini.
1248	Underway to continue operations.
1420	Moored starboard side to Independence to put DSM boarding team aboard.
1420-1547	DSM boarding team aboard Independence.
1547	Underway to target ship USS Bracken (APA-64).
1555	Moored starboard side to Bracken to put boarding team aboard.
1555-1620	DSM boarding team aboard Bracken.
1620	Underway to assigned anchorage.
1705	Anchored in berth 32, Bikini.
11 August	
1003	Underway to retrieve drifting rafts.
1052	Anchored in berth 32, Bikini.
12 August	
1001	Underway to vicinity of target submarine USS Skate (SS-305).
1126	Anchored near Skate.
1150-1225	Continued unspecified operations.
1228	Underway to vicinity of target submarine USS Parche (SS-384).
1300-1330	Conducted unspecified operations, then proceeded to Skate.
1352	Arrived in vicinity of Skate and continued operations.
1418	Ceased operations and proceeded to target submarine USS Searaven (SS-196).
1435	Arrived near Searaven.
1540	Proceeded to Parche.
1543	Arrived near Parche.
1618	Completed operations and proceeded to assigned anchorage.
1636	Anchored in berth 32, Bikini.
13 August	
0758	Underway to vicinity of USS Rockingham (APA-229).
1003-1731	Moored to Mustin to pump water from boiler rooms.
1756	Anchored in berth 32, Bikini.
14-17 August	Anchored in Bikini.
18 August	
1350	After taking on fuel and water, anchored in berth 108-A, Bikini.
19 August	
0920	Underway to New York.
0934-0956	Moored to New York.
1010-1023	Moored to Pennsylvania.
1047-1137	Moored to target ship USS Stack (DD-406).
1145	Laying to in vicinity of Nevada.
1241-1530	Moored to Nevada.
1530	Standing clear to assist USS Preserver (ARS-8) with Nevada.
1620	Proceeded to assigned anchorage.
1650	Anchored in berth 108-A.
20 August	
0742	Underway to take target ship USS Briscoe (APA-65) in tow.
0757	Anchored in berth 202, Bikini.
1010	A four-man working party reported on board for anchor at Kwajalein for Briscoe.
1014	Underway.
1028	Anchored and prepared to take Briscoe in tow.
1212	Underway for Kwajalein with Briscoe in tow.
21 August	En route to Kwajalein with Briscoe in tow.
22 August	
1135	Anchored at Kwajalein.
23 August	Anchored at Kwajalein.
24 August	
0527	Underway to assist in bringing in Pennsylvania.
0750-1132	Assisted Pennsylvania to anchorage in Kwajalein Atoll.
1150	Anchored in berth A-14, Kwajalein.
25 August	
0742-1112	Assisted USS Chickasaw (ATF-83) in towing target ship USS Salt Lake City (CA-25) through Kwajalein Pass to anchorage area.
1139-1210	Moored to Pennsylvania to discharge Chrysler pump.
1225	Anchored in berth A-14, Kwajalein.
26 August	
0530	Underway to assist Preserver with tow.
0645	Passed tow line to stern of Pensacola.
0843	Let go line to Pensacola, then proceeded to assigned anchorage.
0915	Anchored in berth A-14, Kwajalein.
1025	Underway to assist Reclaimer in mooring Crittenden.
1110	Moored to portside of Crittenden.
1210	Cast off from alongside Crittenden.
1230	Moored portside to Reclaimer.
1306	Underway to assigned anchorage.
1335	Anchored in berth A-14, Kwajalein.
27 August	
0638	Underway to assist with Independence.
1000	Passed tow wire to Independence.
1404	Anchored Independence.
1415	Let go tow line from Independence and proceeded to assigned anchorage.
1444	Anchored in berth A-14, Kwajalein.
28-29 August	Anchored in Kwajalein.

30 August
1517 Underway to assist USS Chowanoc (ATF-100) with target vessel USS Brule (APA-66).
1730 Passed tow wire to Brule.
1918 Let go tow wire from Brule and proceeded to anchorage.
2208 Moored to berth A-14, Kwajalein.

31 August-6 September
Anchored in Kwajalein.

7 September
1622 Underway to USS Limestone (IX-158) to take it in tow.
1650 Moored in berth K-11, Kwajalein.

8 September
0637 Underway, maneuvering to take Limestone in tow.
0643 Anchored in berth K-11, Kwajalein.
1040 Underway with Limestone in tow, en route to Pearl Harbor.

23 September Arrived Pearl Harbor.

27 September Departed Pearl Harbor.

8 October Arrived San Francisco.

USS DENTUDA (SS-335)

Crew Size: 58
Bikini Atoll Arrival: 31 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,930 yards (1.8 km) E
Shot BAKER Location: 1,466 yards (1.3 km) NNE
Decontamination Location: San Francisco
Decommissioned 11 December 1946, San Francisco

Task Unit and Function
The submarine Dentuda was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Submarine Division 112 of TU 1.2.4 (Submarine Unit). Dentuda carried special test torpedoes for studies on their effect from the atomic blast.

Shot ABLE (1 July, 0900)

29 June All nonessential personnel were evacuated to Bottineau.

30 June
0908 Dentuda was rigged.
1130 Remaining crewmembers were evacuated to Bottineau.

2 July
1640 Teams A and B reboarded and conducted gas and machinery inspections.
2030 Dentuda opened and found clear of contamination; crew reboarded.

3 July
1544 Moored starboardside to target submarine USS Pilotfish (SS-386), alongside USS Fulton (AS-11) in anchorage 231, Bikini.
1635 Target submarine USS Searaven (SS-196) moored alongside to port.

1645 Target submarine USS Tuna (SS-203) moored alongside Searaven to port.

9 July
0915 Tuna underway.
0918 Pilotfish underway.
0925 Underway from nest, shifting berth.
1014 Anchored in assigned berth, Bikini anchorage.

Shot BAKER (25 July, 0835)

For BAKER, Dentuda was to be submerged.

20 July
0900 Dentuda was rigged for diving.
0923 Commenced making stationary trim dive.
1045 Surfaced from stationary trim dive.

21 July
1800 USS Mender (ARSD-1) came alongside to starboard to suspend lead weights for submerged tests.
1910 Completed suspending lead weights forward.
1920 Mender underway.

22 July
0600 Mender came alongside to suspend lead weights for submerged tests.
0640 Completed hanging weights; Mender underway.

23 July
0640 USS Widgeon (ASR-1) anchored in position close aboard and commenced operations for submergence of Dentuda.
0810 All personnel evacuated to Bottineau. Widgeon submerged Dentuda.

27 July
1533 Surfaced by Widgeon. Radiation readings on Dentuda showed 4 R/24 hours.

28 July
0945 Readings were 1.2 R/24 hours on the boat and 0.4 R/24 hours in the water.
1117 Dentuda was surfaced and beached on Eneu Island by USS Coucal (ASR-8).

29 July
0800 Reading was 2.5 R/24 hours.
1400 Two Geiger monitors had received their daily exposure limit of radioactivity.

31 July
0845 Ten personnel assisted Coucal in clearing hoses and lines.

2 August
0930 Teams A and B boarded Dentuda, finding an average of 0.67 R/24 hours topside. The boat was opened and the air below decks purified.
1240 Inspection teams resealed the boat and departed.

3 August
0930 Teams A and B boarded Dentuda to scrub the topside, flush it, and do repair work. Dentuda was below radiological tolerance inside its pressure hull, and decontamination scrubbing of the topside

USS Dentuda (SS-335)

was continued. Its average was 0.50 R/24 hours, 0.02 R/24 hours below decks, maximum 1.5 to 2.0 R/24 hours. The teams resealed the boat and departed (References 4 and 10).

Between 4 and 13 August boarding teams were aboard Dentuda. The times of their arrival aboard and departure from the boat are listed below:

Date	Arrival	Departure	Team
4 August	0900	1500	A,B
5 August	0930	1530	A,B
6 August	1045	1615	A,B
7 August	0900	1615	A,B
8 August	0945	1605	A,B
9 August	0915	1615	A,B,C
10 August	0950	1615	A,B
11 August	0805	1545	Electricians
12 August	0817	1545	A,B,C
13 August	0830		A,B,C

4 August

0900 Teams A and B boarded and continued repairs and cleaning.

1045 Pump room pumped dry; commenced removing various panels and motors and associated electrical equipment for treatment after saltwater flooding. The entire topside was again scrubbed down. In addition, the wooden decking on the aftergun platform was ripped up and thrown overboard. The metal deck was then given another scrubbing. The reading dropped to 0.8 R/24 hours. The average reading for the day was 0.32 R/24 hours (Reference 4).

1500 Boat sealed and all personnel evacuated.

5 August

0930 Teams A and B boarded and continued repairs and cleaning.

1530 Boat sealed and all personnel evacuated. Scrubbing was continued. Average reading 0.26 R/24 hours (Reference 4).

6 August

0710 Special team boarded boat to assist USS Preserver (ARS-8) in refloating Dentuda.

0750 Dentuda waterborne.

0751 Underway in tow for submarine mooring area.

0940 Moored in submarine mooring buoy No. 4.

0945 Preserver underway from alongside.

1045 Teams A and B reboarded and continued repair work.

1615 All personnel evacuated. Average reading 0.24 R/24 hours (Reference 4).

7 August

0900 Teams A and B reboarded to continue repair work.

1105-1145 Unloaded ammunition.

1615 Teams A and B sealed boat and evacuated. Average reading 0.15 R/24 hours (Reference 4).

8 August

0945 Teams A and B reboarded to continue repair work.

1605 Teams A and B sealed boat and evacuated. Average reading 0.12 R/24 hours (Reference 4). One source states that Dentuda did not reach tolerance until 9 August (Reference 4). However, another source states, "Dentuda Geiger readings below daily tolerance. This has been reported to Radsafe for final clearance to permit crew to move aboard" (Reference 10).

9 August

0830 Crew was transferred from Bottineau to remanned target ship USS Fillmore (APA-83).

0915 Teams A, B, and C reboarded Dentuda to continue repair work.

1615 Teams A, B, and C departed leaving aboard a special detail of one officer and four enlisted men.

1700 Special detail sealed boat and evacuated. Maximum Geiger reading 0.07 R/24 hours. Recommended crew move aboard when cleared by Radsafe (Reference 10).

10 August

0950 Teams A and B reboarded to continue repair work.

1615 Teams A and B sealed boat and evacuated; Geiger readings below maximum daily tolerance.

11 August

0805 Electrician working party with two officers boarded to continue electrical repair work.

1545 Working party sealed boat and evacuated.

12 August

0817 Teams A, B, and C reboarded to continue repair work.

1545 Crew sealed boat and evacuated.

13 August

0830 Teams A, B, and C reboarded to continue repair work.

1020 Moored portside to Fulton.

1030 Officers and crew berthed and messed aboard Fulton with duty section aboard ship at all times. Maximum Geiger reading aboard Dentuda was 0.07 R/24 hours. Ventilation was cleared by Radsafe, although the boat was not cleared for crew to move aboard (Reference 10).

14 August

1306 Underway from alongside Fulton.

1451 Moored starboard side to Fulton.

17 August

1255-1330 Radiological inspection party came aboard and inspected officers and crew. [Crew may have returned to live aboard Dentuda, but log does not specify this.]

20 August

1050-1645 Target submarine USS Parche (SS-384) alongside.

21 August

1730-1750 Watered boat.

22 August

0903 Underway en route to Kwajalein in company with target vessels Fillmore, USS Conyngham (DD-371), Tuna, Parche, and Searaven.

23 August
1117 Moored to Tuna in berth 28, anchorage A, Kwajalein.
1215 Moored to Tuna in berth 28 South, Kwajalein.

28 August
0650 Underway for Pearl Harbor.

5 September
0852 Arrived Pearl Harbor.

14 October Arrived at Mare Island Naval Shipyard.

USS DIXIE (AD-14)

Crew Size: 835
Bikini Atoll Arrival: 24 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 22 nmi (41 km) NNE
Shot BAKER Location: 17 nmi (32 km) E
Decontamination Location: San Francisco
Operational Clearance: 2 October 1946
Final Clearance: By 22 November 1946

Task Unit and Function
Dixie, a destroyer tender, was a support ship in TU 1.8.1 (Repair and Service Unit). Its function was to provide repair and other services to many ships during the operation.

Shot ABLE (1 July, 0900)

30 June
1554 Underway for area outside the harbor, steaming with USS Benevolence (AH-13), USS Bountiful (AH-9), and other vessels.

1 July
1700 Entered Bikini Lagoon.
1821 Anchored in berth 269, Bikini Atoll.

2 July
1135 Changed anchorage to berth 191.

Shot BAKER (25 July, 0835)

24 July
1548 Underway for position outside of atoll.

25-29 July Steamed at sea.

30 July
0716 Entered the lagoon and anchored in berth 191.

2 August
1556 Anchored in berth 365.

7 August
0855 Anchored in berth 191.

14 August
0847 Anchored in berth 57-58.

25 August
1647 Underway for Kwajalein Atoll.

26 August
0916 Anchored at Kwajalein.

9 September
1613 Departed Kwajalein for Pearl Harbor.

USS DUTTON (AGS-8)

Crew Size: 60
Bikini Atoll Arrival: 3 August 1946
Bikini Atoll Departure: 14 September 1946
Location for Shot ABLE: Pearl Harbor
Location for Shot BAKER: En route from Pearl Harbor to Kwajalein Atoll
Decontamination Location: Los Angeles
Operational Clearance: 18 December 1946
Final Clearance: 10 January 1947

Function
Dutton was a surveying ship. Its functions were to survey the probable effects of the atomic bomb on fish and wildlife and to conduct an oceanographic survey on ocean currents in and around the atoll area to determine their characteristics.

Shot ABLE (1 July, 0900)

Dutton was moored in Pearl Harbor for shot ABLE.

22 July
1357 Underway from Pearl Harbor to Marshall Islands.

Shot BAKER (25 July, 0835)

Dutton was en route to Kwajalein Atoll during shot BAKER.

3 August
0840 Anchored at Bikini Atoll in Open Roads.

14 August
1445 Underway to shift berths.
1452 Anchored in berth 207A.

18 August
1100 Anchored in berth 251A.

22 August
0923 Anchored in berth 231.

26 August
1615 Anchored in Open Roads.

27 August
0950 Underway to conduct survey-sounding operations.

30 August Conducted survey-sounding operations.

1-7 September Conducted survey-sounding operations.

11 September Conducted survey operations.

14 September
0614 Departed for Kwajalein Atoll.

15 September
2055 Arrived at Kwajalein.

25 September
1025 Departed Kwajalein for Pearl Harbor.

USS ENOREE (AO-69)

Crew Size: 152
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 24 August 1946
Shot ABLE Location: Anchored at Kwajalein Atoll

USS Enoree (AO-69)

Shot BAKER Location: 17 nmi (32 km) E
Decontamination Location: San Francisco
Operational Clearance: 3 December 1946

Task Unit and Function

Enoree was an oiler in TU 1.8.1 (Repair and Service Unit). Its function was to provide fuel to the other ships during CROSSROADS.

Shot ABLE (1 July, 0900)

Enoree was anchored at Kwajalein Atoll for shot ABLE.

4 July
0751 Arrived at Bikini and anchored in berth 305.

During the period between shots ABLE and BAKER, Enoree provided oil to many task force ships.

13 July
1922 Departed Bikini for Kwajalein Atoll.

14 July
1222 Arrived at Kwajalein Atoll.

16 July Departed Kwajalein for Bikini Atoll.

17 July
1027 Arrived at Bikini Atoll, anchored in berth 305.

24 July
1507 Underway from Bikini Lagoon.

Shot BAKER (25 July, 0835)

25 July Steaming with USS Dixie (AD-14).

30 July
0729 Anchored in berth 305, Bikini.

2 August
1725 Shifted to berth Oboe.

24 August
1437 Departed for Kwajalein Atoll.

25 August
1035 Arrived Kwajalein.

31 August
0800 Departed for Enewetak.

3 September Underway for Kwajalein.

4 September Arrived at Kwajalein.

7 September Underway for Pearl Harbor with APL-30 (a vessel that did not participate in CROSSROADS) in tow.

20 September
1051 Arrived at Pearl Harbor and moored at Fuel Oil Dock after casting off tow.

23 September Three of Enoree's small boats were inspected by radsafe representatives; all three boats were declared radiologically safe for operation.

USS Etlah (AN-79)

Crew Size: 36
Bikini Atoll Arrival: 1 April 1946
Bikini Atoll Departure: 27 August 1946
Shot ABLE Location: 25 nmi (46 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 18 December 1946
Final Clearance: 21 December 1946

Task Unit and Function

Etlah was a net laying ship in TU 1.2.7 (Salvage Unit). Its functions were to place buoys and target vessels in their proper places in the target array and after the detonations to place boarding teams on the target vessels.

Shot ABLE (1 July, 0900)

30 June
1300 Underway to take position for ABLE in area Mercury.

1 July
1340 Proceeding on duty assigned by CTU 1.2.7.
1347 Alongside target vessel LCI-529 [sic]; placed a boarding party aboard.
1352 Underway to target vessel LCI-329.
1404 Alongside LCI-329.
1418 Underway to target vessel LCI-327.
1432-1444 Alongside LCI-327.
1500 Anchored in vicinity of target ship USS LST-133; boarding party left in small boat.
1526 Boarding party returned on board.
1549-1607 Alongside target submarine USS Pilotfish (SS-386); boarding team placed aboard.
1655 Underway for target ship USS LST-220.
1705 Laying to in vicinity of LST-220.
1708-1714 Dispatched boarding party and boat for LST-220; team did not board.
1715 Dispatched boat to target ship USS LST-545.
1720-1742 Team placed aboard LST-545.
1742 Left LST-545 for LST-220 to attempt boarding.
1755 Boarding party returned aboard; did not board LST-220.
1835 Anchored in berth M, Bikini.

2 July
0700 Underway for complete inspection of target vessels.
0740-0751 Placed team on target submarine USS Tuna (SS-203).
0805-0829 Placed team on target submarine USS Dentuda (SS-335).
0829-0854 Placed team on board target submarine USS Searaven (SS-196).
0854-0939 Placed team on board target ship USS LST-661 by means of a small boat.
1012-1056 Placed team aboard target ship USS LST-52 by means of a small boat.
1056-1124 Placed team on board target vessel LCT-874.
1124-1136 Placed team aboard target vessel LCI-332.
1136 Underway for Eneu Island.
1352 Anchored near Eneu Island.

USS Etlah (AN-79)

3 July
1431 Shifted anchorages; anchored in berth M, Bikini.

7 July
0710 Underway to USS Suncock (AN-80).
0820-0930 Engaged in buoy operations with Suncock.
1210 Underway to USS Oneota (AN-85).
1255 Moored to Oneota.
1350 Underway for USS Ottawa (AKA-101).
1430 Moored to Ottawa.
1510 Underway for buoy area.
1534-1649 Moored to Oneota; engaged in stretching third leg and underway to Ottawa.
1733 Moored to Ottawa.
1930 Anchored in overnight berth.

8 July
0710 Underway for buoy area to assist Suncock with moor.
0820 Moored to Suncock.
0935 Underway for Ottawa.
1000-1245 Moored to Ottawa.
1300-1410 Moored to buoy B; engaged in operations.
1430-1525 Moored to Ottawa.
1740-1840 Moored to Suncock.
1905-2005 Moored to Ottawa.
2008 Anchored in overnight berth.

9 July
0900-1000 Moored to Suncock; completed operations.
1015-1130 Moored to Ottawa.
1220-1320 Moored to Oneota; completed mooring operations.
1330-1530 Moored to Ottawa.
1547-1620 Moored to Suncock; completed mooring operations.
1633-1715 Moored to Ottawa.
1720 Moored 200 yards (183 meters) forward of Ottawa.

10 July
0650-0745 Moored to Suncock; mooring operations.
0825-0930 Moored to Ottawa.
1035-1330 Conducted buoy operations off Eneu Island.
1355 Anchored in berth 87, Bikini.

11 July
1123-1250 Alongside Ottawa.
1505 Completed operations.
1520 Anchored.

12 July
0910-0930 Moored to USS Rolette (AKA-99).
0945-1130 Moored to USS Henrico (APA-45).
1205 Anchored.

13 July
1440 Underway for mooring operations on target vessel ARDC-13.
1810 Completed operations on ARDC-13, proceeding to USS Cebu (ARG-6).
1830 Moored to Cebu.

17 July
0650 Underway to Henrico for mooring chains.
0740 Moored portside to Henrico.
1010 Underway for Ottawa.
1033-1140 Moored to Ottawa.
1330 Anchored.

22 July
1230 Underway for Searaven.
1245-1320 Alongside Searaven.
1342-1420 Moored to Ottawa.
1715 Anchored in berth 244.

23 July
1120 Underway for USS George Clymer (APA-27).
1130-1133 Moored to Clymer.
1230-1330 Conducted mooring operations on Searaven.
1405 Anchored off target ship USS Trippe (DD-403).
1455 Underway.
1610-1730 Engaged in mooring operations on target submarine USS Skipjack (SS-184).
1737 Moored to USS Conserver (ARS-39).
1815-1925 Engaged in operations on Skipjack.
1930 Moored to Conserver.
2023-2045 Engaged in operations on Skipjack.
2205 Moored to USS Preserver (ARS-8).
2242 While hanging a 10-ton anchor off a partially submerged submarine, ship's launch was struck with anchor, crushed, and sunk; no personnel injured.
2245-2300 Moored to Tuna.
2340-2345 Moored to Tuna.

24 July Throughout early morning engaged in operations on Tuna.
1315 Boarding team on board Tuna.
2115 Underway to Searaven.
2140 Moored to Searaven.

Shot BAKER (25 July, 0835)

25 July
0100 Underway to anchorage.
0610 Underway out of lagoon.
0808 In formation with CTU 1.2.7.
1125 Anchored in lee of Eneu Island.
1200 Instrumentation Team aboard, underway proceeding to target ship USS Niagara (APA-87).
1240-1325 Moored to Niagara.
1325 Underway proceeding to target ship USS Geneva (APA-86).
1340-1350 Moored to Geneva.
1400-1435 Moored to target ship USS Bladen (APA-63).
1435 Underway for special anchorage.
1455 Boarding operations completed, Instrumentation Team returned to USS Kenneth Whiting (AV-14).
1500 Anchored in berth Queen, Bikini.

28 July
0910 Underway for mooring array.
1020-1050 Moored to Tuna; engaged in operations.
1245 Anchored off Bikini to pick up buoy for mooring.
1425 Anchored off Ionchebi Island to take buoy up to anchor.
1500 Mooring completed, underway to anchorage in berth Queen, Eneu Island.
1510 Anchored in berth Queen.
1600 Anchored off berth 380.

29 July
0805-1410 Underway to perform operations for instrument group.
1500 Boarding team discharged.
1508 Anchored in assigned berth.

30 July
1030-1330 Engaged in operations in target array to salvage underwater instruments.

30 July

1528	Anchored in berth Q.

3 August

0835-1525	Engaged in operations on instrument buoy recovery.
1630	Anchored south of berth 380, Bikini.

7 August

0820	Underway to pick up boarding team and make assigned ships in array.
0920-0955	Alongside target ship USS Stack (DD-406); team aboard.
1015-1200	Alongside Trippe; team aboard.
1350-1505	Alongside target ship USS Banner (APA-60).
1920	After taking on fuel and water, anchored in vicinity of Eneu Island.

8 August

0825	Boarding team 7 aboard.
0900-0927	Alongside target ship USS Ralph Talbot (DD-390).
0945-1012	Alongside target ship USS Rhind (DD-404).
1023-1110	Alongside target ship USS Wilson (DD-408).
1120-1150	Alongside target ship USS Brule (APA-66).
1240	Returned boarding team 7 to USS Wharton (AP-7).
1855	Anchored.

12 August

0750	Underway for buoy operations.
0805	Laying to near USS Haven (AH-12) to pick up monitor.
0845	Monitor aboard, proceeding to center array.
1125	Moored to buoy for pumping.
1435-1515	Engaged in shallow diving operations.
1520-1531	Engaged in shallow diving operations.
1540	Underway to locate sunken buoy.
1805	Anchored.

13 August

0905	Underway to repair buoy.
1000-1535	Started operations to repair mooring buoy.
1612	Anchored in berth 7.

14 August

1250-1610	Engaged in unspecified operations.
1700	Anchored.

15 August

0807	Underway on assigned duty in target area.
0845-1155	Moored to target ship USS Bracken (APA-64).
1310-1700	Moored to port bow of target ship USS Gasconade (APA-85).
1730	Anchored.

16 August

0740	Underway to assist destroyer in raising anchor.
0807-0915	Moored to Wilson.
0930	Alongside Gasconade, furnishing air power to clear fouled anchor.
1345	Underway to USS Bexar (APA-237).
1430-1435	Laying to in vicinity of Bexar to pick up freight.
1505	Anchored in berth 90, Bikini.

17 August

0855-1115	Alongside Gasconade to furnish auxiliary power to clear fouled anchor.
1155	Anchored in berth 90, Bikini.

19 August

0803	Anchored in berth 94, Bikini.

24 August

0855-1145	Alongside Banner, proceeding with operations to hoist anchor.
1403	Anchored in Bikini Atoll in berth 94.

27 August

0953-1030	Alongside target ship USS Mayrant (DD-402); commenced hooking up tow line.
1040	Underway with Mayrant in tow for Kwajalein.

28 August

0725	Stopped to shift tow to USS Current (ARS-22).
0920	Underway in company with Current.
1000	Alongside Mayrant; placed boarding party aboard to adjust rudder angle.
1045	Party aboard, proceeding as before.

29 August

1300	Anchored in Berth A, Kwajalein.

2 September

1253	Left Kwajalein for Pearl Harbor.

12 September

0805	Arrived Pearl Harbor.

USS FALL RIVER (CA-131)

Crew Size: 817
Bikini Atoll Arrival: 27 May 1946
Bikini Atoll Departure: 4 September 1946
Shot ABLE Location: 18 nmi (33 km) ENE
Shot BAKER Location: 12 nmi (22 km) ESE
Decontamination Location: Los Angeles
Operational Clearance: 23 December 1946
Final Clearance: 27 December 1946

Task Unit and Function

The heavy cruiser Fall River served as flagship of TG 1.2 (Target Vessel Group). It supported staff members before and during the operation.

Shot ABLE (1 July, 0900)

1 July

0526	Underway for operating area outside of the lagoon.
1202	Entered the harbor and anchored in berth 386, Bikini Atoll.

2 July

1147	Shifted to berth 91.

3-18 July Anchored in berth 91.

Shot BAKER (25 July, 0835)

25 July

0522	Underway for operating area outside of the lagoon.
1106	Anchored in berth 386.

26-29 July Anchored in berth 386.

28 July
1536 Underway for area 2 nmi (3.7 km) off entrance of atoll.

29 July
1319 Anchored in berth 386, Bikini Atoll.

30 July
0922 Shifted anchorage to berth 91.

31 July-1 August
Anchored in berth 91.

2 August
1415 Shifted to berth 359.

16 August
1655 Departed for Kwajalein Atoll.

17 August
0807 Anchored in berth K-11, Kwajalein.
1655 Departed for Bikini.

18 August
0811 Anchored in berth 56, Bikini Atoll.

25 August
1700 Departed for Kwajalein Atoll.

26 August
0857 Anchored in berth K-11, Kwajalein.

31 August
1758 Left for Bikini.

1 September
0905 Returned to Bikini.

4 September
1755 Left for Kwajalein Atoll.

5 September
0903 Anchored in berth K-11, Kwajalein.

9 September
1558 Underway for Pearl Harbor.

14 September
0912 Moored at Pearl Harbor.

USS FALLON (APA-81)

Crew Size: 127
Bikini Atoll Arrival: 28 May 1946
Bikini Atoll Departure: 1 September 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Bexar
Shot ABLE Location: 1,350 yards (1.2 km) SW
Shot BAKER Location: 540 yards (494 meters) NNW
Sunk 10 March 1948 near Kwajalein Atoll

Task Unit and Function
Fallon, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Transportation Division 91 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
1330 All personnel had been evacuated to Bexar.

1 July
1807 Fires were reported aboard ship (Reference 6, p. I-11-A).

2 July
0925 Fallon reported Geiger sweet.
1545 Boarding team A, the commanding officer, a radiological monitor, and 15 enlisted men came on board to inspect the ship.
1604 Team B, consisting of three officers and twenty-two enlisted men, came aboard.
1723 Fallon declared radiologically safe. The remainder of the teams returned to Fallon.
1730 Team C, consisting of two officers and thirty enlisted men, came aboard.
1922 Team D, consisting of 35 enlisted men, came aboard.

4 July
0850 The CROSSROADS Ordnance Disposal Officer came aboard.

5-10 July Moored in berth 201.

11 July
1435 Shifted to berth 161.

Shot BAKER (25 July, 0835)

24 July
1300 All personnel had been evacuated to Bexar.

26 July
1806 A reading of 4 R/24 hours on Fallon reported by USS Preserver (ARS-8) (Reference 6, p. I-17-B). Preserver was conducting radiological surveys of water in the area.

27 July
0855 Fallon had a 1-hour tolerance level.
1030-1130 Commanding officer, engineering officer, and DSM inspected ship.
1436 Beached to prevent sinking (Reference 6, p. I-17-B; Reference 5, p. D-24).

13-21 August Boarded on 13, 15, 18, 19, 20, and 21 August. Composition of boarding party unknown.

22 August
1330-1430 Salvage party boarded to rig salvage pumps.

23 August Ship's crew left for Kwajalein.
0900-1100 Salvage party boarded to complete rigging salvage pumps.

25 August
1425 USS Clamp (ARS-33) towed ship to mooring buoy for further salvage work.
1510-1600 Ship inspected by commanding officer and engineering officer for flooded spaces.

26 August
1100 Commanding officer and engineering officer returned to Bexar.

28 August Decommissioned.

1 September Left Bikini for Kwajalein, towed by USS Reclaimer (ARS-42).

3 September Arrived at Kwajalein.

USS FILLMORE (APA-83)

Crew Size: 109
Bikini Atoll Arrival: 31 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 2,433 yards (2.2 km) SSW
Shot BAKER Location: 2,012 yards (1.8 km) S
Decontamination Location: San Francisco
Operational Clearance: By 22 November 1946
Decommissioned 24 January 1947, Norfolk, Virginia

Task Unit and Function
Fillmore, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before each shot. Fillmore served in Transportation Division 93 of TU 1.2.6 (Merchant Type Unit).

Shot ABLE (1 July, 0900)

30 June
0900 Officers and crew evacuated to Bayfield.
1031 All boarding teams had departed.
1300 The special animal detail departed.

1 July
1730 Fillmore given radiological clearance for reboarding.

2 July
1240 Reboarding party A with a radiological monitor boarded Fillmore.
1503 Reboarding party B returned.
1529 Reboarding party C embarked.
1535 The radiation monitor declared Fillmore sufficiently free of radioactivity to allow complete operation and occupation.
1538 Monitor departed.

18 July William Day operation was in effect and the crew left Fillmore.

19 July Crew returned to Fillmore.

Shot BAKER (25 July, 0835)

24 July
0937 The officers, crew, and reboarding teams were evacuated to Bayfield.

25 July
1226 Fillmore cleared for reboarding.
1309 Fillmore declared Geiger sweet.
1338 The first boarding team returned to Fillmore (Reference 5, p. D-12).
2312 Radiological clearance given (Reference 5, p. D-19).

29 July
0835 A section of party A with a radiological monitor returned to Fillmore. The monitor left and returned with another monitor at 0940.
0955 The captain returned.
1010 Remainder of party A with party B came aboard.
1155 Monitors declared Fillmore safe except for four areas of the ship.
1530 The monitors reboarded.

1945 Party C returned to Fillmore.

22 August Departed Bikini for Kwajalein.

23 August Arrived at Kwajalein.

27 August
1610 Five radiological monitors boarded to monitor ship and men.
1810 Radiological monitors finished inspection of ship; pronounced the ship radiologically safe and left.

28 August
0820 Departed for Pearl Harbor.

5 September
0938 Moored to pier H-3, Pearl Harbor.

6 September
1345 Two radiological officers came aboard to clear ship.
1545 Radiological officers left ship; results of the inspection unknown.

Later in September, a radsafe inspection of small boats aboard Fillmore found 11 of these craft had been contaminated. Nine of these had been received on board from USS Bottineau (APA-235) on 9 August 1946.

USS FLUSSER (DD-368)

Crew Size: 146
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 4 September 1946
Shot ABLE Location: 18 to 22 nmi (33 to 41 km) S
Shot BAKER Location: Kwajalein Atoll
Decontamination Location: Pearl Harbor
Operational Clearance: By 22 November 1946
Final Clearance: 13 December 1946

Task Unit and Function
The destroyer Flusser served in Destroyer Division 3 of TU 1.2.3 (Destroyer Unit). Its functions were to patrol the surface area, conduct oceanographic surveys, and do radiological monitoring inside and outside of atoll.

Shot ABLE (1 July, 0900)

30 June
1241 Underway for ABLE test.
1322 Received orders to proceed to area Mack.

1 July Steaming independently in accordance with CTG 1.7 Op Plan 1-46, patrolling the south border of area Mack.
1827 Anchored in berth 342, Bikini Atoll.

2 July
0920 Underway to Oroken Island to carry out Operation Ivory in connection with radiological unit dispatch.
1102 Lowered motor whale boat off Oroken Island.
1108 Party embarked in whale boat to go to Oroken Island.
1318 Completed Operation Ivory; motor whale boat returned with landing party.
1330 Proceeded from Oroken Island to Bikini.
1553 Anchored in berth 116, Bikini.
1558 Members of the radiological unit returned to USS Haven (AH-12).

USS Flusser (DD-368)

6 July
0944 Underway from berth for Harbor Entrance Control Vessel (HECV) duty.
1036 Relieved USS Allen M. Sumner (DD-692) of HECV duty.
1042 Anchored in berth 386, Bikini.

12 July
1455 Underway for berth 116S, having been relieved of HECV duty by USS Robert K. Huntington (DD-781).
1551 Anchored in berth 116S, Bikini.

14 July
0534 Underway to operate as station destroyer for shot BAKER.
1313 Anchored in berth 116S, Bikini.

15 July
1006 Relieved Huntington as HECV.
1016 Anchored in berth 386, Bikini.

17 July
0800 Secured as HECV.
0900 On station at Point Zebra.
1300 Resumed duties as HECV.
1303 Anchored in berth 386, Bikini.

18 July
1145 Relieved of HECV duty by Sumner; underway to approach nearby anchorage.
1204 Anchored in berth near HECV.
1304 Underway for BAKER rehearsal.

19 August
1655 Anchored in berth 270A, Bikini.

20 July
1615 Anchored in berth 189, Bikini.

22 July
1510-1825 Engaged in temporary patching of hole in engine room.

23 July
0805 Relieved USS Laffey (DD-724) of HECV duty.
0811 Anchored in berth 386, Bikini.

24 July
1132 Underway from berth 386; relieved of HECV duty by Sumner; stood out for Kwajalein.

Shot BAKER (25 July, 0835)

25 July
0727 Anchored in berth A29, Kwajalein.
1717 Yard tug came alongside to port, delivered radiological pills [instruments to measure radiation], and left immediately.
1803 Underway for Bikini.

26 July En route from Kwajalein to Bikini with members of the Joint Chiefs of Staff Atomic Evaluation Board and their aides as passengers aboard.
0727 Anchored in berth Roger, Bikini.
0800 Members of Joint Chiefs of Staff Atomic Evaluation Board disembarked.
0908 Anchored in berth Item, Bikini.
1800 Underway for Kwajalein with passengers aboard.

27 July
1007 Moored to USS LST-861, Kwajalein.
1712 Underway from Kwajalein to Bikini.

28 July
0759 Anchored in berth Q, Bikini.
1758 Underway for Kwajalein from Bikini.

29 July
0935 Anchored in berth K16, Kwajalein.
1703 Underway for Bikini Atoll.

30 July
0912 Anchored in Bikini Atoll, berth 116N.
1525 Twenty-three enlisted U.S. Marine Corps passengers left the ship.

2 August
1636 Anchored in berth Jig North, Bikini.

5 August
0752 Relieved Huntington as HECV.
0757 Anchored in berth Victor, Bikini.

7 August
1613 Anchored in berth 386, Bikini, to establish visual communication with port director aboard USS Mount McKinley (AGC-7).

8 August
1102 Relieved of duty as HECV by USS Lowry (DD-770).
1437 After refueling, anchored in berth 116N, Bikini.

10 August
0722 Anchored in berth 386, Bikini.
0730 Relieved Lowry of HECV duty.

12 August
1554 Anchored in berth 269, Bikini.
1600 Relieved of duty as HECV by USS Bowditch (AGS-4).
1642 Anchored in berth 112, Bikini.

14 August
1104 Anchored in berth 55A, Bikini.

17 August
1600 After loading torpedoes from USS Dixie (AD-14), anchored between berths 56 and 112.

15 August
0930 Anchored in berth 41, Bikini.

25 August
1525 Underway for Kwajalein.
1632 Dumped ammunition 10 nmi (19 km) outside of Bikini entrance buoys.

26 August
0855 Anchored south of berth K-11, Kwajalein.

31 August
1747 Underway from Kwajalein to Bikini.

1 September
0904 Anchored in berth 111, Bikini.

4 September
1750 Underway for Kwajalein.

5 September
1411 Anchored in berth K-6, Kwajalein.

9 September
1600 Underway for Pearl Harbor.

14 September
0920 Moored to berth H-2, Pearl Harbor.

USS FULTON (AS-11)

Crew Size: 733
Bikini Atoll Arrival: 23 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 21 nmi (39 km) NE
Shot BAKER Location: 14 nmi (26 km) NE
Decontamination Location: San Francisco
Operational Clearance: 24 December 1946
Final Clearance: 10 January 1947

Task Unit and Function
Fulton was a submarine tender in TU 1.8.1 (Repair and Service Unit). Its function was to service submarines used as target vessels during CROSSROADS.

Shot ABLE (1 July, 0900)

1 July Steamed in operating area with USS Dixie (AD-14) during shot ABLE.
1512 Anchored in berth 231, Bikini Atoll.

2 July Alongside target submarines USS Pilotfish (SS-386), USS Dentuda (SS-335), USS Tuna (SS-203), and USS Searaven (SS-196) to discharge freshwater and fuel.

3 July
1515 Pilotfish moored alongside to port.
1546 Dentuda moored alongside to port outboard Pilotfish.
1630 Searaven moored alongside to port outboard of Dentuda.
1643 Tuna moored alongside to port outboard Searaven.

5 July
1045 Pilotfish got underway from alongside to moor outboard of Tuna.
1119 Commenced discharging freshwater to Dentuda.
1120 Pilotfish stood in and moored outboard of Tuna.
1205 Completed discharging freshwater to Dentuda.
1230-1250 Discharged freshwater to Searaven.
1253-1319 Discharged freshwater to Tuna.
1337 Searaven got underway from alongside to shift berths.
1356 Searaven moored alongside to port outboard of Pilotfish, having shifted berths.
1404 Commenced discharging freshwater to Tuna.
1412 Commenced discharging freshwater to Pilotfish.
1421 Completed discharging freshwater to Tuna.
1443 Completed discharging freshwater to Pilotfish.

6 July
1000 Target ship USS Nevada (BB-36) got underway to shift berths.

7 July
1000-1055 Discharged diesel oil to Tuna.
1115-1130 Discharged diesel oil to Pilotfish.
1210 Commenced discharging freshwater to Searaven.
1220 Commenced discharging freshwater to Tuna.
1230 Completed discharging freshwater to Searaven.
1245 Completed discharging freshwater to Tuna.
1300-1325 Discharged diesel fuel oil to Searaven.
1335-1402 Discharged diesel fuel oil to Dentuda.
1414 Commenced discharging battery water to Dentuda.
1505 Commenced discharging lubricating oil to Pilotfish.
1600 Completed discharging battery water to Dentuda.

8 July
1000-1025 Discharged battery water to Tuna.
1646 Completed discharging freshwater to Dentuda.

9 July
0915 Tuna underway from alongside.
0918 Pilotfish underway from alongside.
1333 Target submarine USS Parche (SS-384) moored alongside to port.
1359 Target submarine USS Apogon (SS-308) moored alongside to port, outboard to Parche.
1417 Target submarine USS Skipjack (SS-184) moored alongside to port, outboard Apogon.

10 July
1107 Skipjack underway from alongside.
1119 Apogon underway from alongside.
1438-1508 Pumped battery water to Parche.
1523 Parche underway from alongside.

11 July
1143 Parche moored alongside to port.
1315-1330 Discharged battery water to Parche.
1415-1511 Discharged freshwater to Parche.
2043 Parche got underway from alongside and anchored off the starboard quarter.

12 July
0905 Apogon moored alongside to port.
1330 Apogon got underway from alongside.
1422 Skipjack moored alongside to port.
1518 Commenced discharging freshwater to Skipjack.
1525 Commenced discharging battery water to Skipjack.
1603 Completed discharging freshwater to Skipjack.
1700 Completed discharging battery water to Skipjack.
1705 Skipjack got underway from alongside and anchored in berth 206.

13 July
0628 Target submarine USS Skate (SS-305) moored alongside to port.
1410-1445 Skipjack made stationary trim dive.

14 July
1055-1210 Discharged diesel fuel to Skate.

15 July
1023-1226 Discharged battery water to Skate.

16 July
0915-1050 Discharged freshwater to Skate.
1410 Skate underway from alongside.
1452 Skipjack moored alongside to port.
1653 Skipjack got underway from alongside.

Shot BAKER (25 July, 0835)

24 July
1629 Underway for area outside of the lagoon, steaming with Dixie.

25-29 July Remained steaming outside lagoon.

30 July
0735 Anchored in berth 231, Bikini Atoll.

2 August
1100 Radiological safety council members reported on board for radiological detection duties. It is not known when they left.
1508 Underway to shift berths.
1638 Anchored in berth 386.

3-6 August Anchored in berth 386; engaged in routine activities.

7 August
0902 Underway for berth 231.
1019 Anchored in berth 231.

8-13 August Anchored in berth 231, routine duties.

13 August
1025 Dentuda stood in and moored alongside to port.

14 August
1302 Dentuda underway from alongside.
1335 Underway for new berth.
1417 Anchored in berth 92.
1500 Dentuda moored alongside to port.

15-20 August Anchored in berth 92, routine activities.

20 August
1642 Parche got underway from alongside to port and stood out.

21-25 August Anchored in berth 92, routine activities.

25 August
1635 Departed for Kwajalein Atoll.

26 August
0957 Anchored in berth K-17, Kwajalein.
1312 Dentuda stood in and moored alongside to port.

USS FURSE (DD-882)

Crew Size: 293
Bikini Atoll Arrival: Before 25 June 1946
Bikini Atoll Departure: 28 July 1946
Shot ABLE Location: 30 nmi (56 km) N
Shot BAKER Location: 11 nmi (20 km) NE
Decontamination Location: Los Angeles
Final Clearance: By 22 November 1946

Task Unit and Function
The destroyer Furse served in Destroyer Division 51 in TG 1.6 (Navy Air Group). Its main function was to provide support for drone and photographic operations.

Shot ABLE (1 July, 0900)

30 June
1356 Underway with USS Saidor (CVE-117) and USS Newman K. Perry (DD-883) for area north of Bikini Atoll.

1 July
1906 Anchored in berth 321.

No information is available about its role as USS Shangri-La's (CV-38) plane guard during aircraft launches.

2 July
1825 Anchored in berth 54-A, Bikini Atoll.

5 July
0805 Underway for Kwajalein Atoll.

6 July
0920 Anchored at Kwajalein Atoll.

12 July
1700 Underway for Bikini Atoll.

13 July
0630 Arrived at Bikini Atoll.
1622 Left Bikini Atoll for air rehearsal operations with Saidor and Perry.

14 July
1433 Anchored at berth 53A, Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July
0930 Underway for area outside of lagoon to rendezvous with Saidor and Perry.

25 July
0845 Changed course to maintain plane guard station #2 during flight operations.
1120 Secured from flight operations.
1500 Saidor launched two planes.
1842 On screening station #2, 2,000 yards (1.8 km) from Saidor.

26 July
0344 Proceeding to Bikini Atoll.
0745 Saidor launched three planes.
0818 Laying to 500 yards (457 meters) from Saidor.
0846 Underway to plane guard station #1.
1110 Commenced steaming to plane guard station.
1115 Secured from flight operations.
1345-1405 Saidor launched planes.
1640-1706 Engaged in flight operations.

27 July
0721 On plane guard station #2.
0739-0742 Saidor launched two F6F aircraft.
0835-0900 Flight operations.
1516 Anchored in berth N, Bikini Atoll. Several men were transferred to Furse for passage to Kwajalein Atoll.
1636 Underway to berth N.
1717 Proceeding to station #1 off Saidor in area Paige.

28 July
1725 Anchored in berth H, Bikini Atoll.
1832 Underway for Kwajalein Atoll.

29 July Anchored at Kwajalein Atoll and did not return to Bikini before returning to the United States.

USS GASCONADE (APA-85)

Crew Size: 105
Bikini Atoll Arrival: Before 31 May 1946
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS Bexar (APA-237)
Crew Location for Shot BAKER: Bexar
Shot ABLE Location: 2,687 yards (2.5 km) SSW
Shot BAKER Location: 650 yards (594 meters) SSE
Decontamination Location: San Francisco
Sunk 21 July 1948 off the southern California coast

Task Unit and Function
Gasconade, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. Gasconade served in Transportation Division 94 of TU 1.2.6 (Merchant Type Unit). Gasconade was equipped with Geiger counters and radio transmitters for the Electronics Group.

Shot ABLE (1 July, 0900)

Before shot ABLE, Gasconade's crew was transferred to Bexar.

1 July
1619 Reported to be Geiger sweet (Reference 6, I-14-A).

2 July
1100 Crew returned to live aboard Gasconade.

Shot BAKER (25 July, 0835)

Crew was evacuated to Bexar before the detonation.

29 July
0939 Gasconade had a 30-minute tolerance.
2125 Gasconade still too radioactive to board and remove the test animals (Reference 6, p. I-38; Reference 5, p. D-37-B).

30 July
0850-1015 USS Preserver (ARS-8) alongside to wash down Gasconade (Reference 1, Preserver).
1302 Gasconade still too radioactive to board.
1320-1405 USS Conserver (ARS-39) removed the animals and instruments from Gasconade.

2 August Gasconade thoroughly washed down by USS Sioux (ATF-75) (Reference 6, p. I-71).

A preliminary inspection report on 7 August states that Gasconade was severely damaged (Reference 8). The main deck had a reading of 20 R/24 hours, and where water had accumulated in pockets readings averaged from 6 to 8 R/24 hours; the lowest readings were between 0.2 and 0.5 R/24 hours. The animal compartment in sick bay was 0.8 R/24 hours. Reference 8 also stated that the "ship appears too extensively damaged to permit personnel to live aboard even if radioactivity were reduced to safe limits." A 21 August decontamination report disclosed the measures taken to decontaminate Gasconade:

- Wet sweeping and washdown by firehoses
- Washdown of the upper decks with saltwater
- Pumping contaminated water overboard
- Topside materials jettisoned.

Deck scrubbing and paint removal was not attempted (Reference 2). Table A.4 lists the average and maximum Geiger readings from 7 to 17 August, which have been extracted from the 20 August Damage Report.

Table A.4 USS Gasconade (APA-85) radiation readings (R/24 hours).

	Maximum		Average	
Date	Above Decks	Below Decks	Above Decks	Below Decks
7 August	60	20	8	2
8 August	40	20	6	2
9 August	25	20	5	2.5
10 August	3.5	20	1	0.8
15 August	8	10	1	0.3
16 August	8	8	0.6	0.2
17 August	6	6	1	0.2
24 September			0.4	

Sources: References 2 and 7.

13 August The crew transferred to USS Sylvania (AKA-44).

22 August
1000-1300 Crew returned to Bexar.

24 August
1330 Departed Bikini for Kwajalein in tow by ATA-192.

26 August Arrived Kwajalein.

28 August
1300 Decommissioned.

Gasconade was towed to San Francisco for experimentation and research; it arrived there on 27 January 1947.

USS GENEVA (APA-86)

Crew Size: 115
Bikini Atoll Arrival: May 1956
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS Appling (APA-58)
Crew Location for Shot BAKER: Appling
Shot ABLE Location: 3,062 yards (2.8 km) SW
Shot BAKER Location: 2,780 yards (2.5 km) S
Decontamination Location: San Francisco
Scrapped on 2 November 1966

Task Unit and Function
Geneva, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in Transportation Division 93 of

USS Geneva (APA-86)

TU 1.2.6. Geneva carried Geiger counters and radio transmitters for the Electronics Group.

Shot ABLE (1 July, 0900)

Geneva's crew boarded Appling before the detonation.

1 July
- 1552 USS Burleson (APA-67) removed the test animals from Geneva's topside.
- 1610 Geneva declared radiologically safe (Reference 5, pp. B-12 and B-13).

2 July
- 1158 The captain and a radiological monitor reboarded.
- 1220 Teams A and B returned to Geneva.
- 1330 The radsafe monitor declared Geneva free of all radioactivity.

3-23 July Anchored in berth 365.

Shot BAKER (25 July, 0835)

24 July
- 0630 Began closing up ship.
- 1010 Evacuation of Geneva's crew to Appling complete.

25 July
- 1218 Geneva declared Geiger sweet.
- 2312 Radiological clearance was given (Reference 5, pp. D-11 and D-19).

28 July
- 1618-1636 Test animals removed by Navy Medical Research Unit on USS Conserver (ARS-39).

29 July
- 1335 The commanding officer and the Geiger monitor reboarded Geneva.
- 1350 Team A reboarded.
- 1410 Team B reboarded.
- 1430 Geneva declared Geiger sweet.
- 1530 Team C boarded.
- 1600 Geneva returned to normal operation.

4-5 August A trial run was conducted.

5 August
- 0731 Jettisoned an aircraft.

24 August
- 1647 Left Bikini Atoll.

25 August
- 1258 Arrived at Kwajalein Atoll.

13 October Departed for Pearl Harbor.

21 October Arrived at Pearl Harbor.

25 October Departed for San Francisco.

4 November Arrived at San Francisco.

USS GEORGE CLYMER (APA-27)

Crew Size: 270
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 20 August 1946

USS George Clymer (APA-27)

Shot ABLE Location: >21 nmi (39 km) ENE
Shot BAKER Location: >18 nmi (33 km) E
Decontamination Location: San Diego
Operational Clearance: By 22 November 1946
Final Clearance: 7 February 1947

Task Unit and Function
Attack transport Clymer was a support ship in Transportation Division 31 of TU 1.3.1 (Transport Unit). Its function was to house target ship crews during and after the two detonations.

Shot ABLE (1 July, 0900)

Clymer housed crews from target ships USS Pennsylvania (BB-38) and USS Nevada (BB-36). The crews returned to their ships on 2 and 3 July.

1 July
- 0519 Underway for area Marmon outside the harbor.
- 1728 Anchored in berth 300, Bikini Atoll.

2 July
- 1525 Shifted to berth 244.

7-9 July Moored next to Nevada to furnish it steam.

9 July Collided with Nevada.
- 1917 Anchored in berth 268.

Shot BAKER (25 July, 0835)

23-24 July Personnel from Pennsylvania and Nevada were transferred to Clymer.

25 July
- 0516 Underway for area Marmon, outside the harbor, steaming with TG 1.3.

30 July
- 0535 Reentered Bikini Lagoon.
- 0623 Anchored in berth 262, Bikini Atoll.

2 August
- 1440 Shifted to berth 333.

9 August
- 1026 A radiological test was conducted on Clymer's evaporators. The test concluded that the evaporators were radiologically safe for personnel.
- 1545 Radsafe section of JTF 1 conducted a radiological inspection of Clymer and found no radiation hazards.

20 August
- 0935 Radiological monitors reported on board.
- 1225 Radiological party left and made the following recommendation: "We have examined the passengers, personnel, and material, including evaporators and engine rooms, and find only the stated significant readings which would be no hazard under standard watch conditions. Therefore, we recommend that the ship is radiologically safe." Location of hazards: No. 3 condenser in engine room 0.12 R/24 hours (on surface) and 0.06 R/24 hours (at 1-foot [0.3-meter] distance).
- 1719 Departed for Pearl Harbor.

USS GILLIAM (APA-57)

Crew Size: 91
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Various task force units
Shot ABLE Location: 47 yards (43 meters) NNW
Sunk 1 July 1946, Bikini Atoll

Task Unit and Function

Gilliam, an attack transport, was a target vessel during CROSSROADS. Its crew was evacuated before shot ABLE and never returned. It served in Transportation Division 91 of TU 1.2.6 (Merchant Type Unit). Gilliam was equipped with transmitters under the control of the Electronics Group.

Shot ABLE (1 July, 0900)

Gilliam's crew was evacuated to Bottineau before the detonation. Gilliam sank as a result of the detonation. Diving operations were conducted later for examination of the ship.

Shot BAKER (25 July, 0835)

Gilliam's crew was dispersed to various units of the task force on 8 July.

GILLISS, JAMES M.; see USS JAMES M. GILLIS (AGS-13)

USS GUNSTON HALL (LSD-5)

Crew Size: 305
Bikini Atoll Arrival: 3 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 28 nmi (52 km) NE
Shot BAKER Location: 17 nmi (32 km) E
Decontamination Location: Los Angeles
Operational Clearance: 8 January 1947
Final Clearance: 10 January 1947

Task Unit and Function

The dock landing ship Gunston Hall served in TU 1.8.3 (Dispatch Boat and Boat Pool). Its function was to provide small boats for the boat pool, mail service, interatoll freight, and passenger service.

Shot ABLE (1 July, 0900)

30 June
- 1614 Underway for area outside of the lagoon, steaming with of TG 1.8.

1 July
- 1910 Anchored in berth 94, Bikini Atoll.

2 July
- 1650 Left for Kwajalein Atoll.

3 July
- 0946 Arrived at Kwajalein Atoll.
- 1702 Departed for Bikini Atoll.

4 July
- 0919 Anchored at Bikini Atoll in berth 94.

Shot BAKER (25 July, 0835)

24 July
- 1602 Underway to join TG 1.8 for area outside of the lagoon.

25 July
- 0945 Left the formation en route to Rongelap Atoll.
- 1642 Anchored at Rongelap Atoll.

30 July
- 0850 Left for Bikini Atoll.
- 1526 Arrived at Bikini Atoll and anchored in berth 94.

19 August
- 1636 Left for Kwajalein Atoll.

20 August
- 1038 Arrived Kwajalein Atoll.
- 1628 Underway for Bikini Atoll.

21 August
- 0906 Arrived at Bikini Atoll.

25 August
- 1638 Departed for Kwajalein Atoll.

26 August
- 1205 Anchored at Kwajalein Atoll.

2 September Departed for Pearl Harbor.

8 September Arrived at Pearl Harbor.

USS GYPSY (ARSD-1)

Crew Size: 77
Bikini Atoll Arrival: 10 July 1946
Bikini Atoll Departure: 5 September 1946
Shot ABLE Location: En route from Pearl Harbor to Kwajalein Atoll
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: Pearl Harbor/Los Angeles
Operational Clearance: 9 January 1947
Final Clearance: 19 January 1947

Task Unit and Function

Gypsy, a salvage lifting ship, served in TU 1.2.7 (Salvage Unit). Its functions included towing, underwater work using divers, and salvaging damaged target vessels.

Shot ABLE (1 July, 0900)

10 July
- 0915 Moored in berth 141, Bikini Atoll.
- 1442 Underway to USS LST-861.
- 1522-1636 Moored alongside LST-861 to discharge mail.
- 1735 Anchored in berth 29.

11 July
- 1110 Anchored in berth 141.
- 1725 Anchored in berth 29.

12 July
- 1216 Anchored off Eneu Island.
- 1230 Loaded anchors and chain.

13 July
- 1512 Let go port anchor after shifting anchorage off Eneu Island to salvage lost anchor.
- 1620 Completed salvaging two anchors and chain.
- 1645 Shifted berths.
- 1705 Anchored off Eneu Island.

USS Gypsy (ARSD-1)

14 July

1030-1100	Recovered third anchor.
1105	Underway to USS Fulton (AS-11).
1220	Anchored off Fulton.
1545	Completed transferring anchors to Fulton.
1620	Anchored in berth 29.

16 July — After receiving anchors from USS Henrico (APA-45), anchored in unspecified anchorage.

17 July

0722-0810	Alongside USS Rolette (AKA-99) to dispose of anchor chains.
0828-1032	Alongside USS Ottawa (AKA-101) to transfer anchors and chains.
1122-1420	Alongside USS Enoree (AO-69) to take on fuel.
1500	Anchored in berth 69.

18 July

0925-1020	Alongside USS Palmyra (ARS[T]-3) to load dynamite.
1250	Anchored off Oroken Island and commenced diving operations.

19 July

0700	Diving party left ship to continue diving operations.

20 July

0907	Moored to USS George Clymer (APA-27).
1620	Underway from Clymer.
1704	Moored portside to target submarine USS Apogon (SS-308).
1912	Underway from Apogon.
1932	Anchored in berth 240.

21 July

0602	Moored alongside Apogon.
0810	Underway from Apogon.
0840-1020	Alongside Clymer.
1032-1205	Alongside Apogon.
1350	Anchored in berth 220.
1610-1748	Moored alongside Clymer.
1800-1921	Moored to target submarine USS Dentuda (SS-335), discharging weights.
1943	Anchored off berth 316.

22 July

0550	Underway for alongside Dentuda to complete hanging weights.
0600	Moored to Dentuda, proceeding to Clymer to receive weights for target submarine USS Tuna (SS-203).
0720-1110	Alongside Clymer.
1130-1345	Alongside Tuna, placed weights aboard.
1417	Anchored in berth 64.
1910	Anchored in berth 29.

23 July

1205	Anchored in berth 119.

24 July

0530	Anchored near berth 23.
1205	Picked up monitor for ship during test BAKER.
1300	Underway for operating area for test BAKER.

Shot BAKER (25 July, 0835)

25 July

1210	Anchored off Eneu Island near berth Sugar.

26-27 July — Anchored as before.

28 July

1058	Underway to the vicinity of Dentuda.
1043	Arrived in vicinity of Dentuda, standing by to assist USS Coucal (ASR-8) if required.
1135	Underway to Palmyra.
1200	Standing to off Palmyra.
1325	Anchored in berth Sugar.
1610	Underway to discharge two anchors for mooring Dentuda.
1655	Operations completed, returning to anchorage.
1838	Anchored in unspecified anchorage.

29 July

1229	Underway; proceeding to target area to recover submarine anchors.
1400	Commenced recovering anchors.
1500	Geiger reading of anchor chain 0.25 R/24 hours.
1520	Recovering anchor in vicinity of Ionchebi Island.
1555	Discharged anchor in lee of Ionchebi Island.
1620	Anchor deposited; underway to recover second anchor.
1830	Anchored in unspecified area.

30 July

0600	Underway.
0705	Laying to off USS Reclaimer (ARS-42).
0749	Underway for target submarine USS Searaven (SS-196).
0824	Moored to Searaven.
0840	Underway from Searaven; Geiger meter reading above tolerance.
0910	Commenced washing submarine.
1155	Secured from washing Searaven, laying to.
1532	Proceeding to assigned anchorage.
1600	Anchored in lee of Eneu Island.

31 July — Remained anchored.

1 August

0556	Underway.
0640	Moored to Searaven; commenced recovering anchors.
0725	Underway from alongside Searaven with first anchor.
1020	Discharged anchors to wet storage in lee of Eneu Island, proceeding to Searaven to recover stern anchor.
1145	Moored to Searaven.
1540	Underway from alongside Searaven, proceeding to anchorage.
1618	Anchored off Eneu Island.

2 August

0931	Shifted berths off Eneu Island.
1810	Anchored south of berth 376.

3 August

1055	Underway for salvaging anchors.

1355	Anchored in area of Tuna, sweeping for anchors.
1445	Underway to area of Dentuda to anchor and sweep.
1455	Anchored.
2100	Recovered two anchors and chain.
2114	Underway, proceeding to lee of Ionchebi Island to discharge anchor and chain.
2215	Laying to off north side of Ionchebi Island, discharging anchor and chain.
4 August	
0025	Completed discharging anchor and chain.
0114	Anchored south of numbered berths, near berth 376.
5 August	
0855	Underway to Palmyra.
1005	Anchored off Eneu Island, commenced recovering submarine anchors.
1010	Moored to spring buoy astern of anchorage.
1610	Salvaged anchors.
1630	Underway for wet storage off Ionchebi Island to dispose of anchors.
1645	Anchored off Ionchebi Island.
6 August	
0830-1007	Conducted diving operations in connection with ballooned anchors.
1325-1435	Conducted diving operations in connection with ballooned anchors.
1600	Underway to Ionchebi Island to dispose of anchors.
1840	Anchored.
7 August	
0907	Underway to retrieve anchors.
0930	In vicinity of Ionchebi Island to retrieve anchors.
1054	Underway to retrieve cable.
1115	Cable retrieved.
1120	Underway, laying to off Coucal.
1320	Underway to anchorage.
1355	Anchored in assigned berth.
8 August	
0732	Underway to salvage wire slings from Searaven.
0805	Moored to Searaven, recovering wire slings.
1122	Started to clear side of Searaven, anchor fouled with Searaven anchor chains.
1405	Cleared fouled anchor chain; laying to while awaiting orders from CTU 1.2.7.
1609	Underway, proceeding to anchorage.
1635	Anchored in assigned berth.
9 August	
1435	Moored to spring buoy in berth 54-A.
2245	Underway to recover partially sunken LCM.
2316	Commenced recovery operations of LCM first line to boat.
10 August	
0335	Completed salvaging LCM, proceeding to vicinity of Rolette.
0455	Anchored near Rolette.
0755	Released LCM.
1125	Moored to spring buoy in berth 54-A.
12 August	
1030	Underway to Dentuda and Tuna to discharge anchor and chain.
1108	Moored to Dentuda.
1150	Underway, proceeding to assigned berth, unable to discharge anchor and chain.
1240	Moored to spring buoy 54-A.
13 August	
0900	Underway.
1005	Moored to target submarine USS Skate (SS-305).
1037	Underway after transferring anchor and chain to Skate; proceeding to assigned berth.
1154	Moored to berth 54-A.
1248	Underway.
1357	Moored to target vessel LCT-874.
1430	LCT in tow, heaving in LCT's anchor.
1712	Anchor of LCT-874 away and underway to berth 133 to anchor LCT.
2045	Anchored LCT north of target ship USS LST-133 and berth 163.
2107	Anchored in berth 54-A.
14-18 August	Moored as before.
19 August	
0750	Underway to deliver chain to Fulton for Dentuda.
0815	Anchored off Fulton and transferred chain.
0930	Completed discharging chain and anchor.
0948	Underway to wet storage off Ionchebi Island to recover this vessel's starboard anchor and one shot of chain.
1135	Recovered anchor and chain; proceeding to anchorage.
1225	Moored to berth 54-A.
20 August	Moored as before.
21 August	
0730	Underway.
0757	Moored alongside target ship USS New York (BB-34).
1600	Underway from alongside New York, proceeding to berth 54-A.
1632	Moored to berth 54-A.
22 August	
0900	Discharged winch to LCM.
1330	Underway to pick up anchor and chain of target ship USS Catron (APA-71).
1450	Anchored off Catron.
1515	Started heaving in Catron's anchor.
1945	Underway, shifting berths clear of Catron.
2015	Anchored clear of Catron, 500 yards (457 meters) south of berth 226.
23 August	
0800	Underway; proceeding to target ship USS Butte (APA-68) to take anchor and chain on board.
0825	Anchored off bow of Butte.
1505	Commenced taking in Butte's anchor.
1559	Underway for assigned anchorage.
1620	Anchored in berth 54-A.
24 August	
0945-1230	Fueled from Enoree.
1310-1405	Received water from Enoree.
1410	Underway, proceeding to berth of USS LST-388.
1535	Underway from vicinity of LST-388, proceeding to berth 54-A.

USS Gypsy (ARSD-1)
24 August

1555	Anchored in berth 54-A.

25 August

0714	Underway to transfer chains and anchors.
0755-1040	Transferred anchor chain to USS Shakamaxon (AN-88).
1040	Underway to vicinity of Bikini Island beach to make preparation to clear beach of craft.
1357	Underway from salvage operations.
1402	Moored to beach to salvage target vessel LCT-1237.

26 August

0115	Reveille to start operations for towing LCTs, LCMs, and LCVPs off beach.
0215	Floated all boats clear of beach.
0355	Underway.
0424	Anchored in vicinity of beach at Bikini Island.
1505	Underway, starting operations of clearing Bikini Island beach of LCTs and other craft.
1535	Moored, commenced operations on target vessel LCT-414.

27 August

0230	Commenced trying to haul LCT-414 free of beach at high tide.
0610	Discontinued use of engines, waiting for high tide.
1436	Commenced backing both engines in operations to free LCT-414 from beach.
1517	LCT-414 free from beach.
1605	Having turned LCT-414 over to demolition team of Palmyra, commenced maneuvering to return to beach area to salvage sunken LCM.
1744	Floated LCM clear of beach.
1822	Anchored off Bikini Island.

29 August

0745	Underway to retrieve mooring anchor.
1014	Recovered mooring anchor, commenced maneuvering and approaching sunken target vessel LCT-1187.
1138	Moored off Bikini Island in vicinity of LCT-1187, making necessary preparations to float LCT-1187.
1500	Pulled LCT-1187 off beach and sank it in 70 feet (21 meters) of water.
1645	Underway for Bikini beach to salvage LCM-5 and LCM-6.
1715	Moored off Bikini beach, preparing to salvage LCMs.
1805	Pulled LCM-5 off beach.
1830	Underway to anchorage.
1850	Anchored off Bikini Atoll.

30 August

1200	Operations continued with target vessel LCT-812.
1300	Wire and airhose run out and secured to LCT-812.
1457	Heaved LCT-812 from beach.
1500	Commenced taking ship's moorings, port anchor fouled.
1700	Towed LCT-812 to deep water; LCT-812 sunk.
1715	Anchored off Bikini Island beach.
1810	Hauled LCM-5 from beach.
1904	Proceeding to anchorage off Bikini Island.
1910	Anchored off Bikini Island.

USS Haven (AH-12)

1 September

0750	Underway to haul target vessel LCT-1175 from beach.
0800	Continued operations on LCT-1175.

2 September

1750	Discontinued operations on LCT-1175 and underway.
1907	Moored close to USS Widgeon (ASR-1) to assist in salvage of target submarine USS Skipjack (SS-184). Moored over Skipjack.

3 September

0800	Hauling ship to position to make lift.
1130	Moored ship over bow of submarine.
1155	Submarine surfaced, all clear.
1746	Proceeding to anchorage off Bikini Island.
1832	Anchored off Bikini Island.

4 September

0730	Underway to salvage target vessel LCT-1113.
0745	Moored to LCT.
0800	On receiving orders to cancel operations on LCT, heaved around anchors.
0824	Underway to recover buoyed anchors used previously for salvage work.
1035	Anchors recovered, proceeding to vicinity of Widgeon.
1100	Anchored off bow of Widgeon.
1419	Underway to pick up starboard anchor of Skipjack.
1430	Laying to off Widgeon.
2150	Anchored in vicinity of Skipjack.

5 September

1300	Underway to pick up tow wire from Skipjack.
1307	Anchored off bow of submarine.
1420	Took tow wire off Skipjack.
1946	Departed for Kwajalein towing Skipjack.

7 September

0840	Anchored in berth D, Kwajalein.

8 September — Cast off Skipjack to Widgeon, proceeded to anchorage.

9 September — Towed YF-990 from beach at Kwajalein; cast vessel off to USS Chowanoc (ATF-100).

10-15 September — En route from Kwajalein to Pearl Harbor.

16 September — Arrived at Pearl Harbor.

USS HAVEN (AH-12)

Crew Size: 476
Bikini Atoll Arrival: 12 June 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 21.5 nmi (40 km) ENE
Shot BAKER Location: 11.5 nmi (21 km) E
Decontamination Location: Los Angeles
Operational Clearance: 14 February 1947

Task Unit and Function

The hospital ship Haven served in TU 1.1.2 (Instrumentation). Its function was overseeing the medical logistics of the operation by protecting

personnel from radiological hazards and collecting samples of water, food, clothing, drugs, and general storekeeping items that were tested. Radsafe Section was headquartered aboard the ship. [During the period that Haven was engaged in CROSSROADS activities, it carried the hull number APH-112.]

Shot ABLE (1 July, 0900)

30 June
1552 Left the lagoon for area Graham.

1 July
1504 Anchored in berth 131A, Bikini Atoll.

2 July
1123 Shifted to berth 34A.

5 July
1600 Official observers reported aboard.

Shot BAKER (25 July, 0835)

24 July
1538 Underway for area Graham.

25 July
0835 Observed blast in area Chevrolet.
1519 Anchored in berth Roger, Bikini Atoll.

28 July
1644 Shifted to berth C.

30 July
1035 Shifted to berth 34A.

2 August
1650 Moved to berth 383.

25 August
1603 Departed for Kwajalein Atoll.

26 August Arrived at Kwajalein.

10 October Left Kwajalein for Pearl Harbor.

15 October Arrived Pearl Harbor.

USS HENRICO (APA-45)

Crew Size: 424
Bikini Atoll Arrival: Before 2 June 1946
Bikini Atoll Departure: 16 August 1946
Shot ABLE Location: >13 nmi (24 km) SE (area Federal)
Shot BAKER Location: 8 to 10 nmi (15 to 19 km) SE (area Chalmers)
Decontamination Location: San Francisco
Operational Clearance: 28 January 1947
Final Clearance: 1 February 1947

Task Unit and Function
Henrico, an attack transport, served in Transportation Division 31 of TU 1.3.1 (Transport Unit). Its functions were to house target vessel crews during and after the detonations and to serve as a mother ship for LCPL radiological patrol boats.

Shot ABLE (1 July, 0900)

30 June
1438 Underway for area Mercury, steaming with USS Appling (APA-58) and USS Artemis (AKA-21).

1110 Approached the lagoon entrance.
1115-1135 Lowered seven radiological patrol boats (LCPLs) and departed the lagoon.
1740 Anchored in berth 315, Bikini Atoll.

2 July
1402 Shifted to berth 219 after disembarking teams from target ships USS Bladen (APA-63) and USS Catron (APA-71) and embarking other Bladen teams.
1600 Disembarked boarding team personnel from target ships Bladen, USS Ralph Talbot (DD-390), USS Dawson (APA-79), Catron, and LCTs.

3 July
0545 Lowered all radiological boats in the water.

Shot BAKER (25 July, 0835)

24 July
1500 Underway for area outside of the lagoon, steaming with Appling and Artemis.

25 July
1019-1030 Launched seven radiological patrol boats (LCPLs) near entrance of lagoon.
1542 Anchored in berth Sugar, Bikini Atoll.

28 July Shifted to berth 500 yards (457 meters) west of Charlie.

29 July
0725 Last-minute personnel from target ship USS Bracken (APA-64) reported aboard.
1350 Disembarked Teams A and B from Bladen to return to their ship.

30 July
0834 Anchored in berth 242.
1815 Shifted berths to a berth 300 yards (274 meters) west of 21.

31 July
1313 Anchored in berth 22.

2 August
1422 Moved to berth 354.

16 August Departed for Pearl Harbor and San Francisco.

USS HESPERIA (AKS-13)

Crew Size: 139
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: Kwajalein Atoll
Shot BAKER Location: 15 nmi (28 km) E
Decontamination Location: Pearl Harbor
Operational Clearance: 28 December 1946
Final Clearance: 4 January 1947

Task Unit and Function
Hesperia was a general stores issue ship that served in TU 1.8.1 (Repair and Service Unit). Its function was to provide provisions to other support ships during the operation.

Shot ABLE (1 July, 0900)

30 June
1232 Anchored in berth K-17, Kwajalein.

1 July
1356 Underway for Bikini.

2 July
1222 Anchored in berth 230, Bikini.

3 July
1349 Anchored in berth 145, Bikini.

4-24 July Routine supply-issuing operations.

Shot BAKER (25 July, 0835)

24 July
1500 Underway for area Packard.

25 July
0950 Left formation en route to Rongelap Atoll.
1623 Anchored in berth 35, Rongelap Atoll.

29 July
1830 Underway from Rongelap to Bikini.

30 July
0857 Anchored in berth 145, Bikini.
1147 Anchored in berth 131A, Bikini.

31 July-2 August
Routine operations.

2 August
1852 Anchored in berth 369, Bikini Atoll.

5 August
1641-1817 LCT-1377 moored alongside.

7 August
0926 Anchored in berth 131A, Bikini.

8 August
1257-1526 LCT-1420 moored alongside starboard.

14 August
1020 Anchored in berth 191, Bikini.

22 August
0900 Inspected by JTF 1 Radsafe Ship Clearing Board for radioactivity. Clear of radioactivity except for evaporators.

23 August
1355 Underway for Kwajalein.

24 August
1424 Anchored in berth K-9, Kwajalein.

31 August Underway for Pearl Harbor.

12 September Arrived Pearl Harbor.

USS HUGHES (DD-410)

Crew Size: 81
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 26 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 985 yards (900 meters) SSW
Shot BAKER Location: 625 yards (590 meters) SSW
Decontamination Location: Bremerton, Washington
Sunk 16 October 1948 off southern California coast

Task Unit and Function
The destroyer Hughes was a target vessel during CROSSROADS. Its crew was evacuated before ABLE and never returned. It served in Destroyer Division 1 of TU 1.2.3 (Destroyer Unit).

Shot ABLE (1 July, 0900)

1 July Crew evacuated to Bayfield.

2 July
1330 Team A under commanding officer reboarded to survey damage.
1400 Team B reboarded; commanding officer inspected holds and lower decks and opened up secured compartments.
1415 Started emergency diesel generator for lighting and power. Inspection disclosed extensive superficial damage and damage to boiler air casings. Damage reported to CJTF 1.

5 July
1340-1435 Towed by USS Clamp (ARS-33) from berth 61 to USS Dixie (AD-14) in berth 91 for repair work on boiler air casings.

6 July
1430-1500 YTF-107 removed unstable ammunition.

12 July
0830 Underway from Dixie to assigned berth 163.
1015 Anchored in berth 163, Bikini.

23 July
1710 Team C of reboarding organization left for Bayfield.

24 July
0745 Team B of reboarding organization departed for Bayfield.
1000 Team A left for Bayfield.

Shot BAKER (25 July, 0835)

28 July Beached off Eneu Island, southeastern part of lagoon, by USS Reclaimer (ARS-42) to prevent possible sinking because of damage sustained during BAKER.

1 August
1300 All Hughes personnel transferred from Bayfield to USS Rockingham (APA-229).

10 August
0845-1000 Commanding officer and nine others in boarding party reboarded Hughes for preliminary decontamination and inspection work. Boarding party departed for Rockingham.

12 August
1400 Ship pumped dry, retracted from beach by salvage tug, and moored to a buoy west of Eneu Island.

13 August
0900-1130 Three-man boarding party aboard ship to assist in salvage operations. Boarding party left ship and returned to Rockingham.

14 August
0830-1030 Three officers and boarding party reboarded ship for salvage and inspection work. Boarding party departed.
1400 Four officers and boarding party reboarded for inspection.
1430 Rear admiral boarded ship for inspection of damage.
1600 Rear admiral and party departed.
1615 Ship's boarding party departed for Rockingham.

15 August
0830-1215 Commanding officer and electronics officer with boarding party reboarded ship to continue damage inspections and assist in salvage operations. Boarding party returned to Rockingham.

16 August
0830 Executive officer, first lieutenant, and boarding party boarded ship for inspection and salvage operations.
1130 Boarding party departed ship for Rockingham.

17 August
0930 Captain and electronics officer with boarding party reboarded ship to continue damage inspections and salvage operations.
1300 Boarding party left ship and returned to Rockingham.

19 August
0830 Commanding officer and first lieutenant reboarded ship with reboarding party for inspection and salvage work. Topside average 0.4 R/24 hours (Reference 7).
1130 Boarding party departed for Rockingham.

20 August
0800 Commanding officer, executive officer, and boarding party reboarded ship for salvage work.
1300 Ship docked for inspection in ARD-29. Executive officer and party were relieved by first lieutenant and party.
1630 Boarding party departed for Rockingham.

21 August
0800-1130 Commanding officer and others reboarded ship for inspection purposes; boarding team and executive officer departed.
1300-1700 Boarding team reboarded ship to set material condition Zebra; boarding team departed for Rockingham.

22 August
0800 Commanding officer and others boarded ship to assist in undocking.
0900 Ship undocked and taken in tow by USS Shakamaxon (AN-88).
1100 Moored to buoy; boarding party departed for Rockingham.

23 August
0900 First lieutenant and boarding party reboarded ship to take aboard an anchor and 90 fathoms (162 meters) of chain.
1100 Boarding team departed for Rockingham.

24 August
1700 All Hughes personnel on Rockingham underway for Kwajalein.

28 August
0900 Transferred entire crew of Hughes to remanned target ship USS Niagara (APA-87). Hughes decommissioned.

16 September Topside average 0.3 R/24 hours (Reference 7).

Hughes was towed to Puget Sound Naval Shipyard in May 1947, arriving on 31 May, for radiological tests.

HUNTINGTON, ROBERT K.; see USS ROBERT K. HUNTINGTON (DD-781)

USS INDEPENDENCE (CVL-22)

Crew Size: 343
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 25 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 650 yards (594 meters) SW
Shot BAKER Location: 1,420 yards (1.3 km) W
Decontamination Location: San Francisco
Sunk 26 January 1951 off the southern California coast

Task Unit and Function
Independence, a small aircraft carrier, was a target vessel during CROSSROADS. Its crew was evacuated before both shots. It served in Carrier Division 31 of TU 1.2.2 (Aircraft Carrier Unit). Independence carried ball-crusher gauges under the Ordnance Group and test aircraft on its flight deck.

Shot ABLE (1 July, 0900)

30 June
1017 Evacuated Group II, a total of 8 officers and 103 enlisted men to Rockwall.
1315 Completed evacuation of Group III, 6 officers and 62 enlisted men.
1335-1402 Inspection team aboard.
1412 Captain and his party of 7 officers and 12 enlisted men left for Rockwall. Ship completely secured and no personnel aboard.

1 July
1402 A large fire was reported aboard. Unapproachable due to contaminated water surrounding ship (Reference 5, p. B-11).
1730 Fire extinguished.
1757 More fires and explosions reported (Reference 5, p. B-11).

2 July
1001 Towed by ATA-180 to western target array.
1730 The fires were extinguished (Reference 6, pp. I-25-A, and I-34-A).

4 July By this date, initial boarding team had been aboard (date unknown) and declared the ship safe for reboarding by Teams A and B.

USS Independence (CVL-22)

1341	Captain and his party reboarded the ship.
1353	Team A, consisting of 13 officers and 28 enlisted men, completed reboarding and commenced inspection of the ship with one radiological monitor.
1400-1440	Team B reboarded ship and moved to forward end of the flight deck under the command of the engineering officer.
1547	Party from USS Burleson (APA-67) came aboard to photograph, inspect, and pick up animals.
1630-1715	Evacuated ship.
5 July	
0845	Captain and party reboarded ship.
0905	Team A and selected members of Team B reboarded ship.
1530-1620	Evacuated ship.
6 July	
0845	Captain and party reboarded ship.
0910	Team A and selected members of Team B reboarded ship.
0955-1055	Inspection party aboard.
1540-1645	Evacuated ship.
7 July	
0850	Captain and party reboarded Independence. Team A and selected members of Team B and the ship's company reboarded.
1545-1705	Evacuated ship; three signalmen left aboard for anchor watch.
8 July	
0850	Captain and party reboarded Independence. General working party and designated officers reboarded.
1530-1725	Evacuated ship.
9 July	
1030	Moored to new berth.
1045	Embarked in small boats from Rockwall and proceeded to Independence.
1650	Evacuation of ship completed except for engineering and signal watch.
10 July	
0750	Embarked in small boats from Rockwall and proceeded to Independence.
1625	Completed evacuating ship.
11 July	
0800	Completed boarding ship from Rockwall.
1635	Completed evacuation of ship; one officer and eight enlisted men left aboard as watch standers.
12 July	
0800	Boarded Independence.
1615	Completed evacuation of ship except 37 selected men of B division and other selected divisions.
13 July	
0750	Crew aboard ship.
1550	Commenced evacuation of ship for Rockwall.
1610	Captain departed ship.
14 July	
0745	Embarked from Rockwall in small boats and proceeded to Independence.
1530	Completed evacuation of ship.
15 July	
0730	Embarked from Rockwall and proceeded to Independence.
1630	Evacuated personnel returned to Rockwall for the night.
16 July	
0930	Salvage barge came alongside with divers to check screws and bottom of ship from frame 108 aft.
1700	Completed evacuation of personnel to Rockwall.
17 July	
0755	Party for day's work came aboard Independence.
1037	In newly assigned berth, towed by USS Deliver (ARS-23).
1950	Completed mooring operations.
18 July	
0745	Commenced receiving men from Rockwall.
1314	Ship completely evacuated for William rehearsal.
19 July	
1418	Certain men from the R and E divisions reboarded Independence.
20 July	
0755	Commenced receiving men from Rockwall.
21 July	
0753	Working parties from Independence crew aboard Rockwall began coming aboard.
1600	Completed evacuation.
23 July	
0755	Working parties of Independence crew arrived from Rockwall.
1605	Completed evacuating personnel to Rockwall.
Shot BAKER (25 July, 0835)	
24 July	
0800	Captain and party boarded ship.
1145	Commenced evacuating personnel from ship.
1316	Captain and party left the ship. Ship completely evacuated to Rockwall, engineering plant completely secured, all cross-connecting lines secured, and in condition of maximum watertight integrity for shot BAKER.
27 July	
1655	Portside very radioactive (Reference 6, p. I-24-B).
1 August	Ship not reboarded due to radioactivity.
12 August	Crew transferred to USS Ajax (AR-6).
18 August	
0915-1330	Radsafe monitors and 30-man boarding party opened Independence, inspecting for explosive and toxic gases and lack of oxygen and monitoring radioactivity. A few spaces were tolerable and capable of sustaining life -- all engineering spaces, main deck forward of hangar deck, and a few deck areas. The only damage was the high radioactivity evident on all

	surfaces exposed to weather. Boarding party left.
1000	Commenced transferring personnel to other units for return to United States.

19 August

0930-1320	Boarding party of 41 men and 2 monitors boarded. Proceeded with inspection of ship, opening of compartments, testing for explosive gases, and radioactivity. Soundings were taken of all voids in engineering and C and R spaces. No unusual soundings indicating hull damage other than slight derangement of loose articles of furniture.

A 19 August report documented the radiation found on Independence as follows: 0.4 R/24 hours in the forward D.C. pump room and trunk and compartments A203-2A, A203-1A, A202-A, C407L, C408L, C202L; CPO mess was 4 R/24 hours portside and 1 R/24 hours starboardside; compartment C414T was 2 R/24 hours, C206L was 7 R/24 hours, C515E (8 inches of water) and C309L were 0.6 R/24 hours, and C308-3A and C310L were 1.5 R/24 hours.

20 August	Reboarded Independence. Three radsafe monitors accompanied the 43-man boarding party.
0835-1200	Director of Ship Material aboard to inspect engnieering spaces, hull, electrical systems, and armament.
1320	Evacuated ship.

21 August

0900-1300	Forty-man boarding party with one radiological monitor reboarded ship to pump out engineering spaces and close up ship; topside average 0.65 R/24 hours (Reference 7). Boarding party returned to Ajax.

22 August	Independence decommissioned.
25 August	Towed to Kwajalein by USS Munsee (ATF-107).
1 October	Topside average 0.4 R/24 hours (Reference 7).

On 16 June 1947 Independence arrived at San Francisco where it underwent decontamination studies until 1951.

USS INGRAHAM (DD-694)

Crew Size: 237
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) N
Shot BAKER Location: 16 nmi (30 km) NW
Decontamination Location: Puget Sound
Operational Clearance: 19 November 1946
Final Clearance: 21 November 1946

Task Unit and Function
The destroyer Ingraham served in Destroyer Division 72, Destroyer Squadron 7, under TG 1.7 (Surface Patrol). Its functions were to conduct oceanographic surveys and do radiological monitoring inside and outside the lagoon.

Shot ABLE (1 July, 0900)

1 July	Steaming independently in area near Point Victor.
1823	Stopped all engines; laying to for purpose of taking readings; evidence of slight radioactivity in area.
1900	Underway.
1941	Laying to to take readings.
2241	Laying to to take readings.
2308	Underway in area about 70 nmi (130 km) north of Bikini to collect scientific data in connection with CROSSROADS.
2 July	
0100-0501	Laying to to take oceanographic readings.
1254	Entered Bikini Atoll.
1319	Anchored in berth 344.
3-4 July	Routine activities.
5 July	
1306	Anchored in berth 116, after refueling from USS Enoree (AO-69).
1908	Radiological and oceanographic personnel left ship.
6-7 July	Routine activities.
8 July	
0857	Underway from Bikini Lagoon en route to Point Nan (about 20 nmi [37 km] north of Bikini) for oceanographic survey.
1210	Stopped all engines to begin oceanographic survey.
1225	Laying to and taking bathythermograph data every 20 minutes.
9 July	Laying to, adjusting position to take oceanographic data.
10 July	
0605	Completed bathythermograph readings, underway.
1210	Joined formation with USS Allen M. Sumner (DD-692) and USS Robert K. Huntington (DD-781).
11 July	
1043	Moored to USS Chikaskia (AO-54).
1222	Anchored in berth 116, Bikini.
14 July	
0525	Underway for operating Point Victor for BAKER air rehearsal.
1106	Anchored in berth 116.
18 July	
1242	Underway to Point Victor.
19 July	
1035	Joined formation with USS Laffey (DD-724), Huntington, and USS Walke (DD-723).
2142	Laying to off Adrikan Island to conduct radiological survey rehearsal (Operation Colgate).
20 July	
1418	Underway for Bikini.
1601	Anchored in berth 116N.

USS Ingraham (DD-694)

22 July
1700 Underway from berth 116N en route to Kwajalein.

23 July
0706 Anchored in berth A-29, Kwajalein.
1600 Underway for Bikini.

24 July
0550 Standing in Bikini Lagoon being fueled by Enoree.
0827 Anchored in berth 116.
1230 Underway for test BAKER to vicinity of Point Victor, northwest of Bikini.

Shot BAKER (25 July, 0835)

25 July
0950 Joined up with Huntington, Laffey, and Walke; maneuvered to stay in general vicinity of Bikini Island.
1913 Proceeding independently to position 70 nmi (130 km) north of Bikini.
2220 Stopped all engines.
2225 Ship dead in the water; laying to collecting oceanographic data for CROSSROADS at crossing #6.

26 July
0200 Changed course.
0904 Steering various courses to approach Lukoj Pass to collect oceanographic and radiological data.
0947 Anchored in Lukoj Pass.
1005 Motor whaleboat circling ship taking soundings around anchorage by lead line.
1552 Underway.
1605 Anchored.
1729 Underway to investigate oil slick 2 nmi (3.7 km) north of Nam Island.
1848 On station between Nam and Iroij islands to investigate oil slick for radioactivity.
1946 Underway.
2301 Anchored in berth Sugar, Bikini Atoll.

28 July
1549 Underway, shifting berths.
1613 Anchored in berth Nan in Bikini, conducting radiological survey.

29 July Anchored at berth Nan; conducted radiological survey.

30 July
1020-1127 Refueled from Enoree.
1157 Anchored in berth Nan.
1258 Underway.
1342 Moored to USS Dixie (AD-14).

1 August
0713 Underway for berth 189S.
0734 Anchored in berth 189S.
1645 Radiological party left ship for USS Haven (AH-12).

2 August
0859 Underway to conduct oceanographic survey.
0901 Oceanographic party members came aboard.
1353 Stopped all engines and commenced oceanographic soundings. Took bathythermograph soundings every 6 nmi (11 km). Survey conducted westward of Bikini Atoll.

USS James M. Gilliss (AGS-13)

3 August Continued oceanographic survey, stopping at intervals to take soundings.

4 August
0001 Steaming independently northeast of Bikini Atoll conducting oceanographic survey.
0638-0925 Conducted oceanographic survey; made preparations for entering port.
1007 Anchored in berth King North.

7 August
1004 Anchored in berth 189.

9 August
1055-1206 Received fuel from Enoree.
1241 Anchored in berth 189.

10 August
0754 Underway to San Diego, California, via Pearl Harbor with Destroyer Squadron 7.

15 August Arrived at Pearl Harbor.

USS JAMES M. GILLISS (AGS-13)

Crew Size: 40
Bikini Atoll Arrival: 4 July 1946
Bikini Atoll Departure: 20 August 1946
Location for Shot ABLE: Wotho Atoll (100 nmi [160 km] SE)
Location for Shot BAKER: Wotho Atoll (100 nmi [160 km] SE)
Decontamination Location: San Francisco
Operational Clearance: 13 November 1946
Final Clearance: 13 November 1946

Task Unit and Function
Gilliss was a surveying ship in TU 1.8.5 (Survey Unit). Its functions were surveying the probable effects of the nuclear tests on fish and wildlife and conducting oceanographic surveys to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

4 July
1430 Arrived at Bikini Atoll.
1700 Anchored in berth 207A.

15 July
0710 Underway for a geophysical survey station off Iroij Island.
0830 Reanchored in Bikini Lagoon.

17 July Conducted a geophysical survey off Jelete Island.

18 July Conducted an oceanographic survey off Adrikan Island.

19-22 July Conducted oceanographic surveys in Bikini Lagoon.

Shot BAKER (25 July, 0835)

24 July
0559 Departed for Wotho Atoll.
1625 Arrived at Wotho Atoll.

26 July Steamed to Rongelap Atoll.

1-3 August Conducted oceanographic surveys at Rongelap Atoll.

4 August
0551 Left for Bikini Atoll.
1406 Arrived and anchored at Bikini Atoll.

20 August
1107 Departed for Pearl Harbor.

1 September
0921 Arrived at Pearl Harbor.

USS JOHN BLISH (AGS-10)

Crew Size: 48
Bikini Atoll Arrival: 16 March 1946
Bikini Atoll Departure: 20 August 1946
Shot ABLE Location: Off Burok Island
Shot BAKER Location: Anchored at Rongelap Atoll
Decontamination Location: San Francisco
Operational Clearance: 15 October 1946
Final Clearance: 22 November 1946

Functions and Task Unit
Blish was a surveying ship used as a support ship in TU 1.8.5 (Survey Unit). Its functions were to survey the probable effects of the nuclear tests on fish and wildlife and to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

Blish anchored at Rongelap Atoll before shot ABLE.

1 July Steamed to an area off Burok Island.
1528 Reanchored at Rongelap Atoll.

4 July
0719 Departed for Bikini Atoll.
1524 Anchored at Bikini Atoll.

6-9 July Conducted biological surveys.

11-14 July Conducted oceanographic surveys.

17 July Departed for Rongelap Atoll.

18 July Arrived at Rongelap Atoll.

Shot BAKER (25 July, 0835)

25 July
1034-1540 Steaming off of Burok Island.
1540 Anchored at Rongelap Atoll.

28-30 July Conducted oceanographic surveys at Rongelap Atoll.

31 July
0600-1737 Conducted a geological survey at Rongelap Atoll.
1832 Underway for Bikini Atoll.

1 August
0655 Anchored in an unidentified berth at Bikini Atoll.
0840 Underway to collect bottom samples of the lagoon.

2 August Collected bottom samples of the lagoon.

3 August Conducted an oceanographic survey of the lagoon, then anchored in an unidentified berth.

5-10 August Conducted oceanographic surveys of the lagoon.

12-13 August Took bottom samples northwest of the lagoon.

20 August Departed for Pearl Harbor.

USS KENNETH WHITING (AV-14)

Crew Size: 539
Bikini Atoll Arrival: 29 May 1946
Bikini Atoll Departure: 14 August 1946
Shot ABLE Location: 10 to 15 nmi (19 to 28 km) E
Shot BAKER Location: 15 nmi (28 km) E
Decontamination Location: Los Angeles
Operational Clearance: 11 December 1946
Final Clearance: 21 December 1946

Task Unit and Function
Whiting, a seaplane tender, was used as a support ship in TU 1.1.2 (Instrumentation). Its function was to house and support the scientific personnel.

Shot ABLE (1 July, 0900)

1 July
0505 Eneu personnel came aboard, being evacuated according to ABLE plan.
0506 Bikini personnel came aboard.
0525 Underway from berth 55, Bikini, to area Graham.
0746 Arrived on station in area Graham.
1553 Anchored in berth 55, Bikini.
1605 Eneu and Bikini parties left ship.
1634 Anchored in berth 146, Bikini.
1900 Eneu and Bikini parties returned to ship.

2 July
1318 Anchored in berth 55, Bikini.

9 July
0927 No. 2 LCPL returned damaged to ship.

3-24 July Routine activities, not involved with target vessels.

Shot BAKER (25 July, Bikini, 0835)

25 July
0442 Bikini Island personnel reported on board.
0505 Eneu Island personnel reported on board.
0511 Underway from berth 55.
0724 Arrived on station, 8 nmi (14.8 km) from Point Auto.
1100 Anchored in berth Oboe, Bikini.

28 July
1632 Shifted to berth 381, Bikini.

29 July
0913 Anchored 500 yards (455 meters) due west of berth Able, Bikini.

30 July
1007 Anchored in berth 55, Bikini.

2 August
1612 Anchored in berth 382, Bikini.

7 August
1050 Anchored in berth 55, Bikini.

14 August
0844 Underway from Bikini en route to Pearl Harbor.

19 August
0903 Moored at Pearl Harbor.

USS LAFFEY (DD-724)

Crew Size: 251
Bikini Atoll Arrival: 4 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 19 nmi (35 km) NE (area Hudson)
Shot BAKER Location: 14 nmi (26 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 2 November 1946
Final Clearance: 18 December 1946

Task Unit and Function
The destroyer Laffey served in Destroyer Squadron 7, TG 1.7 (Surface Patrol). Its functions were to conduct oceanographic surveys and perform radiological monitoring during the operation.

Shot ABLE (1 July, 0900)

30 June
1230 Underway for area Hudson outside of the lagoon.

1 July
0959 Underway for radiological patrol.

5 July
1003 Anchored in berth 147S, Bikini Atoll.

8-15 July Conducted oceanographic surveys south of Bikini Atoll.

18 July Left the harbor for areas outside the lagoon.

21 July Reanchored in the lagoon in berth 386.

Shot BAKER (25 July, 0835)

24 July
1230 Underway with USS O'Brien (DD-725) and USS Walke (DD-723) for area Hudson outside the lagoon.

25 July Steaming in company with Walke and O'Brien.
0615 USS Lowry (DD-770) joined formation.
0832 Lowry and O'Brien left formation.
1204 Commenced steaming to remain in area Hudson.
1907 Commenced downwind patrol, steaming singly west of Bikini Atoll.

26 July Steaming singly west of Bikini Atoll, conducted radiological safety patrol.
0525 Secured downwind patrol and set course for Bikini Lagoon.
1015 Anchored in berth 338, Bikini.

27 July Anchored in berth 338, making radiological tests of the water of the lagoon.

28 July
1600 Underway to berth 385N.
1635 Anchored in berth 385N.

29 July Anchored in berth 385N, engaged in making tests for radioactivity in the water of the lagoon.
2030 Secured radiological observations.

30 July Anchored in berth 147S.

2 August
1428 Anchored in berth How South.

5 August
0740 Underway to conduct firing practice.
1755 Anchored in berth How South.

7 August
0920 Anchored in berth 147S.

9 August
0926-1014 Took on fuel from USS Enoree (AO-69).
1025 Underway.
1051 Anchored in berth 147S.

10 August
0751 Underway to San Diego, California, via Pearl Harbor.
1018-1024 Engaged in firing on target vessel LCI-620.
1100-1105 Engaged in firing on LCI-620.

15 August Arrived at Pearl Harbor.

USS LAMSON (DD-367)

Crew Size: 119
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Various ships
Shot ABLE Location: 762 yards (697 meters) NNE
Sunk 1 July 1946, Bikini Atoll

Task Unit and Function
The destroyer Lamson was a target vessel during CROSSROADS. Its crew was evacuated before shot ABLE and never returned. It served in Destroyer Division 1 of TU 1.2.3 (Destroyer Unit).

Shot ABLE (1 July 1946)

Lamson crew was evacuated to Henrico before the detonation. On 1 July Lamson sank as a result of shot ABLE. Diving operations were later conducted for examination of the ship.

Shot BAKER (25 July 0835)

The crew was dispersed among various task force vessels.

LCI-327

Crew Size: 18
Bikini Atoll Arrival: Before 1 July 1946
Bikini Atoll Departure: 1 September 1946

Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 2,441 yards (2.3 km) E
Shot BAKER Location: 2,443 yards (2.3 km) E
Sunk 30 October 1947 near Kwajalein Atoll

Task Unit and Function
LCI-327, a landing craft infantry ship, was a target vessel during CROSSROADS. Its crew was evacuated before shot ABLE and did not return. It served in LCI Group 7 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

1 July
1552 Test animals were removed from topside.
1610 Declared radiologically clear (Reference 5, pp. B-12 and B-13).

2 July
1530 All hands reboarded ship. Commenced inspection of ship to determine damage.

Shot BAKER (25 July, 0835)

27 July
1431 A boarding party returned from LCI-327 (Reference 6, p. I-23-B). Unable to remain aboard because of radioactivity.

28 July
1417 Boarded by another boarding team. Unable to remain aboard because of radioactivity.
1450 Washed down by USS Current (ARS-22) using a high-pressure hose (Reference 5, p. D-31; Reference 6, p. I-32-B).

29 July
0925 Washed down again (Reference 6, p. I-38-B). Unable to reboard because of radioactivity.

Its crew was aboard USS Rockbridge (APA-228) between 1 and 28 August and later dispersed to other ships.

1 September Towed to Kwajalein by ATA-180 and stranded on Bascombe Island until it was sunk.

LCI-329

Crew Size: 16
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 2,892 yards (2.6 km) E
Shot BAKER Location: 3,266 yards (3.0 km) ENE
Sunk 16 March 1948 near Kwajalein Atoll

Task Unit and Function
LCI-329, a landing craft infantry ship, was a target vessel during CROSSROADS. Its crew was evacuated before ABLE shot and never returned. It served in LCI Group 7 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

1 July
1417 Declared radiologically safe (Reference 6, pp. I-9-A and I-19-A).
1841 Declared radiologically safe (Reference 6, pp. I-9-A and I-19-A).

2 July
1552 Test animals were removed from topside.
1610 Reported to be clear of radioactivity (Reference 5, pp. B-12 and B-13).
1803 Initial damage control team aboard with commanding officer. Thorough inspection of the ship began.

Shot BAKER (25 July, 0835)

25 July
1226 Cleared for boarding (Reference 5, p. D-11).
1505 The initial team came aboard.
1529 Declared Geiger sour (Reference 5, p. D-14; Reference 6, p. I-13-B).

27 July
0855 Cleared for boarding.

28 July
1323 Boarded by an initial team.
1952 Declared Geiger sweet (Reference 5, pp. D-24, D-30, and D-34).

Its crew was transferred to USS Rockbridge (APA-228).

10 August
1030 Officers and crew returned to ship.

24 August
0740 Left Bikini for Kwajalein.

25 August
1400 Anchored at Kwajalein.

LCI-332

Crew Size: 17
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 1 September 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 2,210 yards (2 km) SSW
Shot BAKER Location: 1,890 yards (1.7 km) E
Sunk 30 September 1947 near Kwajalein Atoll

Task Unit and Function
LCI-332, a landing craft infantry ship, was a target vessel during CROSSROADS. Its crew was evacuated before ABLE and never returned. It served in LCI Group 7 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

1 July
1439 USS Etlah (AN-79) reported a small fire aboard LCI-332 (Reference 6, p. I-11-A).

2 July
1550 Team A, two officers, and eight enlisted men reboarded and inspected ship. Requested that remainder of crew return from evacuation transport.

Shot BAKER (25 July, 0835)

Crewmembers went aboard ship for unspecified amounts of time during 1 to 23 August. The crew was later dispersed to various task force units. On 28 August LCI-329 was decommissioned. It was towed to Kwajalein where it was used as part of the ship security detail until 22 February 1947.

LCI-620

Crew Size: 16
Bikini Atoll Arrival: Before 30 June 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: Beached, Bikini Island, 3 nmi (5.6 km) ENE
Shot BAKER Location: Beached, Bikini Island, 2.75 nmi (5.1 km) NE
Sunk 10 August 1946, at sea off Bikini

Task Unit and Function
LCI-620, a landing craft infantry ship, was a target vessel during CROSSROADS. Its crew was evacuated before ABLE and never returned. It served in LCI Group 7 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

Crew was evacuated to Bayfield before the detonation. LCI-620 was beached at slot 17 on Bikini Island.

Shot BAKER (25 July, 0835)

Crew aboard Bayfield during the detonation. LCI-620 was beached at slot 17, Bikini. The crew was embarked on USS Rockbridge (APA-228) between 4 and 13 August and on remanned target ship USS Fillmore (APA-83) between 14 and 22 August. Crewmembers went aboard LCI-620 at various times, duration unknown, during the period of 30 June to 3 August.

LCI(L)-549

Crew Size: 22
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 4,553 yards (4.2 km) E
Shot BAKER Location: 3,933 yards (3.6 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 4 April 1947
Final Clearance: August 1948
Final Disposition: Sold 19 August 1949, private purchase

Task Unit and Function
LCI(L)-549, a large infantry landing craft, was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It was a member of TU 1.2.5 (Landing Craft Unit), LCI Group 7.

Shot ABLE (1 July, 0900)

30 June Crew evacuated to Bayfield.

1 July
1317 USS Etlah (AN-79) (Team 7) ordered its team aboard.
1349 Etlah came alongside and the boarding team went aboard.
1355 Declared Geiger sweet by Etlah (Reference 6, pp. 7-I-A-8 and 7-I-A-9).
1610 Declared free of radiological contamination (Reference 5, p. VI-D-12).

2 July
1630 Boarded ship and inspected for damage. No damage except for a shaken galley smokestack.

Shot BAKER (25 July, 0835)

25 July
1307 USS Clamp (ARS-33) reported a boarding team aboard.
1310 Reported Geiger sweet (Reference 6, pp. 7-I-B-8 and 7-B-B-9).

28 July
1952 Reboarded and reported Geiger sweet by the DSM (Reference 5, p. VI-D-34).

LCI(L)-549 suffered no material damage from shot BAKER (Reference 2).

10 August Reboarded.

24 August
0757 Left Bikini for Kwajalein.

25 August
1345 Arrived at Kwajalein, where it remained as part of the ship security detail until June 1948.

LCI(L)-615

Crew Size: 16
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 4 September 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: Slot 14, Bikini Island, 5,500 to 6,000 yards (5 to 5.5 km) NE
Shot BAKER Location: Slot 14, Bikini Island 6,000 yards (5.5 km) NE of center array
Decontamination Location: San Francisco
Operational Clearance: 30 June 1947
Final Clearance: 17 August 1948
Final Disposition: Sold 19 August 1949, private purchase

Task Unit and Function
LCI(L)-615, a large infantry landing craft, was a target vessel for CROSSROADS. Its crew was evacuated before each shot. It was a member of TU 1.2.5 (Landing Craft Unit), LCI 7. It was loaded with ammunition and mines (Reference 3).

Shot ABLE (1 July, 0900)

1 July Beached in slot #14, Bikini Island. All officers, men, and necessary gear on board Bayfield.

3 July
1516 Commanding officer, executive officer, and six men reboarded LCI(L)-615 with

LCI(L)-615

necessary reboarding gear. Upon reboarding, ship found to have been looted, vandalized, and in very dirty condition. Machinery still in good condition. No direct damage resulted from the ABLE detonation.

1600 Commanding officer, executive officer, and six men evacuated the ship. Commanding officer reported verbally that the ship had been looted, vandalized, and was in unfit condition to live on. After the reports were made, officers and men returned to Bayfield with necessary gear.

12 July

0815 Security guard consisting of four men reboarded LCI(L)-615 with necessary gear by order of the commanding officer.

15 July

0900 Executive officer and five men to relieve security watch reported aboard by order of commanding officer.

1230 Executive officer and four men left LCI(L)-615 to reboard Bayfield. Five-man security watch now aboard.

17 July

0515 Rebeached ship.

0540 Made second attempt to rebeach ship. Starboard anchor fouled, leaving it inoperative.

1315 Commanding officer and four crewmembers reported aboard.

1317 Attempted to disengage line fouled in starboard screw.

1400 Attempt unsuccessful.

1455 Retracted from beach.

1505 Maneuvering off beach at Bikini.

1700 Making preparations to rebeach.

1718 Beached ship in slot #14.

1755 Commanding officer and four crewmembers left ship for Bayfield.

18 July

0720 Five-man security detail left.

19 July

1535 Six-man security detail reboarded ship.

22 July

1330 Three men of the six-man security watch evacuated to Bayfield.

24 July

0830 Three-man security watch with necessary gear evacuated to Bayfield.

Shot BAKER (25 July, 0835)

Beached in slot #14, Bikini. All officers, men, and necessary equipment on board Bayfield.

1 August

0800 Commanding officer, executive officer, and four men reboarded LCI(L)-615. Ship found in good condition. All lines had parted and ship was floating approximately 200 feet (61 meters) from shore.

1200 Checked ship for damage. Found stern winch radiator pushed back against cooling fan.

1257 Underway to anchor in berth 44.

1320 Anchored in berth 44.

1400 Commanding officer, executive officer, and two men left ship to get remaining crewmembers. Two men left aboard.

1705 Remaining crewmembers came aboard with all necessary gear. Commanding officer and executive officer boarded USS Rockbridge (APA-228) to receive messages pertaining to operation of LCI(L)-615.

2 August

0800 Commanding officer and executive officer boarded.

3 August

1055 Moored to USS Phaon (ARB-3).

5 August

1500 Entered into drydock.

8 August

1530 Maneuvered to get out of drydock.

1605 Moored alongside ARD-29.

9 August

1130-1248 Took on water from USS Wildcat (AW-2).

1251-1525 Took on oil from USS Enoree (AO-69).

1610 Anchored in berth 44 North.

10 August

1411 Anchored in berth 17.

15 August

1257 Took aboard 60-kw generator.

1355 Anchored in berth 108A.

16 August

0850 Underway to go alongside target ship USS Muqford (DD-389).

0910 Moored alongside Muqford.

1228 Cast off from Muqford and underway to target ship USS Stack (DD-406).

1355 Moored alongside Stack.

1645 Underway with Stack moored alongside.

1845 Underway to anchorage.

1858 Anchored in berth 17.

17 August

0827 Underway to go alongside target ship USS Nevada (BB-36).

0851 Moored alongside Nevada.

1540 Anchored in berth 108A.

19 August

0927 Underway to go alongside target ship Pennsylvania (BB-38).

0940-1458 Moored alongside Pennsylvania.

1518 Anchored in berth 108A.

20 August

0900 Moored alongside USS Palmyra (ARS[T]-3).

21 August

0840 Moored to target ship USS New York (BB-34).

1110 Underway from New York.

1259 Anchored in berth 108A.

23 August

0919 Underway to furnish electrical power to target ship USS Hughes (DD-410).

0940-1130 Moored to Hughes.

1145 Anchored in berth 118A.

24 August
0607 Getting underway for salvage operation.
0652 Moored alongside target ship USS Fallon (APA-81).
1200 Underway.
1225 Anchored in berth 108A.

25 August
0830 Underway for salvage operation.
0842 Moored alongside target ship USS Mayrant (DD-402), supplying power to raise anchor.
1504 Underway.
1520 Anchored in berth 108A.

26 August
0826 Underway to perform salvage operations.
0842-1110 Moored to target ship USS Mustin (DD-413) to furnish electrical power.
1110-1126 Underway to target ship USS Rhind (DD-404) to furnish electrical power.
1126-1309 Alongside Rhind.
1325 Anchored in berth 108A.
1415 Underway for salvage operation.
1435 Moored to target ship USS Ralph Talbot (DD-390) to haul in anchor.
1653 Underway to anchor.
1704 Anchored in berth 124.

29 August
1708 Radsafe monitor aboard.
1714 Underway for salvage operation.
1735-2002 Moored to target vessel LCT-1113 to pump ballast.
2014 Anchored in berth 124.

30 August
0905 Underway to moor alongside Palmyra.
0922 Moored to Palmyra.
1355 Cast off all lines, underway.
1415 Moored to USS Reclaimer (ARS-42) to take on salvage equipment.
1537 Anchored in berth 124.

1 September
1516 Underway to perform salvage operations.
1620 Moored alongside target vessel LCT-818 to pump excess water out.
1707 Underway to anchor.
1823 Anchored in berth 88.

2 September
1429 Underway to USS Widgeon (ASR-1) for salvage operation.
1445 Laying to off Widgeon for salvage operation.
1915 Proceeded to anchorage.
1930 Anchored in berth 88.

3 September
1225 Underway to perform salvage operation.
1255 Laying to off Widgeon, ready to give aid in submarine salvage operation.
1430 Underway to Eneu Island.
1510 Laying to off Eneu beach and making preparations to tow target vessel LCT-818 off the beach.
1635 Commenced towing LCT-818 off beach.
2157 Anchored in berth 88.

4 September
1400 Underway to Kwajalein.

5 September
1145 Moored alongide target vessel LCI(L)-549.

LCI(L)-977

Crew Size: 35
Bikini Atoll Arrival: 8 June 1946
Bikini Atoll Departure: 22 August 1946
Shot ABLE Location: Kwajalein
Shot BAKER Location: Kwajalein
Decontamination Location: Guam
Final Clearance: 7 March 1947

Task Unit and Function
LCI(L)-977, a large infantry landing craft, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). Its function as a support ship was to provide dispatch and mail service, interatoll freight, and passenger service.

Shot ABLE (1 July, 0900)

Anchored at Kwajalein.

Shot BAKER (25 July, 0835)

Anchored at Kwajalein.

9 August
0635 Entered Bikini Lagoon.
1125 Anchored in anchorage C.

14 August
0517 Shifted berths and anchored in berth 251A.

22 August
0845 Left Bikini Lagoon for Kwajalein.

LCI(L)-1062

Crew Size: 35
Bikini Atoll Arrival: 7 May 1946
Bikini Atoll Departure: 22 August 1946
Shot ABLE Location: Kwajalein
Shot BAKER Location: En route from Bikini to Rongelap
Decontamination Location: Guam
Final Clearance: By 4 January 1947

Task Unit and Function
LCI(L)-1062, a large infantry landing craft, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). As a support ship, it provided dispatch and mail service, interatoll freight, and passenger service.

Shot ABLE (1 July, 0900)

At Kwajalein.

Shot BAKER (25 July, 0835)

31 July
0945 Entered Bikini Lagoon.
1111 Anchored in berth 61.

2 August
1709 Anchored off Eneu Island.

6 August
0752 Left for Kwajalein.

9 August
0700 Reentered Bikini Lagoon and anchored in berth 63.

18 August
1549 Returned to the lagoon because of problems with its propeller shaft after various attempts to get underway.
1737 Anchored in berth 44.

22 August
0904 Left Bikini Lagoon for Kwajalein.

LCI(L)-1067

Crew Size: 34
Bikini Atoll Arrival: 18 June 1946
Bikini Atoll Departure: 22 August 1946
Shot ABLE Location: En route Kwajalein from Bikini
Shot BAKER Location: Kwajalein
Decontamination Location: Guam
Operational Clearance: 24 February 1947

Task Unit and Function
LCI(L)-1067, a large infantry landing craft, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). LCI(L)-1067 provided for dispatch and mail service, interatoll freight, and passenger service.

Shot ABLE (1 July, 0900)

1 July En route to Kwajalein from Bikini at time of shot ABLE.

Shot BAKER (25 July, 0835)

25 July At Kwajalein.

3 August
1215 Entered Bikini Lagoon.
1253 Moored portside to USS LST-861.
1648 Moored to USS Wildcat (AW-2).
1832 Anchored in berth 365.

4 August
1309-1357 Moored to USS Sylvania (AKA-44).
1416 Anchored in berth 365.

7 August
1312 Moored to USS LST-388 to take on cargo.

8 August
0612 Underway for Kwajalein.
0810 Left Bikini Lagoon for Kwajalein.

9 August
1227 Moored at Kwajalein.

12 August
0610 Underway from Kwajalein to Bikini.

13 August
0810 Anchored at Bikini.

16 August
0604 Underway from Bikini to Kwajalein.
0645 Left Bikini Lagoon.

17 August
1125 Moored to N.O.B. pier, Kwajalein.

18 August
1042 Underway for Bikini.

19 August
0650 Anchored in Bikini Atoll.

22 August
0746 Underway for Kwajalein.
0853 Left Bikini Lagoon for Kwajalein.

23 August
1910 Anchored in berth 29, Kwajalein.

9 September
1522 Underway for Guam.

16 September Moored at Guam.

LCI(L)-1091

Crew Size: 35
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 25 August 1946
Location for Shot ABLE: Kwajalein
Location for Shot BAKER: Rongelap Atoll
Decontamination Location: Guam
Final Clearance: Estimated 11 December 1946

Task Unit and Function
LCI(L)-1091, a large infantry landing craft, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). It provided for dispatch and mail service, interatoll freight, and passenger service.

Shot ABLE (1 July, 0900)

1 July Anchored at Kwajalein for shot ABLE.

6 July
1240 Underway from Kwajalein to Bikini.

7 July
0917 Moored in berth 56A, Bikini.
1310 Anchored and shifted berths.

8 July
0545 Underway from Bikini to Kwajalein.

9 July
1130 Moored to N.O.B pier, Kwajalein.

10 July
0630 Underway from Kwajalein to Bikini.

11 July
1023 Moored at Bikini.

16 July
0622 Underway from Bikini to Kwajalein.

17 July
1132 Moored to berth A44, Kwajalein.

19 July
0939 Underway from Kwajalein to Bikini.

20 July
0849 Moored to berth 56A, Bikini.

22 July
0610 Underway from Bikini to Kwajalein.

23 July
0935 Anchored in berth K-11, Kwajalein.

Shot BAKER (25 July, 0835)

24 July
0608 Underway from Kwajalein to Rongelap.
0742 Anchored in berth 11, Rongelap.

30 July
1735 Underway from Rongelap to Bikini.

31 July
1005 Anchored berth 191, Bikini.

2 August
0601 Underway from Bikini to Kwajalein.

3 August
1022 Anchored at berth K-16, Kwajalein.

4 August
0700 Underway from Kwajalein to Bikini.

5 August
0830 Moored to berth 362, Bikini.

8 August
0730 Underway from Bikini to Kwajalein.

9 August
1159 Moored in berth A-11, Kwajalein.

10 August
0717 Underway from Kwajalein to Bikini.

11 August
0742 Moored to berth 34A, Bikini.

14 August
0707 Underway with passengers and mail for Kwajalein.

15 August
1030 Moored at Kwajalein.

16 August
0720 Underway from Kwajalein to Bikini.

17 August
1207 Moored to berth 246, Bikini.

23 August
0945 Underwent drydocking.

24 August
0813 Free of drydock.

25 August
1103 Underway from Bikini to Kwajalein.

26 August
1043 Anchored in berth K-23, Kwajalein.

9 September
1620 Departed Kwajalein for Guam Island.

16 September
0748 Moored at Guam.

USS LIMESTONE (IX-158)

Crew Size: 244
Shot ABLE Location: Kwajalein
Shot BAKER Location: Kwajalein

Task Unit and Function

The concrete barge Limestone was originally intended to serve in CROSSROADS as a miscellaneous craft. However, changes in plans resulted in its spending the entire test period at Kwajalein. As such, it was not exposed to radioactivity from the tests. It was towed by USS Deliver (ARS-23) from Kwajalein to Pearl Harbor on 8 September, arriving on 23 September.

USS LOWRY (DD-770)

Crew Size: 244
Bikini Atoll Arrival: 25 July 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: San Francisco
Shot BAKER Location: 15 nmi (28 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 6 November 1946
Final Clearance: By 4 January 1947

Task Unit and Function

The destroyer Lowry was a member of TG 1.7 (Surface Patrol), attached to Destroyer Division 71. It had been outfitted with special oceanographic and radiological equipment to conduct oceanographic surveys and radiological monitoring. It performed monitoring duties both within and outside Bikini Lagoon.

Shot ABLE (1 July, 0900)

In San Francisco during shot ABLE.

Shot BAKER (25 July, 0835)

24 July
1428 Underway to area Hudson, Bikini Atoll, from Kwajalein Atoll.

25 July
1721 Anchored in Bikini Lagoon.
1835 Underway for night radiological monitoring.
1905 Anchored in southern part of Bikini Lagoon.

26 July
0220 Radiological experts reported the presence of radiation.
0424 Underway to shift anchorages.
0506 Anchored in southern part of Bikini Lagoon.
0954 Shifted anchorages.

27 July
1805 Underway from Bikini to Kwajalein.

28 July
0847 Anchored in berth K-6, Kwajalein Atoll.
1745 Underway from Kwajalein to Bikini.

29 July
0810 Arrived at Bikini and anchored in Bikini Lagoon.

31 July Took on provisions from USS Dixie (AD-14).
1316 Anchored at berth 190 South.

2 August
1536 Shifted berths, finally anchoring in berth Love.

7 August
1001 Shifted to anchorage 190 South.

8 August
1017 Anchored in berth 386.

10 August
1631 Underway with ships in Destroyer Squadron 7 for San Diego via Pearl Harbor after a firing run on target ship LCI-620.

LSM-60

Crew Size: 40
Bikini Atoll Arrival: 4 July 1946
Crew Location for Shot BAKER: USS Albemarle (AV-5)
Shot ABLE Location: Kwajalein
Shot BAKER Location: Surface zero
Sunk 25 July 1946, Bikini Atoll

Task Unit and Function
Medium landing ship LSM-60 was a member of TU 1.1.1 (Laboratory Unit). It was the ship from which the bomb was suspended for shot BAKER. Its crew was evacuated before BAKER and did not return.

Shot ABLE (1 July, 0900)

30 June Moored to mooring buoy G at Kwajalein.

3 July
0830-0917 YW-94 alongside to deliver water.
1152 Underway from buoy to USS Gunston Hall (LSD-5) for docking with assistance of USS Munsee (ATF-107) and two YTBs.
1228 Commenced entering Gunston Hall.
1229 YTB-469 cast off.
1230 Munsee cast off.
1236 Moored in Gunston Hall.
1255-1315 Entered Gunston Hall.
1345 With Gunston Hall underway to Bikini.

4 July
0831 Entered Bikini Lagoon.
0920 Gunston Hall anchored in assigned berth.
1000-1245 Clear of Gunston Hall.
1330 Anchored in berth 38, Bikini.

5 July
1345 ATA-124 alongside.
1410 Underway to shift to berth 54A.
1435 Moored to buoy in berth 54A.
1445 ATA-124 underway from starboard side.

8 July
0705 ATA-180 moored to assist in changing berths.
0734 Underway from berth 54A to moor alongside Albemarle.
0805 Moored alongside Albemarle.
1535 ATA-180 alongside starboard side to assist in shifting mooring.
1540 Underway from alongside Albemarle en route to berth 54A.
1700 Moored in berth 54A.

11 July
0530 ATA-180 came alongside to assist in shifting berths.
0550 Underway from berth 54A, to four-point mooring in berth 161.
0645 ATA-180 underway from alongside.
0709 Completed mooring to four mooring buoys in berth 161.
0855 Commenced lowering underwater unit.
1400 Commenced raising underwater unit.
1430 Unit clear of water.
1736 ATA-180 moored alongside out portside to assist in shifting berths.
1806 Underway from four-point mooring in berth 161.
1842 Moored in berth 54A, Bikini.
1850 ATA-180 underway from alongside.

12 July
1400 ATA-180 came alongside portside.
1444 Underway from berth 54A to berth 161.
1530 Commenced mooring.
1600 ATA-180 got underway from alongside.
1610 Completed mooring to four mooring buoys in berth 161, Bikini.

14 July
1600 Commenced lowering underwater unit.
1645 Underwater unit at desired depth.

15 July
1140 Commenced raising detector bell.
1215 Detector bell clear of water.

16 July
0545 Commenced unmooring.
0610 ATA-180 came alongside to assist in shifting berth.
0629 Underway from mooring buoys.
0723 Moored to Albemarle in berth 40.
0729 ATA-180 left from alongside.
0810-1130 Stripped ship in preparation for BAKER.
1215 ATA-180 alongside to assist in shifting berth.
1224 Underway from alongside Albemarle.
1255 Moored to mooring buoy in berth 54A.
1310 ATA-180 got underway.

18 July
0515 ATA-180 alongside starboard.
0540 Underway from berth 54A.
0605 Moored to Albemarle in berth 40.
0610 ATA-180 got underway.
0730 ATA-180 alongside starboard side.
0740 Underway from alongside Albemarle en route to assigned mooring buoys with assistance of ATA-180.
0825 Commenced mooring.
0843 ATA-180 got underway from alongside.
0900 Completed mooring to four mooring buoys in berth 161.
1213 One officer and twelve enlisted men evacuated to Albemarle.
1700 Commenced lowering detector bell.
1730 Detector bell lowered to desired depth.
1910 Two officers and twenty-one enlisted men evacuated to Albemarle; one officer and three enlisted men remained on board.

19 July
1445 Officers and crew returned aboard, resumed normal operations.
1515 Commenced raising detector chamber.
1555 Detector chamber clear of water.

20 July
0807 Underway from berth 161 to berth 54A.
0843 Moored in berth 54A.

24 July
0515 ATA-180 came alongside.
0540 Underway to shift berth with assistance of ATA-180.
0605 Moored to Albemarle in berth 40.
0615 ATA-180 underway from alongside.
0715 ATA-180 alongside starboard side.
0730 Underway from Albemarle to assigned mooring buoy.
0830 Commenced mooring.
0855 ATA-180 underway from alongside.
0935 Completed mooring to four mooring buoys in berth 161.
1230 Evacuated one officer and twelve enlisted men to Albemarle.
1600 Commenced lowering detector bell.
1635 Detector bell lowered to desired depth.
1914 Two officers and twenty-three enlisted men evacuated to Albemarle in preparation for BAKER.

25 July
0609 Final evacuation party left the ship with all personnel accounted for. Ship completely abandoned.

Shot BAKER (25 July 0835)

25 July
0835 LSM-60 was completely destroyed by shot BAKER.

Its crew was dispersed to various units of the task force.

USS LST-52

Crew Size: 63
Bikini Atoll Arrival: Before 30 June 1946
Bikini Atoll Departure: 26 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 1,550 yards (1.4 km) E
Shot BAKER Location: 1,590 yards (1.5 km) N
Sunk April 1948, near Kwajalein Atoll

Task Unit and Function
LST-52, a tank landing ship, was a target vessel during Operation CROSSROADS. Its crew was evacuated before ABLE and did not return. It served in LST Group 9 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

30 June
0900 Evacuated ship; crew aboard Rockwall.

2 July
1011 Boarding team reported on board (Reference 6, p. I-26-A).
1042 USS Etlah (AN-79) reported LST-52 Geiger sweet.
1845 Reboarded ship. Restored to normal operation in berth 109. Ship reboarded after orders from DSM.

3-24 July Crew aboard LST-52.

Shot BAKER (25 July, 0835)

24 July
0900 Crew evacuated to Rockwall.

28 July DSM Geiger reading 4.5 R/24 hours from 30 feet (9.1 meters).

8 August
1000 Geiger readings: main deck average 7 R/24 hours, maximum 12 R/24 hours; first platform average 1.5 R/24 hours, maximum 3 R/24 hours.

14 August Inspected by DSM and ship's representatives.

17 August Staff inspections complete; ship made available for towing.

19 August
1000 Crew shifted from Rockwall to USS Dixie (AD-14).

21 August Average topside Geiger reading 3.9 R/24 hours.

26 August Towed to Kwajalein by USS Clamp (ARS-33).

A 26 August letter on the condition of LST-52 on decommissioning stated that it was very radioactive and therefore did not allow long periods of inspection. It later states that the ship was in fair condition.

27 August Anchored at Kwajalein, berth A-20.

28 August Decommissioned.

30 September Average topside Geiger reading 1.14 R/24 hours.

USS LST-125

Crew Size: 5 (only 2 at Bikini for test)
Bikini Atoll Arrival: 13 July 1946
Crew Location for Shot BAKER: USS Rockwall (APA-230)
Shot Able Location: En route from Subic Bay to Kwajalein
Shot BAKER Location: 3 nmi (6 km) NE, beached on Bikini Island
Sunk 14 August 1946 at sea near Bikini

Task Unit and Function
LST-125, a tank landing ship, was a target vessel during CROSSROADS. Its crew was evacuated for BAKER and did not return. It served in LST Group 9 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

Not present for ABLE. En route from Subic Bay to Bikini Atoll.

8 July
1435 Anchored in berth 63, Bikini Lagoon.

10 July — Shifted to berth 53, Bikini Lagoon.

13 July — Beached on Bikini Island, berth 16. All personnel except for commanding officer and one man were transferred to USS Chilton (APA-38) for return to the United States before test BAKER.

14-22 July — One-man security watch aboard each night.

Shot BAKER (25 July, 0835)

23 July — All personnel departed LST-125 for Rockwall.

31 July — Army requested that ramp be lowered to remove gear. Ship reported to be radiologically clear.

1 August
1405-1515 — Commanding officer boarded ship for inspection. Engine rooms completely flooded.

2 August — Engine room pumped out.

10 August — USS Munsee (ATF-107) and USS Wenatchee (ATF-118) removed ship from beach.

12 August — Staff inspections complete.

14 August
1436 — Towed 5 nmi (9.3 km) southwest of Bikini and sunk by gunfire.

USS LST-133

Crew Size: 78
Bikini Atoll Arrival: 15 April 1946
Bikini Atoll Departure: 29 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 5,550 to 6,000 yards (5.0 to 5.5 km) N, beached on Bikini Island
Shot BAKER Location: 675 yards (617 meters) NE
Sunk 11 May 1948 near Kwajalein Atoll

Task Unit and Function
LST-133, a tank landing ship, was a target vessel during CROSSROADS. Its crew was evacuated for each shot. It served in LST Group 9 of TU 1.2.5 (Landing Craft Unit).

Shot ABLE (1 July, 0900)

Immediately after arriving in the area, LST-133 was beached on Bikini Island. Its crew was evacuated to Rockwall on 25 June.

1 July
1442 — Test animals were removed from topside.
1610 — Declared free of radioactive contamination (Reference 5, p. B-12).

2 July
1710 — Teams A and B returned to LST-133 to put it back in operating condition. An inspection of the ship showed no damage.

3 July
0538 — Anchored in berth 38.
0924 — Shifted to berth 44.
1645 — Team C and remainder of crew returned.

3-23 July — Crew aboard LST-133.

Shot BAKER (25 July, 0835)

23 July
1530 — Crew evacuated to Rockwall.

27 July — DSM reported a Geiger reading of 1.5 R/24 hours measured close aboard.

28 July — DSM reported a Geiger reading of 0.25 R/24 hours at 250 feet (76 meters).

8 August
1020 — IBT-10 reported main deck average 2.5 R/24 hours, inside aftersuperstructure reading, 2.5 R/24 hours, main deck first platform 1.5 R/24 hours, and tank deck aft 0.3 R to 1.0 R/24 hours.

13 August — Blast damage to the ship reported.

19 August — Pumped out approximately 40 tons of water, apparently no leaks in ship.

20 August — Pumped out 90 tons of water from bilges, control room, engine room, and tank deck; apparently no leaks.

21 August — Pumped out approximately 15 tons of water from main engine room.

23 August — Staff inspection completed and made available to CTG 1.2 for disposition. Average topside reading 0.9 R/24 hours.

28 August — Decommissioned.

29 August — Departed Bikini for Kwajalein in tow by USS Achomawi (ATF-148).

30 August — Arrived at Kwajalein.

USS LST-220

Crew Size: 59
Bikini Atoll Arrival: 4 April 1946/12 June 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 3,272 yards (3 km) N
Shot BAKER Location: 3,466 yards (3.2 km) N
Decommissioned: 28 August 1946
Sunk 12 May 1948 near Kwajalein (8°44'N, 167°25'E)

Task Unit and Function
Tank landing ship USS LST-220 was a member of TU 1.2.5 (Landing Craft Unit), LST Group 9. It was a target vessel for shots ABLE and BAKER involved in Army ordnance experiments with poison gases and ammunition.

Shot ABLE (1 July, 0900)

1 July
1756 — USS Etlah's (AN-79) boarding team decided not to board since it was still smoking fore and aft.

2 July
0938 — Etlah reported the boarding team aboard.

1000 Declared radiologically safe by Etlah (Reference 6, pp. 7-I-A-16 through 7-I-A-18).
1634 Team A boarded. Ship found safe for boarding.
1705 Team B boarded.

4 July
1308 Team C reboarded. Full crew now aboard.

5-23 July Crew aboard LST-220.

On 8 July, the damage report indicated that there had been no structural damage. All damage was due to two small fires (Reference 3).

24 July Evacuated crew to Rockwall.

Shot BAKER (25 July, 0835)

28 July
1246 Boarded by the initial boarding teams from USS Current (ARS-22).
1305 Current boarding team departed.
1952 Reported Geiger sour (contaminated), averaging 3.0 R/24 hours (Reference 5, p. 6-D-34).

13 August Boarded by team from ship's crew for inspection.

14 August Inspected by DSM and ship's representatives.

17 August Staff inspections completed.

21 August Average topside reading 0.27 R/24 hours.

28 August Towed from Bikini to Kwajalein. Ship decommissioned.

LST-220 showed no evidence of physical damage from shot BAKER (Reference 2).

USS LST-388

Crew Size: 80
Bikini Atoll Arrival: 14 April 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 28 nmi (52 km) NE
Shot BAKER Location: 22 nmi (41 km) W
Decontamination Location: San Francisco
Operational Clearance: 5 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
Tank landing ship LST-388 was a member of TU 1.8.1 (Repair and Service Unit). Part of its support function was as a recreation ship.

Shot ABLE (1 July, 0900)

30 June
1530 Underway to area Packard.

1 July
1926 Entered Bikini Lagoon and anchored in berth 368.

2 July
1643 Anchored in berth 43.

3 July
0543 Beached in the LST beaching area on Bikini.

Shot BAKER (25 July, 0835)

24 July
1400 Underway.

25 July Steaming with members of CTG 1.8.
0844 Departed for Rongelap.
1600 Anchored at Rongelap.

30 July
1558 Underway to Bikini.

31 July
0525 Reentered Bikini Lagoon and anchored in the vicinity of berth 61.
0645-1700 Beached on Bikini Island.
1705 Anchored in the vicinity of berth 44.

2 August
1742 Anchored in the vicinity of berth Roger.

25 August
1137 Left Bikini for Kwajalein.

USS LST-545

Crew Size: 47
Bikini Atoll Arrival: 3 June 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 4,067 yards (3.7 km) N
Shot BAKER Location: 4,143 yards (3.8 km) N
Sunk 12 May 1948 near Kwajalein (8°48'N, 167°21'E)

Task Unit and Function
LST-545, a tank landing ship, was a member of TU 1.2.5 (Landing Craft Unit), LST Group 9. In addition to serving as a target ship, the Army Ordnance Unit and the Engineering Unit used the ship in some of their experiments. Ammunition and heavy equipment were placed aboard the ship for experimentation.

Shot ABLE (1 July, 0900)

1 July
1317 Boarded by USS Etlah's (AN-79) Initial Boarding Team 7.
1720 Etlah reported the boarding team was aboard.
1749 Reported Geiger sweet by Etlah (Reference 6, pp. 7-I-8-A, 7-I-17-A, 7-I-18-A).

2 July
1630 Team A reboarded.
1734 Team B and rest of crew reboarded.

There was no damage to the ship as a result of the test (Reference 3).

Shot BAKER (25 July, 0835)

28 July
1009 USS Reclaimer (ARS-42) passed close aboard and saw no apparent damage (Reference 6, p. 7-I-29-B).
1100 Boarded by the initial boarding team (Reference 5, p. 6-D-29).

1256 USS Current (ARS-22) reported the boarding team aboard (Reference 6, p. 7-I-B-31).
1952 Reported Geiger sour, average reading 2.0 R/24 hours (Reference 5, p. 6-D-34).

8 August
0909 IBT-10 reported average maindeck reading 0.7 R/24 hours, inside superstructure 0.35 R/24 hours, and tank deck 0.25 R/24 hours.

10 August
0844-1041 DSM inspection team aboard.

15 August Inspections complete. Made available to CTG 1.2 for towing.

21 August Average topside reading 0.096 R/24 hours.

27 August Decommissioned.

28 August Departed Bikini for Kwajalein.

30 August Anchored in Kwajalein.

USS LST-661

Crew Size: 62
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 25 August 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 2,320 yards (2.1 km) NNE
Shot BAKER Location: 2,653 yards (2.4 km) N
Sunk 25 July 1948 near Kwajalein (8°51.4'N, 167°20.3'E)

Task Unit and Function
LST-661, a tank landing ship, was a member of TU 1.2.5 (Landing Craft Unit), LST Group 9. Its main function was as a target ship, and it performed various experiments in that role for the Army Ordnance and Engineering units. Poison gases and ammunition were stored on it for shots ABLE and BAKER.

Shot ABLE (1 July, 0900)

1 July
1402 The Salvage Unit reported fighting fires aboard LST-661 and others (Reference 5, p. 6-B-11).
1533 USS Etlah (AN-79) reported the pyrotechnics on LST-661 were exploding because of the fire on board (Reference 6, p. 7-I-A-12).
1537 DSM directed all ships to stay at least 1,100 yards (1 km) away from LST-661 because of the hazard from the fire and exploding Army ammunition (Reference 5, p. 6-B-12).
1545 Reported Geiger sour by the DSM.
1702 Etlah reported that the LST-661 fire was below deck (Reference 6, pp. 7-I-A-13 and 7-I-A-16).
2026 Fires were still active. It was still dangerous to approach due to the possibility of explosions.

2 July
0852 Etlah reported a boarding team aboard.
0931 Reported Geiger sweet by Etlah's team (Reference 6, pp. 7-I-A-23 and 7-I-A-24).
1610 Smoldering fire on tank deck extinguished.
1655 Team B returned to ship.

5 July
1115 Twenty-seven officers and enlisted men returned to LST-661 from Rockwall.

Shot BAKER (25 July, 0835)

24 July
0830 Officers and men evacuated to Rockwall.

13 August
0830-0835 Commanding officer with Bureau of Ships representative and radsafe team boarded for inspection.
0900 Eleven officers and enlisted men boarded ship for inspection.
0928 Commanding officer returned aboard.
0930 Inspection party left ship.
0931 Commanding officer left ship and returned to Rockwall with inspection party.

25 August Underway to Kwajalein.

27 August Anchored in Kwajalein Atoll.
0900 Six men boarded to remove magnetometer.

28 August
1000 Ship decommissioned.

USS LST-817

Crew Size: 63
Bikini Atoll Arrival: 19 March 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: 38 nmi (70 km) NE
Shot BAKER Location: 24 nmi (44 km) E
Decontamination Location: San Francisco
Operational Clearance: 21 November 1946
Final Clearance: 22 November 1946

Task Unit and Function
Tank landing ship LST-817 was a member of TU 1.3.1 (Transport Unit) as part of Transport Division 31. It and LST-881 were loaded at Pearl Harbor with construction materials. Once the ship arrived at Pearl Harbor, it served as a barracks and storage ship for the Seabees (Reference 5, p. 6-A-20).

Shot ABLE (1 July, 0900)

30 June
1615 Underway with TU 1.3.1 for area Marmon.

1 July
1815 Anchored in berth 39, Bikini.

3 July
1348 Beached on Bikini Island.

5 July
0733 Anchored in berth 39.
1901 Beached at LST landing on Bikini.

11 July Anchored in berth 39, Bikini.

USS LST-817

15 July
0809-1235 Took on freshwater from USS Wildcat (AW-2).
1332 Anchored in berth 38.

16 July
1515 Beached at Bikini.

17 July
0410 Anchored in the vicinity of berth 39.

19 July
1515 Anchored in Bikini Lagoon.

Shot BAKER (25 July, 0835)

24 July
1616 Underway with Division 4 of TG 1.3 for area Marmon.

25 July
0835 Observed BAKER explosion.
1715 Anchored in Rongelap Atoll.

30 July
1735 Underway to Bikini.

31 July
0714 Anchored in berth 39, Bikini.

1 August
1714 Beached at Bikini Island.

10 August
1600 Anchored in Bikini Lagoon.

11 August
0940 Anchored at berth 39.

12 August
1530 Beached on Bikini Island.

15 August
1910 Underway for Kwajalein after taking on potable water from Wildcat.

16 August
1745 Anchored in Kwajalein Lagoon.

20 August
1704 Underway to Bikini.

21 August
1420 Anchored at berth 44, Bikini.

23 August
1726 Underway for Kwajalein.

24 August
1528 Anchored at Kwajalein.

31 August
1224 Underway to United States via Pearl Harbor.

USS LST-861

Crew Size: 80
Bikini Arrival: 2 April 1946
Bikini Departure: 24 August 1946
Shot ABLE Location: >150 nmi (278 km) SE
Shot BAKER Location: >188 nmi (348 km) SE
Decontamination Location: San Francisco
Operational Clearance: 6 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
LST-861, a tank landing ship, served in TU 1.8.1 (Repair and Service Unit). It served as a post office. In addition, it provided provisions or logistic support to other support ships in the operation.

Shot ABLE (1 July, 0900)

30 June
1535 Departed Bikini.

1 July Underway to Kwajalein from Bikini at time of shot ABLE.
1608 Anchored in Kwajalein Atoll.

2 July
0830 Underway to Bikini.

3 July
0750 Anchored in berth 64, Bikini.

Shot BAKER (25 July, 0835)

24 July
1602 Departed Bikini en route to Kwajalein.

25 July
1550 Arrived at Kwajalein.

27 July
1652 Underway for Bikini.

28 July
1347 Anchored in Bikini Lagoon.
1706 Anchored 1,000 yards (914 meters) south of berth 380.

30 July
1200 Anchored in berth 64, Bikini.

31 July-23 August
Periodically shifted berths and anchorages.

24 August
1052 Left Bikini Lagoon for Kwajalein.

25 August
1015 Anchored at Kwajalein.

2 September
1453 Departed Kwajalein en route to Pearl Harbor.

USS LST-871

USS LST-871

Crew Size: 81
Bikini Arrival: 16 June 1946
Bikini Departure: 25 July 1946
Shot ABLE Location: Rongerik Atoll
Shot BAKER Location: 22 nmi (41 km) E
Decontamination Location: San Francisco
Final Clearance: 22 November 1946

Task Unit and Function
LST-871, a tank landing ship, was a member of TU 1.8.7 (Rongerik Evacuation Unit). It was one of the ships used to evacuate the Marshallese from their islands.

USS LST-871

Shot ABLE (1 July, 0900)

1 July	Moored off Rongerik Island at the time of shot ABLE as part of the Rongerik Evacuation Unit.
4 July	
1607	Underway to Bikini.
5 July	
0922	Anchored in berth 58, Bikini.
6-24 July	Anchored as before.

Shot BAKER (25 July, 0835)

24 July	
1351	Underway, departing Bikini Lagoon.
25 July	Observed shot BAKER 22 nmi (41 km) east of Bikini Lagoon as unit guide for a 12-ship column.
26 July	Arrived Kwajalein.
27 July	Departed Kwajalein for Lae Atoll.
28 July	Arrived Lae Atoll.
29 July	
0625	Departed Lae Atoll with 93 natives en route to Wotho Atoll.
1447	Beached at Wotho Atoll.
1616	Underway en route to Rongelap.
30 July	
1204	Anchored at Rongelap.
1855	Cleared Rongelap Harbor en route to Kwajalein.
31 July	Anchored at Kwajalein.

Since it did not enter Bikini Lagoon after BAKER, it was not contaminated. It departed from Kwajalein for San Francisco on 9 August 1946.

USS LST-881

Crew Size: 71
Bikini Atoll Arrival: 14 March 1946
Bikini Atoll Departure: 22 August 1946
Shot ABLE Location: 38 nmi (70 km) ENE
Shot BAKER Location: 25 nmi (46 km) E
Decontamination Location: San Francisco
Operational Clearance: 13 December 1946
Final Clearance: 23 December 1946

Task Unit and Function
LST-881, a tank landing ship, was a member of TU 1.3.1 (Transport Unit). It and USS LST-817 were loaded with construction materials and Seabees at Pearl Harbor. At Bikini, both ships served as barracks and storage ships for Seabees (Reference 5, p. 6-A-20).

Shot ABLE (1 July, 0900)

30 June	
1135	Underway for operating area Marmon.
1 July	
0900	Observed shot ABLE.
1823	Anchored in berth 41 after entering Bikini Lagoon.

USS LST-989

4 July	
0645	Moored to USS Saint Croix (APA-231) in berth 92.
1749	Anchored in berth 57.
8 July	Shifted to anchorage north of Adrikan Island.
9-23 July	Anchored as before.

Shot BAKER (25 July, 0835)

24 July	
1507	Underway for operating area Marmon with Division 4, TG 1.3.
25 July	
1740	Anchored in berth 29, Rongelap Atoll.
30 July	
1745	Underway for Bikini.
31 July	
0720	Anchored at Bikini.
1837	Beached at Bikini LST beaching area.
1 August	
1738	Moored to a pontoon causeway.
4 August	
1940	Anchored in the southwest end of Eneu Island.
22 August	
1211	Departed Bikini Lagoon for Enewetak.
23 August	
1052	Anchored at Enewetak.
25 August	
1249	Departed Enewetak en route to Kwajalein.
27 August	
1051	Anchored in berth K-20, Kwajalein.
31 August	Departed Kwajalein for Pearl Harbor.

USS LST-989

Crew Size: 84
Bikini Atoll Arrival: 11 June 1946
Bikini Atoll Departure: 25 July 1946
Shot ABLE Location: Rongerik Atoll
Shot BAKER Location: 22 nmi (41 km) W
Decontamination Location: San Francisco
Operational Clearance: 19 November 1946
Final Clearance: 22 November 1946

Task Unit and Function
LST-989, a tank landing ship, was a member of TU 1.8.7 (Rongerik Evacuation Unit). During shot ABLE all Rongerik natives were aboard LST-989 as a precautionary measure in the event the islands became contaminated as a result of the CROSSROADS tests.

Shot ABLE (1 July, 0900)

30 June	
1430	All Rongerik natives embarked on LST-989 (Reference 5, p. 6-B-2).

USS LST-989

1 July	Anchored at Rongerik Atoll.
1002	CJTF 1 directed CTU 1.8.7 to disembark natives from LST-989 as evacuation was not required (Reference 5, p. 6-B-8).
4 July	Returned to Bikini.
12-15 July	Transferred aircraft from target ship USS Saratoga (CV-3) to other target ships.

Shot BAKER (25 July, 0835)

26 July	
1130	Anchored at Kwajalein.
28 July	
0510	Underway for Enewetak.
30 July	
1737	Anchored at Enewetak Atoll.
31 July	
1950	All Enewetak natives were embarked on LST-989 (Reference 5, p. 6-D-46).
7 August	
1304	Underway for Kwajalein.
9 August	
1153	Anchored at Kwajalein Atoll.
1456	Underway for Pearl Harbor.

Since LST-989 did not enter Bikini Lagoon after test BAKER, it was not radiologically contaminated.

USS MAYRANT (DD-402)

Crew Size: 109
Bikini Atoll Arrival: By 1 June 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for BAKER: Bottineau
Shot ABLE Location: 3,614 yards (3.3 km) SW
Shot BAKER Location: 813 yards (743 meters) NNW
Sunk 4 April 1948 near Kwajalein

Task Unit and Function

Mayrant served in TU 1.2.3 (Destroyer Unit), Destroyer Division 4. Mayrant substituted for USS Flusser (DD-368) as a target vessel because Flusser was in better mechanical condition. Mayrant's crew was evacuated for each shot.

Shot ABLE (1 July, 0900)

1 July	
1427	All ships in sector 9 were reported radiologically clear except target submarine USS Parche (SS-384) and Mayrant.
1619	Target ships Mayrant, USS Cortland (APA-75), USS Gasconade (APA-85), and USS Butte (APA-68) were reported Geiger sweet by radsafe patrols.
1753	Oneota reported Mayrant Geiger sweet (Reference 6, pp. 7-I-A-14 and 7-I-A-18).
3-17 July	Crew reboarded and lived aboard.

Shot BAKER (25 July, 0835)

24 July	Crew evacuated to Bottineau.

USS Mayrant (DD-402)

1 August	ATA-192 was directed to wash down Mayrant thoroughly with high-pressure hoses (Reference 6, p. 7-I-B-57).
1016	ATA-192 completed washing down Mayrant (Reference 6, p. 7-I-B-67).
3 August	ATA-192 was again directed to wash down Mayrant using high-pressure streams (Reference 6, p. 7-I-B-77). After completing the washdown, Geiger readings were to be taken at 50 feet (15 meters) from each side (Reference 6, p. 7-I-B-77).
0915-1057	Washed down by ATA-192 (Reference 6, pp. 7-I-B-79 and 7-I-B-80).
7 August	Mayrant crew transferred to USS Rockbridge (APA-228). Mayrant was boarded by working parties accompanied by a radsafe monitor to test for radioactivity. After being found safe for reboarding for limited periods of time, the working party then boarded ATA-192 to assist in spraying Mayrant with decontamination solution. The commanding officer and a party of five boarded Mayrant in the morning. In the afternoon, the commanding officer, monitor, and two men boarded for 50 minutes. Topside readings 0.7 to 4.0 R/24 hours.
7-11 August	Work parties continued to board Mayrant to conduct salvage operations and to inspect the ship.
8 August	
1045-1119	Boarded in the morning by ship's crew. Topside average 4.0 R/24 hours; below decks 0.8 R/24 hours.
9 August	
0815-1115	Boarded by 15 men for pumping operations.
1245-1430	Boarded by 13 men for salvage operations.
10 August	
0815-1515	Boarded by 17 men for salvage operations.
1345-1515	Boarded by 3 men to investigate a leak.
12 August	Crew transferred to USS Dixie (AD-14).
13 August	
0830-0915	Boarded by 5 men to remove equipment.
14 August	
0815-1115	Boarded by 13 men for inspection.
1345-1545	Boarded by commanding officer and four men.
15 August	
0815-1045	Boarded by five men for salvage operations.
1300-1545	Boarded by 23 men for inspection.
16 August	
0800-1045	Boarded by a 21-man working party.
25 August	Boarded by unidentified team of at least seven men.
27-28 August	Boarded by an unidentified team of at least four men each day. Crew transferred to remanned target ship USS Bladen (APA-63) for transportation to the United States.

28 August — Mayrant decommissioned; underway to Kwajalein.

29 August — Arrived at Kwajalein.

USS MENDER (ARSD-2)

Crew Size: 49
Bikini Atoll Arrival: 9 July 1946
Bikini Atoll Departure: 4 September 1946
Shot ABLE Location: En route to Kwajalein from Pearl Harbor
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: Los Angeles
Operational Clearance: 3 January 1947

Task Unit and Function

Mender, a salvage lifting ship, was a member of TU 1.2.7 (Salvage Unit). Its functions included salvaging damaged target vessels after the tests, performing emergency repairs, and fighting fires. It also moved mooring buoys and laid submarine weights.

Shot ABLE (1 July, 0900)

En route to Kwajalein from Pearl Harbor at the time of shot ABLE.

9 July
- 0848 — Moored to USS Palmyra (ARS[T]-3) at Bikini.

10-23 July — Routine activities, Bikini Atoll.

Shot BAKER (25 July, 0835)

24 July
- 1210 — Radsafe monitor reported aboard Mender for shot BAKER.
- 1259 — Underway for area Mercury.

25 July
- 1155 — Anchored in assigned anchorage west of Eneu Island.

29 July
- 1831 — Planted a mooring for a submarine in the vicinity of Ionchebi Island after shifting berths.
- 1912 — Anchored in Bikini Lagoon.

30 July
- 0900-1220 — An inspection party came aboard and reported on the damage sustained to Mender's hull during CROSSROADS.

1 August
- 1430-1710 — Swung the stern of target ship USS Hughes (DD-410) into Bikini Lagoon.
- 1731 — Anchored northward of Eneu Island.

5-7 August — Anchored in Bikini Lagoon in special anchorage 1,500 yards (1.4 km) south of anchorage 376.

7 August
- 0740-0846 — Retrieved weights from target submarine USS Tuna (SS-203).
- 1155 — Removed a radioactive 1-1/2-inch wire rope.
- 1606 — Anchored in berth 30.

8 August
- 0912-1505 — Shifted a submarine mooring buoy in the vicinity of Ionchebi Island.
- 1505 — Anchored in berth 30.

9 August
- 1100 — Anchored in berth 108A.

10 August
- 0836-0910 — Cleared a fouled anchor on target submarine USS Searaven (SS-196).
- 0927-1428 — Worked alongside target submarine USS Parche (SS-384) to recover the stream anchor. Sustained damage from Parche as a result of the two vessels rolling together.
- 1428 — Anchored in berth 108A.

11-13 August — Anchored in berth 108A.

14 August
- 1420 — Mender was put in floating drydock ARD-29.

17 August
- 1546 — Out of floating drydock ARD-29.

18-19 August — Anchored in berth 30.

19-22 August — Anchored in Bikini Lagoon.

22 August
- 1602 — Moored portside to target ship USS Fallon (APA-81) to put pumps and generators aboard.
- 1830 — Underway from Fallon to anchorage in vicinity of Eneu Island.
- 1840 — Anchored.

24 August
- 0755-0900 — Stowed hose and pumps for sea aboard target ship USS Pensacola (CA-24).
- 0901 — Anchored in berth 108A.

25-27 August — The crew prepared LCMs, LCVPs, and four pontoon barges to come off Bikini beach.

31 August
- 0800 — A beach party worked on target vessel LCT-1156 [sic] broadside to the beach about 50 yards (46 meters) off. Divers hooked up air connections to blow the tanks forward. There were excessive holes in the center line and the starboard tanks forward. Anchored in Bikini Lagoon.

4 September
- 0628 — Underway with YW (unnumbered) and target vessel LCT-1078 in tow for Kwajalein, thence to Pearl Harbor.

USS MOALE (DD-693)

Crew Size: 247
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) SE
Shot BAKER Location: 18 nmi (33 km) SSE
Decontamination Location: San Francisco
Operational Clearance: 19 November 1946
Final Clearance: 11 December 1946 (Bremerton)

USS Moale (DD-693)

Task Unit and Function

The destroyer Moale was a member of TG 1.7 (Surface Patrol), Destroyer Division 72. It measured radioactivity, took water samples outside the lagoon after each test, and conducted oceanographic surveys.

Shot ABLE (1 July, 0900)

1 July

0558	Underway from berth 386, Bikini, to Orbit Point Sugar.
0830	Commenced circling Orbit Point Sugar.
0950	Remained outside of survey danger area as prescribed.
1102	Entered the lagoon.
1216	Anchored off Eneu Island.
1240-1248	Received contaminated water samples from first drone boat.
1250-1255	Received contaminated water samples from the second drone boat (total samples aboard, 16). Time elapsed from ABLE detonation until water samples were on board was 3 hours, 55 minutes (Reference 6, p. 7-I-A-38).
1305	Underway from Bikini Atoll to Kwajalein.
2140	At Gea Island; YTB-537 came alongside for transfer of the water samples.

2 July

1047	Returned to Bikini and moored to USS Chikaskia (AO-54) in berth 324, Bikini.
1428	Underway to Pearl Harbor.

6 July

1320	Moored at Pearl Harbor.
1352	Underway for San Francisco.

11 July

1325	Moored at San Francisco.

15 July

0832	Underway from San Francisco to Pearl Harbor.

18 July

0730	Anchored at Pearl Harbor.
0958	Underway from Pearl Harbor to Kwajalein.

Shot BAKER (25 July, 0835)

24 July

0815	Anchored in berth 10A, Kwajalein.
1130	Received aboard passenger observers and radiological oceanographic personnel.
1347	Underway from Kwajalein to area Mack, Bikini Atoll.

25 July

0546	Maneuvered in area Mack.
0900	Commenced upwind patrol for radiological survey.
1902	Anchored at Bikini Atoll.

26 July

1635	Underway for a radiological patrol outside the lagoon.
1715	Sighted oil slick. Manuevered on various courses and speeds to determine boundaries of oil slick and maximum radioactivity position.
1905	Completed taking water samples.

27 July

0543-0820	Conducted radiological and oceanographic investigation of oil slick.
1232-1458	Conducted radiological and oceanographic investigation of oil slick.
1712	Anchored in berth 369, Bikini Atoll.

28 July

1525	Underway to conduct a radiological survey off the western end of Bikini Atoll.
2028	Stopping at 5-nmi (9-km) intervals for oceanographic and radiological survey.

29 July

0001	Reported carrying out radiological patrol, taking sounding and water samples off Bokdrolul and Oroken islands. Stopped every 5 nmi (9 km) to take sounding and water samples.
1206	Anchored berth 330, Bikini Atoll.

30 July-2 August — Anchored in berth 189.

3-5 August — Anchored in berth King.

5 August

0732	Underway.

6-7 August — Anchored in berth King.

7 August

0755	Underway to shift berths.
1505	Anchored in berth 305.

While in the Bikini area, Moale participated in gunnery exercises.

10 August

1155	Underway for Pearl Harbor.

USS Mount McKinley (AGC-7)

Crew Size: 824
Bikini Atoll Arrival: 2 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 11 nmi (20 km) ENE
Shot BAKER Location: 8.9 nmi (16.5 km) ESE
Decontamination Location: San Diego
Operational Clearance: 20 December 1946
Final Clearance: 29 January 1947

Function

Mount McKinley, an amphibious force flagship, served as the task force flagship. Several key groups were located aboard the flagship, including JTF 1, telecommunications, and the staff aerological unit.

Shot ABLE (1 July, 0900)

1 July

0511	Underway for ABLE operations, proceeding to assigned station in area Chevrolet.
0800	Maneuvered to keep in assigned station in area Chevrolet.
0901	Bomb detonated over the target ship array in Bikini Lagoon.
1540	Anchored in berth 191, Bikini Lagoon.

2 July

1010	Anchored in berth 112, Bikini.

3-5 July	Anchored in berth 112, Bikini.

Shot BAKER (25 July, 0835)

25 July	
0518	Underway for BAKER Day exercises.
0800	Steaming to maintain position in area Chevrolet.
0835	Bomb exploded beneath target array in Bikini Lagoon.
0858	Received verbal orders to close to the east of Bikini Atoll.
0925	Began maneuvering to maintain position approximately 1 nmi (2 km) west of Bikini Reef.
1718	Anchored in berth Peter, Bikini.
28 July	
1722	Anchored in anchorage Able, Bikini.
30 July	
0842	Anchored in berth 112, Bikini.
10 August	
1759	Underway for Pearl Harbor.

USS MUGFORD (DD-389)

Crew Size: 126
Bikini Atoll Arrival: By 1 June 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 2,690 yards (2.5 km) ESE
Shot BAKER Location: 2,595 yards (2.4 km) NE
Sunk 22 March 1948 near Kwajalein

Task Unit and Function
The destroyer Mugford was a target vessel during CROSSROADS. Its crew was evacuated before each test. It was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 3.

Shot ABLE (1 July, 0900)

30 June	
0930	Teams C and D left the ship.
1150	Captain and Team A left ship.
2 July	
1111	USS Oneota (AN-85) reported that a boarding party was on board Mugford.
1132	Reported Geiger sweet by USS Shakamaxon (AN-88) (Reference 6, pp. 7-I-A-27 through 7-I-A-29).
1530	Captain and Teams A and B and last-minute security party returned to ship.
1533	Inspected ship.

By 4 July the full crew had returned to Mugford.

5-23 July Crew aboard Mugford.

Shot BAKER (25 July, 0835)

24 July	
0910	Team C left the ship.
0945	Team B left ship.
1030	Captain and Team A left the ship.
29 July	
1307-1311	USS Current (ARS-22) reported that its boarding team was aboard Mugford.
1432	Current was instructed to remove black boxes and other instruments that would be damaged by water and wash down Mugford with high-pressure hoses. Subsequently, the orders were changed to wash down only.
1515-1604	Current washed down Mugford, taking care not to hit the instruments. It was not to be boarded after the washing (Reference 6, pp. 7-I-B-42, 7-I-B-44, and 7-I-B-45).
1615-1618	Boarding team aboard.
30 July	
1059	Current sent a boarding team aboard to remove instruments.
1108	Boarding team returned and USS Deliver (ARS-23) was directed to cover Mugford with foam.
1409	Current reported that it had completed washing down Mugford.
1459	Deliver reported that it had reached its radiological tolerance for one day. Mugford was 90 percent covered with foam.
1514	USS Clamp (ARS-33) reported that Mugford was covered with foam.
1547	Clamp reported operations complete (Reference 6, pp. 7-I-B-51, 7-I-B-52, and 7-I-B-54 through 7-I-B-56).
1625	IBT-10 reported short survey indicated 4 to 14 R/24 hours topside.
31 July	
1316	Current reported that it had completed washing down and inspecting Mugford. IBT-1 reported 3 to 6 R/24 hours topside.
1620-1634	USS Reclaimer (ARS-42) came alongside Mugford and placed monitors aboard (Reference 6, pp. 7-I-B-61 and 7-I-B-63).
1907	DSM and radsafe monitors completed inspecting Mugford above and below decks.

Radiological conditions were such that portions of crews could be put aboard for carrying out DSM decontamination procedures for target vessels. Mugford had between 3 and 4 feet (0.9 and 1.2 meters) of water accumulated in the engine bilges (Reference 5, p. 6-D-46). Mugford received no damage from shot BAKER (Reference 2).

1 August	
0800	Commanding officer and boarding party aboard and reported ship highly radioactive. Pumping operations conducted in the afternoon.
2-7 August	Boarded daily for decontamination. Two- to four-hour shifts used with total time aboard about 9 hours per day.
8 August	Decontamination team aboard for 5 hours. Mugford crew transferred to USS Rockwall (APA-230).
9 August	Decontamination team aboard for 4.5 hours.
13 August	Unidentified team of at least three men aboard.
15 August	Urinalysis made on all Mugford crew by USS Haven (AH-12) crew.

18 August — Half of Mugford's crew transferred to remanned target ship USS Bladen (APA-63).

19 August — Towing and anchor team aboard for 45 minutes. Towed to Kwajalein.

21 August — Anchored at Kwajalein.

27 August — Average topside Geiger reading 0.18 R/24 hours.

28 August
1100 — Mugford decommissioned.

USS MUNSEE (ATF-107)

Crew Size: 63
Bikini Atoll Arrival: 25 June 1946
Bikini Atoll Departure: 28 August 1946
Shot ABLE Location: 130 nmi (241 km) SE; en route from Bikini to Kwajalein
Shot BAKER Location: About 20 nmi (37 km) E
Decontamination Location: San Francisco
Operational Clearance: 18 November 1946
Final Clearance: April 1947

Task Unit and Function
Munsee was a member of TU 1.8.1 (Repair and Service Unit). It served primarily as an ocean tug. It maintained material and repair facilities, towed vessels, and disposed of deck cargo ammunition.

Shot ABLE (1 July, 0900)

30 June
1612 — Underway from Bikini to Kwajalein.

1 July
1915 — Anchored in anchorage berth 84, Kwajalein.
1945 — Shifted to berth 80.

3 July
1427 — Underway for Bikini.

4 July
1935 — Moored portside to USS Quartz (IX-150), Bikini.

6 July
0808-0839 — Retrieved ammunition from target ship YOG-83.
0858-0959 — Retrieved ammunition from target ship USS LST-52.
1020-1100 — Retrieved ammunition from target ship USS LST-661.
1155-1248 — Retrieved ammunition from target ship USS LST-220.
1307-1346 — Retrieved ammunition from target ship USS LST-545; took on 19 Army personnel to assist in handling ammunition.
1505-1522 — Retrieved ammunition from target ship USS Hughes (DD-410). Ammunition disposed of at sea.
2028 — Anchored abreast of harbor entrance control vessel after dumping ammunition.

7 July
0808-0943 — Stood by to assist in mooring target ships USS Pensacola (CA-24), USS Nevada (BB-36), and USS Salt Lake City (CA-25).

8-17 July — Engaged in routine activities.

18 July
1005-1154 — Ballasted target submarine USS Searaven (SS-196).
1145-1247 — Ballasted target submarine USS Apogon (SS-308).

Shot BAKER (25 July, 0835)

24 July
1346 — Underway from Bikini.

25 July
1420 — Anchored in Rongelap Atoll.

30 July
1325 — Underway from Rongelap to Bikini.

31 July
1113 — Anchored east of berth 168, Bikini.

1 August — Routine activities. Not involved with target ships.

2 August
0727 — Proceeded to wash down target ship USS Ralph Talbot (DD-390).
0754 — Anchored.

3-4 August — Routine activities.

5 August — Radiological monitor aboard for unknown period of time.

6-9 August — Routine activities.

10-12 August — Maneuvered target ship USS LST-125 to various anchorages.

13 August — Anchored with LST-125 moored alongside.

14 August — Maneuvered LST-125 to various anchorages.

19 August
1416 — Went alongside target ship Prinz Eugen to prepare it for towing.

20 August
1239 — Underway for Kwajalein with Prinz Eugen in tow.

22 August — Arrived at Kwajalein and unhooked tow.
1632 — En route to Bikini.

23 August
1149 — Anchored in Bikini Atoll.

24 August
0805-1155 — Pumped target ship USS Gasconade (APA-85).

25 August
1032 — Departed Bikini Atoll towing target ship USS Independence (CVL-22) to Kwajalein.

27 August
1403 — Arrived at Kwajalein.
1654 — Underway to Bikini.

28 August
0942 — Anchored in berth 227, Bikini.

1551 Underway for Kwajalein with target ship USS Butte (APA-68) in tow.

30 August
1134 Anchored at Kwajalein.

31 August
0955-1030 Monitoring board came on board to check for radioactivity.

2 September Departed for Pearl Harbor.

USS MUSTIN (DD-413)

Crew Size: 112
Bikini Atoll Arrival: By 1 June 1946
Bikini Atoll Departure: 28 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 2,147 yards (1.96 km) ESE
Shot BAKER Location: 1,280 yards (1.2 km) ENE
Sunk 28 April 1948 near Kwajalein

Task Unit and Function
The destroyer Mustin was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 3. Mustin was a target vessel during CROSSROADS. Its crew was removed before both shots.

Shot ABLE (1 July, 0900)

30 June
0924 Commenced evacuating ship.
1100 Captain with final evacuation group departed for Bottineau. Last-minute personnel remained aboard to start diesel generator. Entire ship's company with exception of five men in the last-minute personnel group berthed aboard Bottineau for ABLE.

1 July Entire ship evacuated.

2 July
1003 USS Shakamaxon (AN-88) reported a boarding team aboard Mustin.
1129 Shakamaxon reported it had completed Mustin.
1615 Commanding officer with Team A of reboarding party returned aboard with Geiger counter, monitor, and selected ship's personnel.
1625 Team B returned aboard and commenced inspection of ship below decks.
1800 Team C reported aboard.

3 July
1000 Team D returned aboard.

3-23 July Crew lived aboard ship.

Shot BAKER (25 July, 0835)

23 July
0820 Team C evacuated to Bottineau for BAKER.

24 July
1013 Evacuation completed, except for four last-minute personnel.
1200 Ship evacuated for BAKER.

26 July
1715 USS Preserver (ARS-8) directed to proceed to target ship USS Fallon (APA-81), taking most direct route to Mustin. It was then to proceed with great caution from the vicinity of target ships Mustin and USS Salt Lake City (CA-25) to Fallon.

7 August
1400 Entire crew transferred from Bottineau to USS Rockbridge (APA-228).

8 August IBT-4 reported Geiger readings: average topside 1.5 R/24 hours, maximum topside 4 R/24 hours; average below decks 0.2 R/24 hours, maximum below decks 0.35 R/24 hours.

9 August
0930-1050 Commanding officer and a selected group of officers and men and a radsafe monitor boarded Mustin for a quick inspection of the ship; inspection completed and party returned to Rockbridge.

12 August
0830-1700 Commanding officer with a selected group of men and a radiological monitor boarded Mustin to conduct salvage operations; all personnel returned to Rockbridge.

14 August
0800-1700 Salvage operation group with radsafe monitor boarded Mustin and resumed salvage operation; all personnel returned to Rockbridge. Average topside reading 0.25 R/24 hours.

15 August
0745-1600 Salvage operation group with a radsafe monitor boarded Mustin and resumed salvage operations; all personnel returned to Rockbridge.

17-19 August Transferred 88 men to Rockwall.

28 August
1000 Mustin decommissioned. Towed to Kwajalein.

30 August Anchored at Kwajalein.

30 September Average topside reading 0.12 R/24 hours.

NAGATO

Crew Size: 172
Bikini Atoll Arrival: 28 April 1946
Crew Location for Shot ABLE: USS Rockingham (APA-229)
Crew Location for Shot BAKER: Rockingham
Shot ABLE Location: 782 yards (715 meters) ESE
Shot BAKER Location: 745 yards (681 meters) NNE
Sunk 30 July 1946, Bikini Lagoon

Task Unit and Function
The captured Japanese battleship Nagato was member of TU 1.2.1 (Battleship and Cruiser Unit), Battleship Division 7, serving as a target vessel. Its CROSSROADS crew, composed of U.S. personnel, was transferred to Rockingham before shot ABLE and did not return to live aboard. It participated in scientific experiments carrying ballcrusher gauges.

Shot ABLE (1 July, 0900)

30 June — Crew evacuated to Rockingham.

22 July
- 0958 — USS Clamp (ARS-33) reported a fire on Nagato's forward No. 3 turret (Reference 6, p. 7-I-A-25).
- 1352 — Clamp reported a fire on Nagato's portside bow (Reference 6, p. 7-I-A-31).
- 1416 — Clamp reported Nagato's starboard quarter radiologically safe.
- 1508 — Clamp reported numerous small fires on Nagato, which it was instructed to extinguish.
- 1527 — Clamp reported that the inspection of Nagato was complete (Reference 6, p. 7-I-A-32).

3 July
- 1325 — A fire was reported aboard Nagato. USS Preserver (ARS-8) was ordered to inspect and fight the fire if it could be located. Preserver was unable to locate the fire and proceeded with its previous assignments.

4-7 July — While Nagato crewmembers were berthed aboard Rockingham, work parties boarded the target ship.

7 July — Nagato's crew transferred from Rockingham to USS Rockbridge (APA-228). A watch team was placed aboard Nagato.

12 July — Seventy-five crewmembers were transferred to USS Chilton (APA-38) for transportation to the United States west coat.

16 July — Remaining Nagato crewmembers returned to Rockingham.

24 July — Watch team transferred to Rockingham.

Shot BAKER (25 July, 0835)

27 July
- 1630 — USS Reclaimer (ARS-42) reported Nagato listing to starboard and settling by the stern. Nagato had a 1-hour tolerance from about 50 feet (15 meters) (Reference 6, p. 7-I-B-24).

28 July
- 0945 — When Reclaimer passed Nagato to the starboard, it was down by the stern with an 8° starboard list. The steady increase in list and settling by the stern indicated progressive flooding. Nagato was highly radioactive, precluding reboarding for pumping or towing (Reference 6, p. 7-I-B-28).
- 1652 — Reclaimer reported Nagato's main deck awash, listing to starboard, and down by the stern (Reference 6, p. 7-I-B-34).

29 July
- 1015 — Reclaimer passed Nagato to starboard. Nagato had taken on more list, was down 9 feet (8 meters) forward and 6 feet (5.5 meters) aft, and had a tolerance of 1 to 1-1/2 hours (Reference 6, p. 7-I-B-39).
- 1651 — Reclaimer reported Nagato's main deck awash on the starboard side, the list increasing, and the vessel continuing to settle. There was no change in tolerance (Reference 6, p. 7-I-B-46).

30 July
- 0200 — Nagato sank in Bikini Lagoon.

Nagato's crew was transferred to other CROSSROADS ships. The majority was dispersed among USS Fall River (CA-131), USS Appling (APA-58), and target ship USS Salt Lake City (CA-25) on 4 August.

USS NEVADA (BB-36)

Crew Size: 403
Bikini Atoll Arrival: 28-29 May 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS George Clymer (APA-27)
Crew Location for Shot BAKER: Clymer
Shot ABLE Location: 750 yards (686 meters) E
Shot BAKER Location: 1,030 yards (942 meters) ESE
Decontamination Locations: Kwajalein and Pearl Harbor
Sunk 31 July 1948, off Pearl Harbor

Task Unit and Function

The battleship Nevada was a member of TU 1.2.1 (Battleship and Cruiser Unit), Battleship Division 9. It was the target ship for shot ABLE. Its crew was evacuated before each shot. It also housed several experiments including ammunition and poison gases for the Army ammunition experiment, representative items for the Army Signal Unit, food and clothing for the Quartermaster Unit, ball-crusher gauges, linear- and logarithmic-axis recorders, and four identification and sixteen diaphragm peak-pressure gauges.

Shot ABLE (1 July, 0900)

30 June — Crew evacuated to Clymer.

1 July
- 1018 — PBM Charlie reported a fire on several ships, including Nevada (Reference 5, p. 6-B-9).
- 1435 — Nevada was noted to be smoldering amidship (Reference 6, p. 7-I-A-10).
- 1733 — USS Reclaimer (ARS-42) alongside Nevada fighting the fire (Reference 6, p. 7-I-A-18).

2 July
- 1220 — USS Preserver (ARS-8) put a boarding party on Nevada.
- 1256 — Preserver reported underway to fight fires on Nevada's portside.
- 1308 — Fires extinguished.
- 1537 — USS Clamp (ARS-33) reported a fire on Nevada's No. 4 turret.
- 1541 — Clamp moored alongside, sent boarding team aboard.
- 1545 — Fire party aboard.
- 1605 — Clamp reported the fire on Nevada extinguished and fire party returned to Clamp (Reference 6, p. 7-I-A-33).
- 1647 — Boarding party returned from Nevada.

3 July
- 1335 — The captain with reboarding party A returned to ship to inspect damage.
- 1410-1430 — Member of Bureau of Ordnance with inspection party of eight men came aboard.

1430-1650	Party of nineteen aboard.
1515	Reboarding party B boarded to inspect lower decks and engineering plants.
1730	Gunnery officer and party of ten gunner mates returned to ship to inspect all magazines.
1735	Captain with reboarding party A returned to Clymer.
1800	Boarding party B, except for security watch, departed for Clymer.
1925	Party of eight men came aboard to retest radioactivity of ship.
1930	Navigator and security watch of three officers and seventeen enlisted men came aboard for the night.
1948	Remainder of B party returned to Clymer.
2030	Captain returned to ship for the night.
2040	Radioactivity inspection party left ship; ship found clear of radioactivity except aft of frame 114 on main deck.

With the exception of a 20-man security watch, Nevada remained evacuated. After several days of radiological monitoring and repair work performed by various boarding teams, Nevada was found safe for reboarding by its crew on 8 July.

Shot BAKER (25 July, 0835)

24 July	Crew evacuated to Clymer.
30 July	
1116	ATA-180 reported recovering instruments from Nevada (Reference 6, p. 7-I-B-51).
1 August	
1049	Inspection by USS Deliver (ARS-23) was completed and revealed Nevada to be very radioactive. Deliver's boarding team came back on board (Reference 6, p. 7-I-B-68).
2 August	Deliver worked for 1-1/2 hours on Nevada using high-pressure water hoses (Reference 6, p. 7-I-B-74).
7 August	
1000-1015	Three-man team boarded for inspection.
9 August	
0745	Commanding officer and 27 men boarded.
1135	Sixteen men returned to Clymer.
1300	Teams A and B boarded.
1645	Commanding officer and Teams A and B departed; Geiger readings on quarterdeck 1.9 R/24 hours, forecastle 1.5 R/24 hours.
9-10 August	The entire ship was not opened up nor completely inspected due to lack of time, other work requiring immediate action, and the still relatively high radioactivity. There were no items of major damage apparent that appeared to have been caused by BAKER. However, the ship was still highly radioactive topside and in some spaces below deck (Reference 2).
10 August	
0745	Commanding officer and 91 men boarded.
1015	Team of 23 men boarded.
1130	A group of 104 men returned to Clymer.
1315	A team of 80 men boarded.
1630	Commanding officer and 90 men returned to Clymer.
12, 14-16 August	Small groups of non-Nevada crewmembers boarded each day, probably ship inspection teams.
13 August	
0930-1100	A radiological monitor and five enlisted men returned to Nevada to remove special equipment.
17 August	
0745	Nine men boarded.
0915	Commanding officer and 103 men boarded.
1215	Team of 88 men boarded.
1425	Team of 93 men departed.
1715	Commanding officer and the remainder of those aboard departed.
18 August	Nevada's crew transferred to remanned target ship USS Cortland (APA-75) for transportation to Kwajalein.
19 August	Towed to Kwajalein by Preserver. Seven-man anchor team aboard Preserver from Nevada.
22 August	Arrived at Kwajalein.
27 August	Average topside reading 0.6 R/24 hours.
1 October	Average topside reading 0.4 R/24 hours.

Nevada was towed to Pearl Harbor for radiological inspection, arriving 15 May 1947.

USS NEWMAN K. PERRY (DD-883)

Crew Size: 280
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 4 August 1946
Shot ABLE Location: 30 nmi (56 km) NNE
Shot BAKER Location: 10 nmi (19 km) NE
Decontamination Location: San Diego
Operational Clearance: 17 January 1947
Final Clearance: 25 January 1947

Task Unit and Function

The destroyer Perry was a member of TG 1.6 (Navy Air Group), Destroyer Division 51. Its primary mission was to serve as a plane guard for the aircraft carrier USS Saidor (CVE-117).

Shot ABLE (1 July, 0900)

30 June	
1351	Underway from Bikini.
1 July	
1900	Anchored in berth 304, Bikini.
2 July	
1535	Anchored in berth 55-A.
4 July	
1613	Underway en route to Kwajalein.
5 July	
1006	Anchored in berth 13, Kwajalein.
1249	Underway for Roi Island.

USS Newman K. Perry (DD-883)

5 July

1621 Anchored in berth A-3, Roi.
1736 Underway for Bikini.

6 July
0737 Anchored portside to USS Enoree (AO-69), Bikini.
1013 Anchored in berth 55A.
1645 Underway to Roi Island, Kwajalein.

7 July
0810 Anchored at Kwajalein in berth A-6.

12 July
1730 Underway from Kwajalein to Bikini.

13 July
0809 Moored starboard side to Enoree, Bikini.
1040 Anchored in berth 56.

Shot BAKER (25 July, 0835)

24 July
0918 Underway for plane guard station.

25 July
0650 Maneuvering to take plane guard station No. 1.

27 July
1223 Entered Bikini Channel to transfer photograhic supplies and a civilian technician to USS Mount McKinley (AGC-7).
1327 Rejoined formation.
1427 Commenced laying to 4 nmi (7.4 km) east of Bikini Channel entrance.
1650 Proceeded to screening station 2330 on Saidor.

29 July
1443 Anchored in berth Mike, Bikini Atoll.

30 July
0958 Anchored in berth 55A, Bikini Atoll.

1 August
0912 Moored to Enoree.
1119 Anchored in berth 55-A.

2 August
1402 Anchored in berth F, Bikini Atoll.

4 August
1330 Underway for Pearl Harbor from Bikini Atoll.

9 August
1320 Moored Pearl Harbor.

USS NEW YORK (BB-34)

Crew Size: 536
Bikini Atoll Arrival: 15 June 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Rockbridge (APA-228)
Crew Location for Shot BAKER: Rockbridge
Shot ABLE Location: 1,547 yards (1.4 km) ESE
Shot BAKER Location: 920 yards (750 meters) ESE
Decontamination Location: Pearl Harbor
Sunk 8 July 1948, 40 nmi (74 km) SW of Pearl Harbor

Task Unit and Function
The battleship New York was a member of TU 1.2.1 (Battleship and Cruiser Unit), Battleship Division 7, serving as a target vessel for CROSSROADS. Its crew was evacuated before each shot. Among the experimental equipment on board were food and clothing (provided by the Quartermaster Unit) and free-piston recording gauges.

USS New York (BB-34)

Shot ABLE (1 July, 0900)

30 June
1425 Crew evacuated to Rockbridge.

1 July
1430 USS Reclaimer (ARS-42) noted a smoldering fire amidships on New York (Reference 6, p. 7-I-A-10).
1615-1625 Reclaimer moved alongside New York and extinguished the fire (Reference 6, p. 7-I-A-15).
1648 Team reported the ready service ammunition on New York had overheated (Reference 6, p. 7-I-A-17).
1730 USS Clamp (ARS-33) sent a boarding team aboard.
1742 Boarding team returned to Clamp.
1750 Clamp reported New York Geiger sweet; underway from the target ship (Reference 6, p. 7-I-A-18).
1847 Clamp reported New York Geiger sweet (Reference 6, p. 7-I-A-19).

2 July
1159 Commanding officer and boarding team A returned aboard ship. No radiation detected except telephone radium marker buttons, which were not test-related.
1400 Team B returned aboard and commenced opening up the ship.
1630 Team C returned aboard.
1820 Team D returned aboard.

3 July
1130 Team E returned from Rockbridge.

4-23 July Crew aboard ship.

Shot BAKER (25 July, 0835)

24 July
1125 Crew evacuated to Rockbridge.

25 July
1000-1200 Damage reported (down by stern).
1720 Reclaimer passed close to New York's portside. New York was very radioactive (Reference 6, p. 7-I-B-14).

28 July
0903 Reclaimer again passed New York, which was down slightly by the stern (Reference 6, p. 7-I-B-28).
1936 CJTF 1 reported to Commander Rear Echelon (COMREARECH): "Further inspection of New York indicates about 1,800 tons increase in displacement with the center of gravity of additional water at Frame 103, resulting in trim by stern of about 4 feet. Situation believed stabilized and ship in no danger" (Reference 5, p. 6-D-33).

29 July
1100 A radiological monitor boarded and obtained a reading showing 20 minutes tolerance on deck (Reference 6, p. 7-I-B-40).

USS New York (BB-34)

1212-1415 Washed down by ATR-40 (Reference 6, p. 7-I-B-42).

1634 A radiological monitor reboarded to take Geiger readings (Reference 6, p. 7-I-B-46). Tolerance time had increased to 40 minutes.

30 July Washed down by ATR-40 with a high-pressure stream for 4 hours (Reference 6, p. 7-I-B-48).

31 July

1550 ATR-40 reported New York was thoroughly foamed down using 430 cans of foam (Reference 6, p. 7-I-B-62).

1 August

1025 USS Deliver (ARS-23) completed its inspection of New York (Reference 6, p. 7-I-B-67).

3 August Washed down thoroughly by USS Preserver (ARS-8) using high-pressure streams. Preserver was to report Geiger readings from about 50 feet (15 meters) before and after washing (Reference 6, p. 7-I-B-77).

5 August

1000-1500 The initial boarding team boarded the ship for decontamination operations. Maximum radiation encountered aboard New York was 0.625 R/hr; average reading at the time of the last survey was 0.167 R/hr.

6 August Washdown procedure completed by a tug.

1000-1300 Captain boarded ship with initial boarding team for inspection of ship.

7 August

0800-1500 The first decontamination teams from the ship's company boarded. Four teams were used and were relieved every 2 hours and returned to Rockbridge. The day was spent jettisoning useless, highly radioactive materials, particularly debris and wood items. One group spent the day scouting for boiler compound, lye, cornstarch, scrubbers, gloves, boots, etc. Freshwater was provided by Rockbridge. By early afternoon water was obtained from the firemain and the topside was washed down, with particular attention being paid to the forecastle.

8 August

0800-1545 Four teams were aboard for 2 hours each. Necessary working materials were now assembled and decontamination on the forecastle began in earnest. Solutions of boiler compound and lye were used, and the forecastle was washed down several times. Sand was obtained and holystoning began. Cleaning up of the second deck was also started and numerous pools of water removed, debris cleaned up, and hose gear straightened up.

9 August

0800-1545 Four teams were aboard for 2 hours each. The forecastle was again washed down and holystoned with boiler compound, lye, and sand. Freshwater still had to be hauled from Rockbridge in cans. Approximately 100 men worked on the second deck and considerable progress was made in cleaning up the second and third decks and the officers' quarters.

10 August

0800-1545 Four teams were aboard for 2 hours each. The forecastle was again holystoned with boiler compound, lye, and sand. Air castle and boat decks were washed down with boiler compound and lye: the main deck aft was washed down with saltwater (Reference 4).

Table A.5 shows the results obtained in reducing the forecastle's radioactivity by holystoning with boiler compound, lye, and sand.

Table A.5. Decontamination results on USS New York (BB-34) forecastle.

	Readings (R/24 hrs)			
Frame No.	7 Aug	8 Aug	9 Aug	10 Aug
Bow	1.6	0.7	0.7	0.6
10S	1.7	0.6	0.5	0.45
10P	1.6	0.5	0.5	0.5
20S	1.6	0.62	0.5	0.5
20P	1.3	1.2	0.5	0.5
30S	1.5	1.3	0.6	0.6
30P	1.3	1.2	0.5	0.5
40S	2.0	1.1	0.6	0.5
40P	2.0	1.0	0.7	0.5

Source: Reference 4.

The reduction in radioactivity on the topside main deck aft from one washing with saltwater is reported in Table A.6.

14-15 August

0800-1600 Four teams aboard for 2 hours each.

16 August

0800 Engineering party aboard to make connections to receive power from Reclaimer.

0830 DSM inspection parties and ship inspection parties aboard to collect data.

1115 All parties left ship except an engineering party and pumping detail.

1615 All hands clear of ship.

17 August Two teams aboard 2-1/2 hours each.

1300-2000 Pumping detail aboard.

18 August Two teams aboard 2-1/2 hours each.

0800-1115 Pumping detail aboard ship.

1300-2000 Pumping detail aboard ship.

19 August Four teams aboard for 2 hours each.

0800-1100 Pumping detail on ship.

0830-1500 Anchor detail on ship.

1300-1600 Pumping detail on ship.

20 August Two teams aboard for 2-1/2 hours each.

0800-1130 Pumping detail on ship.

0900-1300 Anchor detail on ship.

Table A.6. Decontamination results on USS New York (BB-34) topside main deck aft.

Frame No.	Readings (R/24 hrs) 7 Aug	8 Aug	9 Aug	10 Aug
70S	1.6	1.6	1.2	1.3
70P	1.2	1.2	1.3	1.5
80S	2.0	3.0	0.8	0.9
80P	1.6	3.0	1.3	0.9
90S	2.4	0.5	0.9	0.6
90P	1.7	1.0	0.9	1.0
100S	2.6	0.7	0.65	0.6
100P	1.7	0.8	0.9	1.0
110S	1.5	1.3	1.0	0.9
110P	1.2	1.5	2.0	1.3
120S	2.0	0.8	0.95	0.8
120P	1.8	1.0	0.9	0.6
130S	1.8	1.5	1.0	0.3
130P	1.6	13.0[a]	0.8	0.7
Stern	0.99	1.5	2.0	---

Note:

[a]Paint chippings.

Source: Reference 4.

21 August — Four teams aboard for 2 hours each.
- 0800 — USS Widgeon (ASR-1) alongside to starboard to assist in hoisting starboard anchor. Ordnance inspection team aboard.
- 0830 — Anchor detail aboard.
- 0835 — Reclaimer came alongside to port to furnish electrical power. Target vessel LCI(L)-615 came alongside to starboard to furnish power.
- 1220 — Reclaimer and LCI(L)-615 cast off.
- 1235 — Ordnance detail left ship.
- 1430 — Starboard anchor was housed.
- 1530 — Widgeon cast off.
- 1545 — Anchor detail left ship. Average topside reading 0.4 R/24 hours.

22 August — Towed to Kwajalein.

24 August — Arrived at Kwajalein.

28 August — New York decommissioned.

New York was towed to Pearl Harbor, arriving on 15 March 1947.

USS NIAGARA (APA-87)

Crew Size: 271
Bikini Atoll Arrival: 31 May 1946
Bikini Atoll Departure: 21 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 3,318 yards (3.0 km) SSE
Shot BAKER Location: 3,060 yards (2.8 km) S
Decontamination Locations: San Francisco, Kwajalein
Operational Clearance: 6 November 1946
Final Clearance: 10 November 1946
Scrapped in 1950

Task Unit and Function

Niagara, an attack transport, served in TU 1.2.6 (Merchant Type Unit), Transport Division 93, as a target vessel. Its crew was evacuated before each shot. The Quartermaster Unit had placed food and clothing aboard it for experimental purposes.

Shot ABLE (1 July, 0900)

30 June
- 0805 — Commenced evacuation of Niagara crew to Bayfield.
- 1528 — Bayfield, with all personnel aboard, underway to operating area about 18 nmi (33 km) east of Bikini Atoll.

1 July
- 1307 — USS Oneota (AN-85) sent a team aboard Niagara.
- 1335-1358 — ATA-192 fought a fire on Niagara without boarding it (Reference 6, p. 7-I-A-8).
- 1524 — Oneota Team 9 reported Niagara Geiger sweet (Reference 6, p. 7-I-A-12).
- 1610 — Niagara declared free of radiological contamination.

2 July
- 1205 — The captain and Team A (six officers, nineteen enlisted men, and one radiological monitor) came aboard to inspect and open Niagara.
- 1425 — Team B (four officers and twenty-four enlisted men) came aboard to light off the boilers.
- 1559 — The radiological monitor returned to USS Haven (AH-12).
- 1715 — Team C (all remaining men and gear) came aboard.

Niagara's crew lived aboard ship until 24 July.

Shot BAKER (25 July, 0835)

24 July
- 1036 — Commanding officer and the last evacuation group were received on board Bayfield.

25 July
- 1129 — CTU 1.2.7 reported Niagara radiologically clear for boarding (Reference 5, p. 6-D-10).
- 1210-1223 — USS Preserver (ARS-8) boarding team on Niagara (Reference 6, pp. 7-I-B-7 and 7-I-B-8).
- 1224 — Radsafe reported Niagara Geiger sweet and recommended all teams be returned aboard.
- 1240 — Instrumentation Team #1 went aboard Niagara (Reference 5, p. 6-D-11).

27 July
- 1022-1144 — An instrumentation team boarded Niagara (Reference 6, pp. 7-I-B-21 and 7-I-B-22).

28 July — Another boarding team was placed on Niagara.

29 July
- 0748 — The commanding officer and Team A left Bayfield to reboard Niagara.

0826	The commanding officer and reboarding Teams A and B reboarded the ship and commenced inspection of it; no apparent damage was noted.
1535	Underway to shift berths in the lagoon.
1607	Anchored in berth 381.
1615	The remainder of crew returned on board with baggage and gear.

Inspections conducted for evidence of radioactivity adjacent to the ship's side revealed about 0.4 R/24 hours, which decreased in intensity on board to a point 5 feet (1.5 meters) from the sides to 0.1 R/24 hours. The average reading of compartments below the waterline was 0.05 R/24 hours (Reference 2).

30 July	All decks and bulkheads in compartments above the waterline were washed down with soap and water. The sides of the ship were also scraped to a distance of about 5 feet (1.5 meters) below the waterline to remove marine growth.
1 August Afternoon	Underway and put to sea to wash the ship's sides. This reduced the Geiger readings approximately 40 percent.
2 August	Speed increased to 15 knots (28 km/hr); however, this did not reduce the radioactivity further. Upon reentry into Bikini, hogging lines with scrapers attached were led around the ship and the bottom scraped in an attempt to remove some of the marine growth.
3 August	Monitor made inspection, finding the ship below 0.10 R/24 hours throughout. Maximum radioactivity on a portion of the ship's hull adjacent to gangway; reading there was 0.095 R/24 hours, about 0.05 R/24 hours higher than the rest of the ship. Safe distance from Niagara's hull reduced from 5 feet (1.5 meters) to 1 foot 0.3 meter).
4 August	Continued to scrape hull. During this time the entire bottom and waterline area were scraped.
5 August	Niagara was again inspected. At this time the monitors declared the ship radiologically safe on all parts and gave it the radsafe clearance required to depart from Bikini.

Due to the position of Niagara's anchorage, materials from decontaminated ships were washed against it. To prevent these materials from clinging to its sides the waterline was washed down with firehoses each day for a week, and the bottom was periodically scraped. At the end of a week, another Geiger inspection showed a maximum of 0.082 R/24 hours at frame 68. The rest of the ship was below 0.018 R/24 hours (Reference 4). The results of one inspection showed the following (R/24 hours) (Reference 4):

Frame No.	Port	Starboard
14	0.042	0.036
28	0.018	0.054
42	0.024	0.015
57	0.017	0.012
68	0.060	0.048
82	0.052	0.024
93	0.053	0.018
107	0.042	0.072
110	0.079	0.072
122	0.096	0.048
135	0.036	0.012

USS O'BRIEN (DD-725)

Crew Size: 237
Bikini Atoll Arrival: 15 June 1946
Bikini Atoll Departure: 8 August 1946
Shot ABLE Location: 43 nmi (80 km) SW
Shot BAKER Location: 12.5 nmi (23 km) W
Decontamination Location: San Francisco
Operational Clearance: 6 November 1946
Final Clearance: 19 December 1946

Task Unit and Function

The destroyer O'Brien (DD-725) served in TG 1.7 (Surface Patrol), Destroyer Division 71. Before its arrival at Bikini, O'Brien had special oceanographic and radiological equipment installed aboard. It conducted radiological patrols, including monitoring the area just inside the lagoon entrance.

Shot ABLE (1 July, 0900)

1 July	Steaming on course in accordance with JTF 1 Op Plan 1-46.
1414	Commenced radiological patrol.
1815	Stopped all engines to obtain radiological data.
2018	Laying to to collect radiological data.
2 July	
0620	Arrived on station; commenced patrolling station.
3 July	At 0038, 0217, 0347, 1006, 1245, 1543, and 2134, laying to on station to obtain radiological data.
4 July	At 0151, 0623, 1005, 1227, 1446, 1835, 2054, and 2345 obtained radiological data on station.
5 July	
0210	Took radiological data on station.
0647	Entered Bikini Lagoon.
0742	Moored portside to USS Enoree (AO-69), berth 30.
0938	Underway to anchorage.
1000	Anchored in berth 190 North, Bikini.
9 July	
1306	Underway to depart lagoon.
9-14 July	Took hydrographic data.
14 July	
0937	Reentered Bikini Lagoon.
1410	Anchored in berth 910, Bikini.
15-22 July	Collected radiological and hydrological data from Bikini and surrounding waters.

Shot BAKER (25 July, 0835)

24 July
1232 Underway for area Hudson for shot BAKER.

25 July
0935-1129 Conducted radiological patrol of Eneu Channel entrance.
1515 Commenced patrolling area Studebaker.
1923 Commenced downwind radiological patrol.
2150 Commenced radiological survey.

26 July
0402-0505 Conducted radiological survey.
1225 Anchored in berth 316, Bikini.
1717 Anchored in berth 357, obtaining radiological data.

27 July
1613 Shifted to berth 370.

28 July
1619 Anchored in berth U, obtaining radiological data.

30 July
0800 Relieved USS Fall River (CA-131) as Harbor Entrance Control Vessel (HECV).
0937 Anchored 600 yards (549 meters) northwest of berth 386.
1114 Relieved as HECV.
1152 Moored in berth 305.
1355 Relieved USS Laffey (DD-724) as HECV.
1406 Anchored in berth 386.

2 August
0813 Relieved of duties as HECV.
0900 Anchored in berth 116S.
1516 Anchored in berth H-North.

5 August
0742 Departed Bikini Lagoon to conduct firing exercises.
1738 Anchored in berth H-North.

8 August
1218 Departed Bikini; underway on oceanographic cruise en route to Pearl Harbor.

USS ONEOTA (AN-85)

Crew Size: 45
Bikini Atoll Arrival: By 2 April 1946
Bikini Atoll Departure: 26 August 1946
Shot ABLE Location: 18 nmi (33 km) SE
Shot BAKER Location: 18 nmi (33 km) SE
Decontamination Location: Pearl Harbor
Operational Clearance: 11 December 1946

Task Unit and Function
Oneota, a net laying ship, served in TU 1.2.7 (Salvage Unit). Its main duties for CROSSROADS included salvaging damaged target vessels after the tests, performing emergency repairs, and fighting fires. These tasks required boarding crews from Oneota to inspect target vessels for damage and radiological contamination.

Shot ABLE (1 July, 0900)

1 July
1222 Entered Bikini Lagoon.
1338 Placed a boarding team on target ship USS Geneva (APA-86) (Reference 6, p. VII-I-8a-A).
1412 Reported fires on USS Bladen (APA-63) and USS Bracken (APA-64) (Reference 6, p. VII-I-9-A).
1430 Pronounced Geneva Geiger sweet (Reference 6, p. VII-I-10-A).
1452 Placed boarding team on USS Niagara (APA-87).
1524 Reported Niagara Geiger sweet (Reference 6, pp. VII-I-11a-A and VII-I-12-A).
1537 Placed boarding team on Bladen.
1542 Reported a small fire on the afterdeckhouse of Bracken (Reference 6, p. VII-I-13-A).
1635 Placed boarding team on target ship USS Fillmore (APA-83).
1725 Placed boarding team on target ship USS Mayrant (DD-402).
1737 Placed boarding team on Bladen.
1855 Anchored in lee of Eneu Island, Bikini.

2 July
0708 Underway to pick up boarding party.
0730 Boarding party aboard.
0815 Moored to the starboard side of Bracken.
0816 Placed boarding team on Bracken.
0854 Boarding team returned to Oneota.
0855 Underway to target submarine USS Parche (SS-384).
0925 Moored to Parche.
0927-0942 Boarding party aboard Parche.
0935 Reported Parche Geiger sweet (Reference 6, p. VII-I-24-A).
0944 Underway from Parche.
1040 Boarding party left in a boat.
1122 Anchored in lee of Eneu Island.
1551 Reported Fillmore Geiger sweet (Reference 6, p. VII-I-33-A).

3-4 July Anchored in lee of Eneu Island.

5 July
1334 Underway from anchorage.
1455 Moored to an LCT portside of USS Palmyra (ARST[T]-3).
1602 Underway.
1612 Anchored 800 yards (720 meters) astern target ship USS LST-661.

6 July
1004 Underway from LST-661.
1020 Laying off near Palmyra.
1045 Proceeding to target array.
1120 Moored to mooring buoy 13.
1247 Underway.
1310 Moored next to USS Rolette (AKA-99) to receive clamp and chain for mooring buoy.
1825 Underway from alongside Rolette.
1858 Anchored in berth 143A, Bikini.

7-17 July Operated in Bikini Lagoon laying mooring buoys in preparation for test BAKER.

18-19 July Departed lagoon.

20-23 July Moored in Bikini Lagoon, laying instrumentation gear.

Shot BAKER (25 July, 0835)

24 July
1320 Joined formation leaving the lagoon.

USS Oneota (AN-85)

25 July
1129 Directed to proceed to the vicinity of USS Kenneth Whiting (AV-14) to embark a special instrumentation team (Reference 6, p. VII-I-6-B).
1810 Anchored in lee of Eneu Island.

26-27 July Anchored in lee of Eneu Island.

28 July
1555 Underway to change berths.
1635 Anchored in unidentified berth in Bikini.

29 July
0805 Underway.
0935 Moored to raft of outermost instrumentation gear station.
0945 Hauled gear aboard.
1017 Underway to assigned anchorage.
1155 Anchored in berth 380, Bikini.

31 July
0745-1415 Underway to instrumentation stations. Reported that it would take one more day to complete the recovery of the vertical stations. Oneota also reported that its radsafe monitor had been ordered removed from the ship.
1120 CTU 1.2.7 reported to Radsafe that removal of the monitor from Oneota without prior notice made it impossible to operate the ship.
1300 Radsafe reported that it had not ordered the removal of the monitor.
1421 Anchored in berth 54, Bikini.
1426 Oneota was directed to discontinue operations for the day because the monitor had been removed (Reference 6, pp. VII-I-60-B and VII-I-61-B).

1 August Directed to recover vertical stations as requested by the Technical Director. Upon completion, it was directed to CTU 1.8.1 for repairs to auxiliary generator (Reference 6, p. VII-I-65-B).
0750-1530 Underway, picking up instrumentation stations.
1530 Ceased operations for the day and proceeded to anchorage.
1543 Anchored in berth 54, Bikini.
1620 Reported having recovered three vertical stations and that there were probably nine more to pick up. However, one was fouled and two were on the bottom. The radioactivity of the instruments had slowed up operations. The estimate of total radioactivity received was 0.1 R (Reference 6, p. VII-I-70-B).

2 August
0745 Underway to target array to collect gauges.
0815 Began collecting gauges.
1055 All gauges aboard, secured operations for the day.
1345 Anchored in lee of Eneu Island after receiving water from USS Wildcat (AW-2).
1744 Underway to shift berths.
1810 Anchored off Eneu Island.

3-6 August Anchored off Eneu Island.

7 August
1745 Underway to shift berths.
1845 Anchored in berth 88, Bikini.

8 August
1812 Anchored in berth 31, Bikini.

9 August Anchored in berth 31, Bikini.

10 August
0745 Underway to shift berths.
0807 Moored portside of ATA-185 to the portside of USS Fulton (AS-11) in order to have repairs made on the #2 auxiliary generator.

11-12 August Moored to portside of ATA-185 to portside of Fulton, awaiting repairs.

13 August
0938 Underway to shift berth with ATA-185 in tow on starboard side.
0950 Anchored in berth 231A, Bikini.

14 August
1252 Underway to moor alongside Wildcat to take on freshwater.
1635 Anchored in berth 58, Bikini.

15-18 August Anchored in berth 58.

19 August
0728 Underway to pick up anchor.
0749 Anchored in berth 95.
1015 Underway to locate anchor in wet storage in vicinity of Ionchebi Island, Bikini.
1148 Anchored in lee of Ionchebi Island.
1345 Underway to shift berths.
1420 Moored to portside of LCT-1184 to portside of Palmyra.
1703 Underway to shift berths.
1718 Anchored in berth 33, Bikini.

20 August
0800 Underway to go alongside target ship USS Carteret (APA-70) to supply power to hoist its anchor.
0837-1035 Moored to Carteret to supply power to hoist motor.
1040 Underway from Carteret to assigned anchorage.
1102 Anchored in berth 33, Bikini.

21 August
1512 Underway to lee of Ionchebi Island to place anchor in wet storage.
1628 Anchored in unidentified berth in Bikini.

22 August
1300 Underway to go alongside target ship USS LST-133 to assist in hoisting its anchor.
1402-1705 Alongside LST-133 to furnish power for hoisting its anchor.
1750 Moored next to USS Severn (AO-61) to take on freshwater.

23 August
0840 Underway from alongside Severn to assigned anchorage.
0850 Anchored in unidentified berth in Bikini.

24 August
1045 Underway to change anchorage.
1155 Anchored in berth 116, Bikini.
1322 Underway to moor alongside Fulton.
1335 Moored portside to Fulton.

25 August
0914 Underway from Fulton.
0924-1203 Moored to LST-661 to furnish power for hoisting anchor.
1205 Underway to assigned anchorage.
1223 Anchored in berth 116, Bikini.
1618 Underway to alongside target ship USS LST-52 to assist in hoisting its anchor.
1635 Tied up alongside LST-52 port to port.
1747 Began supplying power to LST-52.
1755 Underway from alongside LST-52.
1814 Anchored in berth 116 in Bikini Lagoon.

26 August
0851 Underway to furnish power and aid in hoisting anchor of LST-52.
0907-1020 Moored to LST-52 to furnish power for hoisting anchor.
1029 Underway from LST-52.
1052 Moored to USS Etlah (AN-79).
1605 Underway to go alongside target ship USS Ralph Talbot (DD-390) to take it in tow.
1627 Moored to Talbot to take it in tow.
1832 Underway from Bikini with Talbot in tow for Kwajalein.

27-28 August En route to Kwajalein.

29 August
1030 Anchored Talbot.
1040 Proceeding to USS Enoree (AO-69) to take on fuel.
1155 Moored to starboard side of Enoree.
1412 Underway to assigned anchorage.
1424 Moored in berth 29 at Kwajalein.

30 August-5 September
Operated in Kwajalein performing routine buoy-laying duties. Not involved with target vessels during this period.

6 September
1949 Underway for Guam.

7-12 September
En route Kwajalein to Guam.

13 September Arrived at Guam.

USS ORCA (AVP-49)

Crew Size: 215
Bikini Atoll Arrival: 7 May 1946
Bikini Atoll Departure: 12 August 1946
Shot ABLE Location: 22 nmi (41 km) N
Shot BAKER Location: 22 nmi (41 km) N
Decontamination Location: Pearl Harbor
Operational Clearance: 11 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
The small seaplane tender Orca served in TG 1.6 (Naval Air Group) as a terminal for the seaplane shuttle between Ebeye and Bikini islands. Orca was also prepared to provide air-sea rescue in an emergency. It provided turnabout and tacking service for VPB-32. A one-man aerological unit was aboard to obtain surface weather reports when any of the ships were absent from the Bikini area (Reference 6, p. VII-I-13-O). Finally, within the constraints of its limited communications facilities, Orca assisted in local air traffic control (Reference 6, p. VII-I-9-P).

Shot ABLE (1 July, 0900)

30 June
1648 Underway from Bikini to Point Nan for shot ABLE.

1 July
0727 On station at Point Nan.
1530 Assumed station astern of USS Saidor (CVE-117).
1921 Anchored in berth 285, Bikini.

2 July
1042 Anchored in berth 22.

Shot BAKER (25 July, 0835)

24 July
1615 Underway from Bikini Atoll in accordance with CJTF 1 Op Plan 1-46.

25 July
0808 Commenced circling counterclockwise using 8° left rudder in accordance with instructions contained in CJTF 1 Op Plan 1-46.
0835 Observed underwater explosion of atomic bomb in Bikini Lagoon.
0843 Departed from Point Nan.

26 July
1410 Anchored in berth A, Bikini Atoll.

Following BAKER, many seaplanes landed near Orca.

29 July
0945 Anchored in berth P, Bikini.

30 July
0849 Anchored in berth 22.

2 August
1805 Anchored in berth 384.

3 August
0806 Anchored in berth 22.
1235 Shifted fuel to port for purpose of scraping waterline.
1717 Anchored in berth 384.

4 August
0806 Anchored in berth 22.
1631 Anchored in berth 384.

5 August
0805 Anchored in berth 22.
1637 Anchored in berth 384.

6 August
0751 Anchored in berth 22.
1646 Anchored in berth 384.

7 August
0751 Anchored in berth 22.

12 August
1449 Underway from Bikini to Kwajalein.

USS OTTAWA (AKA-101)

Crew Size: 67
Bikini Atoll Arrival: 20 March 1946
Bikini Atoll Departure: 2 August 1946
Shot ABLE Location: 35 nmi (65 km) ENE
Shot BAKER Location: 25 nmi (46 km) ESE
Decontamination Location: Pearl Harbor
Operational Clearance: 13 September 1946
Final Clearance: 13 September 1946

Task Unit and Function

Ottawa, an attack cargo ship, was a member of TU 1.3.1 (Transport Unit). Ottawa and USS Rolette (AKA-99) were loaded with 200 Seabees and construction material at Port Hueneme before sailing for Bikini. At Bikini, they served as barracks and material stores ships for the Seabees.

Shot ABLE (1 July, 0900)

30 June
- 1249 Underway in accordance with CJTF 1 Op Plan 1-46 for operation area Marmon.

1 July
- 1807 Anchored in berth 336, Bikini.

2 July
- 1554 Anchored in berth 35, Bikini.

Shot BAKER (25 July, 0835)

24 July
- 1640 Underway from Bikini Atoll in accordance with CJTF 1 Op Plan 1-46.

25 July
- 1749 Anchored in berth 32, Rongelap Atoll.

28 July
- 0952 Underway for Bikini Atoll.
- 1638 Anchored in berth 359, Bikini.
- 1837 Underway from Bikini to Rongelap.

29 July
- 0631 Anchored in berth 32, Rongelap Atoll.

30 July
- 1753 Underway for Bikini.

31 July
- 0709 Anchored in berth 35, Bikini.

2 August
- 1600 Underway from Bikini to Port Hueneme, California.

USS PALMYRA (ARS[T]-3)

Crew Size: 299
Bikini Atoll Arrival: By 1 June 1946
Bikini Atoll Departure: 5 September 1946
Shot ABLE Location: 28 nmi (52 km) ENE
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Francisco
Operational Clearance: By 22 November 1946
Final Clearance: By 4 January 1947

Task Unit and Function

Palmyra, a salvage craft tender, was the flagship of TU 1.2.7 (Salvage Unit). The duties of this unit included selecting beaching areas, facilitating salvage of damaged ships, performing all underwater work involving divers both before and after the tests, buoy placement, firefighting, and general salvage work. As a floating salvage base, Palmyra carried assorted salvage equipment and housed salvage personnel.

Shot ABLE (1 July, 0900)

30 June
- 1500 Joined formation, took aboard personnel engaged in last-minute work off Ionchebi and Eneu.

1 July
- 0858 In preparation for the flash from atomic bomb ABLE, all hands covered their eyes to prevent blindness.
- 0905 Explosions were observed in Bikini Lagoon, fires were evident in target vessels.
- 1207 Received dispatch from CTU 1.2.7 to remain in reentry area Able.
- 1326 Ordered to send a boat to transfer boarding team from USS Achomawi (ATF-148) to USS Reclaimer (ARS-42) (Reference 6, p. VII-I-8-A).
- 1327 Anchored in berth Able, Bikini.
- 1425 One officer with a 2-man working party left the ship in boat #4 with two burning outfits [to cut anchor chains] for target vessel YO-160.
- 1435 Boat #6 sent to Reclaimer for assignment to boarding team by order of CTU 1.2.7.
- 1520 Boat #5 left the ship to inspect boat pool moorings.
- 1540 Boat #5 returned.
- 1646 Was requested to move LCT-1420 100 yards (91 meters) offshore to prevent beaching (Reference 6, p. VII-I-16-A).
- 1800 Boat #4 returned.
- 2000 Boat #6 returned.

2 July
- 1326 LCM #1 left to assist in beaching target submarine USS Skate (SS-305) on Eneu Island.
- 1430 LCM #2 left to assist beaching Skate.
- 1600 Individual sent to Reclaimer for examination after being exposed to radiological contamination.
- 1605 LCM #2 returned to the ship.
- 1650 LCM #1 returned to the ship.
- 1655 Individual sent to Reclaimer for examination was returned to the ship and declared normal in all respects.

4 July
- 1045 Shifted to berth 141A.

Palmyra had no further contact with target vessels until BAKER.

Shot BAKER (25 July, 0835)

24 July
- 1245 Radiological monitor came aboard.
- 1249 Underway from Bikini in accordance with CTU 1.2 Op Order 1-46.

25 July
- 1130 Anchored in Bikini Lagoon.

25 July

1200 Directed to have two boats made ready with cutting equipment and to report to Reclaimer for instructions (Reference 6, p. VII-I-5-B). One cutting boat (LCPR) was returned to Palmyra before entering the target array.
1255 An officer with a 5-man working party left the ship for the target area.
1335 Working party returned to ship.

26 July
0852 Freshwater tank and intake tested for radioactivity and found to be clear.
1602 Directed to stand clear until Reclaimer passed through anchorage area with target ship USS Hughes (DD-410).
1837 Anchored at berth 344, Bikini.

27 July
1012 Directed to send an LCM to pick up an obstruction buoy and replant it on 4-1/2 fathom (8.2-meter) shoal off north end of Eneu (Reference 6, p. VII-I-21-B).
1336 Directed to send an LCM to beaching area to assist in beaching target ship USS Fallon (APA-81) (Reference 6, p. VII-I-23-B).
1450 Directed to have an LCM plant anchors for Fallon (Reference 6, p. VII-I-24-B).

28 July
1154 Directed to have two LCMs ready to assist in berthing target submarine USS Dentuda (SS-335) (Reference 6, p. VII-I-30-B).
1435 LCM #2 left ship.
1440 LCM #3 left ship.
1618 Anchored 450 yards (411 meters) south of berth 380.
1710 LCM #3 returned.
1830 LCM #2 returned.

29 July
0755 Directed to have boat take a series of soundings around Fallon and Dentuda (Reference 6, p. VII-I-36-B).
0935 Directed to place obstruction buoy in area of sunken target ship USS Saratoga (CV-3) to mark mast and afterend of island (Reference 6, p. VII-I-38-B).
1017 Directed to have an LCM prepared and at high tide to swing stern of Dentuda clear of Hughes (Reference 6, p. VII-I-39-B).
1125 Some Palmyra personnel were directed to report to USS Mender (ARSD-2) with instructions on planting submarine mooring buoy.

30 July
0920 LCM #2 left Palmyra.
1200 LCM #2 returned; crew was contaminated by radioactivity and ordered to change and wash clothes and shoes and to take showers.
1448 Anchored in berth Mike.
1520 Dispatched an LCPR with a dynamiting party to capsized target vessel LCT-1114.
2330 LCPR and dynamiting party returned.

31 July
1620 LCM #1 with 14 men left to haul Hughes' stern off Dentuda.
1920 LCM #1 returned.

2 August
1250 LCM #2 departed with 30 cases of dynamite for blasting on Eneu Island.
1305 LCM #3 departed with a salvage party.
1620 Moored in berth Q.
1630 LCM #3 and salvage party returned.
1850 Moored 500 yards (457 meters) south of berth 380.

3 August
0932 Anchored in anchorage M.

13 August
0940 Radsafe section representative came aboard for temporary duty.

20 August
0855 Target vessel LCI(L)-615 moored to starboard.

21 August
0815 LCI(L)-615 underway.

25 August
1403 Sank radioactive spring buoy by rifle fire.

30 August
0920 LCI(L)-615 came alongside.
1355 LCI(L)-615 underway.

5 September
1815 Underway to Kwajalein.

6 September Arrived at Kwajalein.

7 September
1450 Radsafe Radiological Clearance Board reported aboard and commenced examination of ship and personnel.

USS PANAMINT (AGC-13)

Crew Size: 591
Bikini Atoll Arrival: 29 June 1946
Bikini Atoll Departure: 27 July 1946
Shot ABLE Location: 18 nmi (33 km) NNE
Shot BAKER Location: 9 nmi (17 km) ESE
Decontamination Location: Los Angeles
Operational Clearance: 22 November 1946
Final Clearance: By 22 November 1946

Task Unit and Function

Panamint, an amphibious force flagship, was a member of TU 1.3.3 (Observers Unit). Panamint carried aboard it United Nations representatives, civilian scientists, Congressional representatives, and special press representatives. Because of the press observers, television transmitters and receivers were placed aboard the ship. It also had special equipment for reflectivity measurements.

Shot ABLE (1 July, 0900)

29 June
0930 Arrived at Bikini.
p.m. Nonparticipating observers boarded and inspected target ships Nagato, USS Nevada (BB-36), and USS Independence (CVL-22).

30 June
1700 Put to sea to take up its station for shot ABLE.

1 July
1541 Anchored in berth 250. Observers from Panamint inspected the entire target area in small boats and were permitted to board target ships Nevada, USS Arkansas (BB-33), and German cruiser Prinz Eugen (Reference 6, p. VII-Q-9).

2 July
0954 Underway.
1040 Target ship Japanese cruiser Sakawa sighted sinking by the stern.
1145 Anchored in berth 20.

5 July
1700 Left Bikini Atoll.

6 July
0955 Anchored at Kwajalein.
1500 Began the Pacific cruise that had been planned to occupy the interim period between ABLE and BAKER (Reference 6, p. VII-Q-9).

Shot BAKER (25 July, 0835)

24 July
1145 Sailed from Kwajalein.

25 July Panamint returned to the Bikini area before the BAKER detonation.
1735 Anchored in berth 382, Bikini Lagoon, just inside Eneu Channel. Radioactivity in the water around the target array prevented Panamint from going into the lagoon for inspection. The observers were allowed to examine a target ship, USS Hughes (DD-410), beached on Eneu Island to prevent it from sinking. The observers viewed Hughes at close range from small boats (Reference 6, p. VII-Q-10).

27 July
1820 Left Bikini for Kwajalein (Reference 6, p. VII-Q-10).

USS PARCHE (SS-384)

Crew Size: 61
Bikini Atoll Arrival: 22 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,366 yards (1.3 km) SSW
Shot BAKER Location: 1,580 yards (1.4 km) SW
Decontamination Location: San Francisco
Scrapped July 1970

Task Unit and Function
The submarine Parche was a member of TU 1.2.4 (Submarine Unit), Submarine Division 112, serving as a target vessel. Its crew was evacuated before each shot. The Electronics Group had installed equipment for electronic experiments aboard it. The group monitored 15 separate pieces of radio and radar equipment aboard the boat.

Shot ABLE (1 July, 0900)

2 July
0935 Parche reported Geiger sweet (Reference 6, p. VII-I-A-24).
1155 Teams A and B reboarded.

Table A.7. Number of men decontaminating USS Parche (SS-384) between 6 and 21 August and their lengths of time aboard.

Date	On Board	Departed	Number of men
6 August	1300	1500	12
7 August	0900	1100	10
	1100	1300	--
8 August	0900	1100	20
9 August	0900	1100	20
	1300	1600	20
10 August	0830	1100	30
11 August	0900	1200	8
12 August	0830	1100	20
12 August	1300	1530	20
13 August	0830	1130	20
13 August	1300	1530	20
14 August	0830	1100	30
14 August	1300	1530	20
15 August	0900	1400	--
15 August	1400	1800	--
16 August	0830	1530	40
17 August	0830	1530	40
18 August	0900	1500	20
19 August	0900	1730	--
20 August	0900	1600	--
20 August	1600	0100	--
21 August	0900	1500	--

Note: -- indicates "no value given."

Source: Reference 1, Parche.

Table A.8 Topside shipboard contamination (R/24 hours) aboard USS Parche (SS-384).

Date	Bow	Amidships	Stern	Average
31 July				5.2
1 August				5.1
2 August				4.1
3 August				3.5
6 August	0.8	3.5	0.6	1.6[a]
7 August	0.6	3.0	0.35	0.86
8 August	0.4	2.5	0.3	0.71
9 August	0.3	2.0	0.2	0.50
10 August	0.2	1.6	0.2	0.80
12 August	0.2	0.8	0.2	0.40
14 August	0.12	0.6	0.2	0.27
15 August	0.2	0.57	0.1	0.322
17 August	0.15	0.5	0.05	0.211
18 August	0.08	0.5	0.1	0.236
20 August				0.2

Note:

[a]Below decks reported radiologically safe when opened 6 August except for the conning tower (0.3 R/24 hours) and main induction pipe (2.0 (R/24 hours).

Source: Reference 4.

1210-1510 Opening up boat.

2-24 July Crew aboard.

Shot BAKER (25 July, 0835)

26 July
1600 USS Preserver (ARS-8) was directed to proceed to the vicinity of target submarines USS Skate (SS-305) and Parche to make a radiological survey around five submerged submarines (Reference 6, p. VII-I-17-B).

6-8 August Parche scrubbed down using boiler compound. The boat was cleaned alternately by scrubbing with boiler compound and applying a lye bath.

8 August
0900 Crew transferred to remanned target ship USS Fillmore (APA-83).
0935 Anchored near berth 145.

August 14 Crew delivered a sample of the wood deck to USS Haven (AH-12) for study by the Radsafe Office.

14-18 August Parche scrubbed down with lye and its trim pump hosed it down using high pressure.

19 August
1044 Anchored in berth 112.
1710 Anchored near berth 145.
During the day, the ship was again hosed down. Sulfuric acid removed any rust.

20 August Crew ripped up wood on bridge deck and hosed it down (Reference 4).

The sizes of the working parties and their times aboard Parche from 6 August to 21 August are summarized in Table A.7. Shipboard contamination aboard Parche is reported in Table A.8.

22 August
0745 Parche reboarded with entire crew.
0900 Underway to Kwajalein.

23 August
1100 Arrived at Kwajalein.
1430 Crew transferred to Fillmore.

24 August Crew reboarded for 8 hours.

25 August Crew reboarded for 6 hours.

26 August Crew returned to live aboard.

28 August Departed for San Francisco via Pearl Harbor.

USS PENNSYLVANIA (BB-38)

Crew Size: 484
Bikini Atoll Arrival: 28-29 May 1946
Bikini Atoll Departure: 21 August 1946
Crew Location for Shot ABLE: USS George Clymer (APA-27); USS Rockingham (APA-229)

Crew Location for Shot BAKER: Clymer; Rockbridge
Shot ABLE Location: 1,541 yards (1.4 km) SE
Shot BAKER Location: 1,140 yards (1.0 km) S
Sunk 10 February 1948 near Kwajalein

Task Unit and Function
The battleship Pennsylvania served in TU 1.2.1 (Battleship and Cruiser Unit), Battleship Division 9, as a target ship for CROSSROADS. Its crew left the ship for each shot. Different kinds of materials were placed aboard the ship for experimental reasons. The materials included food and clothing, ammunition, and radio, radar, and electronic equipment.

Shot ABLE (1 July, 0900)

Most Pennsylvania crewmembers were evacuated to Clymer and Rockbridge on 29 and 30 July.

1 July
0335 The last-minute evacuation group left for Rockbridge, leaving no persons aboard.
1314 Explosions amidship noted (Reference 6,
1319 p. VII-I-8-A).
1330 A fire flared up on Pennsylvania and burned continuously until about 1530 when it was extinguished by the DSM salvage parties.
1445 Pennsylvania was reported Geiger sour (Reference 6, p. VII-I-11-A).
1523 Radiological teams in boats B14 and B3 reported Pennsylvania Geiger sweet (Reference 6, p. VII-I-11a-A).
1700 Crew consolidated on Clymer.
1706 USS Current (ARS-22) reported Pennsylvania Geiger sweet (Reference 6, p. VII-I-17-A).
1905 DSM declared Pennsylvania clear for boarding by Teams A and B; to be boarded on the following day.

2 July
1013 The commanding officer and a portion of Boarding Team A departed from Clymer for USS Haven (AH-12) to pick up the radiological monitor.
1130 The radiological monitor was taken aboard the boat and the party headed for Pennsylvania.
1155 The ship's initial boarding team immediately commenced a radiological clearance of the topside.
1325 The topside and the foremast and main mast were found to be radiologically clear, and the inspection was continued below decks.
1407 The casemates (armored enclosures to fire guns from) and main and second decks were found to be radiologically clear.
1415 The engine rooms, fire rooms, and auxiliary spaces were found to be radiologically clear.
1435 The remainder of Team A and Team B was received aboard.
1455 The radiological officer and commanding officer satisfied themselves that Pennsylvania was radiologically clear and safe.
1507 The radiological monitor collected water samples and returned to Haven.
2305 Clearance to turn on freshwater was obtained.

USS Pennsylvania (BB-38)

3 July
1600 Remainder of crew returned aboard.

5 July
1700 Jettisoned two test OS2U aircraft.

6 July
1026-1440 Conducted diving operations to check the underwater condition of the ship.

Shot BAKER (25 July, 0835)

25 July
0357 The last-minute evacuation group was evacuated to Rockbridge.
1408 CJTF 1 told DSM to avoid Pennsylvania as radioactivity on board was sharp with high intensity (Reference 6, p. VII-I-11-A).

27 July
1030 Pennsylvania cleared for the initial boarding team.
1400 Pennsylvania last-minute crewmembers aboard Rockbridge were transferred to Clymer.
1608 USS Reclaimer (ARS-42) passed Pennsylvania, which had a 25-minute tolerance.

28 July Pennsylvania was reported to be slightly down by the stern with a slight starboard list.

31 July
1400 The after section of Pennsylvania was washed down with foamite by salvage vessels.

1 August
0831 USS Deliver (ARS-23) reported having completed covering Pennsylvania with foam (Reference 6, p. VII-I-66-B).

3 August Deliver was instructed to wash down Pennsylvania thoroughly using high-pressure streams and afterwards take Geiger readings from 50 feet (15 meters) on each side (Reference 6, p. VII-I-B-77).

8 August
0930 The first Pennsylvania boarding team, along with the radiological monitors from Haven, commenced a preliminary inspection.
The radiological survey showed a 45-minute to 2-hour tolerance on the weather decks. Geiger readings are presented in Table A.9. Pumping and radiological decontamination was carried on until 1700, at which time the ship was closed up and the boarding team returned to Clymer.

9 August
0845-1630 Boarding team worked on radiological decontamination and pumping of the after compartments. Canvas, manila, and cork floats were removed from the topside, and the starboard side of the quarterdeck was scrubbed in decontamination efforts. The boarding team returned to Clymer.

10 August
0840 The boarding team boarded Pennsylvania and commenced salvage and decontamination work; continued decontamination work on the weather decks with assistance from working parties from target ships USS Independence (CVL-22), USS Pensacola (CA-24), USS Mugford (DD-389), and USS Ralph Talbot (DD-390).

Table A.9. Geiger readings aboard USS Pennsylvania (BB-38) by ship's company the first day of reboarding (8 August 1946).

Location	Reading (R/24 hours) Range	Maximum	Location of Maximum
Starboard, main deck aft	2.0 - 4.0	10.0	Waterline, scuppers
Port, main deck aft	2.0 - 4.0	15.0	Plane
Port, starboard side of forecastle	1.5 - 3.0	18.0	Scupper (waterways) generally had hot spots
Superstructure deck	2.0 - 4.0		Vegetable locker, water accumulated
Main mast	1.5		
Foremast	Slightly >1.5		

Source: Reference 3.

11 August All decontamination work on Pennsylvania was halted.

14 August Radiological monitors tested men who had been on Pennsylvania.

16 August The air in the ice room on Pennsylvania was found radiologically unsafe. The crew returned to remanned target ship USS Niagara (APA-87), where Pennsylvania personnel had been transferred for berthing and messing.

17-21 August Working parties boarded Pennsylvania to inspect and prepare it for towing.

21 August
1400 Pennsylvania underway in tow by USS Chowanoc (ATF-100) for Kwajalein. Topside average 0.7 R/24 hours (Reference 7).

24 August
1100 Pennsylvania arrived at Kwajalein.

29 August Decommissioned at Kwajalein.

20 September Topside average 0.39 R/24 hours (Reference 7).

Pennsylvania underwent radiological and structural studies until 10 February 1948, when it was sunk.

USS Pensacola (CA-24)

USS PENSACOLA (CA-24)

Crew Size: 354
Bikini Atoll Arrival: 28-29 May 1946
Bikini Atoll Departure: 24 August 1946
Crew Location for Shot ABLE: USS George Clymer (APA-27); USS Rockingham (APA-229)
Crew Location for Shot BAKER: Clymer; Rockingham
Shot ABLE Location: 710 yards (649 meters) E
Shot BAKER Location: 640 yards (585 meters) W
Decontamination Locations: Kwajalein; Bremerton
Sunk 10 November 1948, off the coast of Washington

Task Unit and Function

The heavy cruiser Pensacola served in TU 1.2.1 (Battleship and Cruiser Unit), Cruiser Division 23. It was a target vessel for CROSSROADS. Its crew was evacuated before each shot. Food and clothing, radio, radar, and electronic equipment were placed aboard the vessel for experimental reasons.

Shot ABLE (1 July, 0900)

1 July

0340 Completed evacuation of Pensacola to Rockingham. Last-minute security detail evacuated to Clymer.

1630 Clymer and Rockingham reentered the lagoon and proceeded to anchor for the night. Later in the night, Pensacola personnel aboard Clymer disembarked and joined Pensacola crew aboard Rockingham.

1702 Fire noted burning on fantail (Reference 6, p. VII-I-16-A).

2 July

1630 Although Pensacola had not yet been cleared radiologically, the commanding officer made a survey of Pensacola from a small boat but did not board.

3 July

0800 Pensacola cleared radiologically.

0915 The commanding officer, Team A, and radsafe monitor came aboard.

0925 Joint Chiefs of Staff and members of the President's Evaluation Board, who had boarded prior to the commanding officer, left the ship.

1040-1200 Conducted radiological inspections of the topside structures. Topside was cleared radiologically with some exceptions.

1300-1700 Team B on board to open below deck spaces and continue with radiological survey below. Pensacola declared radiologically clear with minor exceptions. A security watch of 3 officers and 23 enlisted men remained aboard.

1320-1430 Task force medical officer on board for inspection.

1-10 July No Pensacola crewmembers regularly berthed aboard, but continued living on Rockingham. The crew worked on Pensacola from 3 to 10 July and returned to Rockingham each night except for a small security detail.

6 July

1349 Shifted by tugs to berth 286.

11 July Crew returned to quarters aboard.

1035 Anchored in berth 161.

Shot BAKER (25 July, 0835)

25 July Crew aboard Rockingham.

0345 Last-minute personnel left ship for Clymer.

The detonation caused extensive damage to Pensacola and it was radiologically unsafe for habitation.

27 July Pensacola crewmembers aboard Clymer apparently transferred to Rockingham.

30 July ATR-87 washed down Pensacola for 4 hours with high-pressure hoses (Reference 6, p. VII-I-49-B). The ship had tolerances of 6 and 8 minutes.

31 July ATR-87 washed down Pensacola with foamite (Reference 6, p. VII-I-57-B).

1 August Work parties from Pensacola boarded USS Preserver (ARS-8) to go alongside Pensacola.

1420 Preserver washed down decks and superstructures with saltwater to reduce high radioactivity after a boarding party from Pensacola found it unsafe.

1600-1623 Repair teams aboard to lay out hoses and pump out flooded compartments. Repair teams left Pensacola and the Pensacola boarding party returned to Rockingham. Radioactivity was too high to permit an accurate assessment of damage.

2 August

0830 Repair parties boarded USS Reclaimer (ARS-42).

1002 Repair parties boarded Pensacola and completed laying out hoses and connected portable pump in preparation for pumping out flooded compartments.

1028 Reclaimer stood clear from alongside Pensacola due to heavy radioactivity, which prevented it from remaining.

1415-1528 Reclaimer alongside Pensacola to complete connecting pump and hoses. High radioactivity prevented reboarding except for short periods of time.

1805-1810 Reclaimer moored alongside to refuel pump.

5 August

1430 Reclaimer went alongside Pensacola. Reboarding groups boarded Pensacola to adjust hoses and to continue preliminary damage inspection.

7 August

1430-1540 Reboarding party from Reclaimer adjusted hoses.

8 August

1510-1610 Reclaimer alongside Pensacola with reboarding party to adjust hoses.

10 August

1030-1130 A small boarding party from Reclaimer came aboard to adjust pump hoses and inspect damage. In accordance with advice from radiological monitor, four men were sent to USS Haven (AH-12) for examination because their hands had been contaminated while working on Pensacola.

1300	The men were examined and returned to duty.
11-24 August	High radioactivity continued to prevent reboarding of the ship except for short periods of time.
14 August	
0830	Radiologists came aboard Rockingham to check all Pensacola personnel who had been on board Pensacola. Results were satisfactory. Pensacola continued to be unsafe for habitation.
17, 19 August	About 200 Pensacola crewmembers were transferred to Clymer.
19 August	Operations were started to pump all the water out of the ship and temporarily plug up the leaks.
22 August	Topside average 1.0 R/24 hours (Reference 7).
24 August	Six men were transferred to Preserver for temporary additional duty in connection with towing and anchoring Pensacola.
0830	A small party reboarded Pensacola to prepare it for towing.
1000	Taken in tow to Kwajalein; crewmembers departed aboard Rockingham.
26 August	Arrived at Kwajalein; the 6-man towing detail returned to Rockingham from Preserver.
28 August	Decommissioned.
1 October	Topside average 0.8 R/24 hours (Reference 7).

Pensacola was towed to Puget Sound Naval Shipyard by USS Hitchiti (ATF-103) and USS Takelma (ATF-113) for radiological research on 21 April 1947.

PERRY, NEWMAN K.; see USS NEWMAN K. PERRY (DD-883)

PGM-23

Crew Size: 39
Bikini Atoll Arrival: 5 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 8 nmi (15 km) S
Decontamination Location: Pearl Harbor
Decommissioned 1947

Task Unit and Function

PGM-23, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool Unit). It was assigned to perform lagoon radiological patrols. These were conducted in the first few days following each test. The ship then performed boat pool duties.

Shot ABLE (1 July, 0900)

30 June	A radsafe party reported aboard to participate in the operation. Evacuated personnel from Iroij and Nam before anchoring off Aomen Island.
1 July	
0445	Underway after evacuation party from Aomen reported aboard.
0650	Rendezvoused with PGM-24, PGM-25, PGM-29, PGM-31, and PGM-32.
1130	Received clearance into lagoon from radsafe section. Commenced making oceanographic and radiological survey of sector Brazil with radiological patrol boats (LCPL-A-1, A-2, A-3, and B-19).
1715	Evacuation party from Aomen departed.
1857	Anchored in berth 33, Bikini.
2 July	
0708-1452	Conducted radiological and oceanographic surveys.
1452	Anchored in berth 40.
3 July	
0653	Underway in accordance with safety plan of CJTF 1 Op Plan 1-46.
1201	Anchored at Bikini.
1345	Underway.
1818	Moored alongside USS Barton (DD-772).
1911	Anchored in berth 21.
4 July	
0910	Shifted anchorage, bearings Beacon "B" 112.5°T, Beacon "C" 76°T, Beacon "E" 31.5°T.
5 July	
0953	Underway from anchorage, proceeding to make radiological surveys of Lukoj, Bokonejien, Nam, Aomen, Iroij, Odrik, and Lomilik islands.
1850	Anchored in berth 3A.
6-23 July	No contact with target vessels.

Shot BAKER (25 July, 0835)

24 July	
0950	Radiological section party aboard, commenced operation of BAKER D-1.
1235	Evacuation of Iroij Island completed.
1605	Underway to drop seismographic and wave measurement buoys.
25 July	
0508	Evacuation party from Aomen Island aboard.
0612	Departed for area Franklin as assigned in CJTF 1 Op Plan 1-46.
1009	Entered the lagoon to await LCPL-A-1, A-2, A-3, and B-19 of lagoon safety patrol; underway conducting radiological reconnaissance of lagoon northwest to north of surface zero (sector Argentina).
1835	Anchored in berth 251, Bikini.
26 July	
0743	Underway, proceeding to make radiological reconnaissance of lagoon in accordance with CJTF 1 Op Plan 1-46.
1657	All monitors and oceanographers departed.
1702	Anchored 700 yards (640 meters) from temporary berth Roger.
27 July	
0614	Proceeded to carry out radiological survey.
1158	Anchored off USS Appling (APA-58).

1230	Radsafe section ordered all crewmembers except 5 men, to depart ship.
1815	Remaining crew left ship for Appling. A new monitor reported aboard.
28 July	
0015	Two officers boarded as skeleton crew.
1315	Four men reported aboard as skeleton crew.
1530	Ten men reported aboard.
1700	All crewmembers except 11 men and officers evacuated to Appling.
29 July	
0700	Crew returned from Appling.
0902	Radiological monitors aboard, proceeding on radiological survey of lagoon.
1818	Anchored in temporary berth I, Bikini.
30 July	
0657-1428	Conducted radiological survey.
1428	Anchored in berth 34A.
31 July	
0822-1132	Carried out radiological patrol.
1132	Anchored 40 yards (37 meters) east of berth 251A.
1600	Shifted to berth 34A.
1 August	
0913	Anchored 400 yards (366 meters) northeast of berth 14.
1349	Shifted anchorage, bearings Beacon C, 129°T, Beacon B, 81.5°T, Beacon E, 26.5°T.
2 August	
1039	Proceeding on decontamination run outside the lagoon.
1324	Anchored 1,600 yards (1.5 km) from berth 370.
1406	Proceeding on decontamination trip outside the lagoon.
1727	Anchored in berth 384.
1835	Shifted anchorage to berth 361.
3 August	
1016	Underway for decontamination run, steaming on various courses and speeds inside lagoon.
1128	Passed lagoon entrance and proceeded on various courses on 6-hour decontamination run outside lagoon.
1710	Anchored in Bikini Lagoon in berth 363.
10 August	
0845	Representatives from USS Bowditch (AGS-4) came aboard for scientific work.
0942	Underway at various courses and speeds making survey of lagoon, stopping every 1,000 to 2,000 yards (0.9 to 1.8 km) to take water samples.
1629	Anchored 300 yards (274 meters) southwest of berth 114.
11-15 August	Routine activities.
15 August	
0845-1201	Towed two target LCMs west of the target array for sinking and sank them.
1828	Anchored 400 yards (366 meters) north of berth 38.
16 August	
1407	Removed a reel placed aboard by the radsafe department.
19 August	
1350-1641	Photographed target ships.
1720	Anchored 400 yards (366 meters) north of berth 38.
20 August	
1032-1546	Underway on photographic assignment.
2111-2248	Steaming on patrol assignment.
21 August	
2206-2346	On patrol assignment.
22 August	
1300-1310	Radsafe officer removed radiological gear.
2047-2219	On patrol throughout target array.
23 August	
2237-2345	Patrolled target area.
24 August	
2045-2147	Patrolled target array.
25 August	
1341	Underway for Kwajalein.
26 August	Anchored in Kwajalein.
28 August	
1135-1243	Checked and declared radiologically safe by Radsafe Section. Radsafe recommended another check for radioactivity be made if the ship were drydocked or major machinery overhauled.
29 August	
2156	Underway to carry out patrol of target ship area.
2321	Anchored in Kwajalein Lagoon in berth 20.
30 August	
0813	Underway to take on fuel and water.
0847-0925	Moored starboard side to USS Severn (AO-61).
1010-1129	Moored alongside USS Enoree (AO-69) to take on fuel oil.
1129	Underway to assigned anchorage.
1221	Anchored in berth 18.
2146	Underway to patrol target ship area.
2222	Anchored in berth 22-King, Kwajalein.
31 August	
2019	Underway to patrol target area.
2215	Anchored in berth 22-King.
1 September	
2144	Underway on nightly patrol of target ship area.
2355	Anchored in berth King-22.
2 September	
1135-1231	Moored alongside LCI-1065, which was moored alongside USS Limestone (IX-158).
1251	Anchored in berth King-22.
2214	Underway to make patrol of target area.
2327	Anchored in berth King-22.
3 September	
2140	Made preparations for getting underway.

2218	Secured from special sea detail, orders to patrol area of target vessels having been cancelled by CTU 1.8.

4 September

0930-1012	Moored alongside USS Tombigbee (AOG-11) to take on water.
1023	Anchored in berth King-17.
1322	Anchored in berth K-9.
1506	Underway.
1525	Moored to starboard side of PGM-24.
1904	Underway.
1907	Anchored in unspecified anchorage, Kwajalein.

5 September

1135	Proceeding to N.O.B., Guam.
1920	Received orders to proceed back to Kwajalein.

6 September

0810	Anchored in berth K-21, Kwajalein.
1537	Moored to portside of PGM-24.

7 September

1312	Anchored in berth K-16.

8 September

1325	Shifted anchorage in berth K-16.
1925	Shifted anchorage to unspecified point in Kwajalein Lagoon.

9 September Departed for Pearl Harbor.

16 September Arrived at Pearl Harbor. An inspection for radioactivity was conducted.

PGM-24

Crew Size: 48
Bikini Atoll Arrival: 14 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 8 nmi (15 km) S
Decontamination Location: Pearl Harbor
Operational Clearance: 13 February 1947
Final Clearance: 13 March 1947

Task Unit and Function

PGM-24, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool Unit). It was assigned to perform lagoon radiological patrols. These were conducted in the first few days following each shot. The ship then performed boat pool duties.

Shot ABLE (1 July, 0900)

30 June

1505	Proceeding to area Franklin.

1 July

0903-0950	Proceeding to area Caterpillar.
1120	Arrived at lagoon entrance.
1145-1210	Proceeding to patrol sector Chile in company with radiological patrol boats LCPL-B-6, B-7, and B-8.
1530	Laying to and changing position in accordance with radiological readings.
1853	Anchored in sector Chile.

2 July

0755	Underway to make radiological patrol of northern part of area in vicinity of target vessels.
1130	LCPL alongside to pick up water samples and record sheets.
1143	Anchored close astern target ship USS Nevada (BB-36).
1147	Underway and laid to, waiting for tugs to tow target ship USS Independence (CVL-22) clear of area.
1240	Anchored close astern to Nevada.
1340	LCPL-B-12 took some oceanographic equipment from PGM-24 aboard.
1430	Underway to western edge of lagoon to take radiological samples.
1530	Arrived on station.
1548	Proceeding to specified sectors, taking samples on arrival.
1935	Arrived in last sector near USS Haven (AH-12).
1945	Received a radiological group aboard from Haven; disembarked group that was aboard.
2004	Anchored at Bikini.

3 July

0906	Underway resuming radiological patrol.
1243	Laying to.
1545	Underway for next station to obtain water samples for radsafe section.
1802	Anchored in vicinity of Haven.

4 July

1000	Underway to resume radiological patrol of western part of lagoon.
1035	Moored alongside PGM-23.
1123	Underway from PGM-23, steaming to first station, carrying out radiological patrols.
1730	Anchored off Haven.

5 July

1116	Underway for Bokdrolul, Bokaetoktok, Adrikan, Jelete, and Lukoj islands to conduct radiological tests.
1232	Arrived at Bokdrolul Island, laying to awaiting radiologists to clear island.
1515	Underway for Oroken and Adrikan islands.
1533	Arrived at passage between Oroken and Adrikan islands.
1816	Anchored in vicinity of Haven.

6-24 July Engaged in routine activities.

Shot BAKER (25 July, 0835)

24 July

1700	Arrived in area Franklin, joining PGM-25, PGM-29, and PGM-32. Proceeded in column to patrol sector.

25 July

0001	Steaming in area Franklin.
0838	Proceeded to area Caterpillar.
0940	Proceeded to lagoon entrance.
1225	Entered the lagoon and proceeded via safest route with Bikini landing party following in LCPL-A-6.
1245	Arrived in new station accompanied by LCPL-B-6, B-7, and B-8, laying to awaiting further orders.
1300	Proceeding to Bikini via safest route.

1330	Arrived in vicinity of Bikini Island; landing party went ashore.
1435	Caught on reef while trying to avoid contaminated water.
1452	Free of reef under own power.
1515	Proceeding back to Eneu with landing party.
1622	Anchored in vicinity of Eneu.
1759	Anchored close to USS Mount McKinley (AGC-7); made preparations to evacuate PGM because of radioactivity.
2259	Evacuated crew to USS Appling (APA-58), except for the captain and three enlisted men.
26 July	
0600	Crew back aboard.
0830	Underway.
1050	On station to conduct radsafe patrol duty.
1725	Anchored in vicinity of Haven; crew evacuated to USS Henrico (APA-45) except for captain and emergency standby team.
27 July	
0525	Crew returned aboard.
0720	Underway for patrol.
1848	Anchored near Haven.
28 July	
0830-1620	Proceeded on patrol.
1825	Anchored in vicinity of Haven.
2110	Shifted anchorage.
29 July	
1137	Moored alongside Haven.
1256	Anchored.
30 July	
0751	Underway to Aomen Island to collect radiological data.
0952	Arrived at Aomen Island, put radiological party ashore.
1230	Proceeded to Nam Island.
1530	Laying to off Nam.
1625	Radiological party returned aboard from Nam Island.
1929	Anchored close astern of Haven.
31 July	
0835	Anchored in berth (N)34A.
1 August	
1407	Proceeding to entrance of lagoon to flush out saltwater system.
1455	Commenced flushing out saltwater system.
1712	Moored alongside USS Wildcat (AW-2).
1945	Anchored in vicinity of Haven.
2 August	
0934	Proceeded to northwestern islands to conduct radiological survey.
1130-1530	On patrol.
1630	Arrived at Athen [Aomen?] Island.
1755	Radiological party returned.
1953	Anchored in berth 383 near Haven.
3 August	
1125	Proceeding out of lagoon to flush saltwater tanks.
1215	Started flushing.
1500	Returned to lagoon, still flushing.
1717	Anchored near Haven.
5 August	
1124	Anchored off Jelete Island.
1830	Anchored near Haven and Mount McKinley.
7 August	
1000	Underway to Bokaetoktok Island.
1220	Arrived at Bokaetoktok Island, laying to waiting for monitor.
1828	Anchored off Haven.
8-12 August	Entered drydock aboard ARD-29 for repair of screws and shafts.
12 August	Towed to Bikini anchorage area by USS Wenatchee (ATF-118).
13-24 August	Anchored. Did not get underway.
25 August	Towed by ATA-124 to Kwajalein.
26 August	Arrived at Kwajalein.
28 August-2 September	Drydocked for repairs.
2 September	Anchored in Kwajalein.
4 September	Patrolled Kwajalein CROSSROADS target area.
5 September	
1235	Departed for Guam.
1935	Ordered to return to Kwajalein.
6 September	Arrived Kwajalein.
9 September	Left for Pearl Harbor.
16 September	Arrived at Pearl Harbor.

PGM-25

Crew Size: 53
Bikini Atoll Arrival: 15 May 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 8 nmi (15 km) S
Decontamination Location: New Orleans
Final Clearance: 28 May 1947

Task Unit and Function

PGM-25, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool Unit). It was assigned to perform lagoon radiological patrols during the first few days following each shot, after which it was to perform boat pool duties.

Shot ABLE (1 July, 0900)

1 July	Underway for area Franklin for CJTF 1 Op Plan for ABLE day.
0920	Proceeding to lagoon entrance.
1130	Entered the lagoon and began radiological patrol with LCPL-B-9, B-10, and B-11.
1300	Entered radioactive area.
1301	Backed clear of radioactive area.
1310	Laying to.
1315	Steaming in sector Denmark.
1620	Original radsafe party returned to USS Haven (AH-12); new radiological party on board.

PGM-25

1630-1700	Conducted a run in assigned sector.
1850	Anchored in night station, Bikini Atoll.
1930	Underway to go alongside PGM-24.
2025	Anchored in vicinity of Haven.
2 July	
0713-1422	Carried out radiological patrol.
1422	Anchored in berth 34A.
1615	Underway to approach starting position of a new set of radsafe surveys.
1700-1800	Made radsafe run.
1820	Anchored in night station.
3 July	
0638	Underway to carry out radsafe patrol.
0800	Laying to off Haven.
0930-1800	Underway on radsafe patrol.
1835	Anchored at Bikini.
1840	Oceanographers and monitors left the ship.
4 July	
1019-1516	Underway on radsafe patrol.
1516	Anchored.
5 July	
1052	Underway on radsafe patrol.
1120-1220	Anchored at Bokonfuaaku Island.
1255-1420	Anchored at Eniaro Island; radiological party surveyed Eniaro and returned.
1430	Survey party departed for Ionchebi.
1550	Underway to pick up radiological party.
1559	Radiological party aboard.
1910	Anchored near Haven.
6 July	
0850-1522	Underway on radiological patrol.
1550	Anchored at Bikini.
8 July	
0830-1450	Underway through lagoon with photographic unit aboard.
1504	Anchored in berth 34A.
11 July	
1020	Underway with monitors aboard to test various islands of the chain by putting monitors ashore to test for radioactivity.
1839	Anchored in berth 34A, Bikini.
12-24 July	Engaged in routine activities.
Shot BAKER (25 July, 0835)	
24 July	
1310	Underway in accordance with JTF 1 evacuation plan for BAKER day.
1930	Arrived in area Franklin.
25 July	
0840	Proceeded to lagoon entrance.
1040	Entered the lagoon and commenced radsafe patrol in company with LCPL-B-9, B-10, and B-11, steaming on various courses at minimum speed.
1145	Laying to in outer edge of sector Chile (northeast to east of surface zero); unable to approach area due to radioactive water. Remained at outer edge of patrol sector.
1615	Anchored in Bikini Lagoon.
1730-1857	Underway for night station.
1857	Anchored in night station.
2221-2247	Shifted berths.
2300-2325	Shifted berths.
26 July	
0150	Underway to new berth by orders of Radsafe.
0220	Anchored.
0905-1720	Underway to make radsafe tests in Bikini.
1720	Anchored in vicinity of Haven.
2120	Received orders to evacuate PGM-25, with exception of 10 men for security watch, because of radioactive contamination.
27 July	
0550	Evacuated officers and crew returned.
0647-1537	Underway to conduct safety patrol.
1537	Anchored in vicinity of Haven.
28 July	
0705-1748	Underway to make radiological survey in target area.
1748	Anchored.
30 July	
0647	Underway on radiological patrol.
1431	Anchored off Eneman and Bikdrin islands.
1910	Anchored in vicinity of Haven, Bikini Lagoon.
31 July	
0805	Underway to proceed to various islands to make radiological surveys on various courses and at various speeds.
1208	Anchored off Adrikan Island.
1420	Underway for Lele Island.
1835	Anchored in berth 34A, Bikini.
1 August	
1235-1710	Underway on radsafe orders to proceed to sea for high-speed decontamination run.
2 August	
0900	Boat from Haven alongside to remove radiological gear.
1700	Shifted berths.
1710	Anchored in berth 34A.
1823	Shifted anchorages; anchored in vicinity of Haven.
3 August	
1915-1322	Underway to make decontamination run at sea.
1701-1803	
1803	Returned to lagoon. Anchored in vicinity of Haven.
5 August	
1350	Boat alongside to remove radiological and oceanography gear.
6 August	
0845-1548	Underway to make survey in target area.
1548	Anchored in berth 362.
7 August	
0840	Underway to target anchorage to take radiological readings near sunken targets.
0947	Anchored near target ship USS Nevada (BB-36).
1528	Underway to anchorage.
1620	Anchored in berth 92.
10 August	
1700	Underway for Guam via Kwajalein.

11 August
0952 Anchored at Kwajalein.

12 August Underway from Kwajalein to Guam.

17 August Arrived at Guam.

PGM-29

Crew Size: 48
Bikini Atoll Arrival: 14 May 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 8 nmi (15 km) S
Decontamination Location: New Orleans
Final Clearance: 28 May 1947

Task Unit and Function
PGM-29, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). It was assigned to perform lagoon radiological patrols during the first few days following each shot, after which it was to perform boat pool duties.

Shot ABLE (1 July, 0900)

30 June
1320 Underway to area Franklin for ABLE day operations.
1600 Arrived area Franklin.

1 July
0910 Proceeding to harbor entrance.
0919 Laying to in area Caterpillar.
1150 Entered the lagoon.
1230-1800 Steaming in Bikini Lagoon, sector England, in company with radiological patrol boats LCPL-B-12, B-13, and B-14 while testing water for radioactivity.
1820 Anchored in Bikini Atoll.

2 July
0725-1732 Underway conducting radioactivity survey.
1732 Anchored.

3 July
0800 Two photographers and two radiological men came aboard.
0900 Photographers left ship.
0935 Steaming while carrying out radioactivity survey.
1240-1532 Anchored off Nam.
1820 Anchored in berth 40, Bikini Atoll.

4 July
0917 Underway in Bikini Lagoon while taking water samples.
1616 Anchored in berth 40, Bikini.

4-24 July Routine activities.

Shot BAKER (25 July, 0835)

24 July
1015 Radsafe party from USS Haven (AH-12) came aboard for BAKER.
1258 Proceeded out of harbor.
1448 Patrolled area Franklin.

25 July
0835 Proceeding to area Caterpillar.
0900 Laying to in area Caterpillar.
1100 Entered lagoon.

1130 In target area carrying out BAKER day operations in sector Denmark (east to southeast of surface zero) in company with LCPL B-12, B-13, and B-14.
1745 Radiological and photographic parties left ship.
1900 Anchored in berth 320, Bikini.
2145 Shifted anchorage.
2250 Due to excessive radioactivity accumulated while carrying out BAKER day activities, all of the crew was evacuated to USS Appling (APA-58) with the exception of the captain, executive officer, and six crewmembers.

26 July
0612 Crew returned to PGM-29.
1230 Underway to sector Holland (west of surface zero) to take water samples.
1350-1403 Observers aboard.
1415 In vicinity of target vessels.
1520-1530 Observers departed.
1645 Anchored in Bikini Lagoon.

27 July
0722 Underway in sector England (south to southeast of surface zero), taking samples of radioactive water.
1230 Entered sector Argentina (north to northwest of surface zero).
1307-1310 Towed LCPL-B-14.
1315 Anchored in area 92, Bikini.

28 July
0653 Monitors came aboard.
0720 Steaming while taking samples of radioactive water in the lagoon.
1728 Anchored in Bikini Lagoon (11°31'10"N, 165°30'30"E).
1827 Shifted to anchorage position 11°30'50"N, 165°30'30"E.

29 July
0910 Monitors boarded.
1031-1850 Steaming in Bikini Lagoon for radiological survey work.
1830 Monitors left ship.
1850 Anchored in position 11°30'45"N, 165° 30'20"E.

30 July
0930-1515 Underway in Bikini Lagoon taking water samples.
1536 Anchored in berth 35.

1 August
1330 Underway.
1533-1641 Proceeded on decontamination run inside lagoon.
1641 Anchored in berth 55, Bikini.

2 August
0830 Monitors boarded.
0930-1614 Proceeded to take water samples for radiological survey.
1745 Anchored in berth 384.

3 August
1300-1546 Steaming in Bikini Lagoon on a decontamination run.
1546 Anchored in berth 361.

4-5 August Anchored in berth 361, Bikini.

5 August
1350 Oceanographic party boarded and removed all oceanographic equipment.

6 August
0850 Oceanography party boarded.
0855 Steaming in Bikini Lagoon taking samples of water.
1040 Water-sampling devices lost.
1130 Oceanography party departed for USS Bowditch (AGS-4).
1142 Anchored in berth 365, Bikini.

8 August
0845-0920 Scientific party on board to make a radiological survey of the PGM-29.

10 August
1815 Underway en route to Guam via Kwajalein.

11 August Arrived at Kwajalein.

12 August Underway for Guam.

17 August Arrived at Guam.

PGM-31

Crew Size: 55
Bikini Atoll Arrival: 29 May 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 8 nmi (15 km) SE
Decontamination Location: Pearl Harbor
Operational Clearance: 17 January 1947
Final Clearance: 25 January 1947

Task Unit and Function
PGM-31, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). It was assigned to perform lagoon radiological patrols during the first few days following each shot, after which it was to perform boat pool duties.

Shot ABLE (1 July, 0900)

30 June
1240 Underway to area Franklin to await ABLE day.

1 July
0905 Underway for assigned area off Eneu Island.
1105 Laying to inside lagoon entrance awaiting LCPL-B-15, B-16, and B-17.
1130 Assembled patrol with LCPLs and stood into target array, sector France (south to southeast of surface zero), surveying radioactivity of the target ships.
1955 Anchored in berth 115, Bikini.

2 July
0600-1350 Conducted radiological survey in accordance with orders of Radsafe Director.
1350 Anchored in berth 42, Bikini.
1603 Underway.
1910 Anchored in berth 227.

3 July
0851 Oceanographic party reported aboard.
0903-1239 Proceeded to different parts of Bikini Lagoon to take water samples for oceanographic survey.
1430 Anchored in berth 370.

4 July
0925-1505 Underway taking water samples for oceanographic survey.
1505 Anchored in berth 42.

5 July
1103-1745 Underway with radiological survey party for various islands around Bikini Atoll. Radiological survey party used a wherry [a small boat] to visit Aerokoj, Aerokojlol, and Enidrik islands and returned to ship.
1750 Anchored in berth 344.

6 July
0830-1600 Underway to islands at western end of lagoon to conduct radiological survey.
1650 Anchored in berth 42.

9 July
0905 Underway with seismologists aboard to clear target array area.
1035 Anchored off Bokonejien Island.
1050 Seismologists went ashore in rubber boat.
1525 Seismologists returned aboard.
1750 Anchored in berth 175, Bikini.

11 July
0830 Seismologists came aboard, proceeded to Nam Island.
0955-1325 Seismologists on Nam Island
1420-1600 Seismologists on Iroij Island.
1830 Anchored in berth 44.

13 July
1708 Underway through target and anchorage areas.
1845 Anchored in berth 44.

Shot BAKER (25 July, 0835)

24 July
1415 Underway to rendezvous with TG 1.8.3 in area Franklin, outside Bikini Lagoon.

25 July
0910 Laying to at lagoon entrance.
1030 Entered the lagoon and proceeded cautiously into target array, sector England (south to southeast of surface zero), taking water samples and radioactivity readings in company with LCPL-B-15, B-16, and B-17.
1337 Stood out of Bikini Lagoon to flush decks with clear water due to high radioactive contamination.
1545 Reentered Bikini Lagoon.
1600 Anchored at Bikini.
1845 All officers and men evacuated to USS Haven (AH-12) in accordance with verbal orders from radsafe due to induced radioactivity in the hull and piping, which occurred when PGM-31 attempted to find a route to the sinking target ship USS Saratoga (CV-3). One officer and five men came aboard from Haven as a security watch.

26 July
0608 Captain and personnel returned to PGM-31 and made preparations to get underway; security watch returned to Haven.
0830-1645 Underway to take water samples in lagoon.
1720 Anchored.

1752	Ship's company except 8-man skeleton crew evacuated to USS Appling (APA-58).

27 July

0600	Crew returned.
0700	Underway to take water samples in target array.
0700-1400	Secured from taking water samples.
1430	Anchored off Eneu Island.
2000	All hands evacuated to Appling except for seven-man security watch.

28 July

1130	One officer and nine men came aboard to relieve skeleton crew.
1605	Captain returned aboard to shift berths due to closing in of radioactive water.
1734	Shifted berth.
2145	Shifted berth.

29 July

0800	Officers and crew returned.
1345-1445	Underway for speed runs to reduce radioactivity.
1605	Anchored.

30 July

0845-1555	Underway to take water samples within the lagoon.
1555	Anchored close aboard Haven.

1 August

1400-1620	Underway on decontamination run outside of Bikini Lagoon to clear hull of radioactivity, steering various courses for best possible decontamination effect.
1800	Anchored close aboard Haven.

2 August

0900-1400	Underway to take water samples in Bikini Lagoon for oceanographic purposes.
1430-1655	Steaming on various courses in attempt to flush off radioactive contaminated bottom.
1730	Anchored close aboard Haven.

3 August

1137-1635	Stood out of Bikini Lagoon, proceeding for decontamination runs to reduce radioactivity on ship's bottom.
1650	Anchored close aboard Haven.

4-10 August Routine activities.

10 August

1742	Underway from Bikini Lagoon to Guam via Kwajalein.

11 August

1005	Anchored in Kwajalein.

12 August Underway to Guam.

17 August Arrived at Guam.

PGM-32

Crew Size: 27
Bikini Atoll Arrival: 5 May 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 7.1 nmi (13.2 km) SE
Decontamination Location: Philippines
Operational Clearance: 10 October 1946
Final Clearance: 10 October 1946

Task Unit and Function

PGM-32, a patrol motor gunboat, was a member of TU 1.8.3 (Dispatch Boat and Boat Pool Unit). It was assigned to perform lagoon radiological patrols during the first few days following each shot, after which it was to perform boat pool duties.

Shot ABLE (1 July, 0900)

30 June

1306	Underway from Bikini Atoll for steaming area Franklin.

1 July

0910	Proceeding to area Caterpillar.
1000	Laying to in area Caterpillar.
1133	Entered the lagoon and steamed to sector Greece for radioactivity survey in company with LCPL-A-4, A-5, B-18, and B-20.
1225-1410	Swept sector Greece.
1410-1955	Swept sector Holland.
1930	Anchored near USS Haven (AH-12) in Bikini Lagoon.

2 July

1551	Three scientists reported aboard to make radiological tests.
1650-1852	Underway for tests.
1852	Anchored near buoy 6, Bikini Lagoon.

3 July

0800	Underway making runs in Bikini Atoll taking water samples.
1315-1330	Lay to off Adrikan Island.
1330-1545	Lay to off Bokdrolul Island.
1810	Anchored near Haven.

4 July

0941-1429	Underway to western end of Bikini Lagoon taking periodic water samples as ordered.
1429	Anchored in berth 34-A.

5 July

0920-1223	Underway among target ships in array, in accordance with instructions from BuAer photographers.
1223	Anchored.

7 July

0825-1610	Toured target area in accordance with instructions from photographers.
1610	Anchored.

Shot BAKER (25 July, 0835)

24 July

1645	Underway for area Franklin.

25 July

0843	Received orders to proceed to area Caterpillar.
0908	Entered area Caterpillar.
0957	Entered lagoon, proceeded to sector France (south to southwest of surface zero) in company with LCPL-A-4, A-5, B-18, and B-20 to take scientific readings and data.
1723	Anchored in vicinity of Haven.

26 July
0941-1728 Collected scientific data in accordance with shot BAKER D+1 operations.
1728 Anchored in vicinity of Haven.
2030 Evacuated personnel to USS Appling (APA-58) due to radioactivity.

27 July
0555 Crew returned to PGM-31.
0745-1615 In target array area to gather scientific data.
1602 Anchored in vicinity of Eneu Channel entrance.

28 July
1609 Underway from anchorage in vicinity of Haven to new anchorage due to radioactivity in this area.
1640 Anchored in vicinity of Appling.

29 July
0800-1642 Underway within Bikini Lagoon collecting scientific data on radioactivity.

30 July
0747-1829 Underway from anchorage to vicinity of target area to gather scientific and radiological data.
1829 Anchored in berth 34.

31 July
1546 Underway to receive fresh supplies and water.
1852 Anchored in berth 52.

1 August
1251-1730 Outside of Bikini Lagoon.

2-10 August Routine activities.

10 August
1820 Left Bikini for Guam via Kwajalein.

11 August
1010 Arrived at Kwajalein.

12 August Departed Kwajalein.

17 August Arrived at Guam.

USS PHAON (ARB-3)

Crew Size: 160
Bikini Atoll Arrival: 2 May 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: Anchored at Kwajalein, 210 nmi (389 km) SE
Shot BAKER Location: 20 nmi (37 km) NE
Decontamination Location: Los Angeles
Operational Clearance: 26 December 1946
Final Clearance: 4 January 1947

Task Unit and Function

The base repair ship USS Phaon (ARB-3) was a member of TU 1.8.1 (Repair and Service Unit). The duties of this unit included repairing, towing, and salvaging ships and supplying provisions. This unit also provided a Fleet Post Office, a motion picture exchange, as well as recreation, welfare, and legal facilities.

Shot ABLE (1 July, 0900)

1 July Anchored in berth 21, King anchorage, Kwajalein, at time of detonation.

2 July
0825 Underway for Bikini.

3 July
0800 Anchored in berth 115, Bikini.

5 July
1400 Moored to target ship USS Arkansas (BB-33).

9 July
1510 Underway from Arkansas.
1535 Anchored in berth 115, Bikini.

10-23 July Routine activities.

Shot BAKER (25 July, 0835)

24 July
1400 Underway from berth 115 to area Packard in accordance with CTU 1.8.7.

25 July
0855 Proceeding independently to Rongelap.
1720 Anchored in berth 4, Rongelap.

30 July
0758 Underway for Bikini Atoll.
1700 Anchored in berth 115, Bikini.

2 August
1615 Shifted berths.

3 August
1050 Target vessel LCI(L)-615 moored alongside for repairs.

5 August LCI(L)-615 underway from alongside.

7 August Shifted berths.

8 August
1605 LCI(L)-615 moored alongside for repairs.

9 August
1015 LCI(L)-615 underway from alongside.

14 August Shifted berths.

14-18 August Alongside target ship LCI-329.

22 August
0945-1020 Radsafe Ships Clearance Board aboard to inspect the ship, and made the following recommendations: "The ship is safe for operation from a radiological standpoint with the exception of the evaporators, which will be checked by the evaporator board."

23 August
0949 Underway for Kwajalein.

24 August
0927 Arrived at Kwajalein.

28 August
1200 Radsafe Ships Clearance Board inspected evaporators. Evaporators radiologically clear for sailing but were not to be opened without presence of a monitor.

3 September Left Kwajalein for Pearl Harbor.

12 September Arrived at Pearl Harbor.

USS PILOTFISH (SS-386)

Crew Size: 52
Bikini Atoll Arrival: 22 May 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 2,506 yards (2.3 km) NE
Shot BAKER Location: 260 yards (238 meters) ENE
Sunk 25 July 1946, Bikini Lagoon

Task Unit and Function
The submarine Pilotfish was a member of TU 1.2.4 (Submarine Unit), Submarine Division 112. It was a target vessel during CROSSROADS. Its crew was evacuated before each shot. Pressure-time recorders and radiation intensity films were placed aboard the boat.

Shot ABLE (1 July, 0900)

30 June
0945 Crew evacuated.

1 July
1549 USS Etlah (AN-79) placed a boarding team on Pilotfish.
1608 Etlah reported its boarding team aboard, clearing Pilotfish. Pilotfish reported Geiger sweet (Reference 6, p. VII-I-13-A).
1730 DSM declared Pilotfish radiologically clear for boarding (Reference 6, p. VII-I-13-B).

2 July
1145 Damage control parties boarded.
1410 Material inspection completed.

There was no damage of consequence to Pilotfish from ABLE (Reference 2). It appears the crew returned to Pilotfish by 3 July.

3 July
1515 Shifted berths, moored alongside USS Fulton (AS-11).

Shot BAKER (25 July, 0835)

24 July
0645 Crew evacuated.
0900 Pilotfish was submerged.

28 July
0954 USS Coucal (ASR-8) reported able to find only two buoys from Pilotfish. (Reference 6, p. VII-I-28-B).

Pressure-time recorders and radiation intensity films were recovered from Pilotfish (Reference 6, p. VII-I-83-B). Efforts to raise boat unsuccessful.

30 July Coucal sent divers to test Pilotfish for radioactivity (Reference 6, p. VII-I-52-B). Efforts to raise boat unsuccessful.
1704 Ceased efforts to raise Pilotfish.

1 August Radioactivity on bottom of the still submerged Pilotfish was reported as 35 to 45 R/24 hours; on deck at 120-foot (37-meter) depth 45 R/24 hours; at 4 feet (1.2 meters) above deck, 2 R/24 hours.

9 August
0900 Officers and personnel transferred to remanned target ship USS Fillmore (APA-83).

13 August Preparations made for diving operations.

16 August Salvage operations continued. Boat listed 30 to 40 degrees to starboard, and the superstructure aft of frame 100 appeared to be displaced about 1 inch (2.54-cm) to starboard. The deck was covered with silt (in some places 18 inches [46 cm] deep) and isolated chunks of coral.

21 August Pilotfish declared lost as a result of BAKER.

An underwater survey was made of Pilotfish during the Bikini resurvey in July 1947.

USS POLLUX (AKS-4)

Crew Size: 154
Bikini Atoll Arrival: 20 May 1946
Bikini Atoll Departure: 19 August 1946
Shot ABLE Location: 22 nmi (41 km) SE
Shot BAKER Location: 11 nmi (20 km) ESE
Decontamination Location: Puget Sound
Operational Clearance: 29 November 1946
Final Clearance: 25 January 1947

Task Unit and Function
Pollux, a stores issue ship, was a member of TU 1.8.1 (Repair and Service Unit).

Shot ABLE (1 July, 0900)

1 July
1800 Entered Bikini Lagoon.
1825 Anchored in berth 287.

2 July
1043 Underway to shift berths.
1124 Anchored in berth 131A.

20 July
1102 Target vessel LCT-1187 moored alongside.
1840 LCT-1187 departed.

Shot BAKER (25 July, 0835)

25 July Observed shot BAKER and proceeded to Kwajalein.

26 July
0833 Anchored at Kwajalein.

4 August
1537 En route to Bikini.

5 August
0654 Entered Bikini Lagoon.
0740 Anchored in berth Q.

19 August
1449 Underway to Kwajalein.

20 August
0820 Arrived at Kwajalein.
1649 Underway to Pearl Harbor.

29 August Arrived at Pearl Harbor.

USS PRESERVER (ARS-8)

Crew Size: 85
Bikini Atoll Arrival: 28 May 1946
Bikini Atoll Departure: 28 August 1946
Shot ABLE Location: 27 nmi (50 km) E
Shot BAKER Location: 12 nmi (22 km) NE
Decontamination Location: Los Angeles
Operational Clearance: 8 December 1946
Final Clearance: 4 January 1947

Task Unit and Function
The salvage ship Preserver was a member of TU 1.2.7 (Salvage Unit). Preserver's main duties included salvaging damaged target vessels after the tests, performing emergency repairs, and fighting fires.

Shot ABLE (1 July, 0900)

30 June
1251 Underway in accordance with CTU 1.2.7 Op Order D-46, proceeding to area Mercury.

1 July
1340 Anchored in special berth C, northwest of Eneu Island.

2 July
0710 Underway to put boarding team aboard target ships.
0806-0840 Boarding team aboard target vessels LCT-816 and LCT-818. LCTs reported to be Geiger sweet (Reference 6, p. VII-I-22-A).
0907 Underway to target vessel YOG-83.
0918 Moored starboard side to YOG-83.
0921-0945 Boarding team on YOG-83.
1006-1035 Boarding team on target ship USS Brule (APA-66); reported Brule Geiger sweet (Reference 6, p. VII-I-29-A).
1055 Laying to, near target ship USS Hughes (DD-410).
1059-1145 Team on board Hughes; reported Hughes Geiger sweet (Reference 6, p. p. VII-I-29-A).
1216 Moored portside to target ship USS Nevada (BB-36).
1220-1245 Team boarded Nevada.
1256 Underway to fight fires on Nevada's portside; Nevada unsafe for boarding (Reference 6, p. VII-I-30-A).
1308 Fires extinguished, proceeded to USS Wharton (AP-7).
1340 Laying to off Wharton.
1347 Boarding team left Preserver via motor launch for Wharton.
1433 Anchored in berth C.

3 July
0836 Underway to pick up instrument party from USS Kenneth Whiting (AV-14).
0915 Proceeding to pick up instruments and buoys.
0935 Commenced salvage operations.
1225 Proceeded to target ship Nagato to investigate reported fires; made inspection, no fires found to exist.
1240 Resumed salvage operations.
1625 Completed salvage operations and proceeded to Whiting to discharge passengers, instruments, and buoys.
1751 Anchored in berth 85, Bikini.

5 July
1640-1720 Loaded instrument buoys and air tanks on LCM.

6 July
0643-0915 Towed Brule to new berth.
1130-1143 Engaged in diving operations to retrieve necessary instrument. Sent diver down to recover instrument, instrument recovered, diver on board.
1255 Anchored in berth 85.
1515-1810 Underway to assist in moving Nagato to new berth.
1838 Anchored in berth 85, Bikini.

8 July
1620-1900 Towed YOG-83 to new berth.
1942 Anchored in berth 85.

9 July
1607 Underway to deliver wire to target ship USS Arkansas (BB-33).
1629-1641 Moored starboard side to Arkansas to transfer wire.
1700 Anchored in berth 85, Bikini.

10 July
1157-1217 Underway to take No. 2 motor launch in tow.
1329 Took motor launch in tow.
1321 Anchored in berth 85, Bikini.
2333 Underway to investigate target vessel YO-160 alongside Arkansas; YO-160 listing to port and in danger of sinking.
2350 Laying to alongside YO-160.

11 July
0055 Underway with YO-160 in tow to area west of target array.
0750 Proceeding to beaching area near Eneu Island.
1525 Cast off tow, standing by.
1530 YO-160 beached on reef northwest of Eneu Island.
1725 Anchored YO-160.
1737 Anchored northwest of Eneu Island.

12 July
0800 Commenced salvage operations on YO-160.
1243 Underway, preparing to tow YO-160.
1415 Commenced towing YO-160 from beach.
1500 Tow cable parted, maneuvered to secure new tow.
1605 Secured tow wire to YO-160, commenced steady pull.
1710 Anchored north of Eneu Island.

USS Preserver (ARS-8)

1745-1800	Sent divers down with shallow-water gear to inspect damage on YO-160.
13 July	
0800	Commenced salvage operations on YO-160.
1112	Commenced steady pull on YO-160 to keep it from broaching.
1325	Towed YO-160 to beach.
1335	Towed YO-160 to lee of Eneu Island.
1432	Anchored near berth 370.
1500	Commenced counterflooding starboard tanks of YO-160.
1625	Got underway to tow YO-160 to shallow water in beaching area off north end of Eneu Island.
1710	Anchored northwest of Eneu Island, YO-160 in tow.
14 July	
0800	Commenced salvage operations on YO-160.
15 July	
1418	Underway to tow YO-160 to temporary mooring in berth 229.
1424	Took YO-160 in tow alongside and proceeded to berth.
1558	Moored YO-160 to mooring buoy in berth 229.
1625	Got underway to assist USS Reclaimer (ARS-42) in moving Nagato.
1725	Moored to buoy in berth 143.
16 July	
1315	Diver on deck; diver had been underwater unspecified period of time.
1335-1540	Second diver down.
1602-1814	Third diver down.
1814	Secured operations for the day.
17 July	
0925	Commenced diving operations to secure wire to Nagato anchor.
0950	Diver secured wire to anchor.
1215	Commenced hauling up Nagato anchor.
1408	Dropped Nagato anchor in assigned spot.
1525	Anchored in berth 85, Bikini.
19 July	Participated in BAKER rehearsal.
1142	Underway to go alongside target ship USS Niagara (APA-87).
1208	Entered Eneu Channel.
1252	Circled Niagara to simulate boarding.
1311	Circled target ship USS Pennsylvania (BB-38) to simulate boarding.
1350	Anchored in berth 85.
20 July	
0623	Underway to tow and anchor YO-160 to anchorage in target array.
0720	Underway with YO-160 in tow.
0820	YO-160 anchored in assigned berth.
1043	Underway from YO-160 to refuel.
1437	Anchored in berth 85.
21 July	
1120	Underway to tow target ship USS Trippe (DD-403) to new berth.
1134	Moored alongside Trippe.
1204	Underway with Trippe.
1448	Trippe anchored in berth 129.
1530	Anchored in berth 85.
23 July	
1123	Underway to bring Nagato to desired heading.
1245	Moored to Nagato.
1340	Took strain on stern cable wire, brought Nagato heading to 085.
1545	After taking anchors on board from USS Henrico (APA-45) to anchor target submarine USS Tuna (SS-203), underway to Tuna.
1639	Anchored in berth 222, Bikini.
2200	USS Etlah (AN-79) moored alongside to receive anchors for mooring Tuna.
Shot BAKER (25 July, 0835)	
24 July	
0105	Completed transferring anchors to Etlah to moor Tuna.
0720	Anchored in berth 85, Bikini.
1221	Boarding Team No. 1 came aboard for BAKER day operations.
1256	Underway from Bikini Lagoon from area Mercury.
25 July	
1101	Entered Eneu Channel.
1128	Anchored in berth C.
1142	Underway to place boarding team on Niagara.
1208-1221	Boarding team on Niagara.
1257-1305	Team boarded target vessel LCT-1115.
1356	Anchored in berth C.
26 July	
1424	Underway to survey target vessels and make radiological survey of water in area.
1750	Tow wire secured to anchor chain of target ship USS Fallon (APA-81).
1830	Due to radioactivity, cast off tow wire and proceeded out of area to anchorage.
1914	Anchored in berth 344.
27 July	
0805-1359	Engaged in Fallon towing operations.
1453	Anchored west of beaching area near Fallon to assist in putting on bow and stern anchors.
1825	Anchoring of Fallon completed.
28 July	
1406-1647	Underway with observers to tour target array.
1710	Anchored 675 yards (617 meters) south of berth 379.
29 July	
0910	Underway to vicinity of Fallon to take Geiger readings.
1005	Moored alongside USS Chickasaw (ATF-83).
1847	Anchored.
30 July	
0811	Underway to wash down target ship USS Gasconade (APA-85).
0850-1015	Washed down Gasconade, concluding with Geiger readings.
1048	Proceeded to beaching area at Eneu to secure anchor to target submarine USS Dentuda (SS-335).
1115	Anchored off Eneu.

USS Preserver (ARS-8)

1450-1708 Engaged in operations to pull stern of Dentuda away from the stern of Hughes.
1730 Anchored in special berth C.

31 July
0755 Underway to wash down target ship USS Conyngham (DD-371) with saltwater and target vessels LCT-705 and LCT-1013 with powdered foam.
0907-1010 Washed down Conyngham with saltwater and moored alongside to send a team aboard with Geiger meters to take readings.
1401 Underway to target ship USS Carteret (APA-70) to take Geiger readings and spray with foam.
1137 Completed taking Geiger readings, commenced spraying down with powdered chemical foam.
1255 Completed spraying Carteret and proceeded to LCT-705.
1327 After taking Geiger readings, commenced spraying LCT-705 with foam.
1340 Completed spraying LCT-705 and proceeded to LCT-1013.
1358-1405 Sprayed LCT-1013 with foam; used a total of 192 5-gallon cans of powdered foam on both target vessels.
1407 Proceeded to USS Palmyra (ARS[T]-3) to renew supply of chemical foam.
1700 Upon receipt of message that no foamite available, got underway to anchorage.
1726 Anchored in special berth C.

1 August
0742 Underway to wash down Carteret in target array.
0810-1004 Washed down Carteret with two 5-inch water monitors.
1017-1027 Monitor team aboard Carteret to take Geiger readings.
1125 Moored alongside Reclaimer.
1335 Underway to target ship USS Pensacola (CA-24).
1415 DSM and party came aboard to direct operations in placing submersible pumps aboard Pensacola.
1425 Party in LCVP boarded Pensacola and found it radiologically unsafe for reboarding.
1440-1522 Washed down Pensacola with two 5-inch monitors from close aboard.
1545 Moored to Pensacola and placed submersible pump aboard.
1550 Boarding team boarded Pensacola to take Geiger readings.
1615 Transferred equipment to deck of Pensacola.
1620 Underway from Pensacola to anchorage east of berth 145.

2 August Routine activities.
1534 Anchored in special berth, 675 yards (617 meters) south of berth 379.

3 August
0733 Underway to wash down target ship USS New York (BB-34) with saltwater and take Geiger readings.
0816-1110 Washed down New York.
1137 Completed taking readings on New York and proceeded to anchorage.
1215 Anchored south of berth 379.

5 August
0927 Anchored in beaching area near Eneu.

6 August
0540-0947 Engaged in towing operations with Dentuda.
1020 Anchored south of berth 379.

7 August
0722-1135 Engaged in towing operations with ARD-29.
1155-1440 Engaged in towing operations with USS Quartz (IX-150).
1506 Anchored in berth 85.

8 August
0735 Underway to pick up boarding teams and board Pennsylvania.
0820 Embarked boarding team.
0910-1630 Boarding team boarded Pennsylvania; team departed via small boat.
1635 Underway en route to vicinity of USS George Clymer to disembark working parties.
1652 Working parties disembarked in LCMs.
1723 Anchored in berth 107.

9 August
0730 Underway to pick up boarding team and board Nevada.
0755 Boarding team aboard.
0815 Moored alongside Nevada.
0913 Boarding team and working party boarded Nevada.
1115-1530 Engaged in pumping operations on Nevada.
1600-1625 Washed down Nevada's decks and superstructure with saltwater.
1630 Boarding team left Nevada via boat.
1648 Anchored in berth 107.

10 August
0725 Underway to embark divers and radiological monitors to recover instruments.
0756-0921 Embarked divers and monitor.
0951 Anchored in berth 285 near instruments.
1118-1523 Diving operations undertaken to recover instruments; located one instrument.
1649 Anchored in berth 107.

12 August
0905 Radiological monitor and six divers reported aboard in connection with gamma meter salvage operations.
0947 Underway to conduct operations in berth 161.
1037 Anchored in berth 161.
1110-1320 Engaged in diving operations to recover gamma meters; failed to find meters due to deep layer (6 to 8 feet [1.8 to 2.4 meters]) of fine coral on bottom.

13 August
1145 Geiger monitor came aboard.
1204-1439 Engaged in diving operations; failed to find wires or meters due to heavy layer of pulverized coral.
1451 Anchored in new position 180 yards (165 meters) off.
1505-1647 Engaged in diving operations in new position; failed to locate wire.
1706 Geiger monitor left the ship.

14 August
0757 Underway to continue operation for recovery of gamma meters by dragging.
0820 Two radiological monitors came aboard.
1159 Anchored in berth 161.

USS Preserver (ARS-8)
14 August

1247-1700	Engaged in dragging instrument cable; failed to locate instruments.
1910	Monitors left the ship.
15 August	
0905-1608	Continued dragging operations for recovery of gamma meters.
1221	Moored alongside Reclaimer to receive equipment that had been placed on Pensacola on 1 August.
1238	Underway to continue dragging operations.
1621	Anchored in berth 107.
16 August	
0756	Got underway to conduct diving operations on sunken target ship USS Saratoga (CV-3) to recover instruments and conduct general examination.
0835	Moored in berth 187.
0852	Sent survey party to determine condition around Saratoga and take soundings.
19 August	
1145	Proceeding to Nevada to take it in tow.
1215	Moored alongside Nevada.
1252	Disembarked anchor detail to Nevada.
1415	Underway for Kwajalein with Nevada in tow.
1424	Anchor detail returned.
22 August	
1105	Anchored Nevada in berth A-11, Kwajalein.
1533	Underway to Bikini.
23 August	
0911	Anchored in berth 90, Bikini.
24 August	
0815	Anchored near Pensacola to take it in tow.
1015	Underway to Kwajalein with Pensacola in tow.
26 August	
0825	Anchored Pensacola in berth A-4, Kwajalein.
1253	Underway to Bikini.
27 August	
0752	Anchored in berth 107, Bikini.
28 August	
0845	Moored alongside target ship USS LST-220 to take in tow.
1122	Underway to Kwajalein with LST-220 in tow.
30 August	
0920	Anchored LST-220 in berth A-4, Kwajalein.
31 August	
0841-0920	Radiological Safety Officer aboard to inspect the ship for radioactivity.
1 September	Underway from Kwajalein to Pearl Harbor.

USS PRESQUE ISLE (APB-44)

Crew Size: 194
Bikini Atoll Arrival: 20 May 1946
Bikini Atoll Departure: 19 August 1946
Shot ABLE Location: 30 nmi (56 km) NE
Shot BAKER Location: About 20 nmi (37 km) NE
Decontamination Location: Los Angeles
Operational Clearance: 12 December 1946
Final Clearance: 21 December 1946

Task Unit and Function
The self-propelled barracks ship Presque Isle was a member of TU 1.8.3 (Dispatch Boat and Boat Pool). The ship provided such services as inter-atoll freight and passenger service and also functioned as a barracks ship.

Shot ABLE (1 July, 0900)

1 July	
0900	Observed shot ABLE from approximately 30 nmi (56 km) northeast of the lagoon.
1910	Entered Bikini Lagoon.
1921	Passed buoy 4 abeam to starboard.
1940	Anchored in berth 369.
3 July	
1212	Underway to shift berths.
1258	Anchored in berth 95.
4-24 July	Routine activities.

Shot BAKER (25 July, 0835)

24 July	Departed Bikini Lagoon.
25 July	
0855	En route from Bikini to Rongelap.
1710	Anchored at Rongelap.
30 July	
0953	Underway to Bikini.
1829	Entered Bikini Lagoon.
1900	Anchored in berth 385.
31 July	
0827	Underway to shift berths.
0925	Anchored in berth 95.
2 August	
1550	Underway to new anchorage.
1655	Anchored east of berth Tare.
7 August	
0927	Anchored in berth 95.
12 August	
0913	Anchored in berth 116.
14 August	
1128	Anchored in berth 95.
19 August	
1736	Departed Bikini Lagoon en route to Kwajalein.
20 August	
1800	Anchored Kwajalein.
2 September	
1603	Underway to Pearl Harbor.
12 September	Arrived at Pearl Harbor.

Prinz Eugen

PRINZ EUGEN

Crew Size: 444
Bikini Atoll Arrival: 11 June 1946
Bikini Atoll Departure: 20 August 1946

Prinz Eugen

Crew Location for Shot Able: USS Rockingham (APA-229)
Crew Location for Shot BAKER: Rockingham
Shot ABLE Location: 1,194 yards (1.1 km) WNW
Shot BAKER Location: 1,990 yards (1.8 km) WNW
Sunk 22 December 1946, Kwajalein

Task Unit and Function
The captured German cruiser Prinz Eugen was a member of TU 1.2.1 (Battleship and Cruiser Unit), Cruiser Division 23. It was a target vessel during CROSSROADS tests and contained representative items from the Army Signal Unit. Its CROSSROADS crew, composed of U.S. personnel, was removed from the ship before each test. Prinz Eugen was actually commissioned during its ferrying to Bikini and was given the hull number of IX-300.

Shot ABLE (1 July, 0900)

1 July
1820 USS Reclaimer (ARS-42) completed inspecting Prinz Eugen (Reference 6, p. VII-I-19A-A).

2 July
1250 USS Conserver (ARS-39) was directed to place a team on Prinz Eugen (Reference 6, p. VII-I-30-A).
1456 Conserver reported Prinz Eugen Geiger sweet (Reference 6, p. VII-I-32-A). Overall condition was good with no major damage.
1540 Disembarked Team A from Rockingham to Prinz Eugen.

3 July Crew returned aboard to live.

21 July
1250 Crew evacuated to Rockingham.

Shot BAKER (25 July, 0835)

1 August
0956 USS Clamp (ARS-33) was directed to place a boarding team on board Prinz Eugen (Reference 6, p. VII-I-67-B).

2 August USS Deliver (ARS-23) was directed to proceed to the vicinity of USS Wharton (AP-7) to pick up a boarding team, proceed to Prinz Eugen to wash it down with high-pressure streams and place boarding teams aboard if radiological tolerance permitted (Reference 6, p. VII-I-71-B).
1152 Clamp reported completing a 4-hour washdown of Prinz Eugen and placed boarding team on board.
1237 Deliver inspection of Prinz Eugen complete; the boarding teams returned aboard their respective ships (Reference 6, p. VII-I-74-B).

3 August
1110-1208 Prinz Eugen boarded by initial boarding
1330-1630 Team A. The after engine room was flooded with 30 inches (76 cm) of water. All compartments were pumped dry. CTG 1.2 ordered an LCM sent to the windward side of Bikini for a load of sand to scrub down Prinz Eugen (Reference 11).

4-10 August Boarded daily for decontamination by four teams of crewmembers rotating every 2 hours. Teams consisted of 17 men at the beginning of this period and increased to 33 men as the radiation level decreased. Near the end of this period, as below decks spaces were radiologically cleared, 125 engineers boarded each day to make the propulsion system operational.

Radiation readings aboard Prinz Eugen between 4 August and 1 October are listed in Table A.10.

16 August
0805 Prinz Eugen personnel transferred to remanned target ship USS Bladen (APA-63).

20 August Towed to Kwajalein by USS Munsee (ATF-107).

Prinz Eugen was later beached on Carlson Island, Kwajalein, and sank in December 1946.

Table A.10. Radiation readings (R/24 hours) aboard Prinz Eugen main deck.[a]

Date	Minimum	Average	High
4 August	1.0	3.7	4.5
5 August	0.9	2.0	3.7
6 August	0.54	1.5	3.5
7 August	0.2	0.8	1.3
8 August	0.4	0.9	1.5
9 August	0.4	0.9	8.0
10 August	0.3	0.7	1.2
14 August		0.45	
1 October		0.35	

Note:

[a]No decontamination required below armor deck.

Source: Reference 4.

USS Quartz (IX-150)

Crew Size: 50
Bikini Atoll Arrival: 6 April 1946
Bikini Atoll Departure: 22 August 1946
Shot ABLE Location: Anchored at Kwajalein
Shot BAKER Location: Rongelap Atoll
Decontamination Location: Puget Sound
Operational Clearance: 12 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
Concrete barge Quartz was a member of TU 1.8.1 (Repair and Service Unit). Large ships obtained dry provisions from this barge.

Shot ABLE (1 July, 0900)

1 July Anchored in berth 79A, Kwajalein Atoll.

3 July
1430 Underway in tow by USS Munsee (ATF-107) for Bikini.

4 July
1925 Anchored 2 nmi (3.7 km) off Bikini Island.

5 July
1400 Anchored in berth 146, Bikini.

18 July
1610 Underway for Rongelap Atoll towed by Munsee.

19 July
1155 Anchored in berth 22, Rongelap Atoll.

Shot BAKER (25 July, 0835)

25 July Anchored in berth 22, Rongelap Harbor.

30 July
1615 Underway in tow by Munsee for Bikini.

31 July
0935 Anchored in berth 168, Bikini.

3 August
0945 Shifted to berth east of berth R.

7 August
1440 Anchored at a berth between 145 and 146, Bikini.

14 August
1445 Anchored in berth 191(A), Bikini.

21 August
1800 Anchored near entrance to Bikini Harbor.

22 August
0645 Underway to Kwajalein towed by USS Sioux (ATF-75).

23 August
1300 Anchored in berth south of King 4, Kwajalein.

31 August
1055 Target vessel LCI(L)-549 alongside.
1355 LCI(L)-549 underway.

3 September
1335 Underway to Pearl Harbor towed Sioux.

15 September Arrived at Pearl Harbor.

USS RALPH TALBOT (DD-390)

Crew Size: 132
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 26 August 1946
Crew Location for Shot ABLE: USS Henrico (APA-45)
Crew Location for Shot BAKER: Henrico
Shot ABLE Location: 1,163 yards (1.1 km) E
Shot BAKER Location: 1,815 yards (1.7 km) WSW
Sunk March 1948 near Kwajalein

Task Unit and Function
The destroyer Talbot was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 1. It was a target vessel during CROSSROADS. Its crew was evacuated before each shot. It carried aboard it special electronic equipment that the Electronic Group monitored.

Shot ABLE (1 July, 0900)

30 June
0930-1145 All personnel evacuated to Henrico.

2 July
1500 Reboarded and commenced inspection of all spaces.
1800 Preliminary inspection complete. Reported damage sustained to CJTF 1. Ship was radiologically safe.

3 July
1130 Completed rehabilitation of ship, resumed normal operations.

Shot BAKER (25 July, 0835)

24 July
0930 Commenced evacuating personnel in accordance with CJTF 1 Operation Plan 1-46.
1100 Completed the evacuation of personnel to Henrico.

2 August USS Reclaimer (ARS-42) proceeded to Talbot and washed it down thoroughly using high-pressure hoses (Reference 6, p. VII-I-71-B).

3 August
1005 USS Clamp (ARS-33) sent a boarding party to inspect Talbot before washing down and found it Geiger sour (Reference 6, p. VII-I-79-B).
1005-1058 Clamp washed down Talbot (Reference 6, pp. VII-I-79-B and VII-I-80-B).

8 August
0940 Talbot Geiger sour. Average readings on main deck, 1.5 R/24 hours; forecastle, 0.8 R/24 hours; maximum reading -- paint chips and rust scales, 4.0 R/24 hours; living space, 0.4 R/24 hours; bridge deck, 2.0 R/24 hours; inside turrets and deckhouses average, 0.7 R/24 hours.

9 August
0830 The captain, department officers, and DSM representatives reboarded and commenced hull and material inspection.
1030 Inspection completed, inspecting parties evacuated the ship.

There are no further reports of reboarding in the ship's log.

13 August All Talbot personnel transferred to USS Rockingham (APA-229).
0957 Talbot Geiger sour. Readings before washing ranged from 2.0 to 4.0 R/24 hours on main deck; canvas up to 8.0 R/24 hours.

17 August Forty-five Talbot personnel transferred to USS Rockwall (APA-230).

18 August Forty-five Talbot personnel transferred to Rockwall.

23 August Topside average 0.3 R/24 hours.

26 August Towed to Kwajalein by USS Oneota (AN-85).

30 September Topside average 0.18 R/24 hours.

USS RECLAIMER (ARS-42)

Crew Size: 73
Bikini Atoll Arrival: 1 June 1946

USS Reclaimer (ARS-42)

Bikini Atoll Departure: 1 September 1946
Shot ABLE Location: 24 nmi (45 km) E
Shot BAKER Location: 11 nmi (20 km) SE
Decontamination Location: Los Angeles
Operational Clearance: 24 December 1946
Final Clearance: By 4 January 1947

Task Unit and Function

The salvage ship Reclaimer served in TU 1.2.7 (Salvage Unit). Reclaimer's functions included salvaging damaged target vessels after the tests, performing emergency repairs, and fighting fires. In addition, the DSM was embarked aboard Reclaimer to coordinate all salvage operations. The DSM aboard Reclaimer made the first inspection of the target array.

Shot ABLE (1 July, 0900)

1 July	Steaming in area Mercury in accordance with CJTF 1 Operation Plan 1-46, with DSM and CTU 1.2.7 embarked.
1116	In accordance with CJTF 1 dispatch, TU 1.2.7 proceeded to reenter Bikini Atoll.
1130	Steaming ahead of TU 1.2.7 to take position as visual guard.
1230	Entered lagoon with CTU 1.2.7, went east, and as areas were declared safe moved in closer. Engaged in safety probe of target area with safety monitors (Reference 6, p. VII-I-6-A), operating in water having a radioactivity level between 0.1 and 1.0 R/24 hours.
1525	Proceeded on various courses and speeds to go along portside of target ship USS Pennsylvania (BB-38) to extinguish fires.
1532-1555	Sprayed water on Pennsylvania fires.
1600	Pennsylvania cleared.
1615	Fought fires on target ship USS New York (BB-34).
1625	New York cleared.
1733-1742	Fought fire on target ship USS Nevada (BB-36).
1742	Cleared Nevada.
1839	Anchored in berth 190, Bikini.
2 July	
0815	Steamed through target area on various courses and speeds while DSM and CTU 1.2.7 directed salvage operations.
1131-1135	Directed stream of water from the forward monitor on Nevada to extinguish fire.
1733-1737	Placed a stream of water on target ship USS Independence (CVL-22) from forward monitor to extinguish fire on hangar deck aft.
1848	Anchored in berth 42, Bikini.
3 July	
0757	Underway through target array.
1000-1030	Laying to off target vessel ARDC-13; put boarding team aboard.
1041-1210	Moored to Nevada and put boarding team aboard.
1220-1310	Moored alongside target ship USS Arkansas (BB-33); boarding team aboard.
1330	Proceeded to salvage unit.
1500-1530	Moored to target vessel YO-160.
1530-1556	Moored to target ship USS Crittenden (APA-77); boarding team aboard.
1645	Anchored in berth Baker, off Eneu Island.
5 July	
1250-1253	Laid spring buoy mooring in berth 54 Able.
1345	Moored alongside LSM-60, the ship from which the BAKER weapon was to be hung.
1354-1440	Towed LSM-60 to spring buoy moor.
1500	Anchored in berth 141, Bikini.
6 July	
0746	Underway from berth 141.
0803	Standing by to tow Nevada.
0936-1145	Towed and reanchored Nevada in berth 269.
1145	Underway from berth 269 for vicinity of USS Haven (AH-12) to pick up safety monitor.
1500	Moored in berth 161.
1600-2045	Engaged in diving operations.
1800	Radiological officers left the ship.
7 July	
0900	Radiological officers came aboard.
0924-1130	Engaged in diving operations on leg of mooring buoy.
1330-1530	Engaged in operations to heave in anchor chain and anchor from buoy.
1520	Physician and party came aboard to make radiological test of two men.
1600	Physician and party left ship.
1645	Radiological monitors left ship.
8 July	
1425-1447	Planted mooring buoy.
1500	Moored in berth 219.
9 July	
0814	Underway to vicinity of target ship USS Pensacola (CA-24) to recover USS Achomawi's (ATF-148) anchor and chain.
0849	Anchored in vicinity of berth 187 and 201.
0927-1736	Engaged in diving operations in search of anchor and chain.
10 July	
0845-1210	Engaged in diving operations to recover Achomawi's anchor chain and anchor.
11 July	
0748	Underway from the vicinity of berth 27 to go alongside target ship USS Brule (APA-66).
0835	Alongside starboard side to Brule in vicinity of berth 59.
0851	Underway with Brule in tow to berth 160.
1040	Anchored Brule in berth 160.
1045	Completed anchoring Brule; underway for target ship USS Mayrant (DD-402).
1125	Anchored in berth 239 near Mayrant.
1514	Underway from berth 239 with Mayrant in tow to berth 142.
1747	Anchored Mayrant in berth 142; let go tow wire.
1805	Underway.
1815	Anchored in berth 141.
12 July	
0915	Underway from berth to USS Palmyra (ARS[T]-3).
0926	Moored alongside Palmyra.
1035	Underway from Palmyra after receiving aboard four reels of 1-5/8-inch wire;

USS Reclaimer (ARS-42)

proceeded to target ship USS Salt Lake City (CA-25).
1125 Underway from vicinity of Salt Lake City.
1145 Anchored in berth 324.
1325 Underway from berth 324 to go alongside ARDC-13 to discharge four reels of wire.
1400 Moored alongside ARDC-13 in vicinity of Eneu Island.
1405 Discharged four reels of wire to ARDC-13.
1408 Underway from ARDC-13.
1415 Anchored in berth 324.

13 July
0727 Underway from berth 324, proceeding to vicinity of berth 161 to assist in re-mooring Salt Lake City.
0930 Laying to in vicinity of Salt Lake City.
0959 Passed tow wire to Salt Lake City and commenced towing it to berth 164.
1108 Anchored Salt Lake City in berth 164.
1110 Let go tow cable.
1135 Moored starboard side to Salt Lake City.
1305 Underway from alongside Salt Lake City.
1338 Anchored in berth 129.

14 July
1040 Underway for vicinity of Haven to salvage LCM.
1115 Took sinking LCM C-43 in tow and proceeded to USS Gunston Hall (LSD-5).
1335 Moored to Gunston Hall near berth 94.
1350 Let go sinking LCM to Gunston Hall.
1356 Underway from alongside Gunston Hall to berth 43.
1405 Anchored in berth 43.

15 July
0745 Underway from berth 43 to vicinity of target ship Nagato.
0805 Moored starboard side to Nagato.
2350 Made preparations for getting underway.

16 July
0015 Underway from alongside Nagato.
0025 Anchored in berth 144, Bikini.
0830 Underway from berth 144 to Nagato.
0913 Moored to portside of Nagato.
1220 Underway from portside of Nagato, proceeding to berth.
1235 Anchored in berth 144.
1312 Commanding officer commenced diving operations to inspect ship's hull.
1318 Secured diving operations.

17 July
0615 Underway from berth 144, proceeding to vicinity of Nagato.
0628 Secured line to starboard side of Nagato and commenced towing to prevent Nagato from swinging toward USS Preserver (ARS-8).
0940 Let go starboard anchor.
0955 Underway in vicinity of Nagato.
1310 Proceeding to portside of Nagato.
1311 Passed tow line to Nagato in preparation to tow it to assigned position.
1327 Commenced towing Nagato.
1410 Anchored Nagato in position, 450 yards (412 meters) from Nevada.
1418 Cast loose tow wire from Nagato.
1500 Moored to buoy in berth 164.
1545 Made all preparations for getting underway.
1555 Underway for vicinity of Nagato.
1615 Secured manila line to stern of Nagato and commenced swinging it to port.
1623 Secured Nagato stern to buoy, cast off tow line, and got underway for berth 164.
1705 Moored to buoy in berth 164.

19 July
1325 Anchored near berth 129.

21 July
0820 Anchored in berth 43.
1023 Underway to plant sonar buoys.
1047 Planted first sonar buoy in vicinity of Yomyaran Island.
1140 Planted second buoy.
1145 Underway to anchorage berth.
1210 Anchored in vicinity of berth 129.

23 July
0923 Underway to go alongside USS Henrico (APA-45).
1005 Moored alongside Henrico.
1225 Underway from Henrico to USS Gypsy (ARSD-1).
1318 Moored to Gypsy.
1340 Underway from Gypsy, proceeding to vicinity of target submarine USS Pilotfish (SS-386).
1425 Moored to mooring buoy in berth 161.
1818 Underway from berth 161 to go alongside Pilotfish to suspend anchors.
1850 Moored alongside Pilotfish.
1910 Commenced suspending first of 4-ton anchors on Pilotfish.

Shot BAKER (25 July, 0835)

24 July
0040 Finished suspending anchors from Pilotfish.
0057 Cleared Pilotfish, proceeding to mooring.
0104 Moored to buoy berth 161.
0823 Underway from berth 161, proceeding to vicinity of Palmyra.
0840 Anchored in vicinity of berth 129.
1130 Embarked CTU 1.2.7.
1311 Underway to area Mercury.

25 July
0945 Task unit proceeded to area Caterpillar.
1052 Began maneuvering to reenter lagoon.
1116 Proceeded throughout target array to inspect targets, outside of Red Line (1 R/24 hours) and inside Blue Line (0.1 R/24 hours), awaiting satisfactory conditions before proceeding to center of the target array.
1737 Anchored in berth 369, Bikini.

26 July
1425 Underway from berth 369.
1500-1752 Engaged in towing and beaching target ship USS Hughes (DD-410).
1805 Proceeding to target array in vicinity of target ship USS Fallon (APA-81).
1815 Left target array.
1854 Anchored in berth 370, Bikini.

27 July
0815 Underway from berth 370 to target array.
1000 Completed inspection of target array.
1025 Anchored near berth 368.
1200 Underway to vicinity of Hughes.
1220 Anchored off Eneu Island.

USS Reclaimer (ARS-42)

1540-1733	Underway and proceeding through the target array on inspections.
1733	Anchored near berth 370.
28 July	
0821	Underway from berth 370 to target array.
0835	Entered target array.
1245	Anchored off Eneu Island, berth 370.
1555	Standing by beaching of target submarine USS Dentuda (SS-335) in beaching area off Eneu Island.
1825	Anchored in berth 380.
29 July	
0855	Underway from anchorage in accordance with CTU 1.2.7 orders to target array.
1058-1105	Alongside New York.
1120	Anchored in berth 282.
1429	Underway from berth 282, proceeding to vicinity of beaching area off Eneu Island.
1740	Anchored in vicinity of berth 380.
30 July	
1040	Underway from anchorage, proceeding to target array on various courses and speeds.
1157	Anchored off Eneu Island.
1430	Underway from anchorage to target array.
1535-1545	Moored to New York; put boarding team aboard.
1600-1605	Put boarding team on Pensacola.
1718-1725	Put boarding team on Pensacola.
1825	Anchored off Eneu Island, Bikini, berth 370.
31 July	
0802	Underway from anchorage near berth 370 while steering through target array.
1110	Anchored near berth 145.
1345	Underway on various courses and speeds throughout target array.
1505	Moored alongside target ship USS Conyngham (DD-371).
1506-1539	Safety monitors and party aboard Conyngham.
1551	Moored alongside target ship USS Wainwright (DD-419).
1552-1610	Safety monitors and party aboard Wainwright.
1615	Underway for target ship USS Mugford (DD-389).
1624-1633	Safety monitors and party aboard Mugford.
1705	Anchored in berth 145.
2 August	
0835	Underway from vicinity of berth 145 to place boarding team and crew aboard Pensacola.
1004-1024	Boarding team aboard Pensacola.
1028	Cleared starboard side of Pensacola, laying to in vicinity of Salt Lake City in berth 188.
1415-1505	Boarding team from Reclaimer on Pensacola starting pumps there.
1528	Underway alongside Pensacola.
1537	Anchored in vicinity of berth 219.
1805-1810	Refueled Pensacola pump.
1830	Anchored in vicinity of berth 356.
3 August	
1500	Underway from vicinity of berth 357, proceeding to vicinity of Pensacola.
1623	Anchored in berth 219.
1850	Anchored in berth 357.
5 August	
1330	Underway from berth 357, proceeding to vicinity of Pensacola.
1425-1518	Alongside Pensacola.
1645	Anchored in berth 357, Bikini.
6 August	
0905	Underway from berth 357 to wash down Pensacola with high-pressure seawater.
0932	Boarding team on Pensacola.
0937	Cleared side of Pensacola.
0955	Began washing down starboard side of Pensacola.
1159	Anchored in berth 188.
1329	Underway from berth 188 to go alongside Pensacola.
1335-1410	In vicinity of Pensacola.
1450	Anchored in berth 188.
1806	Anchored in berth 356.
7 August	
1251	Underway in vicinity of Pensacola.
1415-1548	Moored to Pensacola, placed boarding teams aboard.
1618	Anchored in berth 145.
8 August	
1308-1329	Washed down Pensacola.
1336	Anchored in berth 219.
1457	Underway from berth, proceeding to Pensacola to place boarding teams on board.
1510-1610	Boarding teams on Pensacola.
1808	Anchored in berth 145.
9 August	
0805	Underway to Mayrant.
0856	Moored alongside Mayrant.
0905	Placed two pumps aboard Mayrant.
0920-1000	Pumped out engine rooms of Mayrant.
1000	Anchored in berth 141A. Laying to in vicinity of Mayrant, sending boarding parties aboard at intervals to refuel and service pumps.
1805	Anchored in berth 145.
10 August	
0942	Underway from berth 145.
1025	Moored alongside Pensacola.
1030-1126	Boarding teams aboard Pensacola.
1135	Anchored in berth 160.
1300-1415	Salvage party off ship to service and start pumping procedures on Mayrant.
1631	Anchored in berth 145.
11-12 August	Routine activities.
13 August	
0830-1100	Party off ship to service and refuel pumps on Pensacola and Mayrant.
1350-1530	Party off ship to service pumps on Pensacola and Mayrant.
1605	Underway to Pensacola to exchange salvage pumps.
1600-1638	Pumps exchanged alongside Pensacola.
1701	Anchored in berth 9.
14 August	
0810	Underway to vicinity of Mayrant.
0900-0925	Laying to in vicinity of Mayrant conducting inspections.
0925-0950	Proceeded to Pensacola to service pumps.
1124-1310	Anchored in vicinity of Nevada.

USS Reclaimer (ARS-42)
14 August

1605	Anchored in berth 109.
15 August	
0740	Party left ship to service pumps on board Mayrant and Pensacola.
1255	Working party left to service pump on Preserver
1323	Target vessel LCI(L)-615 alongside.
1350	LCI(L)-615 departed.
1610	Working party off to service pump on Pensacola.
16 August	
0725	Underway to New York.
0819	Moored alongside New York.
1539	Underway from alongside New York.
1615	Anchored in berth 109.
17 August	
0810	Moored alongside Nevada; furnished power to it for 6 hours.
1430-1455	Working party serviced pump on Pensacola.
1600	Underway from alongside Nevada, proceeding to Pensacola to check draft readings and inspect pumps.
1635	Returned to anchorage.
18 August	Routine activities.
19 August	
0835	Moored alongside Pennsylvania.
0940	Commenced furnishing power to Pennsylvania.
0950	Pump detail departed for Pensacola.
1122	Pump detail returned.
1555	Completed furnishing power to Pennsylvania.
1622	Underway from alongside Pennsylvania, proceeding to anchorage.
1650	Pumping detail departed for Pensacola.
1710	Pumping detail returned from Pensacola.
20 August	
0851	Moored alongside Pennsylvania.
1810	Started towing (swinging) Pennsylvania in order to get the turns out of its anchor chain.
2005	Completed swinging Pennsylvania.
2027	Returned to anchorage.
21 August	
0820	Moored alongside New York. Supplied electrical power to New York for about 3-1/2 hours.
1345	Moored alongside Pennsylvania and removed beach gear and winch.
1412	Underway from Pennsylvania, proceeded to anchorage.
1650	Underway to assist in clearing Pennsylvania from lagoon.
1715	Standing by in vicinity of Pennsylvania to assist in towing that vessel. No assistance was required.
1940	Returned to anchorage.
22 August	
1435-1505	Moored alongside Mayrant in order to remove salvage equipment from that vessel.
23 August	Routine activities.
24 August	
0825	Anchored ahead of Crittenden.

USS Rhind (DD-404)

1035	Underway with Crittenden in tow, en route to Kwajalein.
25 August	En route from Bikini to Kwajalein with Crittenden in tow.
26 August	
0920	Anchored Crittenden at Kwajalein.
1042	Moored alongside Crittenden.
1108	Commenced moving Crittenden to come alongside target ship USS Dawson (APA-79).
1335	Underway from alongside Crittenden.
1620	Departed Kwajalein en route to Bikini.
27 August	
1247	Moored alongside Fallon.
1252	Boarding teams went aboard Fallon to remove two generators and conduct pumping operations; these teams remained on Fallon for an unspecified period of time.
1653	Underway from alongside Fallon.
1810	Commenced first of hourly boat trips to Fallon to service salvage pumps.
2100	Made final hourly boat trip of the day to service pumps on Fallon.
28-29 August	Sent working parties on an hourly basis to service pumps on Fallon. These hourly dispatches continued throughout the day and evening hours.
30 August	Continued servicing salvage pumps on Fallon.
0723	Moored alongside Fallon; loaded anchor chain and anchors for ballast on board Fallon.
1210	Underway; proceeded to anchorage.
31 August	Routine activities.
1 September	
1150	Moored alongside Fallon.
1245	Underway with Fallon in tow, en route from Bikini to Kwajalein.
2 September	En route from Bikini to Kwajalein with Fallon in tow.
3 September	
0955	Anchored Fallon in Kwajalein Lagoon. Proceeded to anchorage.
5 September	
1440-1520	Ship's crew and officers inpsected for radioactivity by monitors from Haven; all hands found to be radiologically safe.
6 September	Departed Kwajalein for Pearl Harbor with ARDC-7 in tow.
25 September	Arrived at Pearl Harbor.

USS RHIND (DD-404)

Crew Size: 104
Bikini Atoll Arrival: 1 June 1946
Bikini Departure: 30 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 1,020 yards (935 meters) N
Shot BAKER Location: 2,240 yards (2.1 km) NW
Scuttled 22 March 1948, Kwajalein

USS Rhind (DD-404)

Task Unit and Function
The destroyer Rhind was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 1. It was a target vessel for CROSSROADS. Its crew was evacuated before each shot. It carried instruments, including radio transmitters.

Shot ABLE (1 July, 0900)

30 June
0930-1125 Evacuated ship's crew to Bayfield.

1 July
0418 Secured for final evacuation. Team B departed ship.

2 July
1340 Commanding officer and radiological monitor boarded.
1350 Special boarding Teams A and B boarded the ship and began inspection.
1645 Declared radiologically safe with no explosive or toxic gases or other abnormal hazards present aboard. However, considerable topside damage had occurred and seakeeping ability was reduced.

2-3 July Remainder of crew reboarded.

7 July
0914 Shifted anchorages to berth 127.

Shot BAKER (25 July, 0835)

24 July
0910-1113 Evacuated Rhind crew to Bayfield except for Team B.

25 July
0410 Team B left; Rhind secured for test BAKER.

1 August
1300 Rhind personnel and equipment transferred to USS Rockingham (APA-229).

3 August
1220-1534 USS Conserver (ARS-39) washed down Rhind using high-pressure streams (Reference 6, p. VII-I-81-B).
1534-1537 USS Current (ARS-22) placed a boarding team on Rhind (Reference 6, p. VII-I-81-B); frame 120, 2 to 6 R/24 hours.

10 August
0914-1027 The commanding officer, two officers, nine enlisted men, and DSM boarding party boarded Rhind to determine the effects of test BAKER; no significant damage was discovered. Topside average 1.2 R/24 hours, high 2.5 R/24 hours; below decks average 0.5 R/24 hours, high 3.5 R/24 hours.
1015 A special boarding party cleared the ship.

12 August Topside average 1.1 R/24 hours (Reference 7).

13 August
0930-1030 Three men aboard to pick up chronometer boxes and special radiological film badges and pills [sulfur tablets used to measure radiation].

24 August
1700 Rhind's crew and officers departed from Bikini en route to Kwajalein aboard Rockingham.

28 August
1200 Decommissioned.

30 August Towed to Kwajalein by USS Suncock (AN-80).

30 September Topside average 0.40 R/24 hours (Reference 7).

USS Robert K. Huntington (DD-781)

USS ROBERT K. HUNTINGTON (DD-781)

Crew Size: 234
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 10 August 1946
Shot ABLE Location: 8 nmi (15 km) SW
Shot BAKER Location: 18 nmi (33 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 19 November 1946
Final Clearance: 4 January 1947

Task Unit and Function
The destroyer Huntington was member of TG 1.7 (Surface Patrol), Destroyer Division 72. It had special radiological equipment installed before its participation in the test series. It took water samples and radiological readings outside the lagoon.

Shot ABLE (1 July, 0900)

30 June
1020 Members of the radiological monitoring party reported aboard for temporary duty.
1228 Underway.

1 July Steaming 8 nmi (15 km) southwest of surface zero.
0901 Left downwind danger section.
0920 Changed course and speed to clear danger sector.
2220 Stopped all engines to conduct water soundings.

2 July
0341-0452 Stopped all engines and took bathythermograph and radiological soundings.
0635-0638 All engines stopped to take water samples.
0742-0910 All engines stopped to take water samples.
1226 Commenced maneuvering to take station off Adrikan Pass to conduct soundings.
1336 Stopped all engines and took station off Adrikan Pass.
1359 Commenced maneuvering LCVP.
1535 Took LCVP in tow.
2100 Maneuvered to take position off Adrikan Pass.
2256 Hove to near Adrikan Pass, conducting radiological survey.

3-5 July Took radiological soundings in vicinity of Adrikan Island.

5 July
1050 Anchored in berth 147E, Bikini.

8 July
0857 Underway to conduct hydrographic soundings.

8-11 July Conducting soundings.

11 July
1233 Anchored in berth 116S, Bikini.

12 July
1514 Anchored in berth 386 as the harbor entrance control vessel.

15 July
1059 Anchored in berth 116S, Bikini.

Shot BAKER (25 July, 0835)

24 July
1025 Six radiological monitors reported aboard for temporary duty.
1232 Underway from berth 116S, Bikini.
2143 Stopped all engines to be in vicinity of area Mack, southeast of Bikini.

25 July
2301 Hove to, conducted soundings.
2335 Commenced downwind patrol crossing to locate radioactivity.

26 July
0200 Stopped all engines and took bathythermograph reading.
0954 Anchored in berth 324, Bikini Atoll.

28 July
1455 Underway from berth 324.
1635 Stopped all engines to conduct soundings.
1727 All engines stopped to investigate oil slick.
1840 Hove to to conduct soundings.
2056-2350 Took bathythermograph readings.

29 July
0000 Steaming singly on radiological patrol north of Lomilik Island, stopping every 5 nmi (9.3 km) for Geiger meter probe and bathythermograph readings.
0030-0250 Conducted soundings.
0401 Stopped all engines to conduct radiological test of water.
0515 Passed through radioactive oil slick.
0518 Changed course to steam on western edge of the slick.
0525 Commenced steaming to circle outer boundaries of oil slick.
0638 Stopped all engines to conduct radiological tests of the water.
0751 Investigated new oil slick on the water.
1307 Anchored in berth 337, Bikini.

2 August
0719 Underway from berth 116S to relieve USS O'Brien (DD-725) as harbor entrance control vessel.
0813 Relieved O'Brien.
1603 Anchored in berth Victor, Bikini.

5 August
0747 Underway for firing tests.
1026-1612 Engaged in firing tests.
1620 Anchored in berth Jig south, Bikini Atoll.

10 August
0750 Underway from berth 116S en route to Pearl Harbor.

USS ROCKBRIDGE (APA-228)

Crew Size: 206
Bikini Atoll Arrival: 4 June 1946
Bikini Atoll Departure: 23 August 1946
Shot ABLE Location: 20 nmi (37 km) ENE
Shot BAKER Location: 19 nmi (35 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 6 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
The attack transport Rockbridge was a member of TU 1.3.1 (Transport Unit), Transport Division 31. One of the Transport Unit's primary functions was to house target ship crews during and following the detonations. Crews of target ships that were sunk or rendered uninhabitable by the tests continued living aboard TU 1.3.1 vessels after the detonations unless transferred to other ships.

Shot ABLE (1 July, 0900)

30 June
0920-1530 Evacuated crews of target ships USS Arkansas (BB-33), USS New York (BB-34), and USS Salt Lake City (CA-25) came aboard in preparation for shot ABLE.

1 July
0330 Began evacuation of last-minute personnel from target vessels.
0518 Underway from berth 222, Bikini, for operating area.
0740 Joined TG 1.3 in area Marmon.
1516 Began maneuvering to enter Bikini entrance, awaiting signal to enter.
1704-1835 Anchored in berth 318, disembarking personnel to various transports.

2 July
1444 Shifted anchorage to berth 222.

3-23 July Routine activities.

Shot BAKER (25 July, 0835)

24 July
0855-1607 Evacuated Arkansas, New York, and Salt Lake City personnel.

25 July
0330-0410 Evacuated last-minute personnel from target ships.
0513 Underway from berth 222.
0725 Joined TG 1.3 in area Marmon.
0835 Observed detonation; continued steaming in area Marmon.

27 July
1355-1440 Disembarked last-minute personnel of target ships USS Pennsylvania (BB-38), USS Saratoga (CV-3), USS Parche (SS-384), USS Butte (APA-68), and USS Briscoe (APA-65) to rejoin their crews on other transports.

1444	Maneuvered in vicinity of Bikini Atoll.
29 July	
0630	Anchored in berth Dog, Bikini.
1006	Got underway from berth Dog to rendezvous with TG 1.3.
1156	Joined TG 1.3 in area Marmon.
30 July	
0624	Anchored in berth 281, Bikini.
2 August	
1513	Shifted to berth 332.
9 August	
0840-1100	A representative of Radsafe Section, JTF 1, aboard for radiological survey. Saltwater main in "J" compartment registered some radioactivity and two bunks in its vicinity were removed as a safety precaucaution; evaporator spaces all below tolerance except condensate coolers, which registered 0.35 R/24 hours; area around condensate coolers safe for 7-hour working period per day. Other spaces inspected were found free of radiation hazards.
13 August	
1100	Received target ship USS Dawson (APA-79) personnel from USS Henrico (APA-45).
1330	Received target ship USS Bracken (APA-64) personnel from Henrico.
1730	Target ship USS Conyngham (DD-371) personnel came aboard for berthing and subsistence.
14-22 August	Routine activities.
23 August	Underway for Kwajalein.
24 August	
0713	Anchored in berth L-31, Kwajalein.
29 August	
1553	Underway for Pearl Harbor.

USS ROCKINGHAM (APA-229)

Crew Size: 297
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 24 August 1946
Shot ABLE Location: 18 nmi (33 km) ENE
Shot BAKER Location: 20 nmi (37 km) ESE
Decontamination Location: San Francisco
Operational Clearance: 4 December 1946
Final Clearance: 18 December 1946

Task Unit and Function

The attack transport Rockingham was a member of TU 1.3.1 (Transport Unit), Transport Division 31. One of the Transport Unit's primary functions was to house target ship crews during and following the detonations. Crews of the target ships that were sunk or rendered uninhabitable by the tests continued living aboard TU 1.3.1 vessels after the detonations, unless transferred to other ships.

Shot ABLE (1 July, 0900)

1 July	Steaming in area Marmon.
0815	Set material condition Able.
0840	Published safety precautions in connection with H-hour.
1731	Anchored in berth 316, Bikini.
2 July	
1407	Shifted to anchorage berth 218.
1540	Disembarked Team A from target ship Prinz Eugen.
3 July	
0750-1630	Disembarked target vessel personnel and baggage.
7 July	
0756	Underway to go alongside target ship USS Pensacola (CA-24).
0810	Moored alongside Pensacola in berth 286.
1110	Commenced furnishing saltwater services to Pensacola.
1645	Completed transfer of all personnel of target ship Nagato to USS Rockbridge (APA-228).
1848	Commenced furnishing electricity to Pensacola.
10 July	
0837	Underway from alongside Pensacola.
0905	Anchored in berth 285.
16 July	
0900-1545	Embarked personnel and baggage from Nagato.
21 July	
1250-1830	Embarked Prinz Eugen baggage and personnel.

Shot BAKER (25 July, 0835)

24 July	
0924	Commenced embarking target vessel personnel for shot BAKER, including personnel from Pensacola.
1530	Underway from Bikini.
25 July	
0852	Secured from general quarters and set condition BAKER throughout the ship.
27 July	
1414	Brought aboard one officer and six enlisted men, last-minute personnel of Pensacola from USS George Clymer (APA-27).
30 July	
0707	Anchored in berth 240, Bikini.
1 August	
1145-1530	Took on board cargo and personnel from target ships USS Hughes (DD-410), USS Rhind (DD-404), and USS Stack (DD-406).
2 August	
1620	Shifted anchorage to berth 353.
2130	Recovered a sinking LCM.
5 August	
0955	Received enlisted personnel from Prinz Eugen, Stack, and Rhind.
13 August	
1015-1130	Embarked personnel and baggage from target ships USS Catron (APA-71) and USS Ralph Talbot (DD-390).

15 August
1535-1615 Discharged Prinz Eugen personnel to remanned target ship USS Bladen (APA-63).

16 August
0805-0930 Disembarked Prinz Eugen personnel to Bladen.

19 August
0836-1130 Discharged target ship personnel to USS Rockwall (APA-230). Total discharged: 84 enlisted men from Rhind, 86 enlisted men from Stack, and 118 enlisted men from Pensacola.
1330 Transferred 35 Catron personnel to Clymer.
1455 Transferred 24 Pensacola personnel to Clymer.

23 August Five enlisted men each transferred from Hughes, Rhind, and Talbot to USS Sylvania (AKA-44).

24 August
1649 Underway for Kwajalein.

25 August
1220 Anchored in berth L, Kwajalein Atoll.

29 August
1548 Underway for Pearl Harbor.

USS ROCKWALL (APA-230)

Crew Size: 288
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 19 August 1946
Shot ABLE Location: 23 nmi (43 km) ENE
Shot BAKER Location: 16 nmi (30 km) W
Decontamination Location: San Francisco
Operational Clearance: 17 December 1946
Final Clearance: 27 December 1946

Task Unit and Function
The attack transport Rockwall was a member of TU 1.3.1 (Transport Unit), Transport Division 31. One of the Transport Unit's primary functions was to house target ship crews during and following the detonations. Crews of the target ships that were sunk or rendered uninhabitable by the tests continued living aboard TU 1.3.1 vessels after the detonations.

Shot ABLE (1 July, 0900)

30 June
1015-1420 Embarked officers and enlisted men from target ships USS Saratoga (CV-3), USS Independence (CVL-22), USS LST-52, USS LST-133, USS LST-220, USS LST-545, and USS LST-661.
1453 Underway for area Marmon.

1 July Steamed in company with TU 1.3.1 (less USS George Clymer [APA-27] and USS Rockbridge [APA-228]) in area Marmon.
1722 Anchored in Bikini Atoll in berth 317.

2 July
1030 Team A from Saratoga departed.

1050 Team B from Saratoga departed.
1428 Shifted to berth 223.

3 July
1100 Disembarked 262 enlisted men to Saratoga.
1555 Disembarked 2 officers and 16 enlisted men to Saratoga, 44 enlisted men to LST-133, and 20 enlisted men to LST-52.

12 July
1400 LST-545 came alongside.
1640 LST-545 cast off.

15 July
0935 Target vessel LCI-1115 moored alongside.
1640 LCT-1115 cast off.

16-23 July Routine activities.

Shot BAKER (25 July, 0835)

24 July
1330 Completed embarking 477 enlisted men and officers of the target ships for shot BAKER.
1445 Underway pursuant to CJTF 1 OP Plan 1-46.

25 July
0730 Commenced steaming to join CTG 1.3.
0814 Joined CTG 1.3.

26 July Steaming in company with TU 1.3.1 in area Marmon.

27 July
1356 Dispatched LCVP No. 15 to Rockbridge to pick up 4 officers and 11 enlisted men from Saratoga.
1435 Completed embarking passengers and hoisted LCVP No. 15.

30 July
0634 Anchored in berth 280, Bikini.

2 August
1445 Shifted anchorage to berth 352.

6 August
0921 Received 15 enlisted men from target ship USS Arkansas (BB-33).

8 August
0835 Received 5 officers and 132 enlisted men from target ship USS Mugford (DD-389).

10 August
1330 Transferred 8 officers and 130 enlisted men to Rockbridge.

12 August
1550 Transferred 26 officers and 317 enlisted men of Independence to USS Ajax (AR-6).

18 August
1315 Disembarked 11 officers and 122 enlisted men.

19 August
0900 Began disembarking LST-52 crew to USS Dixie (AD-14).
1554 Underway for Pearl Harbor.

USS ROLETTE (AKA-99)

Crew Size: 151
Bikini Atoll Arrival: 20 March 1946
Bikini Atoll Departure: 26 August 1946
Shot ABLE Location: 27 nmi (50 km) ENE
Shot BAKER Location: 24 nmi (45 km) E
Decontamination Location: San Diego
Operational Clearance: 28 January 1947
Final Clearance: 1 February 1947

Task Unit and Function

The attack cargo ship Rolette was a member of TU 1.3.1 (Transport Unit), Transportation Division 31. Rolette and USS Ottawa (AKA-101) were loaded with construction material at Port Hueneme, California, and sailed with 200 Seabees for Bikini on 5 March. After arriving at Bikini, they served as barracks and material stores ships for the Seabees (Reference 6, p. VII-I-20-A). Rolette was initially designated as an intratransit cargo ship; when Rolette left after BAKER, USS Sylvania (AKA-44) took over handling intratransit freight (Reference 6, p. VII-I-68-A).

Shot ABLE (1 July, 0900)

30 June
- 1300 Underway from berth 18, Bikini, in accordance with CJTF 1 Op Plan 1-46 for ABLE day exercises.
- 1710 Published special ABLE day safety precautions.

1 July
- 1900 Anchored in berth 335, Bikini.

2 July
- 1442 Shifted to berth 18, Bikini.

4 July
- Shifted to berth 56A.

5-23 July
- Routine activities.

Shot BAKER (25 July, 0835)

24 July
- 1628 Underway in accordance with CJTF 1 Operation Plan 1-46 for BAKER day operations.

25 July
- 0923 Proceeded to Kwajalein.

26 July
- 0723 Anchored in berth 17, Kwajalein.

27 July
- 1355 Underway for Bikini Atoll.

28 July
- 0826 Anchored in berth E, Bikini.
- 1550 Underway for Rongelap Atoll.

29 July
- 0657 Anchored in berth 27, Rongelap Atoll.

30 July
- 1610 Two civilians and 73 enlisted men reported aboard for duty with 53rd Naval Construction Battalion.
- 1817 Underway for Bikini from Rongelap.

31 July
- 0650 Anchored in berth 56A, Bikini Atoll.

2 August
- 1650 Shifted to berth 379, Bikini.

7 August
- 1413 Shifted to berth 56A.

8-20 August
- Routine activities.

21 August
- 0815-0940 Radsafe personnel aboard to determine radioactivity level aboard ship.

23 August
- 1045 Fifteen enlisted men from USS LST-817 reported aboard for transportation to Enewetak.

26 August
- 1626 Underway for Enewetak.

27 August
- 1000 Anchored at Enewetak.

29 August
- 1500 One officer and fourteen enlisted men boarded for transportation to Port Hueneme, California.

30 August
- 1329 Underway for Port Hueneme, California.

13 September
- 0959 Moored to Pier 2, Port Hueneme, California.

USS SAIDOR (CVE-117)

Crew Size: 854
Bikini Atoll Arrival: 24 May 1946
Bikini Atoll Departure: 4 August 1946
Shot ABLE Location: 30 nmi (56 km) N
Shot BAKER Location: 15 nmi (28 km) NE
Decontamination Location: San Diego
Operational Clearance: 28 January 1947
Final Clearance: 1 February 1947

Task Unit and Function

Saidor, an escort aircraft carrier, was a member of TU 1.6 (Naval Air Group). Saidor's mission was to train crews and prepare equipment for the atomic bomb tests; to conduct photographic operations, operate helicopter aircraft for radiological reconnaissance, photography, and photographic utility flights on shot days; to provide airborne control of drone boats; to carry out air operations for embarked units; and to provide mapping and other photography before and after the shots. In addition Saidor carried a complete aerological unit that took upper wind radar readings (Reference 6, p. VII-20-O).

Shot ABLE (1 July, 0900)

1 July
- Steaming in company with plane guard destroyers USS Newman K. Perry (DD-883) and USS Furse (DD-882) in area Paige.
- 0708-1130 Conducted flight operations.
- 1250-1257 Conducted flight operations.
- 1610-1710 Conducted flight operations.
- 1900 Anchored in berth 285, Bikini.

2 July
- 1216 Shifted to berth 34.

5 July
0726 Underway for flight operations.
1806 Anchored in berth 34, Bikini.

13 July
1602 Underway with Perry and Furse in area Paige.

14 July
1407 Anchored in berth 34, Bikini Atoll.

Shot BAKER (25 July, 0835)
24 July
0927 Underway in accordance with CJTF 1 Operation Plan 1-46.
1014 Destroyers Furse and Perry in plane guard position with Saidor. Conducted flight operations.

25 July
0652-0710 Launched aircraft.
0847-0933 Conducted flight operations.
1111-1142 Conducted flight operations.
1453-1510 Conducted flight operations.
1751-1810 Conducted flight operations.

26 July
1155 Anchored in berth M, Bikini Atoll.
1250 Underway for flight operations.

27 July
1500 Anchored in berth M, Bikini Atoll.
1600 Underway from Bikini.

29 July
1448 Anchored in berth 348, Bikini.
1813 Underway for Kwajalein.

30 July
0833 Anchored at Kwajalein Atoll.
1602 Underway for Bikini Atoll.

31 July
0845 Anchored in Bikini Harbor in berth 34.

2 August
1702 Shifted to berth Charlie-1.

4 August
1558 Underway for Pearl Harbor.

9 August
1337 Moored to pier F-13, Ford Island, Oahu.

USS SAINT CROIX (APA-231)

Crew Size: 306
Bikini Atoll Arrival: 5 March
Bikini Atoll Departure: 2 August 1946
Shot ABLE Location: 33 nmi (61 km) ENE
Shot BAKER Location: 450 nmi (834 km), at Majuro Atoll
Decontamination Location: San Diego
Operational Clearance: 22 November 1946
Final Clearance: 10 January 1947

Task Unit and Function

The attack transport Saint Croix was a member of TU 1.3.1 (Transport Unit), Transport Division 31. Before the test series began, Saint Croix picked up a small Seabee survey party, Seabee equipment, landing craft, and petroleum products. When it arrived at Bikini on 5 March it served as a station and quarters ship for the Seabees (Reference 6, p. VII-I-20-A). It also housed target ship crews during and following the detonations. It served as the Enewetak evacuation ship during BAKER.

Shot ABLE (1 July, 0900)

30 June
1630 Underway from berth 92, Bikini Island.

1 July Steamed as part of Transport Division 4 of TG 1.3 operating in area Marmon.
0830 Special instructions were read to conform with the safety plan for ABLE day.
1045 Maneuvering to form astern of TG 1.3 for entry into area 4.
1747 Anchored in berth 337, Bikini.

2 July
1519 Underway, steaming on various courses and speeds to conform with the channel.
1613 Anchored in berth 92.

13 July
1033-1125 Target vessel LCT-1115 moored alongside to unload boxed ammunition.
1254-1456 LCT-1115 moored alongside to unload cargo.

17 July
1605-1835 YTF-75 moored along starbord side to transfer atomic bomb test material.

18 July
1558 Underway from Bikini Atoll to Enewetak Island.

19 July
0922 Anchored in berth M-2, Enewetak Island.

22 July
1432 Underway from Enewetak Atoll to Majuro with 21 officers and 56 enlisted men evacuated from Enewetak as passengers.

23 July
1807 Stopped in Kwajalein Harbor to transfer patient to naval hospital.
1815 Underway from Kwajalein en route to Majuro Atoll.

Shot BAKER (25 July, 0835)

24 July
1434 Anchored at Majuro.

25 July
1653 Departed for Enewetak Atoll with personnel evacuated from Enewetak as passengers.

27 July
0739 Anchored in berth Nan 2, Enewetak.
1000 Completed disembarking all Enewetak Atoll evacuees.
1503 Underway from Enewetak to Bikini Atoll.

28 July
0816 Took position astern to TG 1.3 east of Bikini Atoll.

30 July
0640 Anchored in berth 260, Bikini.

2000 In compliance with CJTF 1 dispatch, completed hoisting four drone boats (LCVPs) and miscellaneous pyrotechnics and boat spares on board for lift to San Diego, California.

2 August

1755 Underway from Bikini Atoll to San Francisco via Pearl Harbor and San Diego with 25 Navy officers, 1 Marine officer, 2 Army officers, 473 Navy enlisted men, 33 Marine enlisted men, and 24 Army enlisted men with CROSSROADS drone boat unit and other equipment as cargo.

7 August

1516 Moored to berth K-3, Pearl Harbor.

SAKAWA

Crew Size: 143
Bikini Atoll Arrival: 28 April 1946
Crew Location for Shot ABLE: USS Rockingham (APA-229)
Crew Location for Shot BAKER: Various ships
Shot ABLE Location: 420 yards (384 meters) E
Date and Location Sunk: 2 July 1946, Bikini Lagoon

Task Unit and Function

The captured Japanese light cruiser Sakawa was a member of TU 1.2.1 (Battleship and Cruiser Unit), Cruiser Division 23. It was a target ship and sank as a result of shot ABLE. Its CROSSROADS crew, comprised of U.S. personnel, was evacuated before ABLE.

Shot ABLE (1 July, 0900)

1 July

1556 CJTF 1 directed Sakawa to be moved to a berth for badly damaged ships as soon as safe and practical. Sakawa was burning aft and was still in a radioactive area.

1615 CTG 1.2 reported to CJTF 1 that prospects for getting Sakawa out of the array that day were very poor because reports on the radiological situation were slow coming in.

2 July

0841 USS Achomawi (ATF-148) underway with salvage officer to board Sakawa.

0842 Sakawa was sinking by the stern and burning aft; the aft section was not radiologically safe.

0903 Achomawi laying alongside Sakawa's portside; boarding party on Sakawa.

0905 Boarding party returned to Achomawi; Sakawa radiologically unsafe. Achomawi moved away.

0927 Achomawi approached Sakawa on the starboard side.

0930 Boarding party from Achomawi on Sakawa.

0936 Boarding party returned to Achomawi.

0941 Achomawi attempted to take Sakawa in tow.

1025 USS Reclaimer (ARS-42) noted Sakawa listing heavily to port and settling by its stern, indicating longitudinal flooding of the after portion of the ship. The after part of the ship was not radiologically safe enough to place a salvage party aboard to commence pumping operations. Achomawi cut chain attaching Sakawa to mooring buoy.

1033 List increased sharply.

1035 Main deck port awash to about the center of bridge.

1037 Sakawa's aft bridge disappeared.

1038 Achomawi reported Sakawa in tow but sinking.

1039 Sakawa sank stern first. Nearly 40 frames from bow stuck out of water. Keel out about 30. At 1043 about 20 frames showing forward starboard side.

1043 Sakawa sank vertically; it did not slide under.

1142 Achomawi cut tow line to Sakawa.

1143 Achomawi proceeded to berth G.

Sakawa's crew was dispersed to join the crews of various target vessels.

USS SALT LAKE CITY (CA-25)

Crew Size: 335
Bikini Atoll Arrival: 29 May 1946
Bikini Atoll Departure: 23 August 1946
Crew Location for Shot ABLE: USS Rockbridge (APA-228)
Crew Location for Shot BAKER: Rockbridge
Shot ABLE Location: 895 yards (818 meters) SE
Shot BAKER Location: 1,120 yards (1.0 km) ENE
Decontamination Location: Bremerton, Washington
Sunk 25 May 1948, off the southern California coast

Task Unit and Function

The heavy cruiser Salt Lake City was a member of TU 1.2.1 (Battleship and Cruiser Unit), Cruiser Division 23. It was a target ship for CROSSROADS. Its crew was evacuated before each shot.

Shot ABLE (1 July, 0900)

30 June

1030-1318 Evacuated crew to Rockbridge in preparation for ABLE.

2 July

1330 The commanding officer and 30 men reboarded the ship with a radsafe monitor from USS Haven (AH-12) and commenced opening up and inspecting all spaces above the main deck.

1600 Commenced survey of second deck.

1630 The commanding officer and boarding team evacuated the ship for the night.

3 July

0810-1640 The commanding officer and a boarding team of 50 men with radsafe monitor reboarded the ship and continued clearing lower deck compartments. Completed radiological clearance of entire ship, set condition Zebra below the second deck, and evacuated the ship for the night.

4 July

0805-1630 The commanding officer and a boarding team of 160 men reboarded the ship and continued clearing debris. All personnel returned to Rockbridge for the night.

5 July

0800-1615 The commanding officer and a boarding team of 160 men boarded to continue inspection of the ship and clear away debris. All personnel except a security

detail of 18 men and 2 officers departed for the night.

6 July

0800 Teams A and B, consisting of 150 men, and the commanding officer boarded to continue inspection of the ship and clear away debris.

0835 Underway to anchorage, assisted by ATR-40 and USS Achomawi (ATF-148).

0912 Anchored in vicinity of berth 164.

1640 The commanding officer and boarding team departed for Rockbridge, except for the security patrol.

7 July

0930-1345 All personnel transferred from Rockbridge to Salt Lake City.

Shot BAKER (25 July, 0835)

23 July

0930 Transferred 55 men to Rockbridge in preparation for test BAKER.

24 July

0915-1100 Evacuated remaining officers and enlisted men to Rockbridge.

27 July

0844 USS Reclaimer (ARS-42) passed Salt Lake City abeam to starboard; reading indicated 2-hour tolerance at about 30 feet (9.1 meters).

28 July

0940 Reclaimer passed Salt Lake City, which was down by the stern and listing to starboard.

29 July

1007 Reclaimer passed alongside Salt Lake City. No change in list or trim. One-hour tolerance on ship, eight-hour tolerance in adjacent water.

31 July

1036 USS Clamp (ARS-33) directed to proceed to Salt Lake City and wash down with high-pressure hoses for 3 hours.

1146 Clamp reported monitor advised that remaining in vicinity of Salt Lake City for more than 1 hour was unsafe.

1450 USS Conserver (ARS-39) directed to proceed to Salt Lake City, place monitor on board to make Geiger readings, replenish foam supply, and return to previous assignment.

1521 Conserver reported boarding of Salt Lake City completed.

1652 Conserver inspected Salt Lake City to check foam en route to anchorage.

1 August

0920 Special boarding team of about 50 men reported on board Conserver for reboarding Salt Lake City.

0930 Conserver moored alongside Salt Lake City's portside. Special boarding parties went on board to rig equipment in flooded spaces for pumping them out. Other parties were sent onboard to wash down the main deck areas with high-pressure hoses. A careful record was kept of the exposure of each man to radioactivity to prevent any man from receiving more than the established daily tolerance. The boarding team was on board for approximately 4-1/2 hours.

USS Salt Lake City (CA-25)

2 August

0815 The commanding officer and a team of about 50 men boarded Conserver to continue pumping out flooded spaces and decontaminating Salt Lake City. Conserver hosed down Salt Lake City for about 30 minutes. Average radiation was 3 to 4 R/24 hours on weather decks except the forecastle, which averaged 2 R/24 hours before work was begun. No readings were taken at the end of the day's work (Reference 4).

0845-1600 Conserver moored alongside Salt Lake City's portside to continue pumping out flooded spaces. Washed down forecastle with boiler compound and lye solution and cleared radioactive pieces of metal on the deck. A careful record was kept of each man's exposure to radiation. Conserver cast off from alongside at the end of the day's operations.

3 August

0900 The commanding officer and a boarding team of 50 men boarded Salt Lake City from LCVPs and began decontamination work with soap solution and sand. No other cleaning materials were available (Reference 4). Commenced radiological survey of the weather deck.

1100 The second team boarded the ship and continued scrubbing down with soap and sand. The first team returned to Rockbridge where all men were checked for radiological contamination.

1300 The second team returned to Rockbridge where all men were checked for radiological contamination. Forecastle readings reduced to 1 R/24 hours with steel deck about 0.5 R/24 hours (Reference 4).

4 August

0905 The commanding officer and the first boarding team of 50 men boarded Salt Lake City and continued decontamination. Commenced radiological survey of the ship. Holystoned forecastle with soap and sand. Flushed highly radioactive coral and sand from open bridge, pilot house level, communications deck, and entire main deck. Open bridge and pilot house reduced from 12 R/24 hours to 4 R/24 hours average. Water in some drains and puddles gave high readings; the water was removed later (Reference 4).

0930 Freshwater on the ship was declared radiologically safe for drinking.

1100 Second boarding team reported on board and continued decontamination. First boarding team returned to Rockbridge where they were checked for radiological contamination.

1300 The third boarding team reported on board and continued decontamination. The second team returned to Rockbridge where all men were checked for radiological contamination.

USS Salt Lake City (CA-25)

1500 The third boarding party evacuated Salt Lake City and returned to Rockbridge where all men were checked for radiological contamination.

5 August

0800 Special party on board to start diesel generators.

0910 The commanding officer and a special boarding team of 50 men boarded and commenced cleaning machinery spaces and topside radiological contamination. Commenced daily radiological survey of the ship.

1055 Second boarding team reported aboard to relieve the first team.

1110 First boarding team returned to Rockbridge where all men were checked for radiological contamination.

1300 Third boarding team reported on board to relieve the second team.

1315 Second boarding team returned to Rockbridge where all men were checked for radiological contamination.

1500 Third team returned to Rockbridge where all men were checked for radiological contamination.

A complete survey was begun and readings of representative areas were recorded. Each day the same routine was followed and readings recorded to determine changes. Each day new "hot spots" were discovered that were not previously known to exist. Every effort was made to prevent anyone from receiving more than the established radiation tolerance. It was found necessary to caution men continually about precautions to be taken around radioactive areas. Some men were still found handling debris with bare hands, although rubber gloves were available. Men were worked in groups with one petty officer for every five or six men (Reference 4).

5 August — A strong acetic acid solution was applied to a deck area on the open bridge to determine the value of acid for decontamination. The 4-ft^2 area was scrubbed for 5 minutes after acid was applied and then flushed off. A control area the same size was scrubbed for 5 minutes using only saltwater. Both areas were reduced by exactly the same amount (1.5 R/24 hours to 1.3 R/24 hours) (Reference 4).

The work parties cleared away wood gratings, bunting, and other debris from open bridge, scrubbed the deck, and washed it down. Flushed down well deck, after superstructure deck, and main deck aft. No caustic cleaning materials were available. Average readings on bridge and pilot house were reduced to 2.5 to 3 R/24 hours and communication deck to about 2 R/24 hours.

6 August

0910-1510 Three parties of 50 men each in 2-hour relays boarded (Reference 4). At the end of each period aboard Salt Lake City, men returned to Rockbridge and were checked for radiological contamination. A strong solution of hydrochloric acid was applied to a steel plate and scrubbed for several minutes, then flushed off. No control area was used but the results were very nearly the same as the acetic acid. Sprayed lye solution on bulkheads and deck of open bridge, pilot house level, turret No. 1, communication deck, and forecastle deck. Flushed off lye solution after scrubbing with deck scrubbers, removing several coats of paint from painted surfaces. Readings generally reduced 10 to 15 percent on wooden deck; painted surfaces reduced 25 to 35 percent. Removed vent cover portside, frame 100 main deck. Reading outside was 60 R/24 hours; reading inside was 100 R/24 hours. Flushed out vent with hose, reading reduced to 8 R/24 hours. (Reference 4).

7 August

0915-1500 Three parties of 50 men each in 2-hour relays boarded. When the parties returned to Rockbridge, all men were checked for radiological contamination.

Holystoned main deck from forecastle to well deck. Sprayed lye solution on bulkheads from turret No. 1 to the well deck. Lost electric power at 1400. Unable to wash down scrubbed decks. Cleaned out contaminated newspapers and canvas from wing storage frame 60. Readings reduced from 48 R/24 hours to 4 R/24 hours. Cleaned out debris from spud locker and flushed it out. Reading reduced from 32 R/24 hours to 10 R/24 hours maximum, with about 5 R/24 hours average. A piece of wood deck was removed from the well deck after measuring the radiation of the area. The section was then brought to Rockbridge and planed down with a joiner machine by 1/16-inch cuts; 5/16 inch was removed to bring the wood to tolerance (Reference 4).

8 August — Began boarding with two parties of 80 men each in 3-hour relays to reduce time lost in changing work parties. All men were checked for radiological contamination when they returned to Rockbridge.

Completed flushing loose paint from areas where solution was applied the previous day. The solution had to be reapplied to remove the paint. All bulkheads and turrets in the forward half of the ship had the solution applied that day. Commenced spraying and flushing of bulkheads on after superstructure deck. Considerable paint was removed, although reduction in general radiation was about 10 percent. Where paint collected in puddles around drains on communication deck, reading increased from 1.5 to 5 R/24 hours. Puddles were removed (Reference 4).

9 August — Two parties of 80 men each in 3-hour relays boarded. All men were checked for radiological contamination when they returned to Rockbridge.

Removed radioactive debris from after searchlight platform. Removed pockets of radioactive sand and debris in airplane crane structure and around structure behind the after stack. Removed paint with lye solution from turret Nos. 3 and 4,

secondary conn structure, and gun shield on after superstructure deck. Slight reduction in radiation apparent, although a complete survey was not made after completion of work.

Salt Lake City was not boarded again for the regular daily survey conducted each morning (Reference 4) until further orders.

12 August
0830 Several members of the RadSafe Section reported on board and checked all clothing that had been worn by men working on Salt Lake City.

All pieces of clothing and shoes above tolerance were collected and later disposed of by dumping at sea in weighted bundles. Eleven men sent urine samples to Haven for radiological analysis.

13 August
0830 Four men sent to Haven to recheck urine samples.

17 August
0830 Executive officer and 18 officers and enlisted men boarded to heave in port anchor.
1200 All personnel evacuated the ship.

23 August
1100 Salt Lake City underway for Kwajalein in tow by USS Chickasaw (ATF-83).

24 August
0830 Anchored in berth Love 31, Kwajalein.

28 August Decommissioned.

Salt Lake City was towed by USS Takelma (ATF-113) and USS Hitchiti (ATF-103) to Puget Sound Naval Shipyard, arriving there 28 July 1947. It was used for decontamination experiments and research.

USS SAN MARCOS (LSD-25)

Crew Size: 631
Bikini Atoll Arrival: 19 March 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 28 nmi (52 km) NE
Shot BAKER Location: 18 nmi (33 km) NE
Decontamination Location: San Francisco
Operational Clearance: 24 October 1946
Final Clearance: 18 January 1947

Task Unit and Function
The dock landing ship San Marcos was a member of TU 1.8.3 (Dispatch Boat and Boat Pool Unit). It brought to the forward area a large number of small craft for the Boat Pool and Dispatch Boat Unit, pontoon causeways, and a barge with an 80-ton crane. Its main function during the test was to provide small boats for dispatch and mail service.

Shot ABLE (1 July, 0900)

30 June
1608 Underway for assigned area off Bikini Atoll.

1 July
1528 Anchored in berth 94, Bikini.

2-23 July Routine operations.

Shot BAKER (25 July, 0835)

24 July
1544 Underway to assigned area off Bikini Atoll in conformance with CJTF 1 for test BAKER.

25 July
0001 Steaming in column in area Packard with other vessels of TG 1.8.
0955 Operating with TG 1.1 in area Graham.
1431 Anchored in berth E, Bikini Atoll.

28 July
1531 Underway to sea.
1636 Steaming independently in area Mercury with USS Cumberland Sound (AV-17).

29 July
1630 Anchored 500 yards (450 meters) east of berth U, Bikini Atoll.

30 July
0925 Shifted anchorage to berth 94, Bikini.

2 August
1620 Shifted berths to anchorage in berth Tare, Bikini.

2-24 August Remained anchored at Bikini and engaged in routine small boat services.

25 August
1630 Underway for Kwajalein.

26 August
1136 Anchored in anchorage K, berth 22, Kwajalein.

USS SARATOGA (CV-3)

Crew Size: 589
Bikini Atoll Arrival: 31 May 1946
Crew Location for Shot ABLE: USS Rockwall (APA-230)
Crew Location for Shot BAKER: Rockwall
Shot ABLE Location: 2,260 yards (2.1 km) SE
Shot BAKER Location: 350 yards (320 meters) SSW
Sunk 25 July 1946, Bikini Lagoon

Task Unit and Function
The carrier Saratoga was a member of TU 1.2.2 (Aircraft Carrier Unit), Carrier Division 31. It was a target vessel during CROSSROADS. Its crew was evacuated before ABLE and BAKER and did not return. Among the experimental equipment aboard were clothing and food provided by the Quartermaster Unit, and ammunition and representative items from Army Signal Unit.

Shot ABLE (1 July, 0900)

30 June
0950-1120 Evacuated crew to Rockwall in preparation for ABLE.

1 July
1332 A smoldering fire was noted on Saratoga's flight deck (Reference 6, p. VII-I-8-A).

1348	ATR-40 ordered to fight the fire on Saratoga, but not to board it.
1409-1432	ATR-40 alongside Saratoga to fight fire, reported fire extinguished (Reference 6, pp. VII-I-9-A and VII-I-10-A).
1530	USS Shakamaxon (AN-88) (Team 8) reported placing a boarding team on Saratoga.
1531	Shakamaxon reported Saratoga clear for boarding (Reference 6, p. VII-I-12-A).
1706	Shakamaxon reported Saratoga radioactive, frame 90 aft.
1715	Shakamaxon reported its inspection of Saratoga was completed.
1723	Shakamaxon reported parts of Saratoga radioactive under the flight deck to the waterline, portside frame 90 to fantail; recommended no team board until 2 July.

2 July

0935	Shakamaxon reported Saratoga Geiger sweet (Reference 6, p. VII-I-24-A).

The only evidence of appreciable radioactivity was on the main and flight deck exteriors on the port quarter where 0.2 R/24 hours was recorded by a Geiger counter at 1200 on 2 July. Since the sea on the portside had been declared radioactive on 1 July, the water pumped onto the flight deck by the salvage vessel in extinguishing the flight deck fire may have been the cause (Reference 3).

2-24 July	Crew reboarded to live aboard Saratoga.

24 July

0930-1145	Evacuated crew to Rockwall in preparation for BAKER.

Shot BAKER (25 July, 0835)

25 July

0914	PBM Charlie reported Saratoga listing slightly to starboard (Reference 5, p. 6-D-7).
0924	PBM Charlie reported Saratoga's stack collapsed to port and lying on flight deck.
0938	PBM Charlie reported Saratoga down heavily by stern (Reference 5, p. 6-B-8).
1130	PBM Charlie reported Saratoga in danger of sinking and recommended every effort be made to beach it if possible (Reference 5, p. 6-D-10).
1200	CJTF 1 asked if Saratoga could be cast loose and towed from the target array without boarding; USS Chickasaw (ATF-83) directed to take Saratoga in tow. (Due to the very high radioactivity of the water near the center of the array, salvage ships were not allowed to enter array [Reference 6, p. VII-I-51-B]).
1210	CTU 1.2.7 answered CJTF 1 request in the affirmative. Chickasaw directed to be ready to tow Saratoga to the beach when ordered, but no men were to board it (Reference 6, p. VII-I-7-B).
1408	CJTF 1 told DSM aboard USS Reclaimer (ARS-42) permission granted for Reclaimer to proceed with operations toward Saratoga (Reference 6, p. VII-I-11-B).
1530	Reclaimer stopped, laying to in vicinity of target submarine USS Parche (SS-384). Unable to approach Saratoga due to the radioactive condition of the water (Reference 6, p. VII-I-13-B).
1555	Stern of Saratoga underwater.
1610	Bow and superstructure of Saratoga disappeared below the surface (Reference 6, p. VII-I-13-B).

The Technical Director aboard USS Kenneth Whiting (AV-14) requested services of divers when safe to recover linear and log-time axis and other instruments on target ships USS Arkansas (BB-33) and Saratoga. Technical Director was informed that his request for divers would be included in the diving schedule when the situation permitted and other diving requirements were known (Reference 6, p. VII-I-82-B).

28 July	Pressure-time recorders were recovered from target vessels Arkansas, Saratoga and USS Pilotfish (SS-386). Radiation intensity films were recovered from target vessels Arkansas, Nagato, Saratoga, USS Apogon (SS-308), and Pilotfish (Reference 6, p. VII-I-83-B).

Saratoga's crew was transferred to other CROSSROADS units.

USS SEARAVEN (SS-196)

Crew Size: 58
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,798 yards (1.6 km) NE
Shot BAKER Location: 1,419 yards (1.3 km) SSW
Decontamination Location: San Francisco (Mare Island Naval Shipyard)
Final Clearance: 11 December 1946
Sunk 11 September 1948, off southern California coast

Task Unit and Function

The submarine Searaven was a member of TU 1.2.4 (Submarine Unit), Submarine Division 111. It was a target vessel for CROSSROADS. Its crew was evacuated before each shot.

Shot ABLE (1 July, 0900)

30 June	Evacuated crew to Bottineau in preparation for ABLE.
0800-1130	Secured Searaven at surface.

2 July

0829	USS Etlah (AN-79) placed boarding team on Searaven.
0831	Etlah reported Searaven Geiger sweet (Reference 6, p. VII-I-22-A).
1145-1430	Initial boarding team boarded Searaven for inspection; normal operations restored.

Searaven was undamaged except for slight damage to superstructure plating on the starboard side. Air pressure was vented from the ship and both battery compartments were thoroughly ventilated to remove an explosive percentage of hydrogen.

3 July	
1000	Teams C and D returned aboard Searaven from Bottineau. Remaining crewmembers returned to live aboard Searaven.

USS Searaven (SS-196)

Shot BAKER (25 July, 0835)

22 July — Searaven crew evacuated to Bottineau. No personnel remained aboard.

0415-0635 — Securing submerged boat.
1550 — Submerged in accordance with CJTF 1 Operation Plan 1-46.

29 July
1040 — USS Coucal (ASR-8) surfaced Searaven; condition apparently good (Reference 6, p. VII-I-40-B).

30 July
0900 — USS Gypsy (ARSD-1) directed to wash down Searaven thoroughly with high-pressure hoses, then take readings and try to board (Reference 6, p. VII-I-B-50).
1037 — Gypsy reported washing down Searaven. No change in reading. Additional instruments being obtained from USS Haven (AH-12) (Reference 6, p. VII-I-51-B).
1209 — Gypsy reported Searaven 2.5 R/24 hours. Monitor advised Gypsy to leave vicinity (Reference 6, p. VII-I-52-B).
1518 — Gypsy took Geiger readings in the vicinity of Searaven and requested instructions. Gypsy directed to return to anchorage (Reference 6, p. VII-I-55-B). On deck readings, 1.5 R/24 hours; vicinity reading, 0.35 R/24 hours.
2209 — Searaven decontaminated using seawater and foamite (Reference 5, pp. 6-O-44 and 6-O-45).

31 July
1137 — Coucal was directed to proceed to the vicinity of Searaven and blow ballast tanks as instructed (Reference 6, p. VII-I-60-B).
1420 — Coucal reported Searaven tanks dry, salvage hoses removed, and anchors ready for removal when convenient (Reference 6, p. VII-I-61-B).

1 August
1132 — Gypsy reported placing a 10-ton bow anchor from Searaven in 25 feet (7.6 meters) of water north of Ionchebi Island; buoyed with spherical buoy (Reference 6, p. VII-I-68-B).
1312 — Gypsy reported Searaven's stern anchor fouled (Reference 6, p. VII-I-69-B).
1545 — Gypsy reported Searaven clear (Reference 6, p. VII-I-70-B).

3 August
0900-1155 — Teams A and B aboard to continue decontamination measures. Readings forward of conning tower, 1 to 1.25 R/24 hours; aft of conning tower, 1 to 1.5 R/24 hours.

4 August
0830-1358 — Boarding party boarded to inspect boat. Entered conning tower, control room, forward engine room, and after battery. Found main induction piping flooded by leakage but no major damage. Tests of air indicated presence of an explosive mixture due to presence of hydrogen and fuel oil vapor. Secured boat, all hands returned to Bottineau. Topside average reading 0.82 R/24 hours.

5 August
0845-1515 — Boarding party boarded to resume inspection and decontamination. Made initial inspection of all compartments. Ventilated boat to remove gases. No major damage found. Drained main induction. Topside average 0.51 R/24 hours. Boarding party returned to Bottineau.

6 August
0830-1110 — Boarding party aboard. Commenced inspection of boat's equipment and decontamination measures to reduce radioactivity present, using handybilly pump to hose down weather decks. Scrubbed maindeck with saltwater, soap, and boiler compound solutions (Reference 4); boarding party returned to Bottineau.
1603 — Secured boat.

7 August
0950-1545 — Boarding party on board to continue inspection and decontamination. Used handybilly pump to hose down weather decks. Scrubbed main deck with saltwater, soap, and boiler compound solutions. An additional scrubbing with a lye solution was employed. USS Chowanoc (ATF-100) sprayed boat with a lye solution, and later USS Wenatchee (ATF-118) washed it with saltwater. Topside average 0.59 R/24 hours.

8 August
0851 — First decontamination team came aboard to inspect and decontaminate vessel. Continued scrubbing with boiler compound and lye solution, washing down with saltwater supplied by a handybilly pump. Topside average 0.23 R/24 hours; topside maximum 0.30 R/24 hours.
1303 — Decontamination team #2 aboard.
1547 — Boat secured; personnel departed.

9 August
0815 — Shifted all hands to remanned target ship USS Fillmore (APA-83) for berthing and messing.
0945-1627 — Boarding party came on board to resume inspection and decontamination. Continued scrubbing with boiler compound and lye solution, and washing down with saltwater supplied by a handybilly pump. Topside average 0.28 R/24 hours; topside maximum 0.37 R/24 hours.

10 August
0830-1130 — Boarding team on board for inspection and
1300-1620 — decontamination. Ripped up portion of after cigarette deck and applied lye solution to surface of steel deck thus exposed. Used long-handled scrapers around base of bridge superstructure plating at intersection with main deck. Continually wetting and washing down with hose to prevent danger from dust particles (Reference 4).
0845 — Gypsy cleared fouled anchor.
0915 — Anchor cleared; underway on two main engines. Anchored near berth 224, Bikini.

12 August
0825-1130 — Boarding party on board for inspection
1307-1600 — and decontamination. Topside average 0.2

USS Searaven (SS-196)

R/24 hours; topside maximum 0.25 R/24 hours.

1450 USS Deliver (ARS-23) washed boat with pressure hose.

13 August

0830-1104 Boarding team came on board for inspection and decontamination. Concentrated on bridge and conning tower superstructure; applied strong lye solution to all surfaces and allowed it to remain 3 to 4 hours before washing down (Reference 4). Topside average, 0.2 R/24 hours; topside maximum, 0.31 R/24 hours (in dog house); below decks, sweet.

1315-1552

14 August

0830-1100 Boarding team on board for inspection and decontamination. Concentrated on bridge and conning tower superstructure, applied strong lye solution to all surfaces, allowing 3 to 4 hours before washing down. Also washed down all topside with saltwater continually throughout washing period (Reference 4). Below deck, sweet; topside average, 0.17 R/24 hours; topside maximum, 0.21 R/24 hours.

1300-1535

15 August

0910 Crew aboard, shifting anchorage.

0929 Underway to shift berths.

1000 Anchored near berth 168, Bikini.

1005 Boat secured.

1255-1553 Decontamination party aboard. Topside average, 0.14 R/24 hours; topside maximum, 0.20 R/24 hours.

16 August

1409-1546 Decontamination team aboard to continue decontamination. Topside average, 0.16 R/24 hours; topside maximum 0.34 R/24 hours (in dog house); below deck, sweet. Staff inspections were completed, but the boat's reports were not received.

17 August

0930-1145 Decontamination team aboard to continue decontamination procedures.

1300 Decontamination team reboarded to continue decontamination procedures. Topside average, 0.064 R/24 hours; topside maximum, 0.35 R/24 hours (in dog house).

Topside radiological readings on Searaven are listed in Table A.11.

19 August

0830-1618 Working party aboard to continue decontamination procedures.

1030-1130 Radiological survey party on board to inspect boat.

20 August

0920-1430 Boarding party on board to resume decontamination.

21 August

0820-1115 Boarding party on board to prepare boat for sea.

22 August

0515 Boarding party on board to start gyro and commence preparations for getting underway.

Table A.11. Topside radiological readings (R/24 hours) on USS Searaven (SS-196).

Date	Bow	Conning Tower Fwd	Conning Tower Aft	Over Fwd Engine Room	Stern	Bridge	Topside Avg
7/31	2.5		5.0	4.0			3.83
8/2	1.0	1.25	1.5	1.0	1.5		1.25
8/3		1.25	1.5				0.95
8/4							0.82
8/5	0.5	0.7	0.7	0.7	0.7	1.0	0.72
8/6	0.4	0.6	0.6	0.45	0.5		0.51
8/7	0.3	0.46	0.5	0.35	0.38		0.40
8/8	0.25	0.37	0.35	0.31	0.42		0.34
8/9	0.2	0.25	0.35	0.37	0.25		0.28
8/10	0.26	0.22	0.32	0.35	0.22		0.27
8/12	0.15	0.2	0.23	0.2	0.2	0.23	0.2
8/13	0.14	0.24	0.18	0.23	0.14	0.25	0.19
8/14	0.12	0.16	0.19	0.15	0.12		0.16
8/15	0.14	0.20	0.24	0.22	0.2		0.2
8/16	0.02	0.15	0.05	0.02	0.02		0.05
8/17	0.06	0.12	0.08	0.06	0.06	0.08	0.07
8/18	0.06	0.11	0.07	0.07	0.07	0.1	0.08

Source: Reference 4.

0745 Remainder of crew on board.

0845 Underway for Kwajalein.

1000 Partially flooded main ballast tanks nos. 2 and 3 to increase draft and work on superstructure to decrease radioactivity.

23 August

1057 Anchored in berth A13, Kwajalein.

The entire deck of Searaven was wood except for the area over the mufflers and near the bow. Scrubbing seemed effective on the wooden deck planking only during the first few days of scrubbing. After this the top of the planking was bare. The sides and lower portion were inaccessible. Removal of decking on 10 August allowed cleaning rust and contaminated paint beneath, thereby lowering readings.

Since Searaven was scraped and repainted with only one coat of paint before arriving at Bikini, there were few areas of heavy paint. Removal of light paint and rust by scrubbing did have an initial effect of greatly lowering radiactivity. The majority of Searaven's superstructure had become so rusted through age and exposure during war patrols that removal of all rust was impossible. On several steel castings, which could be cleaned bare, the readings were 0.1 to 0.2 R/24 hours below surrounding areas. No decontamination work was done below decks since all compartments were originally below 0.1 R/24 hours (or soon became so as topside readings dropped) (Reference 4).

Searaven arrived in San Francisco on 14 October 1946 and was decommissioned on 11 December 1946.

USS SEVERN (AO-61)

Crew Size: 145
Bikini Atoll Arrival: 24 May 1946
Bikini Atoll Departure: 24 August 1946
Shot ABLE Location: En route from Pearl Harbor to Bikini
Shot BAKER Location: 15 nmi (28 km) E
Decontamination Location: Los Angeles
Final Clearance: 3 November 1946

Task Unit and Function

The oiler Severn was a member of TU 1.8.1 (Repair and Service Unit). Severn provided fuel and water for other support ships. During the test series it made two trips to Pearl Harbor to refuel.

Shot ABLE (1 July, 0900)

1 July
- 0900 — En route from Pearl Harbor to Bikini.

7 July
- 0803 — Entered Bikini Lagoon.
- 0915 — Anchored in berth 287.
- 1309 — Underway to shift berths.
- 1440 — Anchored in berth 229.

8-16 July — Remained anchored; performed routine duties and was not in contact with target vessels.

16 July
- 0744 — Underway to shift berth.
- 0828 — Anchored in berth 205, Bikini.

17-18 July — Remained anchored; performed routine duties; had no contact with target vessels.

18 July
- 0950 — YOG-70 came alongside to starboard.
- 1037 — YOG-70 cast off after receiving water.

19 July
- 1520 — Anchored in berth 205, Bikini.

20 July
- 1501 — Underway to shift berth.
- 1509 — Anchored in berth 229.

23 July
- 0935 — YOG-63 came alongside to port.
- 1040 — YOG-63 and USCGS Bramble (WAGL-392) cast off after receiving water.
- 1410-1415 — LCT-1184 alongside.

24 July
- 1459 — Underway for area Packard.

Shot BAKER (25 July, 0835)

25 July
- 0835 — Observed shot BAKER.

30 July
- 0724 — Entered Bikini Lagoon.
- 0743 — Passed buoy No. 6, 300 yards (273 meters) to port.
- 0759 — Anchored in berth 270.

31 July
- 0745 — Underway.
- 0833 — Moored to USS Wildcat (AW-2) in berth 370.
- 1651 — Underway.
- 1720 — ATA-187 alongside.
- 1750 — Departed Bikini Lagoon for Pearl Harbor via Kwajalein.

18 August
- 0830 — Reentered Bikini Lagoon from Pearl Harbor.
- 0900 — Anchored in berth 189, Bikini.

20 August
- 1118 — Target vessel LCT-1115 alongside 2 hours for freshwater.

21 August
- 1130 — Target vessel LCI(L)-615 alongside 1 hour.

23 August
- 1005 — Target vessel LCI(L)-549 alongside 2-1/2 hours to receive water.
- 1045 — Target vessel LCI-329 alongside 1 hour, 45 minutes to receive water.

24 August
- 1637 — Departed Bikini Lagoon for Kwajalein.

USS SHAKAMAXON (AN-88)

Crew Size: 38
Bikini Atoll Arrival: By 2 April 1946
Bikini Atoll Departure: 27 August 1946
Shot ABLE Location: 18 nmi (33 km) SE
Shot BAKER Location: 18 nmi (33 km) SE
Decontamination Location: Pearl Harbor
Operational Clearance: 12 December 1946
Final Clearance: 4 January 1947

Task Unit and Function

The net laying ship Shakamaxon was a member of TU 1.2.7 (Salvage Unit). Shakamaxon's main duties included salvaging the damaged target vessels after the tests, performing emergency repairs, and fighting fires.

Shot ABLE (1 July, 0900)

1 July
- 1308 — Ordered to place a boarding team on target ship USS Conyngham (DD-371) (Reference 6, p. VII-I-8-A).
- 1325 — Entered Bikini Lagoon after Shot ABLE.
- 1328 — All of sector 8 declared clear (Reference 6, p. VII-I-8-A).
- 1421 — Alongside Conyngham, placed boarding team 8 aboard (Reference 6, p. VII-I-10-A).
- 1445 — Reported Conyngham Geiger sweet.
- 1453 — Ordered to withdraw eastward after finishing Conyngham.
- 1504 — Ordered to place boarding team (Team 8) on board target ship USS Saratoga (CV-3), using caution because of previous fire (Reference 6, p. VII-I-11-A).
- 1530 — Team 8 reported aboard Saratoga.
- 1531 — Team 8 reported Saratoga clear for boarding (Reference 6, p. VII-I-12-A).
- 1723 — Reported parts of Saratoga were radioactive under the flight deck to the waterline portside, frame 90 to fantail. Recommended no team board until 2 July.
- 1820 — Anchored in berth N, Bikini.

USS Shakamaxon (AN-88)

2 July

0805	Shakamaxon told all ships in its sector were clear and to place boarding teams aboard as desired (Reference 6, p. VII-I-21-A).
0935	Boarding team aboard Saratoga. Reported Saratoga Geiger sweet (Reference 6, p. VII-I-24-A).
0941	Reported Saratoga completed and proceeding to target ship USS Mustin (DD-413).
1003	Reported boarding team aboard Mustin (Reference 6, p. VII-I-25-A).
1132	Reported target ship USS Mugford (DD-389) Geiger sweet and all ships in sector completed.
1140	Directed to proceed to anchorage.
1215	Boarding team discharged; bound for USS Wharton (AP-7) in a small boat.
1245	Anchored in berth N.

3-7 July — Operating in Bikini Lagoon performing routine duties; not involved with target vessels.

8 July

1100-1149	Laid and stretched leg in array area.
1420-1624	Laid and stretched mooring leg in array.
1905	Anchored in berth 36.

9 July

0607	Recovered mooring leg.
0722-0750	Engaged in operation of laying mooring leg.
1234-1359	Laid and stretched mooring leg.
1620	Moored to buoy in array area.
1900	Anchored in berth O-2, Bikini.

10 July

0745-0808	Laid and stretched mooring leg.
1325-1331	Laid and stretched mooring leg.
1350	Anchored in berth 96, Bikini.

11 July

1300	Moored to USS Ottawa (AKA-101) to load heavy leg and anchor.
1410	Anchored in berth 40, Bikini.

12 July

1000	Moored to buoy beside USS Suncock (AN-80); laid and stretched buoy leg.
1050	Underway for USS Rolette (AKA-99).
1152	Anchored in berth 40, Bikini, after taking aboard an anchor chain from Rolette.
1452	Anchored in berth 35 after taking on anchor from USS Henrico (APA-45).

13 July

1610	Laying to in array area for mooring of target vessel ARDC-13.
1930	Received and connected mooring wire to anchor of ARDC-13; laid and stretched mooring wire.
2212	Anchored in berth 35, Bikini.

14 July

1020	Underway to array area.
1135	Anchored in berth 139.
1320	Moored to buoy to attach leg.
1340	Began stretching leg; underway shifting berth.
1705-1711	Stretched leg.
1902	Anchored in berth 35.

15 July

0914	Moored to attach leg to buoy.
1005-1014	Stretched leg on buoy.
1205	Underway to array.
1242	Moored to buoy in array area. Received leg from USS Oneota (AN-85); laid and stretched leg.
1615	Moored to Oneota to receive mooring leg; laid and stretched leg.
1711	Anchored in berth 40, Bikini.

16 July

1240-1304	Laid buoy riser chain; underway to Henrico.
1545	Laying to off target submarine USS Skate (SS-305).
1705	Underway with buoy to stern of Skate.
1801-1810	Laid clump.
1845	Anchored in berth 35, Bikini.

17-18 July — Routine activities; not involved with target vessels.

19 July

1300	Circled target ship USS Fillmore (APA-83).
1315	Proceeding to target ship USS Salt Lake City (CA-25).
1330	Circled Salt Lake City.
1407	Anchored in berth 105, Bikini.

20-23 July — Routine activities; not involved with target vessels.

21 July — Shifted anchorages several times.

Shot BAKER (25 July, 0835)

24 July — Made preparations for sea after working through the night assisting in submerging submarines.

25 July

1154	USS Preserver (ARS-8), USS Clamp (ARS-33), USS Current (ARS-22), and Shakamaxon directed to stay south of the line through target ships Fillmore and USS Cortland (APA-75) and not to cross the line without further orders.
1230	Shakamaxon was told target vessels Fillmore and LCI-329 were clear for a boarding team. Directed to place boarding team on board.
1421	Reported Fillmore Geiger sweet.
1422	Reported boarding team back on board, proceeding to LCI-329.
1457	Reported alongside Fillmore, boarding team on board.
1506	Reported alongside LCI-329, boarding team placed on board (Reference 6, p. VII-I-12-B).
1518	Reported boarding team back on board (Reference 6, p. VII-I-12-B).
1528	Reported LCI-329 Geiger sour.
1615	Reported boarding parties completed assigned vessels, requested instruction.
1628	Directed to proceed to special anchorage (Reference 6, p. VII-I-24-B).
1717	Anchored in berth Tare, Bikini.
1725	Reported cooling water intake slightly sour. Idling engines to clear (Reference 6, p. VII-I-14-B).

USS Shakamaxon (AN-88)

26-29 July	Anchored; not involved with target vessels.
30 July	
1638	Moored portside of Skate.
1800	Underway to anchorage.
1830	Anchored in berth Tare, Bikini.
31 July	
0131	Ordered to go alongside Ottawa for removal of anchors and chain (Reference 6, p. VII-I-58-B).
1 August	Continued to plant submarine mooring in lee of Eneu Island (Reference 6, p. VII-I-66-B).
2 August	Performed routine activities in Bikini; not involved with target ships.
3 August	Directed to proceed to vicinity of Wharton to embark boarding Team 8.
1125	Proceeded to target ship USS Gasconade (APA-85) and placed boarding team on board after ATA-180 completed washing it down (Reference 6, p. VII-I-77-B).
1215	Reported assignment completed, boarding team back aboard Wharton, proceeding to anchorage (Reference 6, p. VII-I-81-B).
4 August	Anchored; not involved with target ships.
5 August	
0942	Radsafe monitors of boarding team #8 reported aboard from USS Haven (AH-12), composed of 1 officer, 4 enlisted men, and 1 civilian.
0947	Eight-man working party of Gasconade came aboard.
10[illegible]0	Eighteen additional members of boarding team 8 reported aboard.
[illegible]00	Working party, composed of 17 members of target ship USS New York (BB-34), reported aboard.
1123	Laying to in vicinity of New York.
1314	Anchored in berth 189, Bikini.
1700-1725	Laying to in vicinity of Wharton to disembark boarding team and working party.
1742	Anchored in berth 378, Bikini.
6 August	
0750	Laying to to pick up boarding team from Wharton.
0820	Boarding team 8 reported aboard.
0800-0909	Alongside target ship USS Pennsylvania (BB-38); boarding team on Pennsylvania; boarding team reembarked.
0937-1005	Alongside target ship USS Butte (APA-68); boarding team on Butte; boarding team reembarked.
1035	Anchored in berth 188.
1306	Nineteen members of New York crew reported aboard.
1323	Anchored in berth 201.
1520	Alongside New York; boarding team and working party disembarked.
1650	Reembarked boarding team; underway from New York.
1720	In vicinity of Wharton; New York boarding party disembarked.
1738	Anchored in berth 378.
7 August	
0910	Anchored in berth 105.
8 August	
0900	Boarding team from Wharton embarked.
0910	Alongside Mustin; boarding team disembarked.
1020	Reembarked boarding team.
1034	Alongside target ship Mayrant (DD-402); boarding team disembarked.
1100	Reembarked boarding team; underway for target ship USS Dawson (APA-79); boarding team disembarked.
1209	Reembarked boarding team.
1204	Alongside target ship USS Barrow (APA-61); boarding team disembarked.
1305	Reembarked boarding team.
1333	Boarding team disembarked to Wharton.
1352	Anchored in berth 105, Bikini.
1750	Anchored in berth 51, Bikini.
9-11 August	Routine operations; not involved with target vessels.
12 August	
1143	Alongside Mugford to take off torpedoes.
1145	Target vessel LCT-1115 came alongside.
1315	LCT-1115 cast off; operation completed. Underway from Mugford.
1333	Anchored in berth 51, Bikini.
13-18 August	Operated in Bikini; not involved with target vessels.
14 August	
1355	Anchored in berth 108 after refueling and receiving water.
19 August	
0850	Alongside target ship USS Hughes (DD-410) to take aboard pump and generator to Salt Lake City.
1125	Underway from Hughes to Salt Lake City.
1227	Alongside Salt Lake City to unload pumps and generator.
1325	Underway from Salt Lake City to berth 108.
1543	Underway to Salt Lake City.
1605	Alongside Salt Lake City.
1645	Anchored in berth 108, Bikini.
20 August	Anchored in Bikini; not involved with target vessels.
21 August	
0845	Moored to target ship USS Pensacola (CA-24) to furnish electrical power to port anchor windlass.
1300	Underway from alongside Pensacola.
1314	Anchored in berth 108.
22 August	
1402	Alongside target ship USS Ralph Talbot (DD-390) to take its anchor aboard.
1650	Talbot anchor aboard.
1655	Underway to anchorage.
1755	Anchored in berth 108, Bikini.
23 August	
0820	Alongside Salt Lake City to receive 3-inch pump.
0835	Underway from Salt Lake City.
0858	Alongside Hughes to unload pump and Talbot's anchor.
1040	Underway from Hughes; duty completed, having placed anchor and pump aboard.
1132	Anchored in berth 108, Bikini.

24 August	Anchored in vicinity of berth 108, Bikini.
25 August	
1018	Underway from USS Gypsy (ARSD-1) to vicinity of target ship USS Fallon (APA-81).
1155	Laying to off Eneu Island.
1400	Anchored in berth 108, Bikini.
26 August	
0927	Moored to Fallon to place transport anchor and chain aboard; furnished electrical power to anchor windlass on Fallon.
1225	Completed unloading transport anchor and chain; secured electric power to Fallon.
1403	Anchored in berth 108, Bikini.
27 August	
1042	Departed Bikini Lagoon for Kwajalein.
28 August	Arrived at Kwajalein.
6 September	Underway to Guam.

USS SHANGRI-LA (CV-38)

Crew Size: 1,935
Bikini Atoll Arrival: 5 June 1946 (Roi Namur)
Bikini Atoll Departure: 25 July 1946
Shot ABLE Location: 43.8 nmi (81 km) SE
Shot BAKER Location: 40 nmi (71 km) SE
Final Clearance: By 22 November 1946

Task Unit and Function

The aircraft carrier Shangri-La was a member of TU 1.6 (Navy Air Group). Shangri-La was responsible for training personnel and preparing equipment for atomic bomb tests. Four drone aircraft (F6Fs) flew from Shangri-La and were used to collect radioactive samples from the nuclear cloud; the drone-control aircraft remained a safe distance from the detonation while directing the drones via radio control. In addition, a complete aerological unit, which took radar upper wind soundings at Bikini, was aboard Shangri-La.

Shot ABLE (1 July, 0900)

30 June	
1625	Underway from Roi Anchorage, Roi Island, Kwajalein Atoll, in company with USS Turner (DD-834) and USS Charles P. Cecil (DD-835).
1 July	
0714-0750	Launched four drone and sixteen drone-control aircraft.
0756	Launched two TBMs.
0901	Observed ABLE explosion.
0956-1004	Landed nine F6F aircraft.
1534	Anchored in berths A-7 and B-5, Roi Island.
1546-1556	Catapault-launched 12 F6f aircraft.
2 July	
1627	Underway from Roi to Bikini with Turner and Cecil.
3 July	
0550	Entered Bikini entrance to channel.
0631	Anchored in berth 285, Bikini.
1628	Underway from Bikini to Roi with Turner and Cecil.
4 July	
0639	Anchored at Roi.
8 July	
0847	Catapaulted two TBMs for Roi Island.
11 July	
1025-1543	Received aboard three drone aircraft from a lighter.
13 July	
1627	Underway from Roi Island for air rehearsal of BAKER.
14 July	
0737-0800	Launched 12 F6F drone-control aircraft and 3 F6F drones.
0925-0931	Landed six F6F drone-control aircraft.
1313	Anchored in berth 228, Bikini.
15 July	
1626	Underway for Roi Island from Bikini with Turner and Cecil.
16 July	
0802	Anchored between berths B-5 and A-7, Roi Island.
17 July	
1100-1130	Self-propelled barge moored alongside with three F6F drones from Roi.
18 July	
1628	Underway to point Tare with Turner and Cecil for William Day rehearsal.
19 July	
0723-0842	Conducted flight operations; launched and landed 12 F6F aircraft.
1243-1244	Launched two TBMs.
1559	Anchored between berths A-7 and B-5, Roi.
20 July	
0940-1000	Launched 12 F6F drone-control aircraft.
21 July	
0900-1000	Self-propelled barge alongside to deliver three F6F drones.
23 July	
1631	Barges carrying one TBM alongside at #1 crane.

Shot BAKER (25 July, 0835)

24 July	
1630	Underway with Cecil and Turner from Roi to Point Tare for BAKER test.
25 July	
0724-0810	Launched 12 F6F drone-control aircraft, 3 F6F drones, and 2 TBMs.
0909-0913	Recovered two F6Fs.
0932-0935	Launched three TBMs.
1354-1403	Recovered nine F6Fs and four TBMs.
1700	Anchored between berths B-5 and A-7, Roi Island.

26 July
- 1515 Self-propelled barge tied up alongside with two F6F planes to be transferred aboard.
- 1602 Self-propelled barge alongside to transfer two F6Fs on board.

27 July
- 0955 Self-propelled barge came alongside to deliver one TBM and one F6F drone.

28 July
- 1240 Received barge from alongside to deliver two TBM aircraft.
- 1455 Received barge alongside to deliver two TBM aircraft.
- 1520 Received barge alongside to deliver one SNB aircraft.
- 1657 Underway from Roi Island to Pearl Harbor.

2 August — Arrived Pearl Harbor. Moored to pier Fox 12-13, Ford Island, Pearl Harbor.

USS SIOUX (ATF-75)

Crew Size: 66
Bikini Atoll Arrival: 11 June 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 94 nmi (174 km) NNE
Shot BAKER Location: 17 nmi (31 km) WSW
Decontamination Location: Los Angeles
Operational Clearance: 28 November 1946
Final Clearance: 4 December 1946

Task Unit and Function

The fleet ocean tug Sioux was a member of TU 1.8.1 (Repair and Service Unit). Sioux moored target aircraft for shot BAKER and engaged in salvage, towing, emergency repair work, and decontaminating target vessels.

Shot ABLE (1 July, 0900)

30 June
- 1315 Underway from Bikini, pursuant to CJTF 1 Evacuation Plan 1-46 with ARD-29 in tow.
- 1915 Joined formation with USS Wenatchee (ATF-118), USS Munsee (ATF-107), and USS Chowanoc (ATF-100).

2 July
- 0853 Anchored at Bikini; ATA-187 alongside ARD-29, assisting in mooring to buoy in berth 270A.
- 0945 ARD-29 secured; underway for Kwajalein in company with Chowanoc.

3 July
- 0830 Moored portside to USS Quartz (IX-150) at Kwajalein.
- 1031 Underway from Quartz with YF-990 in tow.

4 July
- 1445 Anchored in Bikini Atoll.

5-10 July — Operated in Bikini; not involved with target vessels.

11 July
- 1444 Moored starboard side to target ship USS Saratoga (CV-3).
- 1452 Received one F6F aircraft on board to be transported to target ship USS Pennsylvania (BB-38).
- 1455 Underway to go alongside Pennsylvania.
- 1544 Moored starboard side to portside of Pennsylvania.
- 1625 Placed F6F aircraft on deck of Pennsylvania.
- 1630 Underway, returning to anchorage.
- 1645 Anchored in berth 168, Bikini.

12 July
- 0820 Moored starboard side to target ship USS Arkansas (BB-33).
- 0915 Began hoisting cargo from deck of Arkansas and placing it aboard LCT-1415.
- 1317 Underway to conduct towing operation.
- 1652 Anchored in berth 168, Bikini.

13 July
- 0726 Moored starboard side to Saratoga.
- 0805 Received one F6F aircraft from Saratoga for transportation to target ship USS Barrow (APA-61).
- 0810 Underway to Barrow.
- 0900 Placed F6F aircraft on deck of Barrow.
- 0905 Underway to target ship USS Nevada (BB-36).
- 0933 Moored starboard side to Nevada, preparing to lift Army test equipment from deck of Nevada and place it on LCT-1461.
- 0945-1102 Moved equipment from Nevada to LCT-1461.
- 1111 Underway shifting to Nevada's starboard bow.
- 1125 Moored starboard side to starboard bow of Nevada.
- 1146 Resumed removing Army test equipment from deck of Nevada to LCT-1461.
- 1636 Underway to anchorage.
- 1651 Anchored at Bikini.

14 July
- 0810 Moored starboard side to Pennsylvania.
- 0830 Received one Army truck from Pennsylvania for delivery to USS Chilton (APA-38).
- 0840 Underway to Chilton.
- 0905 Moored next to Chilton.
- 1010 Placed Army truck on board Chilton.
- 1020 Underway for routine towing operation.
- 1215 Moored starboard side to Saratoga.
- 1217 Saratoga placed Army test equipment aboard LCT-1415.
- 1220 Underway with LCT-1415 in tow to go alongside Arkansas for more Army test equipment.
- 1430 Moored portside to Arkansas.
- 1550 Removed Army test equipment from Arkansas and placed it aboard LCT-1415.
- 1600 Completed unloading equipment from Arkansas.
- 1607 Underway with LCT-1415 to tow to target ship USS Salt Lake City (CA-25).
- 1715 Moored starboard side to Salt Lake City, removed box of freight from deck of Salt Lake City.
- 1747 Underway with LCT-1415 in tow to Chilton, then proceeded to anchorage.
- 1950 Anchored in Bikini.

15 July
- 1700 Moored portside to target ship USS Crittenden (APA-77).

USS Sioux (ATF-75)

1710 Placed F6F aircraft on deck of Crittenden.
1720 Underway to conduct routine towing operation.
2015 Anchored in Bikini.

16 July
0725 Moored starboard side to portside of Salt Lake City.
0740 Began removing armor plate samples from Salt Lake City.
0820 Underway to go alongside USS Pensacola (CA-24).
0855 Moored starboard side to Pensacola and began removing armor sample plates from Pensacola.
1520 Completed removing armor sample plates from Pensacola.
1535 Underway to conduct routine operations.
2008 Anchored in Bikini.

17 July
0958 Moored starboard side to Nevada.
1015-1430 Removed armor test plates from Nevada.
1440 Underway to go alongside target vessel ARDC-13 and began removing sample armor plates.
1545 Completed removing armor plates from ARDC-13.
1550 Underway to deliver armor plates to USS Saint Croix (APA-231) and then to anchorage.
1844 Anchored in Bikini.

20-22 July Performed routine duties in Bikini not related to target vessels.

Shot BAKER (25 July, 0835)

23 July
1825 Underway from Bikini Lagoon, pursuant to CTG 1.8 serial 1540, to Rongelap Island with ARD-29 in tow.

24 July
1625 Cast off main tow to ARD-29. Underway, pursuant to basic orders; cleared Rongelap Lagoon.
2217 Rendezvoused with Group Two.

25 July
0900 Left formation on orders from OTC, proceeeding to Rongelap Atoll.
1450 Anchored in berth 8, Rongelap Atoll.

30 July
1324 Underway with ARD-29 in tow, en route from Rongelap Island to Bikini Island.

31 July
1055 Anchored ARD-29 in berth 44, Bikini Lagoon.
1134 Anchored in berth 168, Bikini.

1 August
0758 Underway to berth 279 to remove YO-132 from alongside USS Bayfield (APA-33).
0820 Moored to YO-132.
0837 Underway with YO-132 in tow, proceeded to berth 207.
0850 CTG 1.8 directed Sioux and Munsee to report to CTU 1.2.7 for temporary duty in connection with decontamination of target vessels (Reference 6, p. VII-I-66-B).
0930 Moored YO-132 alongside portside of USS Ajax (AR-6).
0945 Underway, reporting to USS Palmyra (ARS [T]-3) for assignment.
1050 Anchored in vicinity of Palmyra.
1330 Sioux directed to get underway to proceed to target ship USS Wilson (DD-408) where it would embark monitors, then thoroughly wash Wilson using high-pressure water streams (Reference 6, p. VII-I-70-B).
1530 Underway to wash down the hull and superstructure of Wilson.
1615-1730 In vicinity of Wilson, spraying saltwater on hull and superstructure.
1832 Anchored in Bikini Lagoon.

2 August
0800 Sioux's commanding officer reported to USS Reclaimer (ARS-42) for a conference. At completion of conference, proceeded to target ship USS Gasconade (APA-85) and thoroughly washed it down using high-pressure hoses.
1129 CTG 1.8 recommended replacing Sioux and Munsee with Chowanoc and Wenatchee rather than transferring equipment and personnel (Reference 6, p. VII-I-73-B).
1550-1935 Engaged in towing and mooring YF-733.
2041 Anchored off Eneu Island, Bikini.

3 August
0605 Underway to berth 44 to take ARD-29 in tow.
0830-1114 Towed ARD-29 to area off Eneu Island.

7 August
0659-1040 Engaged in towing and mooring YF-733.
1310 Anchored in berth 168, Bikini.

8 August
1602 Underway from Bikini Lagoon to Kwajalein Atoll.

9 August
0848 Moored in berth A-87, Kwajalein.
1542 Underway with APL-27 in tow from Kwajalein to Bikini.

10 August
1200 Entered Bikini Lagoon, preparing to moor APL-27 alongside target ship USS Geneva (APA-86) in berth 21.
1532 Moored APL-27 alongside Geneva in berth 21.
1609 Anchored in berth 168, Bikini.

12 August
1539 Underway to Rongelap Atoll.

13 August
0633 Anchored in Rongelap Lagoon, berth 2.

15 August
1408 Anchored in berth 42, Bikini.

20 August
1114 Moored alongside portside of target ship USS Hughes (DD-410), making fast for towing.
1141 Underway with Hughes in tow alongside starboard.
1324 Placed bow of Hughes in entrance of ARD-29.

1329	Cast off from Hughes and proceeded to anchorage.
1336	Anchored in berth 38, Bikini.
22 August	
0635	Underway with USS Quartz (IX-150) in tow for Kwajalein.
23 August	
1250	Anchored Quartz in berth K-4, Kwajalein.
1405	Underway from Kwajalein to Bikini.
24 August	
0826	Anchored in berth 37, Bikini Lagoon.
25 August	
0538	Underway from Bikini to Kwajalein with ARD-29 in tow.
26 August	
1718	Anchored in berth K-8, Kwajalein.
2 September	
1030-1100	Target vessel LCI-329 moored alongside to deliver oil.
3 September	Departed Kwajalein for Pearl Harbor.

USS SKATE (SS-305)

Crew Size: 53
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 23 August 1946
Crew Location for ABLE: USS Bottineau (APA-235)
Crew Location for BAKER: Bottineau
Shot ABLE Location: 400 yards (366 meters) SSE
Shot BAKER Location: 886 yards (792 meters) SW
Decontamination Location: San Francisco, Mare Island Naval Shipyard
Sunk 1948, off San Diego coast

Task Unit and Function

The submarine Skate was a member of TU 1.2.4 (Submarine Unit), Submarine Division 111. It was a target vessel for CROSSROADS. Its crew was evacuated for both shots.

Shot ABLE (1 July, 0900)

1 July	Moored fore and aft to buoys astern of target ship USS Nevada (BB-36) in berth 161, Bikini. No personnel on board.
1210	Received word by radio that Skate was heavily damaged.
1730	Bottineau, with Skate personnel aboard, anchored in Bikini Lagoon.
2 July	Status of Skate uncertain. Officers and crew on board Bottineau anchored in Bikini Lagoon.
0830	USS Widgeon (ASR-1) reported monitor aboard proceeding to Skate.
0903	Widgeon alongside Skate.
0905	Widgeon reported Skate unsafe to board.
0915	Target vessels Sakawa and Skate reported sour.
0946	Widgeon reported Skate in tow, proceeding to beaching area on Eneu Island (Reference 6, p. VII-I-25-A).
1159	Widgeon reported anchored off beaching area with Skate, awaiting high water (Reference 6, p. VII-I-30-A).
1650	Widgeon reported Skate beached and anchored fore and aft (Reference 6, p. VII-I-33-A).
1800	Skate officers made trip to Eneu Island in small boat and circled Skate. Noted sign on each side reading, "Danger: Keep Clear - Very Radioactive." The superstructure was mangled, but inner and outer hulls appeared to be intact.
5 July	
0713	Small boat with reboarding team departed from Bottineau.
0746	Arrived off Skate.
0825	Boarded Skate.
0850	Entered Skate through the after engine room hatch. With the exception of explosive percentages of hydrogen in battery compartments, encountered no dangerous gases or radioactivity.
1320	Completed opening boat.
1820	Anchored in berth 231, Bikini.
5-23 July	Crew reboarded and lived aboard Skate.

Shot BAKER (25 July, 0835)

24 July	
1030	Completed rigging boat for atom bomb and secured the watch.
1035	Crew evacuated to Bottineau.
1500	Bottineau underway and stood out of the lagoon.
25 July	Skate moored fore and aft to buoy between berths 199 and 299 in Bikini Lagoon.
29 July	
0008	DSM and CTU 1.2.7 informed CJTF 1 and CTG 1.2 that they planned to moor target submarines Skate and USS Parche (SS-384) to buoys being planted on lee side of Ionchebi Island.
1029	USS Achomawi (ATF-148) underway from target array with Skate in tow.
1135	Achomawi directed to moor Skate with salvage anchors and heavy wire using dan buoy to mark location of anchor and to buoy retrieving wire.
30 July	
0916	Achomawi reported washing down Skate. It followed up on experimental sections with freshwater and lye and on another section with diesel fuel (Reference 6, p. VII-I-50-B).
31 July	
0850-1220	Achomawi decontaminated Skate (Reference 6, p. VII-I-60-B).
1 August	
0905	Achomawi commenced washing down Skate (Reference 6, pp. VII-I-64-B and VII-I-56-B).
4 August	
1000	Executive officer boarded for a few minutes with the DSM representative who was making his daily check on radioactivity.
5 August	
1345-1445	Skate boarded by all officers, 19 men, and a radiological monitor. Washed down

USS Skate (SS-305)

topside for 1 hour with handybilly pump. Threw all topside manila lines overboard, as they were very radioactive. Vented pressure from all compartments.

6 August
1415-1515 Five officers and nineteen men boarded Skate and worked to reduce radioactivity. Scrubbed topside with boiler compound for 3/4 hour and washed down with one handybilly pump. Swabbed stern with hydrochloric acid. There was a definite, immediate drop in readings due to the acid swab (Reference 4).

7 August
1315-1450 Four officers and sixteen men boarded Skate for decontamination work. USS Wenatchee (ATF-118) gave Skate a lye bath in the morning. Scrubbed with boiler compound for 3/4 hour and washed down with one handybilly pump (Reference 4).

8 August
1420-1530 A decontamination party of five officers and fifteen men aboard Skate. Wenatchee gave Skate a second lye bath and a 2-hour hosing down with saltwater. Scrubbed for 1 hour with boiler compound. Washed down with one handybilly pump (Reference 4).

9 August
0815 Skate officers and crew transferred from Bottineau to remanned target ship USS Fillmore (APA-83).
0905-1020 Decontamination team aboard. Washed down
1300-1700 topside with two handybilly pumps for 2 hours. Removed wood deck by after bathing hatch (Reference 4).

10 August
0815-1610 Boarding team on Skate. Scrubbed forward of conning tower with trichloroethane. Washed down for 2 hours with two handybilly pumps (Reference 4).

11 August
0830-1405 Working party on board.

12 August
0815-1530 Working party on board.
0930 Radiological monitor and electronics inspection party came on board.
1130-1420 Decontaminated by USS Deliver (ARS-23). Scrubbed topside with boiler compound for 2 hours and washed down with two trim line hoses. Completed treatment using a lye bath (Reference 4).

13 August
0815-1800 Working party aboard Skate. Engaged in decontamination treatment. Scrubbed topside between FTR and AER hatches with boiler compound for a total of 4 hours and washed down with trim line hoses. Swabbed conning tower and periscope shears with hydrochloric acid, washed it off, then repeated the operation.
1005-1045 USS Gypsy (ARSD-1) alongside to deliver anchor and chain.
1500-1730 USS Chickasaw (ATF-83) gave Skate a lye bath (Reference 4).

14 August
0845-1545 Boarding team and monitor aboard. Scrubbed topside with boiler compound for a total of 3 hours and washed down thoroughly with two trim line hoses (Reference 4).

15 August
0930-1600 Boarding term aboard. Scrubbed topside with boiler compound and washed down thoroughly with two trim line hoses for 5 hours. Disposed of wood deck from forward 40 MM platform.
0955 Monitor aboard.

16 August
0645-1545 Boarded with 16-man maneuvering team and monitor; Skate underway. Anchored between berths 166 and 188. Washed down for 4 hours with two trim line hoses.
1545 All hands returned to Fillmore via decontamination barge APL-27 alongside USS Geneva (APA-86).

17 August
0945-1515 Boarding team, monitor aboard. Commenced cutting away line lockers forward of conning towers (Reference 4).

19 August
0830-1500 Decontamination working party aboard Skate for sandblasting. Completed cutting away line lockers forward of conning tower. Washed down with one handybilly pump. Commenced sandblasting hull between conning tower and main induction.

20 August
0900-1500 Decontamination party aboard. Continued sandblasting between conning tower and main induction. Washed between hatch and conning tower for 2 hours with one handybilly pump (Reference 4).

21 August
0845-1515 Boarding team on Skate for topside decontamination work.

The readings for Skate are listed in Table A.12.

22 August
0630 Three-man anchor detail aboard for trip to Kwajalein.

23 August
1010 Underway, towed by ATR-40 to Kwajalein.

24 August
1930 Anchored in berth A-13, Kwajalein.

28 August Towed to San Francisco by USS Fulton (AS-11), arriving there on 22 October.

Table A.12. Radiological readings (R/24 hours) aboard USS Skate (SS-305).

Date	Bow	Conning Tower Forward	Conning Tower Aft	Over Engine Room	Stern	Topside Average
8/5	1.0	3.0	3.0	2.5	1.3	2.16
8/6	1.0	2.5	2.5	2.0	0.6	1.72
8/7	0.46	2.0	2.0	1.5	0.4	1.27
8/8	0.45	1.4	1.1	0.65	0.4	0.80
8/9	0.25	1.4	0.96	0.85	0.38	0.77
8/10	0.58	1.5	2.0	0.82	0.45	1.07
8/12	0.4	1.40	2.0	0.85	0.4	1.01
8/13	0.46	0.89	1.30	0.65	0.32	0.72
8/14	0.45	1.0	0.8	0.55	0.35	0.63
8/15	0.35	0.9	1.0	0.65	0.2	0.62
8/16	0.45	0.8	1.2	0.5	0.2	0.63
8/17	0.35	0.85	0.85	0.45	0.3	0.56
8/21	0.4	0.7	0.6	0.55	0.33	0.52

Source Reference 4.

USS SKIPJACK (SS-184)

Crew Size: 78
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 5 September 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 1,122 yards (1.0 km) SSE
Shot BAKER Location: 800 yards (731 meters) S
Decontamination Location: San Francisco, Mare Island Naval Shipyard
Sunk 11 August 1948, off coast of Southern California

Task Unit and Function

The submarine Skipjack was a member of TU 1.2.4 (Submarine Unit), Submarine Division 111. It was a target vessel during CROSSROADS. Its crew was evacuated for both shots.

Shot ABLE (1 July, 0900)

1 July

1630 USS Reclaimer (ARS-42) proceeded to inspect target ships USS Briscoe (APA-65), USS Fallon (APA-81), and Skipjack (Reference 6, p. VII-I-15-A).

1732 USS Current (ARS-22) requested permission to board target submarines USS Apogon (SS-308) and Skipjack (Reference 6, p. VII-I-17-A).

2 July

1155 Current reported boarding team on Skipjack.

1156 Current reported Skipjack Geiger sweet (Reference 6, p. VII-I-30-A).

1610 Teams A and B and radiological monitor boarded.

2-23 July Crew lived aboard Skipjack.

Shot BAKER (25 July, 0835)

24 July Crew evacuated Skipjack.

28 July Skipjack had one salvage hose buoy and one deep buoy showing. In addition, one of the submarine marker buoys was on the surface. Bubbles were rising in vicinity of hose buoy (Reference 10).

29 July

1528 Attempt to surface Skipjack by blowing forward tanks was unsuccessful (Reference 5, p. 6-D-28).

30 July

1100 USS Coucal (ASR-8) moored near Skipjack; Geiger check showed water 0.1 to 0.3 R/24 hours, buoys 1.5 R/24 hours.

1145 Commenced blowing forward tanks.

1200 No movement on Skipjack. Secured blowing. Connected up after hoses using shallow-water diving outfit.

1300 Blew forward and after tanks. Skipjack did not move from position on bottom. (There were two anchors attached aft and three weights and one anchor forward.)

1430 Secured. Further work on Skipjack required a survey of conditions on the boat by a diver.

1 August

1440 Coucal directed to proceed to submarine area, locate Skipjack, and begin planting necessary moorings to resurface submarine (Reference 6, p. VII-I-69-B).

1735 Coucal reported operations complete, anchored in berth, and rigged mooring for diving on Skipjack. Ready to start diving as soon as radiological conditions permit.

August 2

0835 Coucal reported moored over Skipjack; ready to start diving as soon as radiological conditions permit.

1100 Coucal reported Skipjack on bottom on even keel. Deck of submarine covered with coral (Reference 6, p. VII-I-73-B).

1632 Coucal reported having time to make one more inspection dive before sundown. Directed to remain moored over Skipjack (Reference 6, p. VII-I-75-B).

1930 Coucal reported Skipjack inspected from bow aft to salvage air connection on 2G and 5H main ballast tanks with exception of portside of conning tower. Boat listing 3 to 5°. One-quarter inch fine coral sand silt on forward deck, little aft. Salvaged air connections to number 2A, 2G, and 2H main ballast tanks. No structural damage found (Reference 6, pp. VII-I-75-B, and VII-I-76-B).

3 August

0958-1938 Diving operations conducted on Skipjack by Coucal; no damage discovered by diver. Salvage hoses were found cut and kinked.

4 August

0745-1810 Coucal continued diving operations on Skipjack.

5 August

0800-1715 Diving operations conducted on Skipjack by Coucal. Efforts to salvage Skipjack

were unsuccessful. All ballast tanks except 2A showed air leakage at or near tank tops. Operations on Skipjack secured.

6-9 August — Diving operations conducted on Skipjack.

13 August — Diving operations conducted on Skipjack by USS Widgeon (ASR-1).

14-15 August — Salvage operations on Skipjack continued.

17 August — Minor progress made on salvage of Skipjack.

19 August — Attempts to make tight the tops of the main ballast tanks on Skipjack proceeding slowly.

20 August — Salvage on Skipjack proceeding slowly (Reference 10).

3 September — Skipjack raised; boarded at 1305.

5 September — Skipjack departed Bikini for Kwajalein, towed by USS Gypsy (ARSD-1).

7 September — Arrived at Kwajalein.

11 September — Departed Kwajalein for Pearl Harbor, towed by Coucal and USS Palmyra (ARS [T]-3).

22 September — Arrived at Pearl Harbor.

USS SPHINX (ARL-24)

Crew Size: 155
Bikini Arrival: By 14 June 1946
Bikini Departure: 19 August 1946
Shot ABLE Location: 28 nmi (52 km) ENE
Shot BAKER Location: 20 nmi (37 km) E
Decontamination Location: Los Angeles
Operational Clearance: 14 February 1947
Final Clearance: 23 April 1947

Task Unit and Function

The landing craft repair ship Sphinx was a member of TU 1.8.1 (Repair and Service Unit). Sphinx provided a maintenance and repair facility that was in use 82 percent of the time from 1 June to 25 July. Sphinx personnel repaired boat pool boats.

Shot ABLE (1 July, 0900)

30 June
1415 — Underway to assigned operating areas.

1 July — Steaming in column formation with USS San Marcos (LSD-25), USS Gunston Hall (LSD-5), USS Presque Isle (APB-44), ATA-187, and USS LST-388 in area Packard off Bikini Atoll.
1935 — Anchored in berth 369N, Bikini.

2 July
1357 — Anchored in berth 117, Bikini Atoll.

3-23 July — Routine activities; no contact with target vessels.

Shot BAKER (25 July, 0835)

24 July
1348 — Proceeded out of the harbor.

25 July — Steamed in company with Group II of TG 1.8 in area for BAKER test.
0857 — Proceeded independently to Rongelap Atoll.
1820 — Anchored in berth 6, Rongelap Atoll.

30 July
0640 — Underway en route to Bikini Atoll.
1711 — Anchored in berth 117, Bikini.

2 August
1641 — Anchored in a line between berths S and V, Bikini Atoll.

5 August
1010-1030 — Radsafe investigation party from USS Haven (AH-12) aboard to inspect ship evaporators.

7 August
1135 — Anchored in berth 117, Bikini Atoll.

19 August
1031 — Underway for Kwajalein.

20 August
1245 — Moored to buoy C in berth 19, Kwajalein.

20 August-26 September
At Kwajalein, routine activities.

27 September — Target vessel LCI-329 moored alongside approximately 1 hour.

28 September-27 November
Routine activities.

28 November — Sent two LCVPs and crew to assist firefighting aboard LCI-329.

29 November-11 December
Routine activities.

12 December — Radiological safety party boarded Sphinx to conduct a survey. The survey indicated that the ship was generally free of contamination except for the saltwater system. This contamination occurred to almost all the nontarget ships that had entered Bikini Lagoon during late July or August 1946. The radsafe monitors recommended an acid decontamination of the saltwater system and a remonitoring of the ship upon its arrival at Pearl Harbor and the West Coast. As a result of the survey, Sphinx received a radiological operational clearance to proceed to the West Coast.

13 December — Routine activities.

14 December — Departed for Wake Island.

USS Stack (DD-406)

USS STACK (DD-406)

Crew Size: 102
Bikini Arrival: 22 May 1946
Bikini Departure: 19 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 1,322 yards (1.2 km) NNW
Shot BAKER Location: 2,003 yards (1.8 km) NW
Sunk 24 April 1948 off Kwajalein

Task Unit and Function
The destroyer Stack was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 2. It was a target vessel for shots ABLE and BAKER. Its crew was evacuated before each shot.

Shot ABLE (1 July, 0900)

29 June
1515 Boarding Team D transferred to Bayfield.

30 June
0945 Commenced evacuating personnel, baggage, and records to Bayfield. Boarding Team C left ship.
1047 Reboarding Team B left the ship.
1132 Captain and reboarding Team A left the ship. Completed evacuation of personnel to Bayfield.

1 July Anchored in berth 128, Bikini.

2 July
1016 USS Suncock (AN-80) was informed that all ships in sector were clear and to place teams aboard as desired. Team 5 boarded Stack (Reference 1, Suncock).
1115-1143 USS Conserver (ARS-39) placed a boarding team on Stack (Reference 1, Conserver).
44 Conserver reported Stack Geiger sweet.
425 Commanding officer and reboarding Team A left Bayfield to reboard ship.
1440 Picked up safety monitor from USS Haven (AH-12).
1505 Commanding officer made superficial inspection of vessel before reboarding.
1525 Commanding officer, safety monitor, and Team A reboarded.
1540 Reboarding Team B came on board.
1700 Removed personnel film badges, casualty badges, and pills [sulfur tablets used to measure radiation] from locations topside and below decks.
1740 Reboarding Team C came on board.
1835 Reboarding Team D came on board.

Stack crew living aboard by 3 July.

7 July
0818 Underway to shift anchorages.
0831 Anchored in berth 128.

Shot BAKER (25 July, 0835)

24 July
0805 Commenced evacuating crew to Bayfield.
0855 Reboarding Team C left the ship for Bayfield.
1025 Reboarding Team B left the ship for Bayfield.
1040 Captain and reboarding Team A left the ship for Bayfield. Completed evacuating ship.

1 August
1225 USS Achomawi (ATP-148) underway to Stack.
1316-1400 Achomawi washed Stack down with midship monitor (Reference 1, Achomawi).
1320 Captain, crew, baggage, and records from Stack transferred to USS Rockingham (APA-229).
1402-1420 Hose crew went aboard from Achomawi and washed Stack with lye solution.
1537-1541 Sprayed with lye solution.
1621-1643 Achomawi washed down portside with midship monitor.
1652 Achomawi underway to berth 145 (Reference 1, Achomawi).

2 August
0800 Commanding officer, first lieutenant, and eight men reboarded Stack to decontaminate it.
0936 Achomawi underway for Stack.
1006-1009 Achomawi sprayed Stack with lye solution.
1017-1021 Two men from Achomawi boarded Stack.
1038-1043 Achomawi sprayed Stack with lye solution.
1223-1232 Captain of Achomawi, a civilian, and members of the Achomawi boarding team on Stack.
1314-1330 Achomawi sprayed Stack with lye and boiler compound solution.
1350-1352 Achomawi sprayed Stack with lye and boiler compound solution.
1420-1438 Achomawi washed Stack's portside with water.
1441-1504 Achomawi's party took readings on Stack.
1515 Achomawi underway to berth 377 (Reference 1, Achomawi).
1520 Captain, first lieutenant, and eight men left Stack.

3 August
0731 Achomawi underway for Stack.
0840-0932 Achomawi washed down Stack with saltwater (Reference 1, Achomawi).
0900 Decontamination teams 1 and 2 from Stack boarded Stack to decontaminate it.
0957-1055 Achomawi washed down Stack with saltwater on the portside (Reference 1, Achomawi).
1130 Decontamination teams 1 and 2 left Stack.
1330 Decontamination teams 3 and 4 reboarded Stack to decontaminate it.
1620 Decontamination teams 3 and 4 left Stack.

4 August
0810 Decontamination teams 3 and 4 reboarded Stack.
1015 Decontamination team 3 left Stack.
1230 Decontamination team 4 left Stack.
1320 Decontamination teams 1 and 2 reboarded Stack.
1630 Decontamination teams 1 and 2 left Stack.

6 August
1006 ATA-180 underway to Stack.
1010 ATA-180 working party of one officer and six enlisted men from Stack came aboard to assist in decontamination work.
1110 ATA-180 anchored about 500 yards (457 meters) north of Stack in target array.
1226 ATA-180 underway to wash down Stack with decontamination solution.
1235-1430 ATA-180 washed down Stack.
1430-1500 ATA-180 Geiger monitors took readings on Stack.
1500 ATA-180 underway (Reference 1, ATA-180).

7 August
0920-0955 USS Etlah (AN-79) alongside Stack; placed team aboard (Reference 1, Etlah).

10 August
0830 Captain, engineering officer, gunnery officer, first lieutenant, and eight-man working party reboarded Stack to make visual inspection topsides and below decks.
1020 Engineering officer, gunnery officer, first lieutenant, and part of working party left Stack.
1100 Captain and remainder of working party left ship.

16 August
1345 Captain, first lieutenant, engineering officer, and working party reboarded Stack to hoist anchor.
1720 Engineering officer and 18 men left Stack.
1900 Captain, first lieutenant, and working party left Stack.

19 August
1047-1137 USS Deliver (ARS-23) moored to Stack (Reference 1, Deliver).
1130 Engineering officer, monitor, and seven enlisted men boarded to hoist anchor for towing.
p.m. Towed to Kwajalein by ATA-192. Topside average 0.6 R/24 hours (Reference 7).

20 August Arrived at Kwajalein (Reference 1, ATA-192).

21 August Stack crew (86 enlisted men) transferred from Rockingham to USS Rockwall (APA-230).

28 August Stack decommissioned. All mattresses, linen, blankets, napery, manila lines, and cleaning rags were disposed of if they had been contaminated. All waste material and dirt had been removed from the ship before evacuation on BAKER D-1 (Reference 4).

30 September Topside average 0.25 R/24 hours.

SUMNER, ALLEN M.; see USS ALLEN M. SUMNER (DD-692)

USS SUNCOCK (AN-80)

Crew Size: 43
Bikini Atoll Arrival: By 2 April 1946
Bikini Atoll Departure: 30 August 1946
Shot ABLE Location: 18 nmi (33 km) SE
Shot BAKER Location: 18 nmi (33 km) SE
Decontamination Location: Puget Sound
Operational Clearance: 12 December 1946
Final Clearance: 13 December 1946

Task Unit and Function
The net laying ship Suncock was a member of TU 1.2.7 (Salvage Unit). Suncock's duties included monitoring target vessels, salvaging damaged target vessels after the tests, performing emergency repairs, and fighting fires. Following shot BAKER it assisted in recovering an instrumentation string and 2,000 feet (610 meters) of cable laid by USS Current (ARS-22) before BAKER day.

Shot ABLE (1 July, 0900)

30 June
0900 With USS Oneota (AN-85) placed special moorings for small boats and LCTs off Eneu Island at the request of CTU 1.8.3.

1 July
1542 Ordered to proceed east of array and have a monitor check ATA-192's firefighting equipment.
1557 Requested to provide a radiological report of ATA-192 firefighting equipment.
1558 Suncock reported underway for ATA-192 (Reference 6, p. VII-I-14-A).
1636 Reported proceeding to target ship USS Gasconade (APA-85) (Reference 6, p. VII-I-15-A).
1643 Directed to place team on target ships Gasconade or USS Butte (APA-68).
1657 Boarding Gasconade (Reference 6, p. VII-I-16-A).
1741 Reported Gasconade Geiger sweet.
1810 Requested a firefighting ship to fight the fire in Butte.
1811 Boarding team on target ship USS Cortland (APA-75).
1817 Reported Cortland Geiger sweet but dangerous due to several fires in vicinity of the ammunition (Reference 6, p. VII-I-19-A).
1914 Anchored in berth Peter, Bikini.

2 July
0705 Underway for Butte, resuming salvage work begun on ABLE day.
0805 Hove to off starboard quarter of Butte while boarding team went aboard the vessel.
0852 Boarding team came aboard with report on Butte; proceeded toward target vessel USS Barrow (APA-61).
0905 Hove to off starboard side of Barrow; proceeding to Cortland.
1015 Hove to off starboard quarter of Cortland while boarding team went aboard the vessel.
1037 Boarding team returned with report on Cortland; proceeded to seaplanes anchored in harbor.
1045 Stopped near anchored planes; boarding team aboard planes.
1050 Boarding team returned aboard with report on planes; proceeding to target ship USS Wainwright (DD-419).
1120 Stopped off bow of Wainwright; boarding team went aboard the vessel.
1135 Boarding team returned with report on Wainwright; proceeding to target ship USS Wilson (DD-408). Hove to off stern of Wilson; boarding team went aboard the vessel.
1201 Boarding team returned with report on Wilson; proceeding to target vessel LCT-705.
1245 Boarding team returned with report on LCT-705; boarding team proceeding to target vessel LCT-1013.

USS Suncock (AN-80)

1258	Boarding team returned with report on LCT-1013; underway for USS Wharton (AP-7) to return boarding team.
1410	Hove to off portside of Wharton; boarding team disembarked.
1412	Underway for berth P.
1558	Anchored in berth P off Eneu Island.
4 July	
1015	Underway to inspect stern buoy on target ship USS Arkansas (BB-33).
1055-1230	Moored to stern buoy of Arkansas to inspect buoy.
1250-1410	Moored to target ship USS Pensacola's (CA-24) stern buoy to work on it; underway to USS Palmyra (ARS[T]-3).
1605	Anchored in berth 88, Bikini.
6 July	Moored alongside USS Ottawa (AKA-101).
7 July	
0753	Underway to buoy array.
0832	Anchored outside buoy array to await clearance of target ship Nagato.
1240-1412	Commenced connecting leg to buoy in vicinity of Oneota.
1446	Alongside USS Rolette (AKA-99).
8 July	
0619	Underway for mooring array to plant mooring buoy.
0710	Maneuvered into position to plant buoy.
0820-1132	Planted mooring buoy.
1155	Alongside Rolette.
1630	Underway to plant buoy; dropped stern anchor.
1840	Completed planting of buoy; underway for Rolette.
1914	Moored to Rolette.
9 July	
0550	Underway to buoy array to plant mooring buoy.
0810	Proceeding to plant clumps for buoy.
0840	Completed dropping clumps.
1035	Alongside Ottawa to collect mooring gear.
1250	Underway to buoy array to attach leg to buoy clump.
1320-1410	Attached leg to buoy clump.
1515	Alongside Ottawa to receive mooring gear.
1820-1842	Planted mooring gear in buoy array and dropped clumps.
1846	Moored between buoys for the night.
10 July	
0831	Anchored in berth 128, Bikini.
11 July	
1413-1604	Alongside Rolette.
1612	Anchored in berth 56A, Bikini.
12 July	
0805	Underway to buoy array.
0900-1020	Planted buoy in array.
1021	Underway to cut loose buoy.
1130	Completed cutting buoy and secured it to target vessel LCT-816.
1210	Anchored in berth 21A, Bikini.
1512-1601	Alongside USS Henrico (APA-45).
1629	Anchored in berth 57, Bikini.
13 July	
0912	Underway to vicinity north of target ship USS Nevada (BB-36) and then standby to receive wire from target vessel ARDC-13.
1045	Anchored north of Nevada near berth 143.
1458	Underway in vicinity north of Nevada awaiting orders to attach leg assembly alongside ARDC-13.
1730	Cast off ARDC-13.
1833-1839	Attached leg assembly.
1907	Completed dropping leg assembly; proceeded to anchorage near USS Fall River (CA-131).
1943	Anchored off Fall River near berth 91, Bikini.
14 July	
0745	Underway to Oneota.
0828-0745	Moored to Oneota.
1144-1255	Anchored off Henrico.
1255	Underway for Oneota to attach leg assembly to mooring.
1355	Moored to Oneota.
1405-1445	Attached mooring leg to mooring, commenced stretching leg.
1458	Planted leg; proceeded to Ottawa to load mooring leg assembly.
1730	Moored to Oneota.
1800-1830	Attached mooring leg to mooring; commenced stretching leg.
1849	Completed laying leg assembly; proceeded to anchorage.
1926	Anchored north of berth 35, Bikini.
15 July	
0923	Underway to go alongside Oneota [moored off stern of target ship USS Saratoga (CV-3)].
1020-1045	Attached leg to buoy; commenced stretching leg.
1105	Dropped leg; proceeded to Ottawa to receive mooring gear.
1725	Underway from Ottawa to target ship USS Salt Lake City (CA-25) to plant buoy.
1829-1842	Planted buoy; proceeded to anchorage.
1900	Anchored near berth 144A, Bikini.
16 July	
0745	Underway to Ottawa and Henrico.
1440	Received buoy via LCM to complete mooring assembly.
1520	Underway for vicinity of target ship USS New York (BB-34).
1620-1725	Planted buoy.
2001	Anchored off USS Tombigbee (AOG-11).
17 July	
1457	Anchored in berth 207A, Bikini.
19 July	
1326	Proceeding to target ship Nagato; simulated boarding of Nagato.
1420	Anchored in berth 88, Bikini.
1753	Anchored near berth 108, Bikini.
20 July	
0915	Underway to vicinity of Saratoga.
0945-1430	Moored to stern buoy of Saratoga; planted all buoys while in vicinity of Saratoga.
1520	Anchored south of berth 116, Bikini.

USS Suncock (AN-80)

23 July

0630	Salvage boat came alongside starboard side, commenced taking on 1-inch wire.
0750	Finished taking on 1-inch wire; commenced transferring heavy weights to salvage boat.
1041	Finished attaching heavy weights to horns.
1110	Underway to moor to stern of Nevada to plant ballons 100 feet (91 meters) off stern of Nevada.
1130	Moored to stern of Nevada.
1140	Commenced planting heavy weights.
1544	Finished planting heavy weights astern of Nevada. Proceeding to plant heavy weights between Nevada and Nagato.
1658	Anchored between Nevada and Nagato.
1700	Commenced planting heavy weights.
1828	Proceeding to plant heavy weights between Nevada and Arkansas.
1845	Commenced planting heavy weights near Nevada.
2310	Finished planting heavy weights; proceeding to anchor near Fall River.
2340	Anchored off starboard quarter of Fall River.

Shot BAKER (25 July, 0835)

24 July — Suncock and others made preparations for sea after working throughout the night assisting in submerging submarines (Reference 6, p. VII-I-3-B).

25 July

1112	Underway to special BAKER Day berth off Eneu Island.
1143	Anchored in berth R, off Eneu Island.
1151	Underway to Cortland.
1241	Moored alongside portside of Cortland with lines over. Boarding team went aboard Cortland.
1306	Boarding team back aboard. Proceeding to vicinity north of Cortland to await orders.
1402	Proceeding to target ship USS Carteret (APA-70).
1412	Alongside starboard side to portside of Carteret; unsafe for boarding, proceeding to vicinity north of Carteret, awaiting orders.
1423	Stopped north of Carteret.
1436	Proceeding to go alongside Carteret.
1450	Alongside starboard side of Carteret, proceeding to vicinity north of Carteret.
1545	Underway, proceeding to go alongside portside of Carteret.
1554	Alongside portside of Carteret. Geiger sour condition. Proceeding to vicinity north of Carteret.
1559	Stopped in vicinity north of Carteret.
1612	Underway, proceeding to berth R.
1630	Made inspection of engine room and water intake to determine radiological condition (condition normal).
1702	Anchored in berth R off Eneu Island.

28 July

0347	Shifted to berth 379. Suncock and Oneota assigned to unload chain and anchors from Ottawa to be used for Test CHARLIE (Reference 6, p. VII-I-83-B).

29 July — Anchored near berth 399.

30 July

0227-0325	Shifted to berth R to lee of Eneu Island.

31 July

0835	Directed to go alongside Ottawa to assist in loading anchors and chains (Reference 6, p. VII-I-58-B).
1530	Underway from mooring array to take on water.
1758	Completed taking on water from USS Wildcat (AW-2) (Reference 6, p. VII-I-64-B). Moored in berth R.

1 August — USS Etlah (AN-79), Suncock, and USS Mender (ARSD-2) remained at anchor in berth R on standby status (Reference 6, p. VII-I-66-B).

2 August — Shifted to berth 379.

3 August — Suncock was directed to proceed to USS Fulton (AS-11) to embark instrumentation team, then to proceed and recover instrument string and 2,000 feet (610 meters) of cable laid by Current before BAKER day (Reference 6, p. VII-I-76-B).

4-6 August — Anchored in berth.

7 August

0849	Boarding Team #10 reported aboard; underway to Gasconade.
0925-1112	Boarding teams aboard Gasconade; underway to circle Gasconade to take photographs.
1150	Laying to off Wharton.
1155	Boarding team disembarked for Wharton.
1245	Anchored in berth R off Eneu Island.
1425	Anchored in berth 88, Bikini.

8 August

0825	Boarding team #10 came aboard from Wharton; proceeded to target ship USS LST-545 to place boarding team #10 aboard.
0850-0900	Moored to LST-545; boarding team aboard LST-545.
0917-0925	Moored to target ship USS LST-661 while boarding team boarded.
0945-0953	Moored to target ship USS LST-52 while boarding team boarded.
1004-1012	Moored to target ship USS LST-133 while boarding team boarded.
1032-1055	Moored alongside target ship USS Crittenden (APA-77) while boarding team boarded.
1121	Disembarked boarding team #10 to Wharton.
1140	Anchored in berth 88, Bikini.

9-11 August — Anchored in berth 88.

12 August

1106	Underway to assist USS Coucal (ASR-8) in mooring buoys.
1115-1132	Stopped near Gasconade to hoist buoy on deck.
1157	Began planting buoy off bow of Coucal in line with bow of target ship USS Pennsylvania (BB-38).
1159	Completed dropping anchor.
1253	Completed planting buoy on bearings; proceeding to buoy off Pennsylvania.
1310-1318	Stopped off stern of Pennsylvania to hoist buoy on deck; proceeding to plant buoy off Coucal in line with bow of Pennsylvania.

USS Suncock (AN-80)

1358	Completed planting buoy.
1421	Anchored in berth 88, Bikini.
13 August	Anchored as before.
14 August	
0859	Underway to go alongside target submarine USS Parche (SS-384) to clear Parche's fouled anchor.
0930-1110	Alongside Parche to clear fouled anchor.
1118-1201	Anchored in vicinity of Parche; hoisted inoperative motor launch aboard.
1242	Underway to vicinity south of Nevada to recover small cylinder marker buoy.
1309-1345	Stopped south of Nevada; hoisted buoy on deck and secured collapsible balloon to it.
1435	Anchored in berth 54, Bikini.
15 August	
0807	Underway to Crittenden to clear fouled anchor.
0840	In vicinity of Crittenden, awaiting arrival of monitor; captain and working party of Crittenden aboard.
0940	Monitor arrived and boarded Crittenden.
0954-1700	Moored alongside Crittenden.
1650	Cleared and housed fouled Crittenden anchor.
1700	Underway from Crittenden to Palmyra.
1721	Crittenden captain and men disembarked.
1735	Anchored in berth 54A, Bikini.
16 August	
0755	Underway to target ship USS Dawson (APA-79) to furnish power to hoist anchor.
0825	In vicinity of Dawson, awaiting arrival of monitor.
0835	Monitor aboard Dawson.
0845	Moored alongside Dawson.
1153	Underway to Gasconade to assist Etlah in clearing fouled anchor.
1225	Moored to stern of Gasconade.
1320	Proceeding to go alongside target ship USS Briscoe (APA-65) to furnish power to hoist anchor.
1330	Moored alongside Briscoe.
1540	Underway to USS Chikaskia (AO-54) to take on fuel.
1747	Anchored in berth 54 after refueling.
17 August	
0824	Underway for Pennsylvania to furnish power to hoist anchor.
0850	In vicinity of Pennsylvania, awaiting arrival of monitor and working party.
0920	Officer in charge of working party came aboard.
1020	Unable to furnish power to hoist anchor; officer and working party left ship.
1334	After taking on water from Wildcat, anchored in 54A.
18-23 August	Anchored as before.
24 August	
0843	Underway to go alongside Barrow to furnish power to hoist and house anchor.
1121-1255	Moored to Barrow, hoisting and housing anchor.
1310	Moored alongside target ship USS Brule (APA-66) to hoist and house anchor.
1312	Passed power line to Brule.
1554	Anchor on Brule fouled; tools, working party on board, having received tolerance for day (daily allowable tolerance at CROSSROADS was 0.1 R/24 hours); took in power line.
1602	Underway from Brule to anchorage.
1640	Anchored in berth 54A.
25 August	
0827	Underway to go alongside Brule to furnish power to house anchor.
0847	Monitor and working party aboard Brule.
0916	Moored alongside Brule.
0921	Ship-to-shore powerlines connected up and furnished power to anchor windlass on Brule.
1233	Finished furnishing power to Brule; completed housing Brule's anchor.
1244	Cast off lines from Brule.
1300	Transferred monitor and working party to Palmyra.
1318	Anchored in berth 54A, Bikini.
26 August	
0855	Underway to go alongside target ship USS Catron (APA-71).
0925	Moored alongside Catron.
0935	Commenced furnished power for hoisting Catron's anchor.
1415	Underway from Catron to anchorage.
1502	Anchored in berth 91.
27 August	
1110	Underway to go alongside target ship USS Banner (APA-60) to furnish power to hoist anchor.
1113	Assistance not needed, returning to anchorage.
1119	Anchored in berth 91.
28 August	
0838	Underway to go alongside target ship USS LST-220 to furnish power for housing anchor.
0847	Moored to LST-220.
1122	Forward anchor of LST-220 housed and secured; USS Preserver (ARS-8) took LST-220 in tow.
1124	Clear of LST-220; underway for anchorage.
1155	Anchored in berth 128.
1320	Underway.
1338	Moored to Butte.
1558	Butte's anchor housed; disconnected powerline; USS Munsee (ATF-107) took Butte in tow.
1605	Underway to moor alongside target ship LST-545.
1657	Moored to LST-545.
1835	LST-545 anchor housed; USS Clamp (ARS-33) took LST-545 in tow.
1900	Anchored in berth 109, Bikini.
29 August	Anchored as before.
30 August	
0645	Underway to go alongside target ship USS Rhind (DD-404) to take it in tow.
0711	Moored alongside Rhind.
0916	Underway from Bikini en route to Kwajalein with Rhind in tow.
1 September	Arrived at Kwajalein.

2 September — Underway from Kwajalein to Pearl Harbor with Etlah in tow.

USS SYLVANIA (AKA-44)

Crew Size: 208
Bikini Atoll Arrival: 19 April 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 22 nmi (41 km) NE
Shot BAKER Location: 17 nmi (31 km) E
Decontamination Location: Puget Sound
Operational Clearance: 7 December 1946 (Seattle)

Task Unit and Function
The attack cargo ship Sylvania was a member of TU 1.8.5 (Survey Unit). USS Rolette (AKA-99) was initially designated as intratransit cargo ship. Upon Rolette's departure following Test BAKER, Sylvania took over the handling of intratransit cargo.

Shot ABLE (1 July, 0900)

28 June — Anchored at Rongelap Atoll.

30 June
1541 — Underway from Rongelap Atoll en route to area Packard.

1 July
0700 — Arrived area Packard.
0705 — Commenced steaming in company with USS Bowditch (AGS-4) to join TG 1.8.
0805 — Joined TG 1.8 in column formation.
0925 — En route to Rongelap, Rongerik, Ailinginae area to conduct oceanographic survey.
1624 — Commenced steaming on various courses to conform with oceanographic survey in vicinity of Ailinginae, Rongelap, and Rongerik atolls.

2-4 July — Continued oceanographic survey.

4 July
2100 — Departed Rongelap Atoll area for Bikini Atoll.

5 July
1105 — Anchored in berth 231A, Bikini Atoll.

6-23 July — Routine operations not involving target vessels.

Shot BAKER (25 July, 0835)

24 July
1424 — Underway proceeding to survey area of Bikini Atoll.

25 July — Steaming independently en route to area Packard, conducting oceanographic survey.
0600 — Took station in column formation astern of USS San Marcos (LSD-25).
0844 — En route to Rongelap Atoll.
1400 — Anchored at Rongelap Atoll.

30 July
1651 — Underway from Rongelap Atoll to Bikini Atoll.

31 July
1001 — Anchored in berth 40, Bikini.

2 August
1708 — Anchored in berth Mike, Bikini Atoll.

7 August
0848 — Anchored in berth 40, Bikini Atoll.

13 August
1315 — Crew of target ship USS Gasconade (APA-85) received aboard for billeting.

25 August — Underway from Bikini to Kwajalein.

26 August
0850 — Anchored in berth 172, Kwajalein.

27 August
1453 — Underway for Pearl Harbor.

TALBOT, RALPH M.; see USS RALPH M. TALBOT (DD-390)

USS TELAMON (ARB-8)

Crew Size: 158
Bikini Atoll Arrival: By 14 June 1946
Bikini Atoll Departure: 15 August 1946
Shot ABLE Location: Anchored at Kwajalein
Shot BAKER Location: 16 nmi (30 km) NE
Decontamination Location: Los Angeles
Operational Clearance: 12 December 1946
Final Clearance: 21 December 1946

Task Unit and Function
The base repair ship Telamon was a member of TU 1.8.1 (Repair and Service Unit). It was part of the maintenance and repair facility.

Shot ABLE (1 July, 0900)

1 July — Anchored in berth K-18, Kwajalein Harbor.
1630 — Underway en route Bikini Atoll.

2 July
1507 — Anchored at berth 146S, Bikini Atoll.

7 July
1652 — Anchored in vicinity of target ship USS Independence (CVL-22).

9 July
1459 — Anchored south of berth 129, Bikini.

12 July
1318 — Anchored in berth 146S, Bikini Harbor.

Shot BAKER (25 July, 0835)

24 July
1405 — Underway from Bikini Harbor to Rongelap Atoll in company with Group II, CTU 1.8.7, via Packard area.

25 July
1649 — Anchored in berth 10, Rongelap Harbor.

30 July
0703 — Underway from Rongelap to Bikini.
1606 — Anchored in berth 146S, Bikini.

2 August
1618 — Anchored between berths S and V, Bikini.

7 August
0912 Anchored in berth 146S, Bikini.

14 August
1047 Anchored in berth 62, Bikini.

15 August
1509 Underway from Bikini with LCT-1359 in tow for Pearl Harbor.

26 August
1129 Moored in berth T-5, Pearl Harbor.

USS TOMBIGBEE (AOG-11)

Crew Size: 86
Bikini Atoll Arrival: By 14 June 1946
Bikini Atoll Departure: 21 August 1946
Shot ABLE Location: 21 nmi (39 km) NNE
Shot BAKER Location: Anchored at Rongelap Atoll
Decontamination Location: Los Angeles
Operational Clearance: 31 December 1946
Final Clearance: 4 January 1947

Task Unit and Function
The gasoline tanker Tombigbee was a member of TU 1.8.1 (Repair and Service Unit). It provided fuel for the task force.

Shot ABLE (1 July, 0900)

1 July
1810 Entered Bikini Lagoon.
1845 Anchored in berth 343.

2 July
0932 Underway.
1023-1206 Moored alongside USS San Marcos (LSD-25), berth 94N.
1250 Anchored in berth 343.

3 July
0931 Underway.
1016-1304 Alongside target vessel YOG-83.
1400-1556 Moored alongside USS Presque Isle (APB-44), berth 95.
1640-1840 Alongside target ship USS LST-220.
1846 Anchored berth 33.

4 July
0830 Underway.
0941-1025 Alongside target ship USS Hughes (DD-410).
1057-1310 Moored alongside USS Gunston Hall (LSD-5).
1350-1445 Alongside target ship USS Mustin (DD-413).

5 July
0933-1351 Alongside target ship Prinz Eugen.

There was no further contact with target vessels until after BAKER.

24 July Departed Bikini for Rongelap Atoll.

Shot BAKER (25 July, 0835)

25 July
0835 Anchored at Rongelap Atoll.

31 July
0635 Entered Bikini Lagoon.
0711-1103 Moored alongside USS Enoree (AO-69), berth 305.
1134-1650 Alongside USS Severn (AO-61), berth 370.
1702 Anchored berth 343.

1 August
0821 Underway.
0913-1306 Moored alongside USS Mount McKinley (AGC-7), berth 112.
1326-1523 Moored alongside USS LST-388, berth 68.
1553-1643 Moored alongside USS Quartz (IX-150), berth 108.
1655 Anchored berth 147.

2 August
1000 Underway.
1047-1417 Moored alongside USS Saidor (CVE-117), berth 34.
1527 Anchored berth Peter Roger.

4 August
0900 Underway.
0925-1028 Moored alongside USS Sphinx (ARL-24), berth 117.
1058-1350 Anchored.
1415-1425 Anchored in berth 380.
1505-1830 Moored alongside USS Rockbridge (APA-228), berth 222.
1842 Anchored berth 334.

9 August
1229-1505 Alongside Prinz Eugen.

14 August
1203-1516 Moored portside to target ship USS Fillmore (APA-83) to discharge freshwater.
1335-1514 Target vessel LCI-329 moored starboard to receive freshwater.

19 August
1350-1745 Alongside target ship USS Bladen (APA-63).

20 August
1119-1322 Alongside target ship USS Niagara (APA-87).

21 August
1244 Departed Bikini Lagoon for Kwajalein.

22 August
1258 Anchored in Anchorage A, berth F, Kwajalein.

23 August
1016-1328 Alongside target ship USS Cortland (APA-75).

24 August
0907-1311 Alongside Bladen to discharge freshwater.

26 August
1356-1613 Alongside Niagara.

28 August
1507-1644 Alongside Bladen.
1702-1805 Alongside Cortland.

5 September
1030 Departed Kwajalein for Pearl Harbor.

USS TRIPPE (DD-403)

Crew Size: 135
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 20 August 1946
Crew Location for Shot BAKER: USS Bayfield (APA-33)
Shot ABLE Location: 18 nmi (33 km) NE
Shot BAKER Location: 1,320 yards (1.2 km) NNW
Sunk 3 February 1948 near Kwajalein

Task Unit and Function
The destroyer Trippe was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 4. It was a target vessel for BAKER.

Shot ABLE (1 July, 0900)

1 July — Steaming independently in area Hudson with USS Laffey (DD-724) and USS Walke (DD-723).
0911 — Anchored in berth 341, Bikini Lagoon.

2 July
1332 — Anchored in berth 130A, Bikini.

12 July — Anchored in berth 129, Bikini.

16 July
1108 — Underway to shift berths.
1133 — Anchored 610 yards (558 meters) from target ship USS Nevada (BB-36).
1335 — Seven men were evacuated to USS Bayfield (APA-33).

17 July
0939 — Anchored 510 yards (466 meters) from Nevada.
1330 — Transferred three men to Bayfield for transfer of personnel prior to test BAKER.

18 July
1100 — Completed evacuation of all personnel to Bayfield for William Day rehearsal.

19 July
1432-1445 — Reboarding teams returned from Bayfield to put Trippe in operating condition.

23 July
1400 — Evacuated 40 men to Bayfield.

24 July
1015 — Evacuated all remaining personnel.
1030 — All personnel reported aboard Bayfield.

Shot BAKER (25 July, 0835)

28 July — DSM reported Geiger readings of 0.6 R/24 hours at 250 feet (76.2 meters).

30 July — DSM reported Geiger readings of 1.5 R/24 hours at 100 feet (30.5 meters).

1 August — ATA-192 directed to proceed to target ships USS Mayrant (DD-402) and Trippe for a thorough washing with high-pressure hoses.
1016 — ATA-192 completed its work on Mayrant and began work on Trippe.
1430 — Entire Trippe crew transferred to USS Bexar (APA-237).

6 August — Sprayed and washed down by ATA-192.

7 August — Geiger readings topside averaged 4.0 R/24 hours, topside maximum 15.0 R/24 hours; below deck average 1.0 R/24 hours, below deck maximum 6.0 R/24 hours.

8 August — Bridge superstructure 2.4 R/24 hours, after deck house 0.8 R/24 hours, fantail 0.4 R/24 hours; sprayed and washed by USS Achomawi (ATF-148).

9 August — Geiger readings report: forecastle average 0.4 R/24 hours, main deck average 2 R/24 hours, engineering spaces average 0.3 R/24 hours.

10 August
1026 — Commanding officer and inspection party aboard. Geiger readings topside average 2.0 R/24 hours, topside maximum 100.0 R/24 hours [sic]; below deck average 0.7 R/24 hours, below deck maximum 2.5 R/24 hours; inside #1 gun mount 80.0 R/24 hours. No information available regarding time aboard Trippe. [Note: topside maximum listed in the boarding reports believed to be in error, since the maximum topside value on 7 August was 15 R/24 hours.]

12 August
1600 — Trippe unit transferred to USS Dixie (AD-14).

15 August — Staff inspection completed on Trippe and made available for disposition by CTG 1.2.

20 August — Towed from Bikini to Kwajalein by ATR-87.

22 August — Arrived at Kwajalein.

28 August
1100 — Trippe decommissioned.

USS TUNA (SS-203)

Crew Size: 57
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 22 August 1946
Crew Location for Shot ABLE: USS Bottineau (APA-235)
Crew Location for Shot BAKER: Bottineau
Shot ABLE Location: 2,194 yards (2.0 km) NNE
Shot BAKER Location: 1,800 yards (1.6 km) SSW
Decontamination Location: San Francisco
Sunk 24 September 1948, off southern California coast

Task Unit and Function
The submarine Tuna was a member of TU 1.2.4 (Submarine Unit), Submarine Division 111. It was a target vessel for CROSSROADS.

Shot ABLE (1 July, 0900)

30 June
0908 — Received evacuation signal from CJTF 1.
1210 — Rigged in accordance with Submarine Supplement of Instructions to Target Vessels of CROSSROADS Project. Evacuated remaining 17 men and 4 officers in accordance

30 June

with CJTF 1 Operation Plan 1-46 and proceeded to Bottineau for billeting.

1 July

1539 USS Etlah (AN-79) ordered to check water around Tuna carefully before boarding (Reference 6, p. VII-I-12-A).

1542 Etlah reported Tuna not boarded.

1545 Etlah reported Tuna Geiger sour (Reference 6, p. VII-I-13-A).

2 July

0724 Etlah proceeding to Tuna.

0739 Etlah reported boarding team on Tuna (Reference 6, p. VII-I-20-A).

0800 Etlah reported Tuna Geiger sweet (Reference 6, p. VII-I-21-A).

1147-1425 Commanding officer, radiological monitor, three officers, and thirty men reboarded ship for inspection. Conditions normal, commenced normal routine.

1610 Remaining men came aboard.

3 July

1545 Underway for USS Fulton (AS-11).

1645 Moored to target submarine USS Searaven (SS-196) in nest alongside Fulton in anchorage 231.

9 July

0915 Underway for anchorage.

1015 Anchored in Bikini Lagoon.

Shot BAKER (25 July, 0835)

24 July

0920 USS Widgeon (ASR-1) anchored off starboard beam and commenced submergence operation.

1?70 Tuna secured for submergence; four officers and twenty men disembarked to Widgeon.

.115 Widgeon commenced venting Tuna for submergence in accordance with instructions of CROSSROADS Submarine Unit.

1400 Submergence completed. Four officers and remaining crew disembarked for Bottineau.

25 July

1638 USS Reclaimer (ARS-42) backed away from area of Tuna (submerged). Water very radioactive. Also a report was received that one of the submerged submarines (believed to be Tuna) was sighted in its normal submerged position (Reference 6, pp. VII-I-13-B and VII-I-15-B).

27 July

0924 Reclaimer sighted Tuna in submerged position, apparently undamaged (Reference 6, p. VII-I-20-B).

1135 USS Coucal (ASR-8) surfaced Tuna using normal surfacing procedure, Geiger reading 8.0 R/24 hours. No apparent damage (Reference 10).

1645 Reclaimer inspected surfaced Tuna (Reference 6, p. VII-I-24-B).

28 July

0845 Reclaimer passed target submarines Tuna and USS Dentuda (SS-335). Tuna showed signs of flooding and starboard list (Reference 6, p. VII-I-27-B).

USS Tuna (SS-203)

1000 Coucal directed Etlah to remove Tuna's anchors, stern anchors first.

1012 Etlah directed to take anchors recovered from Tuna to wet storage off Ionchebi Island.

1020 Etlah moored portside to Tuna.

1050 Completed operations, underway.

1101 Etlah reported all anchors had been removed; all had to be burned off (Reference 6, p. VII-I-29-B).

1245 USS Chickasaw (ATF-83) directed to take Tuna in tow to buoy in lee of Rochikari Island and to buoy its anchors when cutting them out (Reference 6, p. VII-I-31-B).

1643 Chickasaw reported Tuna secured to buoy in vicinity of berth 251 (Reference 6, p. VII-I-33-B).

It was decided that evening that all remaining ballast tanks of Tuna should be blown (Reference 6, p. VII-I-35-B).

29 July Widgeon directed to wash down Tuna after blowing its ballast tanks (Reference 6, p. VII-I-36-B).

1300 Topside washed down (Reference 6, p. VII-I-43-B). Geiger reading 3.5 R/24 hours (Reference 10). Prior to washdown Geiger reading 4.0 R/24 hours.

1327 Widgeon reported all ballast tanks on Tuna completely vented, deck valves were secured.

30 July USS Achomawi (ATF-148) took aboard USS Wharton (AP-7) boarding team, then proceeded to target submarines Tuna and USS Skate (SS-305) and washed down with high-pressure streams, taking readings before and after (Reference 6, p. VII-I-49-B).

1725 Achomawi reported readings on Tuna before washing down. No appreciable changes after washing down with seawater and foamite (Reference 6, p. VII-I-55-B).

31 July Given a lye bath (Reference 4).

1 August

1245 Commanding officer, 3 officers, radiological monitor, and 18 enlisted men reboarded and commenced reentering procedure and inspection of boat.

1710 Secured boat and evacuated. Below decks radioactivity within tolerance. Damage was negligible (Reference 10).

2 August

0920 Commanding officer, officers, radiological monitor, and crew reboarded to continue inspection, testing, and decontamination work. About half the electrical equipment was operating and work continued. There was no indication on preliminary inspection that any electrical equipment had been damaged (Reference 10). Tuna was decontaminated using saltwater wash and lye bath on bridge (Reference 4).

1610 Secured ship and evacuated.

3 August

0930 Commanding officer, officers, and radiological monitor reboarded to continue inspection, testing, and decontamination work.

0950 Entire crew aboard, including monitor. Decontamination process continuing. Ship decontaminated using saltwater wash. Tuna was below radiological tolerance inside pressure hull (Reference 10).
1620 Boat secured and evacuated.

4 August
0835 Commanding officer, officers, radiological monitor, and crew reboarded to continue inspection, testing, and decontamination work. Decontamination continued with saltwater wash, and lye bath for bridge, gun mount, and hull induction (Reference 4).
1559 Boat secured and evacuated.

5 August
0925 Executive officer, officers, radiological monitor, and crew reboarded to continue inspection, testing, and decontamination work. Officers and crew of target submarine USS Skate (SS-305) completed temporary additional duty this date. Completed inspection of electrical equipment. All electrical equipment operable. Tuna completely cleaned up inside and all machinery was tested except bow planes (Reference 10). Saltwater wash administered (Reference 4).
1558 Boat secured and evacuated.

6 August
0905 Commanding officer, officers, radiological monitor, and crew reboarded to continue inspection, testing, and decontamination work. Saltwater wash; lye bath for bridge, gun mount, and hull induction; carbon dioxide sprayed on main induction (Reference 4).
0945 Commenced battery charge.
1545 Secured battery charge.
1805 Secured boat and evacuated.

7 August
1000 Commanding officer and crew with radiological monitor reboarded to continue inspection, testing, and decontamination work. Saltwater wash administered (Reference 4).
1515 Stationed the maneuvering watch.
1530 Underway to recover anchor.
1620 Completed recovery of anchor; anchor housed.
1630 Moored to buoy off Ionchebi Island.
1645 Boat secured and entire crew evacuated.

8 August
0905 Commanding officer, officers, crew, and radiological monitor reboarded to continue inspection, testing, and decontamination work. Saltwater wash administered (Reference 4).
1615 Boat secured and evacuated.

9 August
0915 Commanding officer and crew returned to boat to continue decontamination and repair work. Saltwater wash administered (Reference 4).
1620 Boat secured and evacuated.

10 August
0920 Commanding officer and crew returned to boat to continue decontamination and repair work. Saltwater wash administered (Reference 4). All Geiger readings below daily tolerance (Reference 10).

11 August
0830 Commanding officer and crew returned to boat to continue repair work. Saltwater wash administered (Reference 4).
1645 Boat secured and evacuated.

12 August
0810 Commanding officer and crew returned to boat to continue decontamination and repair work. Saltwater wash administered (Reference 4).
1610 Boat secured and evacuated.

13 August
0815 Commanding officer and crew returned to boat to continue decontamination and repair work.
1545 Secured boat and evacuated.

14 August
0830 Commanding officer and crew returned to boat to continue decontamination and repair work.
1630 Boat secured and evacuated. Secured battery charge.

15 August
0830 Commanding officer and crew returned to boat to continue decontamination and inspection work.
1100 Underway to shift berths.
1112 Anchored in a position south of remanned target ship USS Fillmore (APA-83).
1710 Boat secured and evacuated.

16 August
0835 Commanding officer and crew returned to boat to continue decontamination and repair work.
1550 Boat secured and evacuated.

17 August
0820 Commanding officer and crew returned to boat to continue decontamination and repair work.
1610 Boat secured and evacuated.

18 August
0825 Officers and crew returned aboard to resume decontamination work.
1550 Boat secured; officers and crew evacuated to Fillmore.

19 August
0828 Officers and crew returned aboard, opened up boat, and resumed decontamination work.
1000-1100 Radiological inspection party aboard to inspect boat.
1600 Boat secured; officers and crew evacuated to Fillmore.

20 August
0850 Officers and crew reboarded; resumed decontamination work.

20 August

1600 Boat secured; officers and crew evacuated to Fillmore.

21 August

0845 Officers and crew reboarded and resumed decontamination work.

Geiger readings aboard Tuna are listed in Table A.13.

Table A.13. Geiger readings (R/24 hours) aboard USS Tuna (SS-203).

	Maximum Topside	Average Topside	Average Below Decks
1 August	---[a]	1.0	0.08 - 0.1
2 August	---	0.85	<0.1
3 August	0.95	0.86	<0.1
4 August	---	0.45	<0.1
5 August	---	0.41	<0.1
6 August	---	0.47	<0.1
7 August	---	0.36	<0.1
8 August	---	0.18	<0.1
9 August	---	0.27	<0.1
10 August	0.08	0.05	0.02
11 August	---	0.05	---
12 August	---	0.11	---
13-14 August[b]			
16 August	0.13	0.1[b]	---

Notes:

[a] No reading available.

[b] On 13-14 August and after 16 August all topside readings taken from a height of 2 feet (0.61 meter) above deck were 0.10 R/24 hours or lower. Higher readings were noted in those areas where the thickest coats of paint and rust spots were present, specifically the main induction pipe and bridge.

Source: Reference 4.

22 August

0856 Underway for Kwajalein.

23 August

1155 Anchored in berth A-28, south Kwajalein anchorage.

28 August Underway to Pearl Harbor.

7 October Underway to San Francisco.

14 October Moored in San Francisco.

11 December Decommissioned.

USS TURNER (DD-834)

Crew Size: 313
Bikini Atoll Arrival: 5 June 1946
Bikini Atoll Departure: 25 July 1946
Shot ABLE Location: 82 nmi (152 km) SE
Shot BAKER Location: 49 nmi (91 km) SE

Decontamination Location: Not contaminated; did not enter Bikini Lagoon after shot BAKER
Final Clearance: By 22 November 1946

Task Unit and Function

The destroyer Turner was a member of TU 1.6 (Navy Air Group), Destroyer Division 51. It provided patrol and plane guard support for the Navy's air units.

Shot ABLE (1 July, 0900)

30 June

1611 Underway from berth A-1, Roi Island, Kwajalein, to point Tare with USS Shangri-La (CV-38) and USS Charles P. Cecil (DD-835).

1 July

0757 By order of CTG 1.6, Turner detached from formation, proceeded independently in conjunction with fighter direction plan for the atomic bomb test.

0900 Atomic bomb was reported released by bombing plane. No visual effects of bomb explosion were observed from Turner's location.

1200 Began patrolling on station Able outside Bikini Lagoon.

1541 Anchored in berth A-1, Roi, Kwajalein.

2 July

1611 Underway for Bikini Atoll.

3 July

0648 Moored to berth 324, Bikini.
0808 Underway for tour of target array.
0949 Anchored in berth 268, Bikini.
1618 Underway to Roi Island with Shangri-La and Cecil.

4 July

0645 Anchored in berth A-1, Roi, Kwajalein.

13 July

1610 Underway for Point Tare with Shangri-La and Cecil.

14 July

0808 Departed from Shangri-La; proceeded to Point Able in accordance with operation order.

1522 Anchored in berth 144A, Bikini Lagoon.

15 July

1617 Underway in company with Shangri-La and Cecil for Roi Island, Kwajalein Atoll.

16 July

0758 Anchored in berth A-1, Roi Island, Kwajalein Lagoon.

21 July

1734 Underway from berth A-1, Roi Island, Kwajalein Atoll, for Bikini Atoll.

22 July

0925 Anchored in berth A-22, Bikini Atoll.

23 July

1723 Underway for Roi Island, Kwajalein Atoll.

Shot BAKER (25 July, 0835)

24 July
- 0915 Anchored in berth A-1, Roi Island.
- 1551 Underway to proceed in company with Shangri-La and Cecil to Point Tare for BAKER test. Sortie order: Cecil, Turner, Shangri-La.

25 July
- 0817 Detached from formation by order of CTG 1.6. Proceeded independently to Point A. Commenced building up maximum speed. Turner's mission was to assist the fighter direction in conjunction with drone control.
- 0903 Attained maximum speed.
- 1050 Ordered by CTG 1.6 to rejoin formation.
- 1150 Rejoined Shangri-La taking plane guard station No. 1.
- 1452 Detached from assigned duty with Shangri-La and CROSSROADS. Proceeding en route Pearl Harbor.

USS WAINWRIGHT (DD-419)

Crew Size: 148
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 23 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 2,159 yards (2.0 km) NW
Shot BAKER Location: 2,952 yards (2.7 km) NW
Sunk 5 July 1948 near Kwajalein

Task Unit and Function

The destroyer Wainwright was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 2. It had equipment aboard for the Electronics Group's experiments. It was a target vessel for ABLE and BAKER.

Shot ABLE (1 July, 0900)

30 June
- 0400 Wainwright evacuation completed; crew aboard Bayfield.

2 July
- 1140 USS Suncock (AN-80) reported Wainwright Geiger sweet (Reference 6, p. VII-I-29-A).

2-23 July Crew aboard Wainwright.

24 July Crew evacuated to Bayfield.

Shot BAKER (25 July, 0835)

28 July Geiger readings of 0.5 R/24 hours at 100 feet (3.1 meters) reported.

29 July
- 1043 USS Current (ARS-22) placed a boarding team on Wainwright (Reference 6, p. VII-I-39-B). Average Geiger reading 2.5 R/24 hours, maximum 3.5 R/24 hours.

30 July
- 1125 Current reported boarding team back from target ship USS Mugford (DD-389), proceeding to wash down Wainwright (Reference 6, p. VII-I-52-B). Average Geiger reading 1.5 to 2 R/24 hours.
- 1316 Current reported boarding team returned from Wainwright; standing by for instructions (Reference 6, p. VII-I-53-B).

31 July
- 1550-1612 USS Reclaimer (ARS-42) alongside Wainwright with boarding team and monitor aboard briefly (Reference 6, p. VII-I-62-B).
- 1907 DSM message to CJTF 1: "DSM and Radsafe inspected [target ships] Conyngham, Wainwright, and Mugford above and below decks. Radiological conditions are such that portions of the crews can be put aboard for carrying out DSM decontamination procedure issued this date to all target vessels. Wainwright has about three to four feet accumulated leakage in engine room bilges" (Reference 5, p. 6-D-46).

1 August Wainwright crew transferred from Bayfield to USS Bexar (APA-237).
- 1007 USS Clamp (ARS-33) reported proceeding to Wainwright, deck apparently on fire.
- 1014 Clamp reported smoke on Wainwright coming from handybilly on deck (Reference 6, p. VII-I-67-B).
- 1305 Ship's force clearing after engine room of water and washing down topside; expected to evacuate about 1500.
- 1535 Geiger readings in firerooms were 0.1 to 0.6 R/24 hours, engine rooms 0.5 R/24 hours, weather deck average 1 R/24 hours.
- 1605 Departed ship.

2 August
- 0800 Ship's team aboard.
- 1605 Secured ship. Weather deck average 0.6 R/24 hours, fire rooms and engine rooms 0.3 R/24 hours, interior spaces about 0.1 R/24 hours.

3 August
- 0840 Ship's team aboard.
- 1630 Secured ship. Topside average, 1 R/24 hours; after director, 2 R/24 hours; main deck, portside, frame 165, 1.1 R/24 hours; fire rooms and engine rooms, 0.3 R/24 hours; lower level, starboard side, forward fire room, 0.9 R/24 hours.

4 August
- 0820 Ship's team aboard.
- 1623 Personnel evacuated. Topside average 0.5 R/24 hours, topside maximum 2 R/24 hours; below decks average 0.3 R/24 hours; after engine room starboard against hull 0.8 R/24 hours.

5 August
- 0810 Team A aboard; Geiger reading 0.2 R/24 hours.

6 August
- 0805 Ship's team aboard.
- 1708 Secured ship. Topside maximum, 0.85 R/24 hours, topside average, 0.5 R/24 hours (portside director on paint); below deck

average, 0.068 R/24 hours, below deck maximum, 0.11 R/24 hours (C.P.O. mess, port bulkhead, next to skin).

7 August
0745 Ship's force aboard.
1700 Evacuated ship. Topside average, 0.09 R/24 hours, topside maximum, 0.5 R/24 hours (top of director); below deck average, 0.08 R/24 hours; below deck maximum, 0.5 R/24 hours (sonar room).

8 August
0810 Ship's force aboard.
1632 Topside average 0.06 R/24 hours, maximum 0.43 R/24 hours (mainmast); below deck average 0.07 R/24 hours, below deck maximum 0.32 R/24 hours (port ice box). Evacuated ship.

9 August
0810 Ship's team aboard.
1700 Securing ship; teams evacuating. Discontinued decontamination work pending clearance by radsafe. Geiger readings: topside average 0.004 R/24 hours, topside maximum 0.4 R/24 hours (top of director); below deck average 0.07 R/24 hours, below deck maximum 0.34 R/24 hours (sonar room).

10 August
0824 Ship's force aboard.
1013 Topside average 0.04 R/24 hours, topside maximum 0.15 R/24 hours (part of #3 uptake); below deck average 0.03 R/24 hours, below deck maximum 1.0 R/24 hours (skin of bilge, sonar room).
1621 Departed ship.

13 August
1035 Ship's Team A aboard to pump engine room dry; reduced stern tube leaks 50 percent.

16 August Staff inspections completed.

18 August
0825-1140 Ship's team and monitors aboard for Geiger survey.

20 August
0800-1530 Majority of Wainwright crew transferred to USS George Clymer (APA-27). Fifteen men aboard to repatch stern tubes.

21 August Commanding officer and 10-man working party from target ship USS Trippe (DD-403) boarded for 4 hours to make repairs and prepare for towing.

23 August Towed to Kwajalein and retained for radiological studies.

Remaining Wainwright crewmembers were transferred to other units at Kwajalein.

USS WALKE (DD-723)

Crew Size: 242
Bikini Atoll Arrival: 27 May 1946
Bikini Atoll Departure: 8 August 1946
Shot ABLE Location: 24 nmi (44 km) NE
Shot BAKER Location: 15 nmi (28 km) E
Decontamination Location: San Francisco
Final Clearance: 23 October 1946

Task Unit and Function
The destroyer Walke was a member of TG 1.7 (Surface Patrol), Destroyer Division 71. The ship was primarily responsible for conducting oceanographic surveys and radiological monitoring during the operation. Oceanographic cruises included bathythermographs and oceangraphic soundings.

Shot ABLE (1 July, 0900)

30 June
1235 Underway to clear Bikini Lagoon.
2000 Arrived in area Mack.

1 July
0157 Changed course and speed, left area Mack, proceeding to area Hudson to take station for shot ABLE.
0340 Arrived in area Hudson.
0941 Secured evaporators.
1241 Set normal condition Baker throughout ship.
1337 Arrived at point bearing 350°T from target ship USS Nevada (BB-36), range 50 nmi (93 km). Changed to reciprocal courses of 350°T and 170°T every 15 minutes to remain in vicinity of present position.
1839 [sic] Commenced steaming on various courses at various speeds to destroy floating object and to make radiological probe.
1832 Laying to, probing. Object in water destroyed.
1940 Completed radiological probe.

2 July Made downwind surface patrol, axis 170°T, 350°T, 50-nmi (93-km) radius.
0209 Changed course, having completed crossing #4. Proceeded to station Baker of radiological patrol.
0612-0837 Stopped all engines and commenced laying to conduct radiological patrol.
0853-1029 All engines stopped; commenced radiological probing.
1058 Underway for Bikini with patient requiring emergency appendectomy.
1100 All engines stopped; hoisted aboard probing wire, losing both thermograph and probe.
1229 Laying in vicinity of USS Benevolence (AH-13) at Bikini.
1533 Proceeded to clear Bikini Lagoon.
1659 Stopped all engines. Laying to at Point Baker radiological patrol.

3 July
1309-1548 All engines stopped; on station Baker off Lukoj Pass. Commenced taking bathythermograph readings.
1737 Proceeded to next station for radiological probing.
1804 All engines stopped; on station Baker for radiological sounding off Lukoj Pass.
1900 Commenced radiological soundings.

4 July
0810 All engines stopped; laying to at position Baker for radiological soundings.
0820 Commenced taking radiological probings.

USS Walke (DD-723)

4 July

1451	Proceeding to go alongside USS O'Brien (DD-725) to pick up radiological instruments.
1523	Commenced laying to off portquarter of O'Brien.
1622	Underway to return to station off Lukoj Pass.
1642	Commenced laying to on station for oceanographic soundings.
5 July	
1313	Anchored in berth 190 South, Bikini.
8 July	
1346	Underway from berth 190 South, Bikini, to take oceanographic soundings.
9-14 July	Took oceanographic soundings.
14 July	
0912	Anchored in berth 190, Bikini.

Shot BAKER (25 July, 0835)

24 July	
1230	Underway for shot BAKER operations, proceeding to area Hudson.
25 July	
0818	Commenced using various courses and speeds to remain within area Hudson until atomic bomb detonation.
0835	Bomb exploded.
1138	Left column, all engines stopped; laying to for test probe.
1231	Underway to rejoin USS Laffey (DD-724) and USS Ingraham (DD-694) in column.
1916	Commenced radiological patrol.
2140	Commenced crossing station #4 of downwind patrol, stopping at intervals to lower probe.
2155	Stopped to lower probe while crossing #4.
2319	Stopped to lower probe while crossing #4.
26 July	Took oceanographic and radiological soundings while on downwind patrol.
0802	Underway to Enidrik Pass to conduct Operation Colgate (oceanographic and radiological probes). Secured from downwind patrol.
1243	All engines stopped; laying to for Operation Colgate.
1637	Anchored inside Enidrik Pass.
1815	Commenced lowering probe.
27 July	
1755	Anchored in berth 330, Bikini Atoll. Took radiological readings with probe.
28 July	
1646	Anchored in berth 307 North, Bikini.
30 July	
0448	Evaporators secured because of radioactivity.
1300	All oceanographers and radiological monitors left Walke.
1354	Anchored in berth 307.
31 July	
0811	Anchored in berth 190 North, Bikini.
2 August	
0858	Underway for oceanographic cruise #71.
3-4 August	Took oceanographic soundings.
4 August	
1139	Anchored in berth L South, Bikini.
7 August	
0830	Anchored in berth 190 North, Bikini.
8 August	
1051	Underway for oceanographic cruise consisting of sounding station at 60-nmi (111-km) intervals northward along 165°T east longitude meridian.
8-10 August	Took oceanographic soundings.
10 August	
1945	Underway to rendezvous with Destroyer Squadron 7 and proceeded to Pearl Harbor.
15 August	
1200	Moored at Pearl Harbor.

USS Wenatchee (ATF-118)

USS WENATCHEE (ATF-118)

Crew Size: 99
Bikini Atoll Arrival: 30 May 1946
Bikini Atoll Departure: 18 August 1946
Shot ABLE Location: 132 nmi (244 km) SE
Shot BAKER Location: 20 nmi (37 km) ENE
Decontamination Location: San Francisco
Operational Clearance: 13 November 1946
Final Clearance: 13 November 1946

Task Unit and Function

The fleet ocean tug Wenatchee was a member of TU 1.8.1 (Repair and Service Unit). Wenatchee maintained maintenance and repair facilities. It assisted in decontaminating target vessels, salvage, towing, and emergency repair work.

Shot ABLE (1 July, 0900)

30 June	
1420	Underway from Bikini for rendezvous with USS Munsee (ATF-107); APL-20 in tow en route to Kwajalein.
1 July	
0900	En route from Bikini Atoll to Kwajalein Atoll with APL-20 in tow. Large ball of fire noted on horizon (Wenatchee 132 nmi [244 km] from detonation).
1825	Anchored with APL-20 in berth 67 Able anchorage, Kwajalein.
2 July	
1440	Underway with YF-733 in tow for Bikini Atoll.
3 July	
1749	Anchored in berth 191-A, Bikini.
5 July	
1450	Underway for target ship USS Saratoga (CV-3) with water barge along portside.
1528	Moored water barge along starboard side Saratoga.
1532	Underway from alongside Saratoga, proceeding to anchorage.
1546	Anchored in berth 191A, Bikini.
6 July	
0650	Underway to assist USS Chikaskia (AO-54).

USS Wenatchee (ATF-118)

0758	Moored portside to Chikaskia.
1100	Underway from alongside Chikaskia to assist USS Rockingham (APA-229) alongside target ship USS Arkansas (BB-33).
1230	Underway from Rockingham to take water barge from alongside Saratoga.
1400	Underway with water barge along portside.
1458	Underway to assist USS George Clymer (APA-27) with target ship USS Nevada (BB-36).
1610	Anchored in berth 268, alongside Clymer.
1700	Anchored in berth 191A, Bikini Atoll.
7 July	
0800	Underway to assist Clymer alongside Nevada.
0930	Let go anchor off portside of Nevada.
1120	Underway to go alongside Clymer.
1140	Moored alongside Clymer; assisting Clymer to go alongside Nevada.
1323	Underway to go alongside USS Ajax (AR-6).
1403-1531	Took on steel plate for target ship USS Salt Lake City (CA-25).
1536	Underway to go alongside Salt Lake City.
1555-1625	Moored to Salt Lake City to deliver steel plate.
1645	Anchored in berth 191A, Bikini.
9 July	Routine activities; not involved with target vessels.
10 July	
0855	Underway with LCT-1132.
0920	Moored LCT-1132 alongside LCT-1341.
0935	Underway to Eneu Island.
1052	Anchored off Eneu Island.
1348	LCT-1130, LCT-1155, and LCT-412 secured to starboard side; proceeded to USS Creon (ARL-11).
1513	Cast off all lines to LCTs, proceeded to Eneu Island.
1602	Took LCT-1377 in tow.
1630	Took target vessel LCT-1187 in tow.
1735	Cast off all lines to LCT-1187 and LCT-1377.
1751	Anchored in berth 191A, Bikini.
11 July	Operated in Bikini; not involved with target vessels.
12 July	
0920	Moored alongside Nevada.
0940	LCT-1420 moored alongside starboard quarter.
1045	Cast off LCT-1420.
1047	Underway to USS Severn (AO-61) for water.
1258	Anchored in berth 191A, Bikini.
1623-1813	Moored to Nevada.
1823	Anchored in berth 191A, Bikini.
13 July	
1011	LCT-1187 moored to starboard.
1040	Transferred Army ordnance material aboard LCT-1187.
1050	Underway from alongside LCT-1187.
1213	Anchored in berth 270A, Bikini.
1355	LCT-1377 moored to starboard side.
18 July	
0850	Underway for ARD-29 with LCT-1377 in tow.
0920	Cast off LCT-1377.
1125	Moored to YF-753.
1140	Underway with YF-753 in tow for Kwajalein.
19 July	
1400	Cast off YF-753 in berth K-19, Kwajalein.
1620	Underway for Bikini.
20 July	
0850	Anchored in berth 191A, Bikini.
22 July	
1303	Anchored abeam to Saratoga.
1313	Underway from Saratoga to USS Chowanoc (ATF-100).
1423	Anchored in berth 191A, Bikini.
Shot BAKER (25 July, 0835)	
24 July	
1555	Underway from Bikini Atoll.
1638	Maneuvered to get in formation with ships of TU 1.8.7.
25 July	
0835	En route to Rongelap, Marshall Islands; observed atomic bomb blast.
1505	Anchored in vicinity of berth 5, Rongelap Atoll.
30 July	
1540	Underway with YF-733 moored to starboard side en route to Bikini Atoll.
31 July	
0925	Anchored in berth 191-A, Bikini Atoll.
1 August	
0848	Commenced salvage operations on submerged LCM.
1455	Made all preparations for getting underway.
1520	Underway with LCM in tow to designated disposition area.
1630	Let go LCM and allowed to sink as directed.
1707	Anchored in berth 191A, Bikini Atoll.
2 August	
1315-1800	Conducted salvage operations on beached target ship USS LST-125.
1905-2300	Attempted to tow beached USS LST-817 off beach.
3 August	
0610	Underway, commencing operations of towing LST-817 off beach.
0620	LST-817 pulled off beach.
0633	Anchored in berth 61, Bikini.
6 August	
1353	Received 500 pounds (225 kilograms) of lye from USS Pollux (AKS-4) and 500 pounds (225 kilograms) from USS Clamp (ARS-33).
1405	Underway for decontamination operations.
1630	Anchored in berth 369, Bikini.
7 August	
0755	Underway for decontamination work on unspecified target ship.
1125	Anchored in berth 198, Bikini.
1250	Underway for decontamination work.
1719	Anchored in berth 108A, Bikini.
8 August	
0758	Underway for decontamination work.

USS Wenatchee (ATF-118)
8 August

0844-0915 Conducted decontamination operations on target submarine USS Skate (SS-305).
0950-1034 Conducted decontamination operations on target submarine USS Parche (SS-384).
1105 Anchored in vicinity of Ionchebi Island.
1255 Underway for decontamination operations on Skate.
1420 Secured decontamination operations on Skate and proceeded to Parche.
1452-1613 Conducted decontamination operations on Parche.
1645 Anchored in berth 108-A, Bikini Atoll.

9 August
1720 Underway to assist USS Dixie (AD-14) in taking target ship USS Cortland (APA-75) to berth 190.
1836 Anchored in berth 108A, Bikini.

10 August
1000 Transferred decontamination tanks to LCT-1184 and decontamination supplies to USS Chickasaw (ATF-83).
1116 Anchored in berth 191A, Bikini.
1627 Underway to assist towing LST-125 off beach.
1645 Anchored in berth 6, Bikini.
2140 Secured tow wire to LST-125.
2345 Underway to anchorage in berth 61, Bikini.

11 August
0010 Underway to take strain on tow wire secured to beached LST-125.
0215 Secured salvage operations on LST-125.
0220 Anchored in berth 6, Bikini Atoll.
1350 Underway, commenced to take strain on tow wire to beached LST-125.
1420 Secured salvage operations on LST-125.
1505 Anchored in berth 61, Bikini.

14 August
0730 Underway from APL-27.
0820 Cast off APL-27 from target ship USS Geneva (APA-86).
0955 Moored APL-27 to portside of Geneva.
1010 Anchored in berth 147.

18 August
1753 Underway to Kwajalein.

19 August
1149 Anchored in berth 15, Kwajalein Atoll.

27 August
1610 Anchored with stern line on Skate.

28 August
0630 Underway with Skate in tow.
0920 Cast off tow wire from Skate and standing by while USS Fulton (AS-11) took Skate in tow.

28 August
1040 Underway for Pearl Harbor.

USS WHARTON (AP-7)

Crew Size: 493
Bikini Atoll Arrival: 29 May 1946
Bikini Atoll Departure: 25 August 1946
Shot ABLE Location: 10 to 15 nmi (19 to 28 km) E
Shot BAKER Location: 15 to 18 nmi (28 to 33 km) E

USS Wharton (AP-7)

Decontamination Location: Puget Sound
Operational Clearance: 10 February 1947 (Seattle)

Task Unit and Function
The transport Wharton was assigned to TU 1.1.2 (Instrumentation Unit). The ship furnished laboratory and base facilities during the operation. In addition, it was the flagship for the Director of Ship Material.

Shot ABLE (1 July, 0900)

30 June
1453 Underway for inner area Graham.
2000 Proceeding at various courses and speeds to conform with traffic in inner area Graham off Bikini Atoll in accordance with JTF 1 Operation Plan.

1 July
1050 Formed column astern of USS Haven (AH-12). Order of ships in column: Haven, Wharton, USS Burleson (APA-67), USS Kenneth Whiting (AV-14), USS Cumberland Sound (AV-17).
1315 Ordered to proceed independently.
1541 Anchored in berth 33, Bikini.
1655 Anchored in berth 92, Bikini Atoll.
2132 Director of Ship Material returned on board.

2 July
1542 Anchored in berth 89, Bikini.

Shot BAKER (25 July, 0835)

24 July
1458 Underway for inner area Graham off Bikini Atoll in accordance with JTF 1 Operation Plan. Director of Ship Material's staff and instrumentation unit aboard.

25 July
1144 Formed column astern of Burleson. Order of ships in column: Burleson, Wharton, Whiting, Cumberland Sound, USS San Marcos (LSD-25) and USS Albemarle (AV-5). Column maneuvered on various courses and speeds to area Ford of JTF 1 Operation Plan.
1215 Wharton assumed tactical command of TG 1.1, Burleson proceeded independently.
1415 Anchored in berth Queen, Bikini Atoll.

28 July
1617 Anchored in berth Fox, Bikini Atoll.

30 July
1355 Anchored in berth 145, Bikini Atoll.

31 July
0915 Anchored in berth 145, Bikini.

14 August
1040 Anchored in berth 91, Bikini.

25 August
1700 Underway for Kwajalein.

26 August
0908 Anchored in berth K-10, Kwajalein Atoll.

28 August
1109 Underway for San Francisco.

USS Widgeon (ASR-1)

WHITING, KENNETH; see USS KENNETH WHITING (AV-14)

USS WIDGEON (ASR-1)

Crew Size: 86
Bikini Atoll Arrival: By 1 June 1946
Bikini Atoll Departure: 5 September 1946
Shot ABLE Location: 24 nmi (44 km) E
Shot BAKER Location: 12 nmi (22 km) SE
Decontamination Location: San Francisco
Operational Clearance: 13 December 1946
Final Clearance: 10 January 1947

Task Unit and Function

The submarine rescue vessel Widgeon was a member of TU 1.2.7 (Salvage Unit). Its main duties included salvaging the damaged target vessels after the tests, performing emergency repairs, and fighting fires.

Shot ABLE (1 July, 0900)

30 June

1252 Underway to join formation of TU 1.2.7.

1 July

1343 Anchored in boat pool anchorage, berth E, Bikini.

2 July

0657 Underway in accordance with CTU 1.2.7 orders, proceeding to center of target array.
0830 Radiological monitor reported aboard.
0850 Moored portside to target submarine USS Skate (SS-305).
0851 Radiological monitor boarded and inspected Skate. Skate found to be Geiger sour.
[illegible]:10 Cut Skate's forward port anchor chain to clear mooring buoy. Commenced rigging Skate for towing astern.
0935 Underway, proceeding to assigned beaching area to beach Skate.
1152 Anchored off beaching area Eneu Island, Bikini.
1542-1646 Beached Skate.
1657 Radiological monitor left the ship.
1709 Anchored in berth E, Bikini.

3-4 July Anchored as before.

5 July

1135 Shifted anchorage.
1210-1800 Conducted diving operations searching for planted instruments; recovered planted instrument.
1911 Anchored in berth 106, Bikini Lagoon.

6 July

0541 Proceeding to center of target array for diving operations.
0815 Transferred planted instrument to USS Kenneth Whiting (AV-14).
0900-1320 Conducted diving operations; recovered planted instruments.
1354 Underway to shift berths.
1420-1755 Conducted diving operations.
1830 Moored in berth 161, Bikini.

7 July

0536 Underway to shift berths for diving operations.
0600 Moored in Bikini Lagoon.
0838-1010 Conducted diving operations to clear fouled anchor.
1131 Shifted moorings.
1134-1807 Conducted diving operations, recovering slipped anchor.
1858 Anchored in berth 161, Bikini Harbor.

8 July

1232 Moored in center of target array for diving operations.
1240-1905 Conducted diving operations searching for planted instrument; recovered planted instrument.
2015 Moored in berth 161, Bikini Harbor.

9 July

0700 Transferred underwater instrument to Whiting via motor launch.
1014 Underway to search for sunken target ship USS Anderson (DD-411).
1030 Anchored in berth 163 for diving operations.
1035-1146 Conducted diving operations, searching for sunken Anderson; found Anderson.
1245 Completed laying four-point moor around Anderson.
1315 Moored in berth 324.

10 July

0746 Underway to go alongside USS Fulton (AS-11) to transfer submarine rescue chamber.
0847 Transferred submarine rescue chamber via motor launch to Fulton while laying to off Fulton.
1005 Moored in four-point moor in berth 163 over Anderson.
1030-1630 Conducted diving operations, searching for instruments and estimating damage to Anderson.

11 July

0720 Underway to recover four-point moor.
0911 Completed recovering four-point moor and proceeded to assigned anchorage.
0925 Anchored in berth 106, Bikini.

12 July

0726 Moored over sunken target ship USS Carlisle (APA-69) in berth 219, Bikini.
0828-1500 Conducted diving operations, searching for instruments on Carlisle.

13 July

0818-1900 Conducted diving operations, searching for instruments on Carlisle.
0925-1655 Underwater photo unit party on board.

14 July

0810-1606 Conducted diving operations on Carlisle.
1648 Anchored over Anderson in berth 163.
1655-1900 Conducted diving operations, searching for sunken Anderson; located Anderson.

15 July

0815-1610 Conducted diving operations over Anderson, recovering two torpedoes from Anderson.

16 July

0800-1645 Conducted diving operations, recovering anchor and chain from Anderson.

USS Widgeon (ASR-1)

17 July
1345-1425 Conducted diving operations over Anderson.
1510 Anchored in berth 106, Bikini.

18 July Not involved with target ships.

19 July
1801 Moored over sunken target ship USS Gilliam (APA-57) in berth 160.

20 July
0800 Commenced diving operations, searching for Gilliam. Radiological monitor reported aboard in connection with diving operations.
1030 Secured from diving operations.
1305 Underway to shift anchorage.
1418 Moored over Gilliam by target ship USS Brule (APA-66).
1638-1845 Conducted diving operations.

21 July
0800-1230 Conducted diving operations over Gilliam.
1530 Anchored in berth 187, Bikini.

22 July
0700 Moored alongside target submarine USS Searaven (SS-196).
0730-1557 Submerged Searaven.
1729 Anchored in berth 229, Bikini.

23 July
0641 Moored alongside target submarine USS Dentuda (SS-335).
0700-0910 Submerged Dentuda.
1035-1504 Attempted to submerge target submarine USS Skipjack (SS-184).
1608 Anchored in berth 205, Bikini.

24 July
0552 Moored alongside Skipjack.
0604-0742 Submerged Skipjack.
1003-1347 Submerged target submarine USS Tuna (SS-203).
1235 Radiological monitor reported aboard for CROSSROADS.
1500 Anchored in berth 90, Bikini.

Shot BAKER (25 July, 0835)

25 July
0455 Underway to join TU 1.2.7 formation.
0844 Joined TU 1.2.7 formation.
1127 Anchored in berth P, Eneu Island.
1930 On orders of commanding officer, commenced distilling freshwater.

26 July Anchored in berth P, Bikini.

27 July
1310 Secured evaporators.
1311 Underway to moor in vicinity of Dentuda.
1408 Anchored in vicinity of Dentuda.
1415-1553 Surfaced Dentuda.
1647 Anchored in berth P, Bikini Harbor.
1715 Commenced distilling freshwater on orders of commanding officer.

28 July
1317 Underway to moor in vicinity of target submarine USS Apogon (SS-308).
1345 Secured evaporators.
1412-1520 Attempted to surface Apogon.
1607 While en route to assigned anchorage, commanding officer ordered commencement of distillation of freshwater.
1746 Anchored 1,200 yards (1.1 km) south of berth 376, Bikini.

29 July
0755 Underway to area of beached Dentuda.
0850 Secured evaporators.
0950 Moored in vicinity of Tuna.
1010-1129 Blew ballast tanks on Tuna.
1137-1259 Washed down Tuna to clear radioactivity.
1353-1534 Blew ballast tanks on Dentuda.
2252 Anchored 1,200 yards (1.1 km) south of berth 376, Bikini Harbor.

30 July
0759 Underway to area of beached Dentuda.
0845 Secured evaporators.
0922-1118 Washed down Dentuda for radioactivity.
1146 On order of commanding officer commenced distilling freshwater.
1149 Anchored off Eneu Island.
1605 Anchored in berth P, Bikini Harbor.

31 July
0919-1001 Blew forward torpedo room and forward battery room on Dentuda.
1408 Underway to go alongside and wash down target ship USS Hughes (DD-410).
1414-1500 Washed down Hughes.
1628-1713 Blew all ballast tanks on Dentuda.
1736-1834 Pulled Dentuda further on beach with the use of beaching gear.
1928 Anchored in berth P, Bikini Harbor.

1 August Anchored in berth P, Bikini.

2 August
1600 Moored in berth 358, Bikini Harbor, next to USS Ajax (AR-6) for boiler repairs and upkeep.

12 August
0945 Anchored in berth 18, Bikini.

13 August-3 September
Widgeon attempted to surface Skipjack.

13 August
1310-1948 Conducted diving operations on Skipjack, connecting salvage hose to compartments and ballast tanks.

14 August
0815-1825 Engaged in diving operations on Skipjack.

15 August
0830-1915 Engaged in diving operations.

16 August
0800-1915 Engaged in diving operations.

17 August
0800-1930 Engaged in diving operations.

18 August
0715-1820 Engaged in diving operations.

19 August
0730-1900 Engaged in diving operations to salvage Skipjack.

20 August
0725-1830 Engaged in diving operations to salvage Skipjack.

21 August
0700-1915 Engaged in diving operations to salvage Skipjack.

22 August
0740-1830 Engaged in salvage and diving operations.

23 August
0645-1950 Engaged in diving and salvage operations on Skipjack.

24 August
0710-1845 Engaged in diving operations to salvage Skipjack.

25 August
0715-2035 Engaged in diving operations.

26 August
0630-1818 Engaged in diving operations.

27 August
0645-0930 Engaged in diving operations.
0827-1732 Attempted unsuccessfully to surface sunken Skipjack.

28 August
0730-1830 Engaged in diving operations on Skipjack.

29 August
0725-1830 Engaged in diving operations on Skipjack.

30 August
0740-1920 Engaged in diving operations on Skipjack.

1 September
0735-2040 Engaged in diving operations on Skipjack.

2 September
0730-1240 Engaged in diving operations.
1329-1905 Attempted unsuccessfully to surface sunken Skipjack.

3 September
1158 Skipjack completely surfaced.
1305-1535 Washed down Skipjack.

4 September Moored in berth 205, Bikini.

5 September
1809 Underway en route to Kwajalein.

7 September
1251 Moored next to Skipjack in berth D-17, Kwajalein, after fueling.

9 September
0937-1119 Towed Skipjack to drydock.
1318-1443 Radsafe party on board ship for radiological clearance before sailing.

10 September
2012 Received radiological clearance for sailing from USS Haven (AH-12).

11 September
0925-1334 Tested all ballast tanks on Skipjack.
1345 Underway for Pearl Harbor.

USS WILDCAT (AW-2)

Crew Size: 128
Bikini Atoll Arrival: 12 May 1946
Bikini Atoll Departure: 19 August 1946
Shot ABLE Location: 30.5 nmi (56 km) NE
Shot BAKER Location: Anchored at Rongelap Atoll
Decontamination Location: Puget Sound
Operational Clearance: 9 January 1947
Final Clearance: 10 January 1947

Task Unit and Function
The water distilling ship Wildcat was a member of TU 1.8.1 (Repair and Service Unit).

Shot ABLE (1 July, 0900)

30 June
1340 Underway for ABLE day evacuation of Bikini Lagoon to area Packard (subarea Baker, sector axis 055°).
1920 Arrived area Packard (subarea Baker).

1 July
0800 Exercised at atomic precaution drill.
0820 Secured from atomic precaution drill.
0845 Crew mustered at quarters in preparation for bomb drop. All precautions taken to protect crew from injury.
0930 Secured from quarters.
1252 Proceeded to area Caterpillar.
1337 Arrived area Caterpillar.
1946 Anchored in vicinity of berth 369, Bikini.

2 July
0635 Anchored in berth 370, Bikini. Began to distill water using evaporator unit.

3 July
1325-1412 PGM-31 moored alongside to receive water.
1441-1750 USS Furse (DD-882) moored alongside to receive water.
1705-1745 ATA-124 moored alongside to receive water.
1945 Secured distillation units due to minor mechanical breakdown.

4 July
1520-1637 USS James M. Gilliss (AGS-13) moored alongside to receive water.

5 July
0800-0850 YMS-354 moored to starboard for water.
0915-1010 USS John Blish (AGS-10) moored to starboard for water.
0940-1015 YOG-63 moored to starboard for water.
1325-1430 USS Shakamaxon (AN-88) moored to starboard for water.
1327-1347 YMS-463 moored to port for water.
1450-2200 USS Tombigbee (AOG-11) moored to starboard for water.
1500-1535 PGM-25 moored to port for water.

6 July
0834-1005 PGM-24 moored to starboard to receive water.
1100-1335 USS LST-871 moored to starboard for water.
1341-1750 Target ship USS LST-661 moored to starboard for water.
1450-1547 PGM-34 moored to port for water.

USS Wildcat (AW-1)

1507-1744 USS LST-989 moored outboard to LST-661 for water.
1558-1733 LCT-1184 moored to port for water.
1603-1731 LCT-1420 moored off LCT-1184 for water.

7 July
0945-1055 ATA-187 moored to starboard for water.
1425-1510 PGM-29 moored to starboard for water.
1535-1625 YMS-358 moored to starboard for water.

8 July
0904-0932 YMS-463 moored to starboard for water.
1034-1205 Target vessel LCI(L)-549 moored to starboard for water.
1314-1422 USS Deliver (ARS-23) moored to starboard for water.
1411-1444 ATA-180 moored to starboard for water.
1648-1740 ATA-187 moored to starboard for water.

9 July
0853-1010 LCT-1361 moored to starboard for water.
1105-1150 YP-636 moored to starboard for water.
1203-1245 YMS-354 moored to starboard for water.
1445-1532 Gilliss moored to port for water.

10 July
1234-1340 USS Chikaskia (AO-54) moored to port to discharge fuel oil and receive water.
1456-1616 YMS-413 moored to starboard for water.
1540-1632 USS Chowanoc (ATF-100) moored to starboard for water.

11 July
0653 Underway to go alongside target ship Prinz Eugen to discharge cargo water and boiler feed water.
0820 Moored portside to Prinz Eugen.
0835-1430 Prinz Eugen received cargo water; commenced discharging boiler feed water directly from distilling units to Prinz Eugen.

12 July
1000-1048 PGM-32 moored to starboard for water.

13 July
0950-1145 Prinz Eugen received cargo water.
1350 Prinz Eugen secured from receiving boiler feed water.
1418 Underway to assigned berth.
1535 Anchored in berth 370, Bikini.
1738-1825 PGM-31 moored to starboard for water.

14 July
0837-1027 YMS-358 moored to starboard for water.
1212-1242 YMS-354 moored to starboard for water.

15 July
0752-1235 LST-817 moored to starboard for water.
0910-0930 YMS-463 moored outboard for water.
0937-1047 YOG-63 moored outboard of LST-817 for water.

16 July
1249-1330 YP-636 moored to starboard for water.
1600-1750 USS Etlah (AN-79) moored to port for water.
1825 Cargo water salted; secured from issuing water.

17 July
1330 Commenced pumping water from #3 port and starboard tanks due to salty water.
1621 Secured #2 and #3 evaporators.
1830 Secured from pumping #3 port and starboard tanks.
1910 Commenced distilling on #2 and #3 evaporator units.

18 July
Pumped saltwater out of tanks #1 and #4.
1403 Underway for Rongelap.

19 July
Pumped out saltwater.
0412 Changed courses to return to Bikini before arriving at Rongelap.
1455 Anchored in berth 370, Bikini.

21 July
2025 Commenced pumping saltwater from #2 starboard and #2 port tanks over side.
2027 Secured #3 distilling unit.

22 July
0900 Secured from pumping water out of #2 port and starboard cargo tanks.

23 July
1700 Commenced distilling on #3 distilling unit.

Shot BAKER (25 July, 0835)

24 July
1400 Underway en route to Rongelap Atoll.

25 July
0700 Commenced pumping saltwater from #1 port and starboard tanks over the side.
0754 Anchored in berth 21, Rongelap.
0900 Secured pumping from #1 port and starboard tanks.
1752 YW-92 moored to starboard to discharge cargo water and receive unchlorinated distilled water.
1808 YO-199 moored outboard of YW-92.
1810-2225 Received cargo water from YW-92.
2245 YW-92 commenced receiving unchlorinated distilled water for flushing tanks.

26-29 July Routine activities.

30 July
0020 YW-92 secured from receiving water.
0025 Commenced distilling in #1 tank.
0637-0648 YW-92 received cargo water.
0749 Underway from Rongelap to Bikini.
1605 Anchored in berth 370, Bikini.

31 July
0900-1530 Commenced watering USS Severn (AO-61).
1555-1746 USS Suncock (AN-80) moored to port for water.
1715-1742 ATR-40 moored to starboard for water.

1 August
1145-1615 LST-817 received cargo water.
1309-1412 ATA-192 moored to port for water.
1420 Commenced fueling ship from YO-199.
1500-1545 YO-199 received cargo water.
1610-1703 USS Deliver (ARS-23) received water.
1640-1730 PGM-31 moored to starboard to receive water.
1650 Completed fueling ship.
1659 YO-199 underway.
1713-1824 PGM-24 moored to starboard aft to receive water.

USS Wildcat (AW-1)

2 August
0915-0935 YMS-463 moored to starboard for water.
1207-1312 USS Oneota (AN-85) moored starboard side for water.
1620-1820 After shifting berths, USS Palmyra (ARS [T]-3) moored to starboard for water.
1750-1844 ATA-124 moored to port to receive water.

3 August
1655-1817 LCT-1067 moored to starboard for water.

4 August
0920-0940 USS Dutton (AGS-8) moored to starboard for water.
1035-1137 USS John Blish (AGS-10) moored to starboard for water.
1117-1132 LCT-1359 moored to port for water.
1745-1840 LCT-1377 moored to port for water.

5 August
0926-0949 YMS-463 moored to starboard for water.
1025-1130 USCG Bramble (WAGL-392) moored to starboard for water.
1320-2318 Tombigbee moored to starboard for water.
1520-1802 USS LST-881 moored to port for water.

6 August
0842-1030 USS Wenatchee (ATF-118) moored to starboard for water.
0910-1038 USS Clamp (ARS-33) moored to port for water.
1135-1306 PGM-32 moored to starboard for water.
1305-1414 USS Achomawi (ATF-148) moored to port for water.
1314-1357 USS Chickasaw (ATF-83) moored to starboard to receive water.

7 August
0840-0905 Dutton moored to starboard for water.
1302-1342 PGM-29 moored to starboard for water.
1411-1500 PGM-31 moored to starboard for water.
1503-1555 ATA-180 moored to starboard for water.
1727-1915 Etlah moored to starboard for water.

8 August
1056-1150 USS Munsee (ATF-107) moored to portside for water.
1100-1135 PGM-24 moored to starboard for water.
1335-1445 ATA-192 moored to starboard for water.
1405-1500 LCT-1361 moored to portside for water.
1505-1556 USS Sioux (ATF-75) moored to starboard for water.
1702-1715 YMS-463 moored to port for water.

9 August
1130-1300 Target vessel LCI(L)-615 moored to starboard for water.
1227-1305 YMS-354 moored to port for water.

10 August
0743-0900 USS Coucal (ASR-8) moored to starboard for water.
0907-0950 Achomawi moored to port for water.
0920-0955 PGM-25 moored to port for water.
1050-1115 PGM-29 moored to starboard.
1125-1230 ATA-187 moored to port for water.
1300-1405 Deliver moored to starboard for water.
1642-1740 PGM-31 moored to port for water.
1730-1758 PGM-32 moored to starboard for water.
1747-1759 YMS-463 moored to port for water.

11 August
0825-0905 Dutton moored to starboard for water.

12 August
1210-1320 ATA-124 moored to port for water.
1152-1212 LCT-1359 moored to starboard for water.
1440-1620 LCI(L)-549 moored to starboard for water.
1537-1622 Gilliss moored to port for water.
1639-1750 Clamp moored to starboard for water.

13 August
0804-1745 Tombigbee moored to starboard for water.
1305-1455 LCI(L)-1091 moored to port for water.
1503-1535 YO-199 moored to port for water.

14 August
0840-1023 Shakamaxon moored to starboard forward for water.
0915-0958 YP-636 moored to portside forward for water.
1010-1055 PGM-23 moored to portside forward for water.
1032-1050 YMS-463 moored to starboard aft for water.
1425-1525 Munsee moored to portside for water.
1426-1440 Dutton moored to starboard forward for water.
1430-1605 Oneota moored to starboard aft for water.
1431-1515 YMS-354 moored to port forward outboard for water.
1615-1725 Wenatchee moored to starboard aft for water.
1755-1848 LCI(L)-977 moored to starboard aft for water.

15 August
0955-1040 Target vessel LCT-1115 moored to starboard for water.
1316-1535 LCT-1316 moored to port for water.
1322-1509 LCT-1420 moored to LCT-1361 for water.
1507-1602 Blish moored to starboard for water.
1650-1910 LST-817 moored to starboard for water.

16 August
0950-1102 ATA-185 moored to starboard for water.
1345-1442 LCT-1377 moored to starboard for water.
1453-1529 ATA-124 moored to starboard for water.

17 August
1040-1303 Suncock moored to starboard for water.
1103-1215 ATA-192 moored to port for water.
1240-1324 YMS-413 moored to port for water.
1837-1853 YMS-463 moored to starboard for water.

18 August
0822-1004 LCI(L)-1062 moored to port for water.
0905-1040 Tombigbee received water.
1010-1035 Dutton moored to port for water.
1450-1507 Two radsafe inspectors came on board to test for radioactivity and left. All working spaces safe for personnel.
2130 YW-92 moored to starboard to discharge water.

19 August
0700 YW-92 underway from alongside, having discharged water.
1159 Underway for Kwajalein.

20 August
1140 Anchored in berth George, anchorage Able, Kwajalein.

21 August
1000-1415 YW-94 moored to starboard for water.

22 August
1120-1245 Wenatchee moored to portside for water.
1519 YW-94 underway from alongside after receiving water.
1537-1640 Munsee moored starboard forward for water.

24 August
1310-1346 YO-178 alongside to receive water.
1705 YW-94 alongside to receive water.

25 August
0807 YW-94 underway from alongside.

26 August
0953-1037 ATA-192 moored to starboard forward for water.
1650-1933 Tombigbee moored to starboard for water.

28 August
1656 Underway from Kwajalein en route to Pearl Harbor.

9 September
1506 Moored to berth F-7, Pearl Harbor.

USS WILSON (DD-408)

Crew Size: 115
Bikini Atoll Arrival: 1 June 1946
Bikini Atoll Departure: 19 August 1946
Crew Location for Shot ABLE: USS Bayfield (APA-33)
Crew Location for Shot BAKER: Bayfield
Shot ABLE Location: 1,480 yards (1.6 km) NW
Shot BAKER Location: 1,766 yards (1.6 km) NW
Scuttled 8 March 1948 near Kwajalein

Task Unit and Function
The destroyer Wilson was a member of TU 1.2.3 (Destroyer Unit), Destroyer Division 2. It was a target vessel for ABLE and BAKER.

Shot ABLE (1 July, 0900)

30 June
0930-1130 Evacuated crew to Bayfield. Set condition Able throughout the ship.

1 July Anchored in berth 127, Bikini. Ship secured for ABLE except spaces needed by last-minute personnel.
0330 Secured all machinery and spaces for ABLE.
0400 All personnel left ship for ABLE.

2 July
1445 Commenced reboarding Wilson. Secured from condition Able.

3-23 July Crew aboard Wilson.

Shot BAKER (25 July, 0835)

24 July
0730 Started evacuating personnel to Bayfield in preparation for BAKER.
0920 Captain and all personnel left the ship except nine last-minute personnel.

25 July Anchored in berth 128, Bikini.
0230 Started securing ship for test BAKER.
0330 Started all equipment that was to be in operation at the time of test BAKER.
0400 Last-minute personnel departed. Ship set for BAKER.

1 August All personnel moved from Bayfield to USS Bexar (APA-237).

7 August The initial boarding party boarded Wilson prior to washdown to take readings. Trained in port mount torpedo tubes and retrieved auxiliary echo sounding gear streamed from fantail. Sprayed ship with hot solution of lye and boiler compound, allowing it to set 1 hour before washdown with high-pressure hose. (See Table A.14.) Took comparative readings after washdown. Four men boarded the ship and received exposures between 0.5 and 0.75 R. [No film badges located; exposures are assumed to be estimated.]

Table A.14. Representative Geiger readings (R/24 hours) on reboarding USS Wilson (DD-408), 7 August 1946.

Location	Before Washdown	After Washdown
Forecastle deck forward	1.5	1.0
Under forward Uptakes	9.0	3.0
Main deck amidships	4.0	3.5
Main deck fantail	3.0	3.0
Superstructure deck forward	4.5	4.0
Bridge wing port	5.5	5.0
Bridge wing starboard	3.5	2.5
Rubber mats, bridge wing, port (max)	16.0	16.0
Forecastle deck, starboard, frame 40 (min)	1.0	0.5
10 feet (3 meters) from side (avg)	0.04	a
Inside After Deckhouse (avg)	3.0	a

Note:

[a]No reading.

Source: Reference 4.

9-10 August Wilson boarded; unit of personnel unknown.

12 August Commanding officer and inspecting party of 11 men boarded Wilson. Lit off emergency diesel generator. Found no damage or evidence of flooding. Average tolerance topside 30 minutes, below decks 3 hours; high tolerance topside 2 hours, below decks 6 hours; average topside reading 1.95 R/24 hours.

13 August Recovered casualty film badges. No readings taken.

15 August Anchor detail aboard; attempted recovery of underfoot anchor with negative results due to fouling with port anchor. No readings taken. Forecastle tolerance 3 hours. Party aboard about 2 hours.

16 August Anchor detail aboard; completed recovery of underfoot anchor with assistance of

USS Etlah (AN-79); anchor placed on forecastle, but not secured to deck due to absence of proper material. Tolerance remained 3 hours on forecastle. Unpainted (or with light coat of paint) forecastle deck had low Geiger readings because of its excellent drainage; heavily painted maindeck and fantail with comparable drainage had readings double or three times that of forecastle (Reference 4). Party aboard about 3 hours, 15 minutes.

18 August — Working party boarded to hoist anchor and prepare it for towing to Kwajalein by ATA-180. Transferred 53 men to USS Rockwall (APA-230).

19 August — Underway in tow by ATA-180 for Kwajalein. Transferred 33 men to Rockwall.

21 August — Arrived at Kwajalein.

28 August — Wilson decommissioned.

YMS-354

Crew Size: 28
Bikini Atoll Arrival: 27 March 1946
Bikini Atoll Departure: 14 September 1946
Shot ABLE Location: 64 nmi (119 km) E (Rongelap)
Shot BAKER Location: 65 nmi (120 km) E (Rongelap)
Decontamination Location: Guam/Marianas
Operational Clearance: 20 December 1946
Final Clearance: 10 February 1947

Task Unit and Function

The minesweeper YMS-354 was a member of TU 1.8.5 (Survey Unit). As part of the survey unit, its mission included surveying the probable effects of the nuclear tests on fish and other wildlife and conducting an oceanographic survey to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

1 July
- 0720 — Underway to change anchorage at Rongelap.
- 0830 — Anchored in south pass of Rongelap.

3 July
- 2133 — Underway to Bikini.

4 July
- 1255 — Moored in berth 315, Bikini.

5 July
- 0915 — Moored in berth 207A, Bikini.

8 July
- 0535 — Underway to conduct fishing survey in Bikini Lagoon.
- 1605 — Moored in berth 205A, Bikini.

9-11 July — Engaged in fishing surveys in Bikini Lagoon, returning to Bikini Lagoon each day.

12 July — Moored alongside USS Ajax (AR-6).

14 July
- 1340 — Moored to YMS-358.

15 July
- 0530 — Underway to conduct fishing survey of Bikini Lagoon.
- 1505 — Moored in berth 205A, Bikini.

17 July
- 1725 — Underway for Rongerik.

18 July
- 1245 — Anchored at Rongerik.

19 July
- 0605 — Underway to conduct fishing survey.
- 1350 — Anchored in Rongerik Lagoon.

21 July
- 0900 — Underway for Rongelap.
- 1430 — Anchored in berth 2, Rongelap.

Shot BAKER (25 July, 0835)

24 July
- 1401 — Anchored in berth 3, Rongelap.

26-27 July — Conducted fishing surveys around Rongelap, anchoring or mooring each day at the end of the survey in Rongelap Atoll.

29 July
- 0615 — Underway to conduct fishing survey of Rongelap Atoll.
- 1605 — Anchored in Rongelap Atoll.

30 July
- 1620 — Underway to Bikini.

31 July
- 0710 — Proceeding to conduct fishing survey off Bikini Atoll.
- 1410 — Moored in berth 205A, Bikini.

1 August
- 0535 — Underway with YMS-413.
- 0547 — Anchored in Bikini Lagoon.
- 0920 — Underway to YMS-413, anchored in berth 206B, Bikini.
- 1000-1227 — Moored to YMS-413.
- 1310 — Moored to ARD-29.
- 1500 — Entered ARD-29 to be drydocked.

3 August
- 1643 — Cast off from drydock.
- 1655 — Anchored off Eneu Island.

6 August
- 0613 — Underway to conduct fishing survey in Bikini Lagoon.
- 1425 — Moored to USS Cebu (ARG-6) in Bikini Atoll.

7 August
- 0613 — Underway to conduct fishing survey.
- 1735 — Moored to YMS-413, Bikini.

9 August
- 0614 — Underway to conduct fishing survey off Bikini Atoll.
- 1340 — Moored starboard side to YMS-413, which was moored to USS Ajax (AR-6) in berth 205A, Bikini Atoll.

10 August
- 0640 — Underway to conduct fishing survey of Bikini.

1220 Moored near Ajax, berth 205A, Bikini.

12 August
0620 Underway to conduct fishing survey of Bikini Atoll.
1200 Anchored at Bikini.

14-16 August Conducted fishing surveys of Bikini Atoll, returning each day to moor in Bikini Lagoon.

22 August
1220 Entered drydock of ARD-29.

23 August
0952 Ship clear of drydock.
1327 Anchored in berth 251A, Bikini.

27 August-2 September
Engaged in wire dragging operations and wire drag surveys off the southern area of Bikini Atoll. Returned each day to Bikini.

4-11 September
Conducted wire drag surveys, returning to anchor each evening in southwest Bikini Lagoon.

14 September
1153 Underway for Kwajalein.

15 September
1558 Anchored at Kwajalein.

21 October
0700 Underway to Guam.

YMS-358

Crew Size: 31
Bikini Atoll Arrival: 27 March 1946
Bikini Atoll Departure: 14 September 1946
Shot ABLE Location: Rongelap, 65 nmi (120 km) E
Shot BAKER Location: Rongelap, 65 nmi (120 km) E
Decontamination Location: Guam/Marianas
Operational Clearance: 20 December 1946
Final Clearance: 10 February 1947

Task Unit and Function
The minesweeper YMS-358 was a member of TU 1.8.5 (Survey Unit). As part of the survey unit, its mission included surveying the probable effects of the nuclear tests on fish and other wildlife and conducting an oceanographic survey to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

1 July
0847 Anchored at Rongelap Atoll.

3 July
0530 Underway for routine fishing.
1235 Anchored off Rongelap.

4 July
0405 Underway for Bikini.
1245 Anchored in berth 390, Bikini.

5-16 July Engaged in routine fishing, returning each evening to Bikini.

17 July
1700 Underway to Rongerik.

18 July
1243 Anchored off Rongerik Island.

19-22 July Engaged in routine fishing, returning each evening to Rongerik Island.

23 July
0545 Underway for routine fishing.
1320 Secured from fishing, en route to Rongelap.
1854 Anchored off Rongelap Island.

24 July
0600 Underway for routine fishing.
1236 Anchored off Rongelap Island.

Shot BAKER (25 July, 0835)

25 July Anchored off Rongelap Island.

26-29 July Engaged in routine fishing, returning each evening to Rongelap Lagoon.

30 July
0523 Underway for routine fishing.
1419 Moored in Rongelap.
1721 Departed for Bikini.

31 July
1330 Moored in berth 390, Bikini.

1-5 August Engaged in routine fishing, returning each evening to Eneu Island.

8-17 August Engaged in routine fishing, returning each evening to Bikini Lagoon.

26-31 August Engaged in wire dragging operations, returning each evening to anchor in the western end of Bikini Lagoon.

1-2 September
Engaged in wire dragging operations, returning each evening to Bikini Lagoon.

4-11 September
Engaged in wire dragging operations, returning each evening to Bikini Lagoon.

14 September
1201 Underway from Bikini to Kwajalein.

15 September
1605 Moored in berth K-15, Kwajalein.

21 October Departed Kwajalein for Guam.

YMS-413

Crew Size: 32
Bikini Atoll Arrival: 27 March 1946
Bikini Atoll Departure: 14 September 1946
Shot ABLE Location: At Rongelap, 65 nmi (120 km) E
Shot BAKER Location: At Rongelap, 65 nmi (120 km) E
Decontamination Location: Guam/Marianas
Operational Clearance: 20 December 1946
Final Clearance: 10 February 1947

YMS-413

Task Unit and Function
The minesweeper YMS-413 was a member of TU 1.8.5 (Survey Unit). As part of the survey unit, its mission included surveying the probable effects of the nuclear tests on fish and other wildlife and conducting an oceanographic survey to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

1 July
0900 Moored at Rongelap Atoll.

3 July
0540 Underway for fishing operations.
1210 Anchored at Rongelap.
2146 Underway for Bikini.

4 July
0715 Commenced fishing operations.
1555 Moored at Bikini.

7-9 July Engaged in fishing operations at Bikini, returning to the lagoon at the conclusion of fishing activities each day.

11-13 July Engaged in fishing operations, anchoring at Bikini at the conclusion of each day's activities.

16 July
0532 Underway for routine fishing operations.
1445 Moored in Bikini.

17 July
1710 Proceeding to Rongerik Atoll.

18 July
0735 Commenced routine fishing operations near Rongerik.
1245 Moored at Rongerik.

19 July
0550 Underway for Rongelap.
0732 Rongelap trip postponed, anchored at Rongerik.

20 July
0610 Underway for Rongelap.
1025 Anchored at Rongelap.

21 July
0510 Underway for Rongerik.
1535 Moored at Rongerik.

22 July
0555 Underway to Rongelap.
1118 Moored in Rongelap Atoll.

24 July Engaged in routine fishing operations; moored at Rongelap at day's end.

Shot BAKER (25 July, 0835)

25 July
0835 Moored at Rongelap Atoll.

26-29 July Engaged in routine fishing operations; moored at Rongelap at the end of each day.

30 July
1624 Underway to Bikini.

31 July
0615 Fell out of formation for fishing operations.
1230 Moored at Bikini.

2-7 August Engaged in routine fishing operations; at conclusion returned to Bikini.

9-10 August Engaged in routine fishing operations; at conclusion returned to Bikini.

12-13 August Engaged in routine fishing operations; at conclusion returned to Bikini.

15-17 August Engaged in routine fishing operations; at conclusion returned to Bikini.

28-29 August Engaged in streaming wire dragging gear; at conclusion returned to Bikini.

31 August-6 September
Engaged in streaming wire dragging gear; at conclusion anchored in Bikini Lagoon.

9-11 September
Engaged in wire dragging operations; at conclusion anchored in Bikini.

14 September
1205 Underway from Bikini to Kwajalein.

15 September
1547 Moored in berth K-15, Kwajalein.

21 October Underway from Kwajalein to Guam.

YMS-463

Crew Size: 17
Bikini Atoll Arrival: 22 March 1946
Bikini Atoll Departure: 14 September 1946
Shot ABLE Location: At Rongelap, 65 nmi (120 km) E
Shot BAKER Location: At Rongelap, 65 nmi (120 km) E
Decontamination Location: Guam/Marianas
Operational Clearance: 20 December 1946
Final Clearance: 10 February 1947

Task Unit and Function
The minesweeper YMS-463 was a member of TU 1.8.5 (Survey Unit). As part of the survey unit, its mission included surveying the probable effects of the nuclear tests on fish and other wildlife and conducting an oceanographic survey to determine the character of the ocean currents in and around Bikini Atoll.

Shot ABLE (1 July, 0900)

1 July Anchored at Rongelap Atoll.

4 July
2210 Underway to Bikini Atoll.

5 July
0645 Anchored at Bikini Island.

9 July Took continuous lead line readings throughout night for biological survey off anchorage.
0855 Anchored off Nam Island, carrying out extensive biological surveys.

12 July Shifted berths.

YMS-463

15 July
2005 Underway for Rongelap.

16 July
0937 Anchored at Rongelap.

23 July
0900 Commenced taking soundings near reefs on western side of Rongelap.
1630 Anchored at Rongelap.

24 July
1535 Conducted geological survey.
1800 Anchored at Rongelap.

Shot BAKER (25 July, 0835)

25 July
1703 Scientists aboard to conduct biological survey on northeast end of Rongelap.
1850 Anchored at Rongelap.

26 July-1 August
Engaged in geological and biological surveys in vicinity of Rongelap.

1 August
1454 Underway from Rongelap to Bikini.

2 August
0210 Anchored at Eneu Island anchorage, Bikini Atoll.

3 August
0958 Anchored in berth 251A, Bikini.

5 August
1235-1600 Took soundings at southeast tip of Eneu Island and entire outer eastern end of Bikini Atoll.
1700 Anchored at Eneu Island anchorage.

6 August
0955-1247 Took dredging samples and engaged in dredging operations.
1407 Anchored at Eneu Island anchorage.

7 August
0956 Underway to take soundings off outer edge of Bikini Atoll.
1058-1600 Took soundings.
1900 Anchored at Bikini anchorage.

8 August
0822 Underway to take soundings on seaward side of Bikini Reef.
0943-1409 Took soundings.
1732 Anchored in berth 251A, Bikini.

9 August
0845 Underway to conduct biological survey.
1230-1728 Conducted biological survey.
1816 Anchored in berth 251A, Bikini.

12 August
0500-1956 Conducted survey, anchoring in berth 251A, Bikini, at conclusion.

17 August
0800-1915 Conducted biological survey; anchored berth 251A, Bikini.

28-31 August Engaged in wire dragging operations, anchoring each night at Bikini.

1-6 September
Engaged in wire dragging operations, remaining in Bikini Lagoon at end of the day.

9-11 September
Engaged in dragging operations; remained in harbor at end of the day.

14 September
1150 Underway for Kwajalein.

15 September
1540 Anchored in anchorage K-15, Kwajalein.

21 October Departed Kwajalein for Guam.

APPENDIX A
REFERENCES

1. Ships' Logs
   (Cited by ship's name, e.g., Reference 1, ATA-192).

2. Major Damage Report
   (A report specified by OpPlan 1-46 for each target ship -- often referred to as "Report No. 5").

3. Commanding Officer's Report
   (A report specified by OpPlan 1-46 for each target ship -- often referred to as "Report No. 11").

4. Decontamination Reports
   (A report from the target ships' commanders on decontamination activities following BAKER).

5. Report on Atomic Bomb Tests ABLE and BAKER, Operational Report, Volume I
   January 1947
   NTIS AD 473 986 XRD-206

6. Report on Atomic Bomb Tests ABLE and BAKER, Operational Report, Volume II
   January 1947 XRD-206

7. Message from the Radsafe Group on USS Haven
   021100Z October 1946 S-36 60Z 267

8. Inspection Reports
   (For the cited target ship)

9. Geiger Readings, USS Crittenden (APA-77)
   Commanding Officer to Commander Task Group 1.2
   23 August 1946

10. Boarding Reports
    (For the cited target ship)

11. Dispatch from Commander Task Group 1.2 aboard USS Rockingham (APA-229) to Director of Ship Material
    3 August 1946

APPENDIX B

RADIOLOGICAL SAFETY DOCUMENTS

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COMMANDER JOINT TASK FORCE ONE

OPERATION PLAN NO. 1-46*

ANNEX E -- SAFETY

APPENDIX I

GENERAL CONSIDERATIONS OF RADIOLOGICAL SAFETY

TEST ABLE

1. THE PROBLEM -- GENERAL INTELLIGENCE

(a) When an atomic bomb explosion occurs, physical forces of extreme intensity are released at the center of the disturbance. They are propagated outward in all directions.

(b) Casualties may be produced directly by blast, heat, light, ultra violet radiation, gamma rays, neutrons and radioactive fission products which give off beta and gamma radiation. These are described as primary effects.

(c) Casualties may be produced indirectly as a result of secondary hazards created by the above primary influences.

(d) The flash from the explosion will cause heat burns similar to those produced by any explosion. Even thin clothing provides some protection against this form of flash burn. Wood is charred on the surface within certain areas. Fires may be started.

(e) The light is so intense that the retina of the eye may be seriously damaged by this influence alone. The skin may be "sunburned" by the ultraviolet radiation. Reflections from the water may intensify the heat and ultraviolet light radiation effects.

(f) The blast is similar to that of most explosions but somewhat more prolonged in duration and of much greater intensity and extent.

(g) The most harmful radiation appears in two forms. The primary radiation which occurs at the time of the flash is indeed a flash of hard gamma rays and neutrons. This flash exposure is very short, casualties are likely to result from this primary radiation if the exposure occurs within 4,000 yards of the center of the disturbance.

(h) These neutrons create a secondary hazard by inducing radioactivity in certain elements within the range of approximately 2,000 yards. As a result, objects in the area immediately under the bomb will become radioactively hazardous to personnel. Similarly, particulate matter in the air within range of these rays may become radioactive, and present an airborne hazard; similarly, the water may present a waterborne hazard.

(i) Besides the above sources of radioactivity there is still a third form. As the bomb is fired, so-called "fission products" are discharged into

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*With changes entered through 15 July 1946, Change #7.

the air, mostly in particulate form, and they constitute a cloud of highly radioactive material which makes up the "downwind" hazard. Most of this material is carried to 20,000 to 60,000 feet, becomes greatly diluted and dispersed by the wind and air movements and is borne "downwind." Gradually the particulate matter falls out. This "fall-out" may set up localized areas of hazard. It appears unlikely that there would be any significant hazard from this airborne dissemination at a distance of more than 200 nautical miles from the target.

(j) A rain of radioactive droplets may occur as a result of these tiny radioactive particles serving as a nucleus for the formation of rain droplets. This would probably follow "downwind" behavior. If the humidity of the air is high at the time of firing, the shock wave may compress the air to such an extent that rain may be produced and if so, this rain may contain radioactive material.

(k) Fission products will be deposited in the water directly and present a waterborne hazard.

(l) The above paragraphs describe the general features of the radioactivity hazard and it is with these facts in mind that the Radiological Safety Plan TEST ABLE is prepared (Appendix II to this Annex).

2. PROTECTION

(a) Against the primary effects, underground shelters offer considerable protection providing they are of such a nature as to withstand the light, heat, and blast, and provided they have sufficient thickness of earth or concrete intervening to filter out the gamma rays and the neutrons. This is purely passive defense. Equivalent thickness in still is required on ships for protection against the primary radiation hazard which accompanies the flash.

(b) Against the secondary radioactivity hazards <u>detection</u> and <u>avoidance</u> provide the best protection. This is the basis of the Safety Plan as far as radiological hazards are concerned.

(c) Against the light injuries to the eyes, special goggles are required for personnel within 25 nautical miles of the flash if looking at it.

3. DETECTION

Suitable instruments indicate directly both the presence of and intensity of the radioactivity at a given place. This applies to air, surface of land and water, subsurface water, target ships, drones, aircraft, and any situation where radioactive contamination might be present.

4. AVOIDANCE

Area reconnaissance, the maintenance of a "contamination situation map," and the posting of areas of hazard constitute the active measures for avoidance.

5. ANTICIPATED HAZARDOUS AREAS

(a) Immediately under the bomb burst there will be a large area of dangerous radioactivity. This will probably be more extensive in the water

after the surface burst than after the air burst and more extensive in the air after the air burst.

(b) Downwind, an airborne radioactive hazard will exist. The characteristics of this will depend on meteorological influences (altitude, wind speed and direction, variations in wind speed and direction at various altitudes up to 60,000 feet, humidity of air).

(c) Contaminated water from the lagoon may move down current, in accordance with prevailing water mass movement. The order of magnitude of the radioactivity is not known. It will certainly be much greater in the surface burst than in the air burst.

(d) The "fall out" from downwind cloud may set up contaminated water masses downwind and these water masses will follow prevailing currents. Dispersion may be slow.

(e) There is some indication that dilution may be facilitated in the water by dispersion and vertical mixing of the radioactive materials. If so, this will materially influence downcurrent surface water contamination and enhance safety.

(f) All individuals or objects entering contaminated areas may transfer hazardous radioactivity to clear areas. Examples -- drones sampling column or clouds, craft entering contaminated areas of lagoon, etc.

(g) Relation of compartmentation, ventilation, etc. on target ships to persistence or intensity of radioactivity is unknown and must be explored during this operation. It must be assumed that there is a significant relationship favoring the build-up and persistence below decks.

6. OPERATIONAL INTELLIGENCE

(a) When fission occurs the immediate reaction is intense radiation of ultra-violet light and heat waves, gamma rays, and neutrons. This is accompanied by the formation of a large ball of fire. A shock wave is initiated which is more sustained that that of an ordinary explosion. The ball of fire produces a mushroom-shaped mass of hot gases, the top of which rises at the rate of 10,000 feet per minute at least until it reaches about 30,000 feet. In the cone-shaped trail is left a "column" of boiling clouds, 3 to 10 nautical miles in diameter, characterized by extremely high temperatures, a moment of incandenscence, noxious gases, violent turbulence and a strong updraught. Surrounding this visible column is an invisible cone-shaped zone of highly dangerous contamination. The column is then carried downwind, the direction and velocity being determined by the direction and velocity of the wind at the various levels of air from 0 to 60,000 feet altitude where the top, or "crest" probably layers out.

(b) [not reproduced]

(c) Even at 20 nautical miles the light is of such intensity as to be painful to the unprotected eye, producing an immediate temporary blinding, lasting for a half hour or more. The heat of the flash is felt on the bare skin. Approximately 50 seconds after detonation, at 10 nautical miles, the push of the shock wave or waves is felt distinctly and the roar of the explosion is heard. It, like the shock wave, is more sustained than the sharp crack of the normal TNT explosion.

(d) Areas of radioactive hazard thus occur (1) immediately under the bomb burst, (2) in the air and in the downwind clouds, and (3) on the surface of land or water where radioactive materials fall out of the downwind clouds.

(e) By means of instruments such as Geiger-Muller Counters it is possible to detect the areas of contamination and to measure the intensity of the radioactivity.

(f) The unit of radioactivity selected for practical purposes is the roentgen. For purposes of safety in this operation, it is considered that an individual should not have a total exposure of over 50 or 60 roentgens in two weeks. If an individual receives 10 roentgens in one day, or 60 roentgens in two weeks he will be withdrawn from active participation in the operation. The maximum allowable dose or tolerance for daily exposures over a long period is 0.1 roentgen.

(g) The intensity of the radioactive hazard tends to decrease with time due to (1) decay of radioactive materials and (2) dispersion, dilution, and transference from the immediate site.

(h) The intensity of the radiation from the fission products in the "column" decreases inversely with time in hours after the first hour so that an area which had 15 roentgens per hour at one hour after detonation would have an intensity of 7.5 roentgens at two hours after detonation and 5.0 roentgens at three hours, assuming, however, that no additional radioactivity had been added in the meantime (fall out of cloud, wind drift of particles, etc.). This latter point is especially important to those in the downwind positions (planes and DDs).

(i) Besides the Geiger counters, photographic film is used as an indicator of exposure to radioactivity. Certain personnel will wear film badges to indicate absence or presence of radioactivity exposure.

7. Test B will present problems somewhat different from Test A but the general principles will remain the same. The radioactivity in the water will undoubtedly be greater and contaminated areas remain hazardous for a longer period.

APPENDIX II

RADIOLOGICAL SAFETY PLAN, TEST ABLE

Organization:

Radiological Safety Section, Chief of Section

(a) Radiological Safety Control Unit

(b) Radiological Safety Advisory Board

(c) Radiological Safety Reconnaissance Units

(1) 2 PBM Units

(2) 2 Helicopter Units

(3) 6 "Downwind" Destroyer Units

(4) 3 "Upwind" Destroyer Units

(5) 6 Lagoon Patrols
6 Gunboat (PGM) Units
20 LCPL Units

(6) 6 "Cloud tracking aircraft" Units

(7) 2 Drone Boat Units

(d) Radiological Safety Monitor-Advisors

(e) Radiological Safety Technical Service Units.

1. GENERAL INFORMATION. Appendix I to this Annex contains general information on the radiological situation expected to develop. It is the responsibility of the Manhattan District to prepare and execute this plan and to pass on the qualifications of and train the personnel necessary thereto.

2. MISSION. To protect personnel from the hazards peculiar to the use of the atomic bomb during Operation CROSSROADS and to enable personnel to return safely to the target area at the earliest possible moment.

3. TASKS

(a) The Radiological Safety Control Unit will consist of the Section Chief and his control staff. This unit will be based in Radiological Safety Control, aboard MT. MCKINLEY. It will receive, plot, and analyze radiological information sent in by the reconnaissance and advisory units. It will maintain the radioactivity situation map. It will control the reconnaissance units in order to obtain the necessary information. It will consult with the advisory units. It has the ultimate, complete, and vitally important responsibility of advising CJTF-1 as to the location, severity, and probable significance of hazardous areas, and advising him on action recommended for the safety of personnel. It will furnish to CJTF-1, prior

to How hour, a prediction as to the probable downwind direction of the cloud mass and the downwind current movement of the contaminated water masses.

(b) The Radiological Safety Advisory Board will consist of the senior scientists and officers of the Safety Section. This board will advise the Chief of the Radiological Safety Section on technical matters including correlation of aerologic and oceanographic data and anticipating likely air currents and water currents that might govern the distribution of the bomb cloud and water extensions. This board will assist the section chief in preparing the radiological predictions prior to ABLE and BAKER days. It will assist the section chief in preparing his reports of the operation, particularly the technical section thereto.

(c) The radiological safety reconnaissance units are composed of one or more "monitors" and their assistants. The term "monitor" will be applied to personnel of this section qualified for service in the radiological measurement activities of the section. They will be placed on various reconnaissance destroyers, gunboats, landing craft, and planes. They will operate directly under the Chief of the Section and must at all times be in direct communication with him through his control unit. They are equipped with portable Geiger counters and other radiological equipment that indicate the presence of and measure the intensity of the radioactivity. "Personnel badges" (film) will be carried on the person of all monitors and their assistants. These will serve to detect total exposure. These badges will be worn for one day only, will be collected by the senior monitor of each unit, and will be labelled as to date, area, and name. They will be turned over, as soon as practicable, to the Photometric Unit, Radiological Safety Section, on board HAVEN. In their reports to Control, monitors will report the instrument used and the radiological strength in terms of roentgens. Monitors will generally operate within the safe fringe outside the limit of the danger areas. The success of all these reconnaissance units depends primarily on excellent communications between monitors and control and on accurate and easily understood descriptions of the position the monitor at the time of each report and the accurate location of the areas he is reporting on. Each monitor of individual monitoring party will be in direct two-way communication with Radiological Safety Control at all times.

For purposes of describing positions and courses of ships and planes carrying reconnaissance units a radiological axis will be used. The origin of this axis will be the target. Its direction, to be announced by CJTF-1 (by dispatch to all radiological safety reconnaissance units) about How minus one hour, will be based on the direction of the wind at all altitudes. At the time it is announced it may be in the same direction as the sector axis but, whereas the sector axis may be changed from time to time, the radiological axis will not be changed unless there is a wind shift of more than 20°. Thus the axis itself is described as 000° (RRA) or 360° (RRA). Weather predictions indicate that this axis will be approximately 090^{o}(True).

3.(c)(1) PBM Units. A PBM unit consists of one senior monitor and one assistant embarked in a PBM. Each unit is equipped with a minimum of:

1 Geiger counter

1 Ionization meter (Ion meter)

2 Personnel badges

1 Electrometer pencil

1 Casualty badge.

There will be two such units, one of which acts as a reserve during the first phase of the operation. They will be based at Ebeye. These units will make the first radiological reconnaissance of the lagoon area. The two PBMs will take station at Orbit Point "Victor" (bearing 315°(T) distant 30 nautical miles from the target), at 2,000 feet altitude, by How hour minus thirty (30) minutes. On order of CJTF-1, probably about Mike hour plus twenty (20) minutes, the PBMs will proceed in company to a position 5 nautical miles upwind of the target or to such other positions as may be directed by CJTF-1. They will break formation and PBM Charlie will approach the lagoon along the sector axis. When 3 nautical miles from the target the plane will start traversing the suspect area, at 2,000 feet altitude, in a series of parallel flights normal to the wind direction and closing in on the target. These flights shall be not less than 6 nautical miles long, 3 nautical miles on either side of the target, and 1 nautical mile apart except that flight lines 1/2 nautical mile apart will be flown between points 1 mile either side of the target. If a dangerous amount of radioactivity is not encountered, the PBM will continue until 2 nautical miles past the target. As soon as PBM Charlie finishes this pattern it will drop down to 1,000 feet and repeat it. It will also notify PBM Dog, which will come in at 2,000 feet and will cover the same area (a rectangle 6 nautical miles by 5 nautical miles) by making similar flights parallel to the wind direction, with the first such flight on the side nearest the entrance to the lagoon of Tab 1 to this Appendix). Upon completion of this it will withdraw to the upwind position until PBM Charlie has completed the crosswind explorations at 1,000 feet when PBM Dog will repeat its pattern at this altitude. PBM Dog will repeat its pattern at this altitude. PBM Charlie will repeat its pattern at 500 feet, again followed by PBM Dog. As each plane finishes at 500 feet it will withdraw to the upwind station, report, and await further orders. If indications of dangerous radioactivity are encountered the path is shortened and a series of short passes are made of Tab 1) to this Appendix). The object is to just approach the contaminated area and then turn abruptly, circle upwind, and then move downwind for the next pass, until the limits are roughly located. Upon arriving at a point 2 nautical miles downwind of the target each plane will discontinue the exploration and return to the upwind position and await orders. If the examination at any level cannot be completed, explorations at lower levels will not be attempted unless ordered, and planes will withdraw to the upwind position. Further movements of these units will be ordered by CJTF-1 in accordance with the radiological situation at the time.

3.(c)(2) [DELETED]

3.(c)(3) "Downwind" Destroyer Units. A "Downwind" Destroyer Unit consists of one senior monitor and one or more assistants. Attached to each unit are 2 oceanographers of the Oceanographic Unit. There are six of

these units embarked in Destroyers 722, 723, 724, and 725 of Destroyer Division 71 and [Destroyers] 781 and 694 of Destroyer Division 72. The Destroyers and the embarked units are equipped as follows:

General for each:

2 Geiger counters #263

1 Ionization meter #247

50 Casualty badges

350 Personnel badges

1 Counting rate meter with recorder and distant indicator. Water tap lines attached to an intake for radiological measurement purposes.

1 Deep-water counter with recorder and deep-water indicators plus 1,000 feet length electric cable and reel, davit, and one spare probe.

Special for DD 722, 723, 724, and 725:

5 Nansen bottles

6,250 feet 5/32" wire

1 Oceanographic sampling winch, meter wheel, and davit

1,000 4-oz. bottles

1,000 16-oz. bottles

2 Plankton nets

375 Kelvin sounding tubes

1 Bathythermograph winch, instruments, and boom.

Special for DD 722 and 724:

1 Filter Queen with proportional alpha counter

1 Scanning counter

Special for DD 770 and 781:

3 Nansen bottles

1,000 feet 1/8" wire

1 B.T. winch, meter wheel and davit for oceanographic sampling

500 4-oz. bottles

500 16-oz. bottles

2 Plankton nets

185 Kelvin sounding tubes.

The function of these units is to define and measure the water and surface air contamination outside of the lagoon. They will establish the early limits of the radiologically dangerous areas in air and water, will trace

the movement of the cloud masses, will obtain surface and deep-water samples for testing groups and oceanographers, and will obtain biological samples.

At How hour, Destroyer 722 will be at Point "Willys," 725 at the "Initial Point," 781 at Orbit Point "Baker," and 724 and 723 in area "Hudson." At the "bombs away" signal, 725 and 781 will proceed on course 90° (RRA) at maximum speed for 30 minutes and will then return at half that speed to a bearing of 165° (RRA) from the target, with the 725 40 nautical miles distant and the 781 60 nautical miles distant.

At Mike hour, 722 proceeds to a point just off the entrance to the lagoon, makes a thorough radiological reconnaissance of the entrance, and then runs along the southern edge of the atoll and proceeds to a point bearing 165° (RRA) from the target, distant 22 nautical miles. It turns onto course 270° (RRA) and crosses the cloud path. When the first appreciable indication of radioactivity is noted in the surface water the Destroyer will stop and the unit will take deep-water samples and deep-water radiological measurements at 50-foot intervals down to the maximum depths at which radioactivity is detected. It will then continue crosswind. When the peak of greatest activity is reached, probably when on bearing 180° (RRA) from the target, similar samples and measurements will be taken. The same procedure is used when the surface water indications are just dying out. When this Destroyer reaches the line bearing 195° (RRA) from the target, it will make a left turn onto this bearing line and will follow it to a point 80 nautical miles distant from the target, where it will make a similar crossing of the path back to bearing line 165° (RRA). At Mike hour, Destroyers 724 and 723 leave area "Hudson" and proceed in that order around the northern edge of the atoll. At Mike hour, Destroyer 694 will proceed at maximum speed to join Destroyers 723 and 724 and thereafter will continue with them on downwind patrol. They round the western end of the atoll until they intercept the line bearing 195° (RRA) from the target. They follow this bearing away from the target until the individual ships reach the points at which they will cross over to the other boundary of the cloud path (165° [RRA] from the target). Destroyers of both patrols will make crossing from one boundary line to the other in a leap frog fashion, taking soundings as described above for the 722.

No crossing may be made without permission of CJTF-1. No destroyer will make a crossing until all crossings nearer to the target have been started, unless otherwise ordered by CJTF-1. The two outside bearing lines, 165° (RRA) and 195° (RRA), may be changed by order of CJTF-1. Between Mike plus 1 and Mike plus 3 hours, the maximum speed for all "downwind" destroyers will be 10 knots. Between Mike hour and Mike plus 1 hour and at all times after Mike plus 3 hours, maximum speed will be 20 knots. Exception to this is the 30-minute run of 725 and 781 immediately after release of the bomb. These operations will continue in the above manner until the distant limits of detectable radioactivity are reached. Thereafter, when ordered by CJTF-1 (approximately ABLE plus two days), they will return to the region of the atoll; and, as ordered by CJTF-1, will take such stations as will enable them to survey the spread of the contaminated water through the reef channels and will continue there until such waters are free of

contamination. Any Destroyer finding itself in an area with a radioactivity of more than 0.1 roentgen per twenty-four hours will withdraw immediately to a safer point.

3.(c)(4) [not reproduced]

3.(c)(5) Lagoon Patrols. A lagoon reconnaissance patrol consists of one gunboat and its embarked unit and three or four LCPLs and their embarked units, as tabulated below. The senior monitor in the gunboat shall direct, supervise, and coordinate the work of the radiological units of the gunboat and its attached LCPLs. The Commanding Officer of the gunboat is the patrol commander. He shall be guided by the technical advice of the senior monitor in directing the movements and other activities of the patrol. A Gunboat Unit consists of two or three senior monitors and assistants. One or two oceanographers will be attached to each unit. There are six such units, each of which is embarked in a gunboat (the term PGM will not be used in order to prevent confusion with PBM). Each unit has the following equipment:

1 Ion meter #7

1 Geiger counter #263

1 Ionization meter #247

1 Counting rate meter with recorder and distant rate meter

1 Deep-water counter with recorder and distant indicator plus 500 feet electric cable and hand-operated reel

3 Nansen bottles

1,000 feet wire; 1 B.T. winch, 1 boom

250 4-oz. bottles

350 16-oz. bottles

125 Kelvin tubes.

An LCPL Unit consists of three monitors and at least one assistant, embarked in an LCPL. There will be 20 such units. Three or four of these units will be attached to each of the six lagoon patrols. Five LCPLs will be equipped with surface rate meters and will be known as the "Able" Type. They will be numbered "Able" one through five. The other fifteen will be known as the "Baker" Type and numbered "Baker" six through twenty. Oceanographers will be attached, if available, to each of the "A" Type units. Marine life parties will be attached to Units B19 and B20. All units carry the following equipment per unit:

2 Geiger counters #263

1 Ionization meter #247

Personnel badges for 50 percent of personnel

100 Water sample bottles

Lagoon charts

3 Casualty badges.

Each LCPL will have, in addition to the usual crew, a boat officer. The boat officer is in command of the boat and has complete authority over all personnel in it. He will be guided by the advice of the senior monitor in directing the movements of his boat and on matters pertaining to its radiological mission and safety. A primary duty of the boat officer is the accurate plotting of the boat's positions.

The Patrols are constituted as follows:

Patrol Name	Gunboat	LCPLs
Brass	23	A1, B9, B12, B19
Cobalt	24	A6, B7, B8
Gold	25	A2, B10, B11
Iron	29	A3, B13, B14
Nickel	31	A4, B15, B16
Steel	32	A5, B17, B18, B20

The duties of the patrols are to determine the early boundaries of the contaminated area in the lagoon and to trace the movement of the area and the changes in the intensities of the radioactivity in the contaminated waters. When the situation permits, some of these units may be diverted by the Chief of the Radiological Safety Section to other scientific activities. At the time of detonation, the gunboats are in area "Packard," and ARTEMIS, APPLING, and HENRICO are in area "Mercury." At Mike hour, the gunboats will move into area "Caterpillar" and the APAs and AKAs to area "Cadillac." As soon as favorable reports are received from DD-722, probably by Mike plus one hour, CJTF-1 will order these units to approach the lagoon. The gunboats will take position in line abreast, 600-yard interval, across the lagoon; in order from the right 23, 24, 25, 29, 31, and 32. They will stand by until joined by their LCPL units. As quickly as practicable the LCPLs will be launched not more than one nautical mile from the lagoon entrance and will join their respective gunboats. As soon as each patrol is assembled, it will proceed carefully to its assigned sector. These are as follows:

Brass to Argentina

Cobalt to Brazil

Gold to Chile

Iron to Denmark

Nickel to England

Steel to France.

In each patrol, the gunboat will lead the way to the line of target ships within its sector, work down the line toward the center, and establish a forward position at the edge of the contaminated area and about midway

between the boundaries of its sector. If no contaminated water is found in a particular sector the senior monitor of that patrol will report immediately to the Chief of the Radiological Safety Section and the patrol will be reassigned. The LCPLs will closely follow their gunboat to the assigned line of target ships and will work down that line in alternate serpentine courses about the targets. They will also investigate the ships not in line. They will then assist the gunboat in more closely determining the boundaries of the contaminated area. They shall report their positions and readings every 30 minutes or whenever significant radiological changes are encountered (a sudden or steady rise in readings of 0.01 R). Should communications in LCPLs fail, they will communicate their findings to their PGM for transmission to Radiological Safety Section on MT. MCKINLEY as expeditiously as possible. As the area changes in position and intensity, each patrol will continue to trace it. As soon as possible, CJTF-1 will order the two upwind patrols to move around the target and take over the two, hitherto unassigned, downwind sectors, "Greece" and "Holland." The upwind positions will be taken over by the "Upwind" Destroyer Units. LCPLs B19 and B20 will be released by the Chief of the Radiological Safety Section for other duties as practicable.

3.(c)(6) Cloud-Tracking Aircraft Units. These Units consist of one monitor and one assistant embarked in a B-29 or F-13. A photographer will be attached to each unit. There will be six such units, two of which will be in reserve, the other four divided into 2 pairs. Each unit is equipped with a minumum of:

1 Geiger counter #263

1 Ionization meter #247

2 Personnel badges

1 Electrometer pencil.

These units will attempt to follow the course of the high-level cloud mass and report its positions as it is carried downwind. The Photographer will take pictures of the cloud, which will be sent to the Chief of the Radiological Safety Section as soon as possible. Prior to How hour these units are based on Kwajalein. At Mike hour plus 30 minutes the two pairs of units will take station on either side of the cloud approximately 30 nautical miles from it, bearing 90° (RRA) and 270° (RRA) from it at 25,000 feet, or high enough to be above the normal cloud ceiling, if possible. These planes should fly back and forth on courses parallel to, and keeping pace with, the high cloud mass. they will keep at the optimum distance from the cloud for ease of observation. The planes of each pair will fly in opposite directions on a flat oval course in order to obtain the best fixes on the dimensions and positions of the cloud and the best possible photographs for later checking of this information. The pilots will report to the Force Fighter Director on the visibility of the highest cloud mass, its apparent height, size and position, and its movement. These reports will be made every fifteen minutes. All reports will be immediately transmitted by the Force Fighter Director to Radiological Safety Control. On detection of the presence of radioactivity, the pilot will immediately report it and, with advice from the monitor, ascertain the extent of the hazard in order to outline the extent of the hazardous area.

The pilot will be guided by the monitor when the necessity of taking evasive action arises due to dangerous amounts of radioactivity. In such a situation, the ventilators will be closed until clear of the contaminated area to avoid as much contamination inside the plane as possible. The monitor will be guided by the limitations as to safe or permissible exposures in accordance with basic radiological safety measures set forth in Appendix I to this Annex. They will at all times take into consideration the possibility of contamination of the fuselage and the possibility of contamination and exposure of the personnel while returning to the air base. The pilot will keep in mind the possibility that a dangerous amount of radioactive material may bar his path toward his air base, forcing him to seek an alternate course free from such danger. He must therefore terminate his survey while he still has sufficient fuel for several times his straight course to the base.

3.(c)(7) A drone boat unit consists of a remotely controlled LCVP with a radio broadcast geiger counter installed. It is used primarily for sampling purposes, but the radiological information obtained should be very valuable to this section. At about Mike plus thirty minutes, the drones will proceed from the entrance of the lagoon to the target and return in accordance with the Drone Boat Plan (Annex CC).

(d) Radiological Safety Monitor-Advisors. The Chief of the Radiological Safety Section will assign trained monitors to certain commands and planes within the force and will properly equip them. These monitors will advise their commands and pilots on subjects concerning radiological safety. Although their duties are not primarily reconnaissance, it is essential that they be able to communicate rapidly with Control on matters of radiological safety for two purposes: (1) to report any evidences of radioactivity, and (2) to receive advice on actions to be taken for safety reasons.

One group of these monitor-advisors must be planned for separately from the others, as they are almost as important from a reconnaissance as from an advisory standpoint. This is the group of monitors and their assistants who are assigned to the Director of Ship Material (see Re-boarding and Inspection Plan -- Annex X). One or two of these monitors will be attached to each of the ten Boarding Inspecting Teams. Ten additional monitors are assigned to a special pool to be employed as the Director of Ship Material may required. Each of the monitors of pairs of monitors assigned to the ten teams will have the following equipment:

1 Geiger counter #263

1 Ionization meter #247

1 Zuto (6 only)

Report sheets

Personnel badges.

Each individual will have:

Coveralls, boots and gloves

Gas mask

Oxygen breathing apparatus

First-aid equipment

Emergency rations and canteen of water.

The duties of these monitors must be coordinated with those of the Damage Control Safety Section to insure that personnel boarding target ships do not subject themselves to unrecognized hazards. These monitors will report, as promptly as possible, their radiological findings to Radiological Safety Control via Director of Ship Material. In addition, these monitors will distribute beforehand, and collect afterwards, the casualty badges, personnel badges, and Penny's blast gauges assigned to certain target ships. They will also provide safety reconnaissance for the Naval Medical Research section and will place films for measurement of exposure of animals to radiation.

(e) Radiological Safety Technical Service Unit. This unit is composed of the instrument repair personnel, the photometrists, and the analysts of water, soil, fish, etc. The first group will maintain, repair, and calibrate all of the many and varied instruments of the section. They will supply monitoring equipment to all planes operating in the area after Mike hour that do not carry monitors. They will train the pilots in the use and meaning of such instruments. The duties of the photometrists are:

Calibration of film exposure standards

Preparation of casualty and personnel badges

Processing of exposure films.

Estimation of exposures as indicated by films.

Recording of results.

The monitors will provide personnel badges (film) to personnel entering hazardous areas. These badges will be collected each day by the monitors, and the photometrists will assess and record the radiation exposure of each person so exposed. The analyst group will analyze samples of water, soil, fish, etc. from both chemical and radiological standpoints.

3.(x)(1). The section will provide such information as CJTF-1 and his staff may require for indoctrination and orientation of personnel in regard to radiological hazards and behaviors of the column and cloud masses.

3.(x)(2). The section will provide consultation service for the staff of CJTF-1 with regard to radiological safety problems in planning and in operation.

3.(x)(3). Special radiological reconnaissance, not essential to safety, may be conducted by monitors when safety requirements are not overriding.

3.(x)(4). Radiological reconnaissance will be extended to land surfaces of the lagoon as soon as is practicable. For approaching instrument towers on islands, special monitors will be assigned to accompany the landing parties.

3.(x)(5). Monitors will frequently check radioactivity of various parts of their own ship or craft, including underwater hull and all intakes, particularly condensers, boilers, and other places where there may be a concentration from contaminated water.

3.(x)(6). Monitors, and personnel accompanying them on radiological reconnaissance, will carry their own food and water while on a mission.

3.(x)(7). Special situations may permit the assuming of a calculated risk in order to let certain key personnel enter a hazardous area to make highly desirable observations when the total amount of radiation to be received is less than 10 roentgen units. This may be permitted only on direct instructions from Radiological Safety Control. Details of the situation and clearance therefor will be carefully logged by the accompanying monitor and at Radiological Safety Control.

3.(x)(8). It is possible that the cloud of radioactive materials will be in the path of air travel between Kwajalein and Guam or Kwajalein and Johnston for part of the time during the period from Mike plus 24 hours to Mike plus 48 hours. Other air routes may be similarly threatened. It will be possible on ABLE minus 1 day to predict fairly accurately the probable course of the cloud movement during the period Mike hour to Mike plus 24 hours. During this period, Mike hour to Mike plus 24 hours, the course of the cloud can be plotted fairly accurately, and from field reconnaissance data available at that time the hazard across these flight paths can be predicted for that and subsequent periods.

3.(x)(9). No flights within 150 nautical miles of Bikini will be permitted unless as a part of Operation CROSSROADS (see Air Plan -- Annex F, and Security Plan -- Annex D). Recommendations concerning release of this restriction will be made to CJTF-1 by the Chief of the Radiological Safety Section after consultation with the Aerologist at Radiological Safety Control and after the correlation of pertinent data has been made.

3.(x)(10). The general disposition of ships on ABLE day is shown in Annex J to this plan.

3.(x)(11). The primary considerations that govern the entry into the lagoon relate mainly to the hazards anticipated (Annex I). Of these, the radiological hazard is of particular importance because of the lack of information relative to just how intense, how widespread, and how persistent it may be.

3.(x)(12). The Radiological Safety Section will join the rest of JTF-1 in a full-scale rehearsal on Queen day.

3.(x)(13). For Test "B" the same general plan of radiological reconnaissance will be effected, modified in such detail as the situation may required. The main differences will be greater distances from the target at "How" hour and a slower approach to the target area in the reentry and target ship inspection phase and such changes as are required to meet new weather conditions. (See Radiological Safety Plan Test BAKER -- Appendix X to this Annex).

3.(x)(14). An official report of scientific and operational data will be submitted, through Technical Staff channels, to CJTF-1. The usual operation report will be submitted through channels. See Annex BB.

3.(x)(15). Historical data will be prepared as directed by Deputy Task Force Commander for Technical Direction (Annex BB).

3.(x)(16). For movements of MT. MCKINLEY and HAVEN see Annex A.

4. Logistics in accordance with Annex B and Appendix VII to this Annex.

5. Communications in accordance with Annex C and Appendix VI to this Annex. Chief of Section in HAVEN except when in MT. MCKINLEY between Queen minus one day and about ABLE plus five days and during similar period at time of Test "B."

APPENDIX IV

SAFETY PRECAUTIONS

1. SAFETY OF PERSONNEL ABOARD SHIP AT TIME OF DETONATION

(a) Protection at Time of Detonation

(1) General. CJTF-1 will direct the operations of ships and aircraft in such a manner as will assure a maximum degree of safety to all personnel involved.

(2) Ships at time of detonation

(aa) No ships will be permitted closer than ten (10) nautical miles to the point of detonation at the time of detonation.

(bb) Most of the ships of the Force will be 20 nautical miles or more from the point of detonation at the time of the detonation.

(cc) Ships and personnel essential to the safe and expeditious accomplishment of the technical mission will be approximately 18 nautical miles from the point of detonation at time of detonation. Three ships will be 10 nautical miles at time of detonation.

(dd) The position of the SECTOR AXIS (Annex I, Reentry Plan) will be established on the basis of wind direction at intended time of detonation.

(ee) The ships of the Force will be directed to operate in designated areas upwind of a line through Point Auto, normal to the SECTOR AXIS.

(3) Individuals at time of detonation

(aa) Individuals on board ships of the Force will be protected collectively by the operation of the ships from the hazards of blast, heat, and radioactivity. This protection is a primary consideration in establishing the distances ships will be from point of detonation at time of detonation.

(bb) Individuals on board ships of the Force will be required to take individual action in the protection of their own eyes at the time of the detonation. The required action is given. The responsibility for carrying out this action is that of the individual himself. This fact will be made known properly to all individuals concerned by those having proper responsibility therefor.

(cc) All Commanding Officers of ships shall observe the following safety regulations in regard to personnel who are not provided with goggles.

1. At How hour minus 10 minutes, Commanding Officers of all ships within 30 nautical miles of Bikini Atoll will assemble topside all hands not otherwise required below decks, to observe phenomena of the bomb explosion.

2. At How hour minus 5 minutes, commanders will have read clearly over the loud speaker system the safety regulations that have been specifically prepared by CJTF-1. The instructions read to ships' personnel will include what to do and how and where to face between the time the command is given to look away and the occurrence of the bomb flash. Commanding officers shall clearly indicate direction in which to look.

3. At the signal "RELEASE MINUS TWO MINUTES" Commanding Officers shall order all hands (a) to face in a direction properly indicated by him as being away from Bikini Atoll, (b) to look down at the deck, (c) to shut their eyes, and (d) to cover their closed eyes with the bent arm against the face. Personnel will remain in this position until after the flash, at which time they may "carry on." It is safe to view with the naked eye the incandescent column that follows the flash.

(dd) All Commanding Officers of the ships shall observe the following safety regulations in regard to personnel who are provided with approved goggles:

1. The Commanding Officers shall add "ADJUST GOGGLES" to his command at the time of "RELEASE MINUS TWO MINUTES."

2. Those with approved goggles may look directly at the flash or otherwise as they desire.

3. They must not remove goggles until after the flash. The flash may be taken as the signal to remove the eye protection and observe the phenomena that follow the explosion.

(ee) Approved goggles (Navy All Purpose Goggles, 4.5 Neutral Density Filter Replacement) will be provided for all personnel on ships nearer than 20 nautical miles at time of intended detonation (H hour) and for observers (not ships' personnel) on Press and Observer ships.

(ff) Emphasis, throughout, will be placed by responsible leaders on the fact that, while no serious damage can result from looking at the flash at a distance of 20 nautical miles or more, the flash is so blinding it will prevent the individual from seeing the beautiful display of colors in the incandescent column of cloud and the gigantic clouds that follow the explosion.

(b) By direction of CJTF-1, these instructions pertaining to individual protection of the eyes are included in the operations plan and will further form the basis of suitable instructions to be issued separately to (a) commanding officers, and (b) press and observers.

(c) There need be no concern on the part of individuals for their personal safety if they will (a) follow the commands of their respective commanding officers, (b) observe the intent of the instructions as to safety for the eyes, and in the case of participating observers, monitors, operational and technical personnel intimately participating in the operation, if they observe all requirements of this annex.

2. DANGER FROM RADIOACTIVE OBJECTS ON TARGET SHIPS

On target ships and possibly on the islands of the lagoon, certain objects may become dangerous to handle due to the effects of radiation, or to contamination with radioactive material. Because of this subtle hazard no personnel of the Force will handle objects on target ships unnecessarily. Under no circumstances will souvenirs be taken from target ships. This is particularly important as far as scrap metal is concerned. Commanding Officers will disseminate the required information to personnel within their command, and will enforce this safety regulation. This regulation will apply not only to service personnel but to civilian technical observers and to official visiting observers, as well.

3. SAFETY OF PLANES AND AIRBORNE PERSONNEL

(a) General Safety Precautions Applicable to All Air Operations

(1) With the exception of the bomb-carrying and pressure-drop aircraft and such other aircraft that CJTF-1 may direct, all planes airborne between How minus 2 hours and Mike plus 30 hours will be equipped with a Geiger counter or will carry a monitor with a portable counter.

(2) Personnel in planes airborne between How minus 2 hours and Mike plus 30 hours, including the bomb-carrying and pressure-drop aircraft, will wear on each person a personnel badge (supplied by the Radiological Safety Section through the Air Monitors) to indicate whether or not they have been exposed to radioactivity. In each aircraft there will be a minimum of one casualty badge to record possible higher intensities of radiation.

(3) At MIKE hour no aircraft will be within twenty (20) nautical miles radius of the Target, except that certain aircraft whose missions so require may be fifteen (15) nautical miles radius from the Target (Appendix II to Annex F); and the bomb-carrying airplane and pressure-drop aircraft, which must be 10 nautical miles (slant range) from the point of detonation, going away, at Mike hour plus 40 seconds. Between Mike hour and Mike plus six minutes, no aircraft will approach closer than 8 nautical miles to the cloud column. Between Mike plus six minutes and Mike plus thirty minutes, all aircraft will maintain a minimum distance of 8 nautical miles from the point of detonation and will keep clear of the Radiological Danger Sector, which is defined as an atmospheric and surface area of radioactive contamination that commences at the center of the target array and spreads leeward with the prevailing winds. The Radiological Danger Sector will be announced from Flag Headquarters and will be bounded by true bearings from the center of the target array.

(4) No plane will approach closer than 8 nautical miles to the rising column or the visible cloud, or within 10 nautical miles of a visible "downwind" cloud mass, even if equipped with instruments for detecting and measuring radioactivity.

(5) In the column that follows the ball of fire (Mike hour to Mike hour plus 6 minutes), the radioactive hazard will be pretty well confined to the visible column and to the air within 2 to 3 miles of it. If approached, it should be upwind or crosswind. In the "downwind" areas, the visible clouds will probably be surrounded by an invisible envelope beyond the visible cloud. The downwind "fallout" of radioactive particles will also be invisible. It is to detect these invisible hazards that radiological instruments and monitors are provided.

(6) Between Mike hour plus 6 minutes and Mike plus 30 hours, no planes will be airborne in any of the areas occupied or traversed by the cloud and its fallout except (1) those required by the Radiological Safety Section in the execution of the Safety Plan, (2) those specifically cleared by the Deputy Commander for Aviation, or (3) unless Radiological Safety Control, based on reconnaissance, declares the air safe earlier than Mike plus 30 hours. Included in (1) would be planes required for safety reconnaissance and those for air-sea rescue and safety patrol.

(7) [Deleted]

(8) All planes equipped with monitors or radiological instruments, except pilots in single-seated planes, will, while airborne, maintain a two-way communications contact, on a specially allocated frequency, with Radiological Safety Control, Flag Headquarters, CJTF-1. They will be subject to the safety requirements of this control. Pilots in single-seated planes will maintain such contact with the Force Fighter Director as safety demands.

(9) During all air operations, the Commander Joint Task Force One will be continuously advised from Radiological Safety Control,

Flag Headquarters, JTF-1, as to the safety of operating planes and personnel in order that he may terminate the operation or direct such changes in operations as the situation may require for the safety of operating personnel.

(10) CJTF-1, on advice of the officer in charge of Radiological Safety Control, will direct when and where planes may be airborne, as soon as reconnaissance indicates area of hazard and areas free from hazards due to radioactivity.

(11) Radiological measurement instruments will be provided by Radiological Safety Section for all manned planes during the air operations except the bomb-carrying and pressure-drop aircraft and others specifically excepted by CJTF-1 above.

(12) Personnel from Radiological Safety Section will be assigned to units participating in air operations in order to provide required briefing and indoctrination of personnel for these specific operations, and to provide technical advice and monitoring services essential to safe conduct of the operation. The senior representative of the Radiological Safety Section so assigned will be responsible for getting required instruments and approved goggles to the operating unit and will see that the instruments are properly installed in the plane. He will issue "casualty badges" and "personnel badges" (film) to personnel before flights.

(13) All operational planes, including drones, which have been airborne between Mike hour and Mike plus 30 hours, will be monitored for radioactivity on landing. This will be the responsibility of the monitor assigned to the air unit for this specific purpose and will not be the responsibility of the monitor within the particular plane. In monitoring planes, the monitor will pay special attention to the oil filter and to oil splashes on the exterior of the plane where radioactive particles will be held, if at all, on the plane. It is believed that, excepting the drones, no other planes will collect enough radioactive materials to be a hazard to ground crews. In the case of the oil splashes or oil filters that are contaminated, the hazard will have little range (a few feet at the most). Risk will be incurred only by (a) prolonged exposure within a few feet of the contaminated part or parts of the plane (hours, not minutes) and/or (b) direct touch or handling of the oil filter or oil splash. Most radioactive particles will not adhere to the clean skin of the plane. Greasy spots and oil splashes will collect radioactive particles. Hosing down with water would remove most of the loosely attached radioactive particles if there were any there. Air movement (wind) would have the same influence. This would occur (a) naturally in flight, (b) standing in the open (weathering).

(aa) "Drones" will be considered as being heavily contaminated until proven otherwise by the monitor specifically assigned to the drone landing site. He will be prepared to keep personnel away from the immediate vicinity of the drone until he has monitored it and advised the local commander of its safety or hazard. He will then advise the local commander as

to the necessity for posting sentries, delimiting areas of hazard, and such other actions as are required to protect personnel locally. Ground crews and personnel approaching drones that have been exposed will wear "personnel" badges as provided by, and in accordance with the instructions of, the monitor assigned to the landing site.

(bb) In the event that seaplanes are forced to land in contaminated waters, it will be the responsibility of the monitor specifically assigned to the seaplane base, or other landing place, to apply such measures as are required for detection of hazard on return of the aircraft to base and make recommendation to the local commander as to actions desirable to protect personnel locally.

(cc) The above considerations (bb) apply to PBMs engaged in reconnaissance of the air over the lagoon.

(14) [Deleted]

(15) [Deleted]

(16) Except for certain missions especially authorized by Radiological Safety Control, the pilot of any airplane, upon finding radioactivity, will take immediate evasive action, leaving the area in such a manner as to put the area of contamination directly on his stern as quickly as possible.

(17) When a pilot encounters a situation such as that described in paragraph (16), he will take the necessary action at once and report the observations and his actions, including position and altitude, to Radiological Safety Control, Flag Headquarters, CJTF-1 as promptly as practicable.

(18) The action described in paragraphs (16) and (17) is a "MUST" as life shall not be risked beyond this point.

(19) If planes do not encounter conditions depicted in paragraph (16), they will continue with the operation as planned.

(20) All monitors, and all personnel employing radiological measuring instruments, will keep a log of observations if at all practicable. These logs should confirm the information reported to the Radiological Safety Control, Flag Headquarters, CJTF-1.

(21) Any air operation may be terminated at any time by the Commander Joint Task Force One on advice from the Chief of the Radiological Safety Section, if it appears that continuation of the operation entails an unwarranted risk. Meteorological conditions may alter the behavior of the radioactively contaminated column, or of the downwind clouds in such a manner as to present an unpredictable hazard. This is unlikely to occur before Mike hour plus 6 minutes. Likelihood increases progressively after this time, requiring that the initial phase of the air operations be concluded by Mike hour plus 30 minutes.

(22) "Casualty badges" (films) and "personnel badges" (films) used in air operations will be collected by personnel of Radiological

Safety Section upon completion of the operation. These devices will be suitably labelled and as promptly as possible returned to Photometric Division, Radiological Safety Section on board HAVEN for processing.

(23) Personnel and planes engaged in these air operations will be monitored by personnel of the Radiological Safety Section immediately after landing. Observations will be logged and where significant readings are found, reported at once to Radiological Safety Control, Flag Headquarters, CJTF-1.

(24) If planes for press, radio, nonparticipating observer, or photographic purposes are airborne during the period of the air operations, or thereafter, they will comply with the requirements of this appendix.

(25) Should any plane be unable to maintain contact with the Force Fighter Director, and hence be unable to get directions relative to hazardous areas, the pilot will take such action as will take him at once toward safer upwind areas and withdraw from the operation until communications are reestablished.

(b) Protection of Eyes at "H" Hour

(1) General-purpose goggles fitted with ND 4.5 Filter Replacements will be provided all personnel airborne at "H" hour. An exception is in the case of the Navy Drone Unit (Task Unit 1.6.1), which will employ a special blue-amber combination of light filters specified by dispatch. No other unit will deviate from the use of ND 4.5 goggles unless so authorized by CJTF-1. Senior radiological monitor attached to air operation units will see to it that they are available and will check to see that all personnel airborne at this time are so equipped before taking to the air. He will also see to it that they have had previous instructions in the proper use of the goggles and in eye protection.

(2) The bombardier on the bomb-carrying aircraft will announce a warning to put on goggles at two minutes before the time of bomb release. At start of the automatic tone signal (one minute before bomb release), all personnel will adjust the goggles over their eyes. (Note exception as to copilots in para. 3.(b)(4) below.) Immediately after announcing "bomb away" for the last time, the bombardier will issue his final warning to put on goggles.

(3) At signal for bomb release ("bomb away," stop of tone signal), as an extra precaution all personnel will turn their faces away from the target until after the flash of light and heat occurs, after which time they may immediately remove the goggles and observe the rise of the incandescent column or cloud.

(4) Copilots in planes with copilots will take extra precautions to ensure greater safety. They will attempt to protect eyes completely. Copilots will have goggles adjusted by Release minus 5 minutes. At start of automatic tone signal (one minute before bomb release) copilots will cover goggles and eyes with bent arm in order to completely protect the eyes. After the flash, arm and

goggles may be removed and the column observed. This will permit copilots to take over in case pilot is temporarily blinded.

(5) The chances that a pilot will be partially blinded while using these goggles are remote, particularly if the pilot's position is such that he cannot, or does not, view the explosion directly.

4. The Chief of the Radiological Safety Section will issue to the force such additional safety precautions as are necessary.

APPENDIX IX

GENERAL CONSIDERATIONS
RADIOLOGICAL SAFETY
TEST BAKER

1. PHENOMENA ACCOMPANYING THE EXPLOSION

In Test BAKER, the mechanism of the nuclear reaction will be identical with that in Test ABLE. However, since the explosion in Test BAKER will occur in a water rather than in a gaseous medium, the phenomena that will be observed as a result of this explosion will be quite different from those that were seen in Test ABLE.

In Test ABLE, the sphere of hot gases formed by the nuclear reaction has been aptly described as a "ball of fire" that rises rapidly toward the stratosphere. In Test BAKER, the hot gases will take the form of a rapidly expanding "bubble" below the surface of the water of the lagoon. This "bubble" quickly rises to the surface of the water. It is the interaction of the "bubble" with the water that is responsible for the new or modified phenomena that are described below.

A. RADIATION

The water that encloses the "bubble" is much more effective in absorbing radiation (both gamma rays and neutrons) than is air. Hence, the primary radiations produced by the nuclear reaction will have a much smaller range than they did in the ABLE shot.

B. HEAT AND LIGHT

The water will cool the hot gases much more rapidly than did the air. Hence, the temperature of the "bubble" when it reaches the surface of the lagoon will be low as compared with the initial temperature. This means that heat and light will not be emitted in intensities that will injure persons nearby. Observers in the air and in surface vessels will see an illumination of the water and overlying clouds but will not be conscious of a "ball of fire" rising from the surface of the lagoon.

C. WATER BLAST

The water will accept a certain portion of the energy of the "bubble." This energy will then be propagated in the water outwards from the explosion in the form of a shock wave. This water blast will be more damaging to ships' hulls than was the airblast (the analogue of the water blast in the previous test). Probably, various reflections may either enhance or diminish the forces exerted in different locations so that the damage may not be uniformly or symmetrically distributed about the center. This has its analogue in airblast also.

D. MOVEMENT OF THE WATER

The rapid expansion of the "bubble" will cause a number of different types of responses in the surrounding water: (a) A mound of water and steam in the "dome" above the expanding gas bubble will be thrown upward from the surface of the water. This water will rise to a height estimated to be 5,000 to 8,000 feet and before breaking up into spray will have a calculated diameter of about 2,500 feet. (b) After the water from the "dome" has ceased rising, its summit will be pierced by a jet of water forced up from the bottom of the lagoon with the collapse of the gas bubble. This jet of water, called the "plume," may extend vertically two or three miles into the air in a matter of 10 to 15 seconds. Most of the water will fall to the lagoon in a matter of minutes. A small fraction of the water may remain suspended in the air as vapor. This column of vapor has been called the "ghost plume." Some of the gaseous detonation products in the "bubble" may escape up the ascending water and spray mass and collect about the top of the plume. These will be radioactive.

E. WAVE FORMATION

As a result of the movement of the huge masses of water described under section D, waves will be produced on the surface of the lagoon. These waves will spread out from the point of detonation in a concentric fashion. The waves will probably not be greater than 50 to 75 feet in height and 500 yards in length. At a radius of 4,000 feet the wave height will decrease rapidly as the waves move outward.

F. DISPOSITION OF FISSION PRODUCTS

As the bubble disappears, the fission products formed by the nuclear reaction will be dispersed in the water of the lagoon, as well as in the water of the dome and the plume. It is estimated that fifty percent or more of the fission products will be present in a circumscribed area in the lagoon within a few minutes after the explosion. Water vapor containing fission products will remain in the vicinity of the plume as a "ghost plume." The upper portion of this ghost plume may eventually form a low-lying cloud that will be carried off by the prevailing winds. It is possible that such a cloud may draw in the fission products from a wide area and concentrate them in the form of rain. The high-level mushroom-shaped cloud so characteristic of nuclear explosions in air will

not occur in this test, although a small cap of vapor may develop at the top of the plume.

2. HAZARDS RESULTING FROM THE EXPLOSION

The hazards resulting from Test BAKER can be divided into two types according to the time at which they make their appearance.

A. IMMEDIATE HAZARDS

(1) LIGHT AND HEAT

The water will shield the observers from the initial intense flash of light and heat and will rapidly cool the bubble so that these factors will not present a serious hazard to observers. Thus, the explosion can be viewed with safety by the naked eye from a distance of 7 or more miles.

(2) WATER AND AIR BLASTS

The blast waves will not be strong enough to affect ships at a distance of ten or more miles from the point of detonation, particularly because of the interposition of the reef.

(3) FRAGMENTS

It is possible that large fragments may be accelerated to high speeds in the air and that their trajectories may extend for considerable distances. It is extremely unlikely that these fragments will cover a distance of ten miles.

(4) WAVES

A series of waves on the surface of the lagoon will be formed by the explosion. These waves may have an initial height of 50 to 75 feet, but will rapidly expend their energy and probably not wash over Bikini Atoll. The waves will not endanger ships at a distance of 10 miles.

(5) RADIATION

The range of the gamma rays and neutrons produced by the nuclear reaction should be much less than that in Test ABLE because of the radiation-absorbing properties of the water surrounding the "bubble" as it is formed. The fission products present in the "bubble" then will be mixed intimately with the water in the plume and lagoon. Those fission products in the plume should emit intense radiation over a small distance in the air because there is considerable absorption of radiation by the water in the plume. Hence, there is no reason to believe that there is a hazard from radiation at the points of observation.

B. DELAYED HAZARDS

(1) DELAYED HAZARDS OF THE WATER OF THE LAGOON AND TARGET VESSELS DUE TO RADIOACTIVITY

It is estimated that the greater part of the fission products will be present in the lagoon after the water in the plume has returned to the surface. Most of the radioactivity that has not

gone up in the air will be uniformly distributed throughout the volume of a cylinder of water whose central axis will be formed by a line drawn upward to the surface of the water from the point of detonation. Most of the radioactive fission products in the water and spray that return to the lagoon from the plume will probably fall around and over this cylinder and shortly thereafter form a tongue on the surface extending several miles in the downwind direction from the contaminated cylinder described above. All ships in the area accupied by the tongue thus will be heavily contaminated by radioactive materials falling from above. Thus, it is the hazard from the radiation emitted by the fission products present in the large volume of water in the target area that present the greatest hazard to personnel returning to the lagoon. The hazardous radiation will be primarily gamma and beta in character. Beta rays are dangerous only if the radioactive materials are kept in contact with the skin for a long period of time or if the materials are taken into the body in appreciable quantities. The danger to personnel from inhalation or ingestion of radioactive materials is nonexistent when the radiation hazard in the cleared area is below 0.1 R/24 hours.

(2) DELAYED HAZARDS OF THE WATER OF THE AIR IN THE REGION OF THE "GHOST PLUME" DUE TO RADIOACTIVITY

The residual radioactive materials that have been left in the air with water droplets in the ghost plume should be rapidly carried away by the prevailing winds within thirty minutes after the explosion so that there should be no danger from these materials except in the downwind region.

(3) DELAYED HAZARDS OF THE CLOUD DUE TO RADIOACTIVITY

As mentioned above, it is possible that the upper portion of the plume may form a low-lying cloud, the radioactivity of which may be precipitated in the form of rain in the downwind area. This hazard may be greater in Test BAKER than in Test ABLE since the airborne radioactive material will be concentrated in the lower altitudes. However, for the same reason, the danger sector will be narrower in the BAKER Test.

3. PROTECTION

A. Against the primary effects of radiation, distance will provide necessary protection.

B. Against the secondary effects due to excessive waves, airblast and underwater shock, distance will provide necessary protection.

C. Against the secondary hazards due to radioactivity, detection and avoidance provide the best means of protection. This will form the basis of the Safety Plan as far as radiological hazards are concerned.

4. DETECTION AND MEASUREMENT OF RADIOACTIVITY

Suitable instruments will indicate both the presence and intensity of the radioactivity at a given place. The methods successfully employed in Test ABLE will be used. Instruments will include Geiger counters, protexi-meters, pencil elctrometers, ionization chambers, personnel badges (film), casualty badges (film), surface rate meters, underwater counters, "probe" meters, etc.

5. AVOIDANCE AND MEASUREMENTS

Area reconnaissance, maintenance of "contamination situation maps," designation of contamination areas by suitable means to JTF-1, and the posting of dangerous areas in ships or on land surfaces will constitute the active measures of avoidance. Exposures in excess of 0.1 roentgen per day will be avoided and this will be the limit of tolerance acceptable during the operation. This can be effectively measured by the methods em-ployed in Test ABLE. This is well within the safety limits. In Test BAKER, due to the greater intensities of residual radioactivity anticipated, it will be particularly necessary to observe this limitation of exposure.

6. ANTICIPATED HAZARDOUS AREAS

A. IN THE AIR

(1) Air immediately over the surface of the lagoon, particularly directly over the center of the target array, may be dangerous due to: (a) radiation from surface of the water of the lagoon and from the target ships, and (b) to fallout of mist containing radioactive materials.

(2) The most serious radiation hazard will exist in the air within 3 feet of the surface of contaminated water. This will be particu-larly serious in the surface water initially in the central tar-get area and particularly during BAKER Day. The intensity of gamma radiation from the target area water will be great enough to be hazardous for vertical distances of from 500 to 4,000 feet. These hazards due to water contamination may persist for several days and decrease in intensity with time and dilution with clean lagoon water. It is likely that the air for some distance above the sur-face of the water of the lagoon and downwind of the explosion may present a relatively high content of radioactive materials in mist or vapor that will be hazardous to planes flying at altitudes of 500 to 1,500 feet for several hours.

(3) Beyond the lagoon and downwind there will be an airborne hazard due to radioactive mist or particles. In some instances this may be held up in a low-level cloud, which may present a serious haz-ard. This may travel downwind for a distance of 100 to 150 miles or more. At a distance of 200 to 300 miles, it is unlikely that any air hazard may exist for air operations. Airlanes at a dis-tance of over 400 miles will be endangered at no time.

B. IN THE LAGOON

(1) WATER HAZARDS

(A) SURFACE WATER

The surface water (to a depth of 40 feet) will contain radioactive particles that are initially deposited in the central area of the target array and will tend to move down current at a rate of approximately 0.5 knot. Downwind of this central area, there will be additional contamination of surface water as a result of water falling from the "plume." This will make surface operations dangerous downwind and down current from the central area for an unpredictable time since the exact pattern of the contaminated surface area cannot be predicted, since much of it will depend upon the character of the surface winds and waves and the height and characteristics of the "plume" arising from the explosion.

(B) Subsequently, the surface water will receive an additional contamination. This may arise from contaminated water that has formerly been in the lower layers of the lagoon and moves in the opposite direction to the surface layers; thus, this deep layer can come up to the surface (upswell) upwind to the target area. Following this upswelling the deep water mixes its contamination with the surface water and moves downcurrent with it. It is anticipated that many subtle hazards difficult to forecast may arise in the water of the lagoon during the first three or four days. Later, the distribution of the radioactive material within the water of the lagoon may tend to be more homogeneous. Brisk surface winds will tend to favor mixing and dilution. Some surface water will leave the lagoon and will carry with it some radioactive material. Some entrances to the lagoon may be hazardous as a result of this. Winds, tides, and length of time decay following a detonation will exert important influences in this respect.

(C) SUBSURFACE WATER

Subsurface water (below 40 feet) will be contaminated with radioactive material initially in the region of the central target area. This will tend to move generally to the east "upwind" at a rate of approximately 0.1 knot (while the surface moves to the west at approximately 0.3 knot). Mixing and diffusion of the radioactive material within the water may be so slow as to prolong the persistence of very hazardous undiluted masses of water with high radioactivity. This may give rise to irregular areas or patches both below the surface and on the surface of the water of the lagoon.

(2) HAZARDS IN TARGET SHIPS

(A) TOPSIDE SURFACES

Topside surfaces will become contaminated with water containing radioactive materials. This will arise from water falling

from the "plume" and from contaminated water of the lagoon being splashed on the target ships. In general, there will be negligible induced radioactivity in the metals of the ship. Evaporation of the water will tend to leave radioactive fission products dried on the exposed surfaces of the ships.

(B) BELOW DECKS

Below decks and in compartments of the target ships, radioactive hazards will be found due to some exent to radioactivity in the water outside the compartment or radioactive material on the surface of the ship. In the main, the more serious hazards will arise from water initially highly contaminated and trapped within the compartment. Due to the fact that this water will usually not be diluted by water from without the compartment, the benefits of dilution, mixing, and dispersion will be lacking. This will result in localized hazards of relatively high intensity and probably with greatly increased persistence.

(C) HAZARDS ON THE ISLANDS OF THE ATOLL

If waves of contaminated water roll over the land surfaces, radioactivity may be found in these areas. It is likely this will not occur during the early phases following the explosion as the contamination within the water is well localized. Later, land surfaces downwind may be contaminated by water or mist settling out from the air. Later, also contamination within the water of the lagoon may extend into such areas as may wash up on the sandy beaches of the islands. Lesser contamination may be found at variable distances from the beach, depending on how far the wind may carry contaminated spray and droplets in from the beach. Serious hazards will hardly be developed in this manner.

(D) HAZARDS AT A DISTANCE

Airlanes beyond 400 miles will not be endangered at any time. It is probable that no hazard will exist for planes operating at distances beyond 300 miles. Special monitoring is desirable for islands within 200 miles downwind. Contaminated water leaving the lagoon will not set up hazards at a distance beyond 50 miles. It is believed that projectiles will not create a hazard beyond a distance of 10 miles from point of detonation.

7. ESTIMATE OF RADIOACTIVE HAZARDS IN RELATION TO OPERATIONS

A. SELECTION OF A DAY TO SHOOT

If the winds at all altitudes below 25,000 feet are within a sector no greater than 5°, and if this sector lies within 45° and 135°T, the most suitable conditions will exist with regard to radiological safety. Winds from the southeast will not be as desirable as those from the east or northeast due to the greater likelihood of upwelling of contaminated water in the lagoon near the entrance to Enyu Channel.

B. SAFETY OF SHIPS OF FORCE

(1) If at the time of detonation all ships of the Force are stationed upwind of the detonation and not closer than 10 nautical miles to the central target area, they will be safe from any effects of the explosion.

(2) Subsequent to the detonation the radioactivity that is airborne will be carried downwind and away from the areas to which the ships have been assigned. By the time reentry can be attempted, no danger from particles falling out of the air will exist within the lagoon.

(3) During reentry, it will be necessary for the radiological reconnaissance of the lagoon to establish the distribution and characteristics of the radioactive contamination within the lagoon before any ships may be permitted more than limited entry. It may be possible to have ships essential to the early reentry and safety reconnaissance operations approach within the entrance to the lagoon where they may be safe until the termination of that working day. This possibility seems likely due to the fact that diffusion and dispersion of the radioactive products within the water is expected to be slow enough on BAKER Day to safely permit essential ships to enter just inside the lagoon, but prepared to withdraw on an hours notice and planning to withdraw from the lagoon before dark. By BAKER plus one day, it is expected that the contamination within the water may have spread in such a manner as to constitute a hazard that can be determined only by radiological safety reconnaissance. During the first few days following BAKER Day it will be necessary each day to conduct a cautious safety reconnaissance and limited reentry operation. It is likely that ships not essential to the early reentry phase and to the safety reconnaissance cannot reenter the lagoon for five or more days. Hazards that may be anticipated in connection with boating and with the operation of the ships may make such reentry of other ships impracticable if not actually unsafe.

C. AIR OPERATIONS

(1) PERIOD MIKE TO MIKE PLUS 30 minutes

There is strong evidence to indicate that the hazard from blast, heat, and light will be essentially negligible. There is also good evidence to believe that during the first six minutes that the radiological hazard will be confined to a cylinder not to exceed 5 miles in radius and extending vertically upward. After 6 minutes the hazard tends to move downwind as the spray and mist are carried by the wind. Operations outside the prescribed RADEX will be safe provided that the visible cloud of mist or shower of water (if any) is avoided at a minimum distance of 5 nautical miles and that the intensity of radioactivity does not exceed 0.1 roentgen per 24 hours. While the intensity of the radioactivity during this period is believed to be high, its distribution will probably be quite localized and limited to the area to be designated as RADEX. Operations within this area would be dangerous during this 30-minute period.

(2) PERIOD AFTER MIKE PLUS 30 minutes

(a) PBM CHARLIE

It is unlikely that there will be any hazard from mist or fallout after Mike plus 30 minutes, but it must be anticipated as the central target array is approached. The contours of radioactivity from the surface of the lagoon will be approached cautiously in the same manner as in Test ABLE. It is not known whether this will be observed at greater altitudes. This information will be ascertained by this reconnaissance. The intensity of the radiation given off from the water surface will be greater at lower levels, i.e., from surface up to 4,000 feet.

(b) PBM DOG

It is unlikely that any radioactivity will be encountered in the air over the ships of the force. Reconnaissance of the air over the lagoon will be detected as in Test ABLE.

(c) Personnel in helicopters, if operating over contaminated areas of the lagoon, would be in danger of falling into dangerous water in case of engine failure.

(e) Planes operating in the air over the lagoon will be exposed to radioactive effects, if they enter those areas that PBM Charlie and PBM Dog ascertain to present a radioactive hazard. The day-to-day changes in these areas can be determined only by the reconnaissance of these areas on successive days by PBM Charlie and PBM Dog. Surface reconnaissance may assist in localization of these hazards in the air over the lagoon. This hazard may not be important after BAKER plus one day.

(e) Planes operating near the lagoon after Mike plus 30 minutes will not be exposed to radioactive hazard if they avoid the downwind sector provided by an extension of the radial boundaries of the RADEX. In general, this area in Test BAKER will be similar to the Surface Survey Sector. It will extend for 150 miles from the central target area.

(f) Air-sea rescue planes cannot operate within the lagoon until the water is safe radiologically.

(g) PBM planes of Bikini-Kwajalein air shuttle will not be able to operate from the lagoon until a suitably safe anchorage for the seaplane tender can be provided. This is unliekly before Mike plus 5 days.

D. DRONE BOAT OPERATIONS

The operation of BEGOR and the TBM planes will be in safe areas. The hazard of this operation lies in the handling of the radioactive water samples. Adequate protection can be provided in the manner planned. This may be accomplished by using several persons for short times, i.e., still within the period required to give no more exposure than 0.1 roentgen.

E. LAGOON PATROL

The PGMs and LCPLs will commence operations within the lagoon at a time when there is no danger of fallout from the air. Initially they will probably be able to advance well within the entrance to the lagoon and with safety detect and outline the contaminated surface layers and the deeper layer, which may upwell in unexpected places. It appears to be likely that this phase of the operation can be successfully conducted on BAKER Day. The operation on BAKER Day plus one will have to be initiated more cautiously than on BAKER Day due to this uncertainty of the spread of the contamination within the water of the lagoon. It is possible that the reconnaissance of the waters of the surface layers of the lagoon and of the lower layers may be required beyond five days. During this operation the air within 3 feet of the surface of the water will contain the most significant radioactivity. The methods of protection employed in Test ABLE will be equally successful in Test BAKER. "Hot" areas that upwell may "trap" PGMs or LCPLs, so this hazard will be anticipated. Destroyers operating within the lagoon would anticipate similar hazards as the small craft.

F. DESTROYERS

The likelihood of a serious radioactive hazard within 50 miles of the lagoon on the downwind side will be much more likely than in Test ABLE. Within 20 miles of the lagoon, this will probably be confined to the Surface Safety Sector. The intensity of the contamination due to fallout on the surface of the ocean cannot be predicted with accuracy, but it is probable that it would fall quickly due to dilution and dispersion within the water. A cautious approach to the boundaries of the Surface Safety Sector will be required. The methods employed in Test ABLE will provide ample protection to personnel in the destroyers. Instructions from Radiological Safety Control will assist, during the operation, the destroyer units in locating and avoiding dangerous areas. Contaminated water from the lagoon will probably not be found until BAKER Day plus one. The movement from the lagoon can be tracked with safety, employing methods employed by the Destroyers on ABLE day.

G. REBOARDING OF TARGET SHIPS

(1) It is likely that the water of the lagoon may be radiologically safe for Initial Boarding Teams to traverse prior to the time that they may attempt to board the ships.

(2) Initial Boarding Teams will encounter a variety of hazards of radioactivity. While this is due primarily to the high intensity of radiological contamination of the water of the lagoon, the next important factor will be the probable irregularities of areas of hazard within the target ships. This will require a more cautious and probably slower topside reconnaissance than in Test ABLE. Exterior surfaces may be contaminated with radioactive particles that adhere to the surface after contaminated water evaporates and leave a persistent deposit.

(3) Inspection Teams A and B will encounter hazards not encountered in Test ABLE. Compartments that are flooded or to which radioactive water gains access may be hazardous. The prevention of

dilution and the retention of highly contaminated water in this manner will constitute a serious hazard. The intensity and the duration of this form of hazard cannot be predicted. The special preparation and training of monitors in this aspect of the operation will facilitate the movement within the ships and provide adequate safety.

(4) Instrument Teams reboarding target ships will encounter the hazards characteristic of the phase at which they board the target ship, namely Initial Boarding Team or Inspection Team phase.

H. FIREFIGHTING AND SALVAGE

Firefighting and salvage operations will be limited in the early phases by the intensity and distribution of the contamination of the water and by the radioactivity of the target ship, or ships, involved. It is unlikely that such operations can be conducted prior to BAKER Day plus two, probably later. Monitors specially trained to assist in the conduct of such operations will be necessary.

I. DIVING OPERATIONS

Diving operations will be hazardous as long as the water in the lagoon is radioactive. Water at all depths must be monitored. It is impossible to predict just what radioactive hazards may exist in or near sunken ships. Methods employed in later phases of Test ABLE will be equally successful in ascertaining the presence, intensity, and distribution of such hazards.

J. REENTRY OF SHIPS OF THE FORCE

Reentry of ships of the Force will probably be delayed beyond BAKER Day plus four. Until the water of the lagoon is radiologically safe from the standpoint of small boating and from the standpoint of operating evaporators and condensers it will probably be impracticable to have the ships of the Force reenter the lagoon and take up permanent anchorages.

K. REOCCUPATION OF TARGET SHIPS BY SHIPS' CREWS

Reoccupation of target ships by ships' crews will be delayed. The time at which this may take place can only be determined by the situations encountered by the Reboarding Teams. Careful monitoring will be required until it can be shown that habitation within the ship is safe and the conditions required for the normal operation of the ships are known to be safe.

8. FACTORS TENDING TO REDUCE DANGERS FROM PREDICTED RADIOACTIVE HAZARDS

A. FROM GAMMA RADIATION

Despite the fact that enormous quantities of high-energy radiations may emanate from the contaminated water and cloud there are certain physical facts that will make it possible to approach and delineate such areas without excessive danger. They may be listed as follows:

(1) The intensity of radiation will diminish with the distance from the source.

(2) There will be considerable absorption in the intervening air between observer and source.

(3) The geometric consideration will also influence the distance of approach to the contaminated area. Since the source will be spread over a wide area. Flights over the area will be subject to radiation at various angles from the entire source. On the surface, however, the subtended angle will be so small, an individual will be affected only by material on the near side of the contaminated area.

B. FROM BETA RADIATION

To receive excessive amounts of beta radiation in a situation such as Test BAKER, it would be necessary to come in very close contact with the contaminated material. Protection from this will be unnecessary if the gamma radiation intensities are low.

C. The radioactive materials in the air and the water of the lagoon will become less in quantity and concentration with time. The factors that tend to bring about this diminution are as follows:

(1) DECAY WITH TIDE

The mixture of fission products is known to decay inversely with time, in hours.

(2) DILUTION AND DISPERSION

There will be slow but appreciable dilution with the surrounding media (air and water). Mixing will occur in both vertical and horizontal planes.

(3) TRANSFERRENCE

There will be gradual transfer of materials away from the test site by wind movement in the air and by currents in the water.

Serial: 019 30 August 1946

From: Commander Task Group One Point Two, JTF-1

To: All CROSSROADS Activities on Kwajalein -- Bikini Area

Subject: Safety Precautions Incident to Boarding Target Vessels Laid-Up at Kwajalein and Bikini

1. Boarding of the target vessels now laid up at Kwajalein and Bikini will be necessary from time to time during the coming months in connection with such work as ammunition inspection and disposal, scientific investigation, inspection and maintenance of watertight integrity and structural safety, etc. These vessels, in addition to the hazards which are inherent in any uninhabited ship which has been closed up and laid up for a long period of time, present certain other peculiar hazards which are the direct consequences of the participation of the ships as targets in the two atomic bomb tests of the past summer. These hazards, to which all personnel boarding these ships will be subjected, fall into four general categories as follows:

(a) Radiological hazards

(b) Explosive hazards

(c) Hazards due to concentration of poisonous or noxious gases and vapors in enclosed spaces

(d) Structural hazards.

2. The purpose of this letter is to summarize in convenient form the hazards to be expected and the safety precautions to be observed when boarding the target ships. It is not intended to be a treatise on the subject. All responsible officers are expected to read and familiarize themselves with [sources of safety information cited but not reproduced herein], and by appropriate instruction and indoctrination of their men, familiarize them with the dangers of the job in hand in order that their own ignorance will not lead them into danger or disaster.

It is emphasized that all possible dangers and emergencies which may arise cannot be covered in this letter, and that responsible officers are expected to exercise prudence and sound judgment in dealing with any situation not specifically covered herein.

3. GENERAL RULES

(a) All target ships, regardless of their previous radiological history, or the amount of CROSSROADS work previously expended on them must be assumed to be radiologically hazardous. Parties boarding them will invariably be accompanied by radiological monitors, and all radiological safety precautions will be scrupulously observed.

(b) The predominance of one type of hazard in any particular job to be done must not be allowed to prevent consideration of other types of hazards which may be simultaneously present, even though in lesser or supposedly negligible degrees.

(c) Safety of personnel shall be the governing consideration at all times. No job is of sufficient urgency or importance to justify departure from this guiding principle.

(d) The Pensacola, because of the presence on board of dangerously unstable 8-inch powder, is out of bounds to all personnel. No one shall be permitted to board this vessel without the express authority of SOPA in each instance.

Due to the unusual character of the conditions existing in the Pensacola, special instructions with regard to this ship will be issued at a later date.

4. RADIOLOGICAL HAZARDS

(a) [CTG 1.2 Serial 699, 17 Aug 1946] will be the governing directive for radiological safety of personnel working on target vessels. Salient points of this directive, as well as additional precautions pertinent to the nature of the work to be done, are set forth in the following subparagraph.

(b) While on the job, personnel will wear only the work clothing which is specifically issued to them for that purpose on the APL-27.

(c) Despite consideration of physical comfort, sleeves will be rolled down and gloves and proper footgear will be worn while working on target ships.

(d) All individuals while on the job will wear film badges, which will be issued, collected and processed in accordance with existing instructions.

(e) Monitors will invariably be procured and clearance obtained from RadSafe prior to boarding. Required advance notice will be given in so far as practicable.

(f) All personnel will be processed through the APL-27 for issue of clothing and for radiological decontamination on the way to and from work on the target ships. Since this activity is well established and familiar to all concerned, detailed instructions for its operation are not repeated here. The activity will be administered by the Commanding Officer of the Geneva and subsequently by the Commanding Officers of such vessels as may successively relieve and take over the functions of station ship and hotel ship now being performed by the Geneva.

(g) With the decontamination center on the APL-27 in operation and the use of "sour" boats, it is not believed that the prevention of contamination of non-target ships will present a serious problem. RadSafe will make periodic surveys of non-target ships and will issue such instructions from time to time as are deemed necessary.

(h) Boats used for carrying working personnel back and forth between the APL-27 and the target ships will be monitored and scrubbed when necessary as described in [CTG 1.2 Serial 699].

(i) With the possible exception of ammunition disposal, the remaining work to be done on the target vessels will not involve the same degree of intimate contact with sources of contamination as did the earlier decontamination work on these ships. Nevertheless, the same dangers still exist, and the same precautions will be exercised.

(j) Working parties will be kept concentrated as much as possible and men will not be permitted to roam about the ship at random.

(k) All hands should be warned that standing pools of water about the decks, even in supposedly uncontaminated parts of the ship, are potentially serious radiological hazards. The reason for this is that during rain squalls water may wash over a contaminated part of the ship's structure and then be carried through the drainage system and deposited in a clean part of the ship.

(l) Ship's blowers will not be operated except when necessary, and then only when the ventilation system has been checked by RadSafe and cleared for operation.

(m) Due to the danger of inhaling radioactive dust, no dry sweeping or dusting will be done on any part of the target vessel. It is not considered likely that any work of this nature will be required. If accumulation of dirt or trash interferes with efficient working, it will be removed by hosing down, if practicable, otherwise by wet brushing or wet swabbing. Swabs if used will never be wrung out by hand but will be taken topside and placed in a bucket of water, if available, otherwise hung on the life lines to dry.

(n) The danger of ingestion of radioactive material by the mouth must always be borne in mind. All working personnel must be made conscious of this danger and instructed not to eat or smoke or otherwise place contaminated hands in, on, or near the mouth. Lunches will under no circumstances be served to men on the target vessels and working parties will not be fed until thay have been processed through the decontamination center on the APL-27.

(o) No men with open wounds not securely covered and protected by bandages will be permitted to perform work on target vessels, and officers in charge of working parties will be vigilant to detect and eliminate men with such wounds. This precaution particularly applies to wounds on the hands, which should not only be bandaged but also protected by rubber gloves while working. Any wound, however small, received while working aboard target vessels should be immediately scrubbed well with soap and clean water. The injured man will then be processed through the decontamination center and taken to sick bay on the Haven where surgical debridement may be performed.

(p) Handling of objects on board target vessels will be reduced to the minimum required by the nature of the work to be done. The

practice of taking objects as souvenirs from target ships will be vigilantly guarded against and sternly suppressed.

(q) No personnel shall go below decks on target vessels unless wearing oxygen rescue breathing apparatus or positive pressure mask.

(r) An additional inhalation hazard exists in connection with such mechanical operations as cutting and chipping. Personnel performing such work will wear rescue breathing apparatus or positive pressure masks.

(s) If evaporators are opened for any purpose, such as removal of tubes or scale, all personnel on the job will wear rescue breathing apparatus or positive pressure masks. Shirt sleeves will be rolled down and rubber gloves will be worn. A radiological safety monitor will also be in attendance.

(t) Any articles or materials to be removed from target vessels will be monitored in an area where no contamination exists prior to being taken aboard any non-target vessel or sent to any shore installation.

5. EXPLOSIVE HAZARDS [not reproduced]

6. HAZARDS DUE TO NOXIOUS OR POISONOUS GASES OR VAPORS [not reproduced]

7. STRUCTURAL HAZARDS [not reproduced]

TASK GROUP 10.12
OPERATION PLAN
ComBikResurvGroup No. 1-47

ANNEX J

RADIOLOGICAL SAFETY AND HEALTH PLAN

I. ORGANIZATION

A. Radiological Health Section

1. Evaluation of radiological hazards and recommendations for safety procedures

2. Photographic dosimetry

B. Radiological Safety Section

1. Monitoring operations

2. Decontamination "change stations"

C. Radiological Health Advisory Board

1. This Board will consist of the Radiological Health and Safety Officers and such scientific personnel as may be appointed by the Project Officer of the resurvey. It will advise, evaluate, and make recommendations in writing to the Radiological Health Officer in special radiological health matters not covered in BuMed directives; i.e., radiological clearance of questionable areas.

II. STAFF

A. Radiological Health Officer

B. Radiological Safety Officer

C. Radiological Health Advisory Board

III. MISSION

The mission of the Radiological Health and Safety organization will be to protect personnel from radiological health hazards that may be encountered in the Bikini Scientific Resurvey operations.

IV. TASKS

A. The Radiological Health Officer and the Radiological Safety Officer will prepare the Health and Safety Plans to be followed in this operation, and will be responsible for the execution of radiological health and safety directives. They will organize and direct all medical and technical elements of the operation required to execute this plan.

B. The Radiological Health and Radiological Safety Plans are attached hereto as Appendixes I and II, respectively.

Appendix I

Radiological Health Plan

I. RECOGNIZED RADIOLOGICAL HAZARDS

A. Two types of radiological hazards are recognized: "external radiation" and "internal radiation." The former is the type received when standing in the path of a powerful X-ray beam. The latter produces an effect similar to that resulting from the ingestion of radium or the inhalation of radioactive dust.

B. Because of the natural radioactive decay that has taken place since Test A and Test B, the "external radiation" hazard is of lesser importance, but in some localities may prove to be dangerous.

C. The "internal radiation" hazard, however, may still be important. It is characterized by the fact that the injurious material produces damage only when it gains access to the body through ingestion, inhalation, or through breaks in the skin. It may best be visualized on the one hand as comparable to the hazard present in the mining of radioactive materials (inhalation), and on the other to that encountered in the painting of radium dials (ingestion). Even in cases of extreme exposure, characteristic clinical findings may not appear for several years. Even when the exposure is not sufficient to cause death, it may produce tumors in various tissues.

II. ESTIMATE OF CURRENT RADIOLOGICAL HAZARDS

A. General Information

1. The detonation of an atomic bomb liberates an enormous quantity of electromagnetic radiations and neutrons. The electromagnetic radiations include infrared, visible light, ultra-violet light, X-rays, and gamma radiation.

2. Thereafter, the products formed during the fission process emit gamma rays and beta particles, constituting the "external radiation" hazard.

3. The bomb also releases other products that constitute an "internal radiation" hazard.

B. Present Hazards as a Result of Test A (airblast)

1. None.

C. Present Hazards as a Result of Test B (underwater blast)

1. In an underwater burst such as Test B, the radiation resulting from residual radioactive products still may be of considerable magnitude.

2. The products of fission sometimes are absorbed and concentrated in and on ships, corals, algae, and animals. At the present time, radiation hazards of this sort seem remote.

3. However, the highly dangerous unfissioned material producing alpha radiation has a half-life of several thousand years, and will be practically undiminished in intensity due to decay. It was more or less concentrated immediately following Test B, but probably will not be more widely distributed within the atoll area.

4. These unfissioned alpha emitters, together with the fissioned beta- and gamma-radiating products, will occur in greatest concentrations in the area of the coral crater produced by the underwater blast.

5. The sunken ships in this area can be considered contaminated to a relatively high degree, and other areas throughout the lagoon will be considered dangerous until radiologically cleared.

6. Algae, fish, and other marine organisms may contain relatively high concentrations of both fissioned and unfissioned materials.

III. PERSONNEL PRE-EXAMINATION

A. All personnel, both military and civilian, who are to participate in the Bikini Scientific Resurvey will be required to have a special physical examination prior to entering upon such duty.

B. Special medical records, separate from the individual's health records, will be set up under the cognizance of the Radiological Health Officer, and will be classified Confidential.

C. Particular attention will be given to a history of skin sensitivity and respiratory allergy, and it will be necessary to eliminate from contact with radioactive material personnel who have chronic infections or chronic conditions of any nature, particularly skin or respiratory infections, blood dyscrasias, extensive fungus infections of the skin and scalp, precancerous lesions, and all open wounds on the hands.

D. The clinical laboratory examination will include, in addition to a complete blood count, an erythrocyte sedimentation rate, and X-ray of the chest, and a complete urinalysis. Beta counts will be made on the urine when indicated, and if necessary, more extensive radiochemical analysis will be completed. The X-ray of the chest is considered important for future reference, and will be made on full-sized film and filed in the "special medical record."

E. These examinations must be completed before personnel will be given medical clearance to engage in the Bikini Scientific Resurvey.

IV. PERSONNEL FOLLOW-UP EXAMINATIONS

A. All personnel will be given a follow-up medical examination upon completion of the Bikini Scientific Resurvey, even though it is unlikely that any evidence of overexposure will be encountered if safety regulations are followed.

B. Particular attention will be given to the hands for any signs of radiation effects, such as reddening of the skin around the nails or

changes in the fingerprints. These observations will be used as a screening method to select those who should be referred to a Medical Advisory Board for more careful evaluation.

C. The urine will be carefully studied in case of accidental overexposure to radiation or radioactive materials. Beta counts will be made, and if twice background or higher is found in any urine sample, more extensive radiological tests will be carried out.

D. The follow-up examination will include complete blood counts, and an erythrocyte sedimentation rate. All blood samples should be obtained under similar technique, and at the same time of day for each individual. Since a variety of changes is possible in the blood picture after exposure to radiation, all blood counts will require interpretation by a medical officer trained in the special problems of hematology in radiation sickness. In cases suspected of overexposure, or when unexplained laboratory findings occur, total erythrocyte and leucocyte counts will be made, and urine beta counts repeated. Individuals presenting these findings, and individuals known to have received overexposure to external radiation, as shown by photographic dosimetry, will be eliminated from further possible exposure pending the outcome of these studies.

V. PERSONNEL PROTECTION

A. General Information

1. All personnel will be issued protective clothing consisting of caps, green work pants and shirts, canvas gloves, and work shoes.

2. This uniform will be worn by all personnel working at tasks or in areas considered dangerously radiologically contaminated.

3. The wearing of protective clothing and the use of other designated protective measures must be rigidly followed until the radiological situation has been evaluated by the Radiological Safety and Health Sections.

4. Navy Gas Masks with B-2 canisters will be made available for use in situations where radioactive dust is found present in hazardous amounts.

5. The Radiological Health Officer will make recommendations as to changes in safety regulations as the situation may require.

B. Beach Working Parties

1. Initial beach working parties will be accompanied or preceded by a Radiological Safety Officer, and all members of each party will wear the prescribed protective clothing.

2. The Radiological Safety Officer will determine if any contamination exists, and will collect suitable samples of materials for laboratory examination aboard ship.

3. Great care shall be taken to avoid eating or eating with, drinking or drinking with, any materials found on the islands until radiological clearance has been given. In most cases this

clearance will require shipboard laboratory tests of the materials in question. (There shall be no swimming in lagoon waters until clearance has been given by the Radiological Health Officer.)

C. Scientific Expeditions to Beaches and Reefs

1. A Radiological Safety Officer will accompany all initial expeditions to reefs and beaches.

2. All protective measures will be executed until the radiological situation has been fully determined and clearance given by Radiological Health Officer.

3. Care must be exercised to avoid cuts and scratches from sharp coral, as open wounds are extremely hazardous when handling materials contaminated with radioactive fission products and unfissioned materials. If any such wounds occur accidentally, the Radiological Health Officer will be notified immediately.

D. Camps Ashore

1. All new camp sites and existing camps, buildings, and other materials, which may be utilized as a shore-based camp for living purposes, will be checked by monitors before use, and laboratory analyses of samples will be made, when and if indicated.

2. Particular attention will be given to drinking water in tanks and service pipes. Water analysis will be made before such facilities are rehabilitated for use.

3. All gear that is found on Bikini Island associated with the preparation of, and handling of food and drink, must be thoroughly scrubbed clean, and radiologically cleared before being returned to such service.

4. Rusty or corroded materials must not be allowed to come in contact with food or drink.

5. The north end of Bikini Island was the most heavily contaminated, and special precautions must be taken if camp sites are required in this area. Under no circumstances will marine life of any type (found within or about the atoll) be eaten, unless prior radiological health clearance has been given.

E. Diving Operations

1. The deep-water diving operations for the inspection of the sunken target ships probably will constitute the greatest radiological hazard to Resurvey personnel. Most of these operations will be within or about the coral crater formed by the underwater blast. The coral and sediment, as well as the ships in this sector, were highly radioactive following Test B of last year. Allowing for natural decay, there still will be considerable radiation present, together with hazardous quantities of fissioned and unfissioned material.

2. All protective measures will be adhered to by personnel engaged and assisting in those operations.

3. Radiological Safety Officers will determine the extent of the radiation, and safe working period with deep-water survey probes, at the site and prior to the diver's descent.

4. All diving clothing, gear, and associated equipment that has been submerged will be washed off with a stream of water as it is hoisted, carefully monitored, and further decontaminated if necessary.

5. Divers will be monitored, and will proceed through the "change station," if necessary, for decontamination prior to being re-monitored. If any part of the body exceeds twice background count, showering or scrubbing with soap and water must be repeated until this level has been attained.

6. All personnel handling diving gear and associated equipment that comes in contact with radioactive materials will be processed in the same manner as divers.

7. While it is anticipated that radiological hazards in connection with shallow-water diving along atoll reefs will be minor, all diving areas will be initially checked by monitors with underwater probes, and laboratory samples will be taken for analysis if necessary. Based upon the monitoring reports and laboratory findings, and Radiological Health Officer will determine the protective measures necessary.

VI. PROTECTIVE PROCEDURES AND EQUIPMENT

A. Monitoring Instruments

1. For general field and personnel monitoring, the type 263 Geiger tube survey meter will be used. This instrument can detect both beta and gamma radiation in a range from less than 0.001 R/24 hr. In addition, by use of earphones, background counts can be determined.

2. For alpha detection in the field, the portable "Zeuto" nylon window ionization chamber will be used. Since this instrument requires the presence of considerable alpha activity in order to respond, a negative indication does not signify complete absence of alpha emitters. Laboratory analysis of suspected samples will be required.

3. For gamma radiation measurements in the vicinity of sunken ships and bomb crater coral, the Type 235 survey meter with an ionization chamber in an extended probe will be used. This instrument has a gamma range of from 0.001 R/24 hr to 0.6 R/24 hr, but will not detect the presence of alpha or beta radiation.

4. For supplementing film badges, the pencil type quartz fiber dosimeter will be used. This pocket type instrument depends upon the ionizing discharge of gamma radiation. It has a range from 0 to 2.0 R. Pencil dosimeters will be worn by all deep-water divers and by others as conditions indicate.

B. Photographic Dosimetry

1. A photographic dosimetry unit will be set up to issue, receive, and process film badges. The Radiological Health Officer will have cognizance of this unit. The Type K film badges used will totalize the amount of general body radiation received. They have a gamma range from 0 to 2.0 R.

2. Film badges will be worn by all deep-water divers, and all others contacting significant radiation, and will be processed daily for divers, and for others at intervals dictated by the radiation contacted.

3. Complete records will be kept of name, badge numbers, date, and hours of exposure. The exposure will be totalized for each individual concerned, and entered into the total dosage record for the operation.

4. As a general rule, an individual will be permitted to reengage in the same operation the following day only if the tolerance limit of total body radiation of 0.1 R per day has not been exceeded.

C. Decontamination "Change Stations"

1. Personnel decontamination or "change stations" will be established aboard Chilton (APA-38), Coucal (ASR-8), and on LCI(L)-615, if necessary.

2. All personnel returning to these ships who have been engaged in operations resulting in contamination to clothing or body will proceed through the "change station."

3. A special compartment will be provided for the removal of contaminated clothing; handwashing facilities, including brushes for scrubbing the nails, will be provided separate from the showers.

4. After gross dirt and contamination are removed from the hands by repeated scrubbing with soap and water, personnel will proceed to the shower and wash the body, repeatedly soaping and rinsing. They will then dry themselves in the shower room and reenter the noncontaminated dressing room, where they will be completely monitored, with special attention being given to the hair, hands, and feet. A Type 263 survey meter with earphones shall be used for personnel monitoring.

5. If any part of the body reads above twice background count, a second scrubbing and shower must be taken, and the decontamination process repeated until this level is attained, prior to donning clean clothing.

6. Contaminated clothing will be laundered in a special-purpose laundry, which will be used exclusively for such purposes. The wastewater from the portable laundry equipment will be pumped over the side and not connected to the ship's sanitary system. Monitors will inspect the laundry equipment from time to time to make sure that it is not accumulating any contamination. Clothing

that exceeds twice background gamma plus beta after repeated laundering will be discarded and disposed of in a safe manner.

D. Radiological Sample Handling and Storage

1. Care will be exercised in handling and storing radioactive samples to prevent the spilling and spreading of contaminated material about the ship.

2. All samples must be placed in covered bottles or jars wherever practicable before being brought aboard ship and well-packaged or placed in leakproof containers in such a manner that no wet or dry material can escape.

3. Special storage spaces will be designated and properly marked for the storage of "hot" samples. These spaces shall be so located that no personnel can receive more than 0.1 R/24 hours radiation from them.

4. Shelves in sample rooms shall be lined with paper or other suitable disposable material to protect against or pick up any accidental spills.

5. Scientific laboratory work tables used for contaminated material likewise shall be covered with disposable paper to prevent the accumulation of radioactive materials. This is important both as a health measure and as an aid in keeping laboratory background counts low.

6. Suitable, well-marked disposal cans shall be provided in sample sorting rooms and technical laboratories for the disposal of discarded radioactive specimens and wastes. No radioactive wastes will be discarded in the ship's sanitary system, since radioactivity will accumulate and may later present a difficult decontamination problem.

7. Monitors will be assigned to make periodic inspections of sample rooms and technical laboratories.

Appendix II

Radiological Safety Plan

I. ORGANIZATION

Chief of Section and Radiological Safety Officers. The Radiological Safety Section will be based aboard USS Chilton (APA-38).

II. GENERAL INFORMATION

Appendix I to this Annex contains general information relative to the radiological situation expected to be encountered by personnel engaged in the operations to be undertaken by the Bikini Scientific Resurvey.

III. MISSION

To determine the magnitude of the radiological hazards existing within the operational area, and to furnish the Radiological Health Officer with such data and reports as may be required to permit an accurate evaluation of the radiological situation, and the formulation of policies and procedures necessary for the protection of personnel engaged in the operation.

IV. TASKS

A. Monitoring Operations

1. Preliminary Survey of Bikini Island

Radiological Safety Officers will accompany the initial parties ashore on Bikini Island, and will begin a preliminary radiological survey thereof. This preliminary survey will be completed as soon as practicable, and particular emphasis will be placed upon the monitoring of all existent buildings or structures on the island.

2. Diving Operations

a. Deep Water

Two (2) Radiological Safety Officers will be aboard USS Coucal (ASR-8) during all deep-water diving operations conducted from that vessel. One (1) Radiological Safety Officer will operate the deep-water probe during such operations, and one (1) Radiological Safety Officer will be responsible for the monitoring of all divers returning aboard Coucal, together with the monitoring of all samples brought to the surface by the divers.

Detailed instructions as to precautionary measures to be taken in connection with deep-water diving are contained in paragraph V.(E) pf Appendix I to this Annex.

3. Core Sampling

One (1) Radiological Safety Officer will be aboard LCI(L)-615 during all core-sampling operations conducted from that ship. The Radiological Safety Officer will be responsible for the monitoring of all samples and personnel engaged in the work on the vessel.

4. Accompaniment of Beach and Boat Parties

Radiological Safety Officers will accompany all beach and boat parties working within the operational area until such time as specific localities have been determined to be free from radiation hazards and properly cleared by the Radiological Health Officer.

5. Periodic Inspections

Radiological Safety Officers will periodically check various parts of the ships for radioactivity. Such checks will include condensers, evaporators, fire mains, flushing systems, etc. where

there may be a concentration of deposition of radioactive materials from contaminated water.

6. Special Radiological Reconnaissance

Special radiological reconnaissance, not essential to safety, may be conducted by the Radiological Safety Section when safety requirements are not overriding.

V. PROTECTION OF PERSONNEL

A. Film Badges

Radiological Safety Officers will issue film badges daily to individuals entering hazardous areas, and will collect these badges at the end of each day for delivery to the Photographic Dosimetry Unit. This procedure will be followed until such time as radiological reconnaissance indicates that it may be modified in specific instances. All exceptions to this procedure will be cleared and announced by the Radiological Health Officer.

B. Protective Clothing

1. General

Radiological Safety Officers will insure that members of all scientific work parties are equipped with the following items of protective clothing:

Cap, "baseball type"

Shirt, working, green twill

Trousers, working, green twill

Shoes, field

Gloves, canvas (will be issued whenever radiological conditions warrant).

C. Clothing for Divers

Personnel engaged in shallow-diving operations in areas presenting a radiological hazard will be provided with the following items of protective equipment in addition to their normal diving gear:

Gloves, canvas

Coveralls.

D. Decontamination

1. Decontamination, or "change stations," will be established aboard Chilton, Coucal, and LCI(L)-615, if required.

2. Radiological Safety Officers will monitor all personnel upon the completion of personnel decontamination procedures, and each individual will be responsible for reporting to the Radiological Safety Officer in attendance for such monitoring prior to donning his clean clothing.

3. Detailed instructions as to the decontamination procedures to be followed is contained in paragraph VI.(C) of Appendix I to this Annex.

E. Technical Reports and Data

1. The Radiological Safety Section will receive and maintain files of monitoring reports compiled during the operation, will maintain the "radiological situation map," and will compile such additional data as may be required by the Project Officer, Bikini Scientific Resurvey.

2. The Radiological Safety Officer will cooperate with the Radiological Health Officer, and will submit all data pertaining to the existent radiological situation to him for review and evaluation.

BIKINI SCIENTIFIC RESURVEY
USS CHILTON (APA-38)
c/o F.P.O., San Francisco, California

16 July [1947]

MEMORANDUM:

From: Radiological Safety Officer
To: Project Officer

Subj: Radiological Reconnaissance of Bikini Island and Prayer [Eneman] Island

1. In compliance with instructions contained in Project Officer Memorandum No. 3-47, dated 14 July 1947, the Radiological Safety Officer, together with three officer monitors, accompanied the Project Officer and Technical Director ashore in the advance landing party at approximately 1200 hours, 15 July 1947, for the purpose of making a radiological survey of those areas of Bikini Island that may be occupied during the initial phases of the Resurvey Operation.

2. Since a preliminary survey of the beach in the vicinity of the initial landing site northwest of Beacon D indicated that existent radiation intensities were of the order of 0.004 R/24 hours and well below the established tolerance, four additional monitors were brought ashore, and a general survey of the northwestern tip (map reference 2406) and central sector (map reference 2605, 2606, 2704, 2706) of Bikini Island were initiated.

3. Shortly after the initial landing on Bikini, the Technical Director and one officer monitor reembarked and proceeded to Prayer Island (map reference 0690) to make a radiological reconnaissance of that area.

4. The general reconnaissance referred to in paragraph 2 above indicated that all of the low-intensity radiation encountered on the central sector of Bikini was confined to the sand beaches along the lagoon side of the island and to debris (life rafts, fenders, lines, etc.) that had washed up on the beach. The survey of the northwestern tip of Bikini indicated intensities of approximately 0.03 R/24 hours in algal beds and other scattered localities throughout that sector. Throughout the remainder of the surveyed areas, only background counts were observed.

5. Observed intensities on Prayer Island were not above background, except for scattered pieces of debris, which produced readings somewhat above background count.

6. Representative samples of sand, soil, or coral were taken from each sector of the islands surveyed, and have been turned over to the laboratory for analysis and evaluation.

REPORT OF FINDINGS

MEDICAL LEGAL BOARD, BIKINI SCIENTIFIC RESURVEY

A. Statement of the General Radiological Situation

1. The radiological survey of Bikini Atoll conducted by personnel of the Radiological Safety Section during the period 15 July 1947 through 26 August 1947 indicated that while certain isolated areas and accumulations of debris washed ashore on the lagoon beaches continued to produce beta and gamma radiation in excess of the tolerance of 0.1 roentgen per 24 hours, as outlined in Paragraph 8(f) of letter, Bureau of Medicine and Surgery, Navy Department, EN10/Radsafe P2-4, dated 31 January 1947, the residual beta and gamma radiation present throughout the the land, beach, and exposed reef areas of the atoll was well within this same tolerance limit.

2. The maximum activity observed by radiological safety officers during the course of this survey was obtained on a deposit of tarry material on a ledge of rock located on the sand spit extending west of Bikini Island. This localized area produced a beta plus gamma reading of 0.6 roentgens per 24 hours, and a gamma reading of 0.18 roentgens per 24 hours.

B. Summary of Radiological Safety and Health Precautions

1. The radiological safety and health precautions prescribed in the Radiological Safety and Health Annex to the Resurvey Operation Plan were observed throughout the course of the operation.

2. Radiological safety officers accompanied all scientific work parties during the initial landings on islands or areas within the lagoon, and continued to accompany these groups until such time as it had been determined that the area in question was free from any hazardous concentrations of radioactive materials. These officers were equipped with Model 263 Survey Meters, manufactured by the Victoreen Instrument Company, and carried pocket electroscopes or dosimeters to record the accumulative external radiation to which the group was being exposed.

3. Each deep-sea diver returning aboard USS COUCAL (ASR-8) was thoroughly hosed down with a stream of saltwater while still on the stage and prior to being taken aboard to insure that all radioactive materials adhering to his suit and associated gear were washed off. Following the removal of his diving suit, each diver and his gear was monitored with a Model 263 Survey Meter by one of the two radiological safety officers stationed aboard this ship to detect the presence of any beta or gamma radiation on either his person or his equipment. Personnel monitoring was carried out aboard USS CHILTON (APA-38) until such time as it had been determined that this procedure was no longer required. Personnel decontamination or "change" stations were established in both COUCAL and CHILTON for the use of personnel in the event that monitoring indicated the presence of excessive radiation on either their persons or their clothing.

4. All members of scientific work parties wore individual film badges during the initial stages of the operation and until such time as it had been determined that this procedure could be modified, or dispensed with entirely in the instance of areas that had been radiologically cleared. In view of the fact that the deep-sea diving and underwater inspection operations conducted on the sunken ships within the target area were considered to be the most hazardous from the standpoint of exposure to radiation, film badges and pocket dosimeters were carried by each diver throughout the course of this work. Three film badges, each enclosed in a waterproof rubber covering, were attached to the inner clothing of each diver prior to his descent to the bottom; one at chest height, one at waist height, and one in his shoe. These film badges were delivered to the Photodosimetry Unit for developing and analysis at the conclusion of each dive during the early phases of the work, and later at weekly intervals when it had been determined that hazardous concentrations of radioactive materials were not being encountered.

5. Of the total of 517 film badges processed by the Photodosimetry Unit of the Radiological Health Section, no badge carried during the course of the resurvey operations gave evidence of exposure to beta or gamma radiation in excess of the tolerance limits referred to in Paragraph A.1 above.

C. Summary of Chemical and Biological Studies

1. Biological studies and investigations carried out during the course of the resurvey operations indicated the presence of varying amounts of radioactivity in the marine life of Bikini Lagoon, though not in sufficient concentrations to afford an external radiation hazard. Instructions issued by the Task Group Commander, upon the recommendation of the Radiological Health Advisory Board, directed that no marine life whatsoever would be eaten by personnel attached to the expedition.

2. Recreational swimming at certain designated beach areas on Bikini Island was permitted only after a chemical analysis of the lagoon water indicated a plutonium content of less than 10^{-11} grams per liter of water. A gross analysis of the fission products present in the water indicated a content of less than 10^{-12} curies per liter of water.

3. On the basis of the radiochemical analysis of edible fruits taken from Bikini Island, the original ban against the eating of such fruits obtained on Bikini Island was lifted on 24 July 1947 by the Task Group Commander upon the recommendation of the Radiological Health Advisory Board.

Statement of Findings of the Board

1. In view of the data obtained and the observations made during the period 15 July 1947 through 26 August 1947, the undersigned members of the Medical Legal Board, Bikini Scientific Resurvey, attest, that to the best of their knowledge and belief, no individual assigned to, attached to, or participating in the Bikini Scientific Resurvey operations during this same period of time was exposed to radiation in excess of the established standards.

APPENDIX C

INSTRUMENTATION DIVISION PROJECTS

APPENDIX C

Instrumentation Division Projects

PROJECT	TITLE	GROUP
II - 1	Air Dropped Condensor Blast Gauges	013H
II - 2	Linear and Logarithmic Time Axis (Pressure Recorders)	013G
II - 3	Air Blast Aluminum Foil Meters	013G
II - 4	Air Blast Ball Crusher Gauges	013G
II - 5	Air Blast Free Piston Gauges	013G
II - 6	Pyramidal Orientometers	013G
II - 7	Underwater Pressure - Crusher Gauges, Diaphragm Gauges	013G
II - 8	Underwater Pressures - Piston Gauges	013G
II - 9	Shock Wave Velocity - Chronographic and Blast Switches	013G
II - 10	Shock Wave Velocity - Argon Flash Units (Test A)	013G
II - 11	Shock Wave Velocity - Eastman Cameras	013G
II - 12	Fire Ball Growth - O'Brien Cameras (Test A)	013G
II - 13	Measurement of Blast Wave Velocity in air and water using Sonobuoys	013D
II - 14	Hydrophones - Low Frequency	013G
II - 15	Strain and Displacement Gauges	013C
II - 15 (a)	Long Base Displacement Gauges	013C
II - 15 (b)	Lead Strip Gauges	013C
II - 15 (c)	Seismic Displacement Gauges	013C

II - 15 (d)	Multi-Frequency Gauges	013C
II - 16	Underwater Pressure Gauges	013C
II - 16 (a)	Diaphragm Pressure and Tourmaline Crystal Gauge	013C
II - 16 (b)	DeJuhasz Gauge (underwater)	013C
II - 16 (c)	Tourmaline P.E. Gauges (Telemetrical)	013C
II - 16 (d)	Ball Crusher Gauges	013C
II - 16 (e)	Modugno Gauges	013C
II - 17	Blast Pressures - Diaphragm Gauges	013C
II - 17 (a)	Diaphragm Blast Gauges, TMB	013C
II - 17 (b)	Statham Blast Gauges	013C
II - 17 (c)	DeJuhasz Pressure Time Gauge	013C
II - 18	Velocity Gauges	013C
II - 18 (a)	Velocity Meters, Wire Recorders, Acetate Film Recorders	013C
II - 18 (b)	Impulse Velocity Gauges	013C
II - 19	Accelerometers	013C
II - 19 (a)	Mass Plug Accelerometer	013C
II - 19 (b)	Putty Gauges	013C
II - 19 (c)	Indenter Accelerometer	013C
II - 19.1	Bodily Motion Gauges	013C
II - 19.1 (a)	Pallograph	013C
II - 19.1 (b)	Jacklin Accelerometer	013C
II - 19.1 (c)	Shock Displacement	013C
II - 19.1 (d)	Long Base Strain Gauges, Peak Recording and Time Recording	013C
II - 20	Roll and Pitch Recorders	013C

II - 21	Magnetometers	013C
II - 22	Ship Temperature Measurements	013C
II - 23 (a)	Maximum Pressure in Target Ships	013C
II - 23 (b)	Pressure - time recorders	013C
II - 24	Blast Pressures; Cans, Drums, Pipe Gauges	013A2
II - 25	VGTA Recorders in Navy F6F Drones	Task Unit 1.6.14
II - 26, II-27	Effect of Blast on Flight of B-17 Drones and B-29, F-13 Aircraft	T.G. 1.5
II - 28	Inductiphones, Kwajalein, Washington, D.C.	013G
II - 29	Shock Wave Velocity - Reflecting Mirrors (Test A)	013C
III - 1	Echo Sounders (portable)	013B
III - 2	Echo Sounder (ships)	013B
III - 3	Echo Sounders (buoy mounted portable)	013B
III - 4	Bottom Pressure Recorders (Hand Started)	013B
III - 5	Bottom PressureRecorders (Blast Started)	013B
III - 6	Water Height Indicators	013B
III - 7 & 8	Television Cameras and Transmitters	013B
III - 10 & 11	Cameras on Eneu, Bikini, and Aomen Islands (III-10), Cameras on Aircraft (III-11)	013B
III - 12	Sono Wave Buoys	013B
III - 13	Bottom Pressures (Shore Connected Inductiphones), Nam and Iroij	
III - 14	Bottom Pressures (Shore Connected Inductiphones) Eniwetok, Kwajaelin, Wotho, and Rongelap	013B

III - 15	Surveys from U.S.S. Bowditch	013B
III - 16	Seismology	013B
III - 16 (a)	Seismographic Measurements during Test B	013B
III - 16 (b)	Inductiphones	013B
III - 17	Water Temperature Recorders	013B
III - 18	Wind Recorders	013B
III - 19	Gamma Ray Cavity Meters	013B
III - 20	Oceanography in Support of Radiological Safety	013B
IV - 2	Effects of Explosion on Transmission and Reflection of Electromagnetic Waves	013D
IV - 3	YR Radio Beacon and AN/CPN-6 Radar Beacon, Enidrik Island (ECO EX-42,49) (Test A only)	013D
IV - 4	Observation of Radio and Radar Transmission from Target Vessels (ECO EX-7) (Test A)	013D
IV - 5 (a)	Bikini Television Installation (ECO EX-19A)	013D
IV - 5 (b)	Airborne Television Installations (ECO EX-19B)	013D
IV - 6	Long Range Acoustic Observation (ECO EX-62) (Test A Only)	013D
IV - 7	Investigation of Spherics Disturbances Generated (ECO EX-63(1)).	013D
IV - 8	Telemetering of Geiger Counters and Ion Chambers (ECO EX-64)	013D
IV - 9	AAF Island Instruments	AAF Instrumentation
IV - 10	AAF Drone Instruments	AAF Instrumentation

	AAF Instruments in Manned Planes	AAF Instru-mentation
IV - 12	Electronic Timing Signals	013H
IV - 13	Firing Signals (Test B)	013H
IV - 14	Long Range Monitoring of Transmission from Target Vessels. (ECO EX-11)	013D
IV - 15	Detection of Radar Reflections from Ionized Column at a distance 2500 miles, (ECO EX-48)	013D
IV - 16 (a)	Radar Observation of Ionized Column from Kwajalein (Test A only)(ECO EX-51)	013D
IV - 16 (b)	Radar Observation of Ionized Column from Short Distances (ECO EX-63(2))	013D
IV - 17	Operation of Remotely-Controlled Drone Boats to Obtain Water Samples for Radiological Analysis (ECO EX-65)	013D
IV - 18	Telemetering Air and Water Pressure (ECO EX-22)	013D
IV - 19	Infra-red Measurement (ECO EX-63(2))	013D
V - 1	Destroyer Monitors	013E
V - 2	Seaplane Monitors	013E
V - 3	Boat Monitors	013E
V - 4	Boarding Parties	013E
V - 5	Fixed Base Monitors	013E
V - 6	Gun Boats (PGMs)	013E
V - 7	Channels around Bikini	013E
V - 8	Airborne in Planes	013E
V - 9	Photometric Film Badges	013E

V - 10	Radiation Intensity by Sonne-Strip Cameras and Lead Film Packs	014M
V - 11	Radiation Intensity vs. Time inside Target Ships	013H
V - 12	Gamma Ray Intensimeters	013E
VI - 1	Spectography	013G
VI - 2	Total Radiation, Photoelectric Units	013G
VI - 3	AAF Spectography	013K
VI - 4	Total Radiation, Unfocused Thermocouples	013G
VI - 6	Focused Thermocouples	013G
VII - 1	Gamma Ray Timing (Test B only)	013H
VII - 2	Fast Neutron Density (Test A only)	013H
VII - 3	Radiochemistry	013H
VII - 3	Radiochemistry	013H
VIII - 1 thru VIII - 4	Seismology	013J
VIII - 5 thru VIII - 8	Tide Measurements	013J
VIII - 9	Terrestrial Magnetism	013J
VIII - 10	Atmospheric Conductivity	013J
VIII - 11	Ionospheric Reflectivity	013J
VIII - 12	Ionization in Air	013J
VIII - 13	Microbarographs	013J
Vlll - 14	Microbarometric Measurements	013J
VIII - 15	Sound Ranging	013J
VIII - 16	Electromagnetic Propagation	013J
VIII - 17	Geiger Counter Observations	013J

VIII - 18	Radiosonde Carrying Geiger Counters	013J
IX - 1	Fastax cameras, Island Photography	013K
IX - 2	Island Photography	013K
IX - 3	Island Photography	013K
IX - 4	Island Photography	013K
IX - 5	Island Photography	013K
IX - 6	Island Photography	013K
IX - 7	Island Photography	013K
IX - 8	Island Photography	013K
IX - 9	Army Air Force Photography - C-54 Installations	013K
IX - 10	Army Air Force Photograph - F-13 Installations	013K
IX - 11	Navy Aerial Photography	013K
IX - 12	Navy Aerial Photography	013K
IX - 13	Navy Aerial Photography	013K
IX - 14	Navy Aerial Photography	013K
IX - 15	Target Vessel Cameras	013K
IX - 16	High Speed Eastman Cameras	013K
IX - 17	Icaroscopes	013K
IX - 18	Drum Spectograph	013K
IX - 19	Bowen High Speed Camera	013G

APPENDIX D
BIKINI ATOLL ISLAND SYNONYMS

APPENDIX D
ISLAND SYNONYMS
BIKINI ATOLL

Underscored entries are the names of the islands as used in this report. Island names enclosed in quotation marks were used by Joint Task Force 1 for the islands of Bikini. CAPITALIZED entries are the code names used by later joint task forces. All other entries are spellings of the islands that may appear in other literature.

ABLE	Bokbata - Bokobyaada - "Boby"
Adrikan	YOKE - Arriikan - "Aran"
Aerokoj	OBOE - Airukiiji - "Arji"
Aerokojlol	PETER - Airukiraru - "Airy"
Airukiiji	OBOE - Aerokoj - "Arji"
Airukiraru	PETER - Aerokojlol - "Airy"
"Airy"	PETER - Aerokojlol - Airukiraru
ALFA	Bokaetoktok - Bokoaetokutoku - "Boku"
"Amen"	GEORGE - Aomen - Aomoen
Aomen	GEORGE - Aomoen - "Amen"
Aomoen	GEORGE - Aomen - "Amen"
"Aran"	YOKE - Adrikan - Arriikan
"Arji"	OBOE - Aerokoj - Airukiiji
Arriikan	YOKE - Adrikan - "Aran"
BAKER	Bokonejjen - "Bone"
Bigiren	ROGER - Bikdrin - "Biren"
Bikdrin	ROGER - Bigiren - "Biren"
Bikini	HOW
"Biren"	ROGER - Bikdrin - Bigiren
"Boby"	ABLE - Bokbata - Bokobyaada
Bokaetoktok	ALFA - Bokoaetokutoku - "Boku"
Bokbata	ABLE - Bokobyaada - "Boby"
Bokdrolul	BRAVO - Bokororyuru - "Boro"
Bokoaetokutoku	ALFA - Bokaetoktok - "Boku"
Bokobyaada	ABLE - Bokbata - "Boby"
Bokonejjen	BAKER - "Bone"
Bokonfuaaku	ITEM - "Bokon"
Bokororyuru	BRAVO - Bokdrolul - "Boro"
"Boku"	ALFA - Bokaetoktok - Bokoaetokutoku
"Bokon"	ITEM - Bokonfuaaku
"Bone"	BAKER - Bokonejjen
"Boro"	BRAVO - Bokdrolul - Bokororyuru
BRAVO	Bokdrolul - Bokororyuru - "Boro"
CHARLIE	Nam - Namu
"Cherry"	WILLIAM - Jelete - Chieerete
Chieerete	WILLIAM - Jelete - "Cherry"
Coca	(Bikini Atoll)

DOG — Iroij - Yurochi - "Yuro"

EASY — Uorikku - Odrik - "Uku"
ELMER — Parry - Medren (Enewetak Atoll)
"Eman" — TARE - Eneman - Eninman - "Prayer"
"Enar" — KING - Eniairo
Eneman — TARE - Eninman - "Eman" - "Prayer"
Eneu — NAN - Enyu
Enewetak — FRED - Eniwetok (Enewetak Atoll)
Eniairo — KING - "Enar"
Enidrik — UNCLE - Eniirikku - "Erik"
Eniirikku — UNCLE - Enidrik - "Erik"
Eninman — TARE - Eneman - "Eman" - "Prayer"
Eniwetok — FRED - Enewetak (Enewetak Atoll)
"Erik" — UNCLE - Enidrik - Eniirikku
Enyu — NAN - Eneu

FOX — Lomilik - Romurikku - "Romuk"

FRED — Enewetak - Eniwetok (Enewetak Atoll)
GEORGE — Aomen - Aomoen - "Amen"

HOW — Bikini

"Ion" — MIKE - Ionchebi
Ionchebi — MIKE - "Ion"
Iroij — DOG - Yurochi - "Yuro"
ITEM — Bokonfuaaku - "Bokon"

Jelete — WILLIAM - Chieerete - "Cherry"
JIG — Yomyaran - "Yoran"

KING — Eniairo - "Enar"

Lele — SUGAR - Reere - "Reer"
Lomilik — FOX - Romurikku - "Romuk"
LOVE — Rochikarai - "Rokar"
Lukoj — VICTOR - Rukoji - "Ruji"

Medren — ELMER - Parry (Enewetak Atoll)
MIKE — Ionchebi - "Ion"

Nam — CHARLIE - Namu
Namu — CHARLIE - Nam
NAN — Eneu - Enyu

OBOE — Aerokoj - Airukiiji - "Arji"
Odrik — EASY - Uorikku - "Uku"
Oroken — ZEBRA - Ourukaen - "Oruk"
"Oruk" — ZEBRA - Oroken - Ourukaen
Ourukaen — ZEBRA - Oroken

Parry — ELMER - Medren (Enewetak Atoll)
PETER — Aerokojlol - Airukiraru - "Airy"
"Prayer" — TARE - Eneman - Eninman - "Eman"

"Reer" — SUGAR - Lele - Reere
Reere — SUGAR - Lele - "Reer"
Rochikarai — LOVE - "Rokar"
ROGER — Bikdrin - Bigiren - "Biren"
"Rokar" — LOVE - Rochikarai
"Romuk" — FOX - Lomilik - Romurikku
Romurikku — FOX - Lomilik - "Romuk"
Rukoji — VICTOR - Lukoj - "Ruji"
"Ruji" — VICTOR - Lukoj - Rukoji
SUGAR — Lele - Reere - "Reer"

TARE — Eneman - Eninman - "Eman" - "Prayer"

UNCLE — Enidrik - Eniirikku - "Erik"
"Uku" — EASY - Odrik - Uorikku
Uorikku — EASY - Odrik - "Uku"

VICTOR — Lukoj - Rukoji - "Ruji"

WILLIAM — Jelete - Chieerete - "Cherry"

YOKE — Adrikan - Arriikan - "Aran"
Yomyaran — JIG - "Yoran"
"Yoran" — JIG - Yomyaran
"Yuro" — DOG - Iroij - Yurochi
Yurochi — DOG - Iroij - "Yuro"

ZEBRA — Oroken - Ourukaen - "Oruk"

APPENDIX E
GLOSSARY OF TERMS

Many of the definitions in this glossary relating to nuclear device and radiation phenomena have been quoted or extracted from The Effects of Nuclear Weapons (3rd edition), S. Glasstone and P.J. Dolan, 1977.

accelerometer. An instrument for determining the acceleration of the system with which it moves.

activation products. Radioactive nuclides produced by the irradiation of a stable nuclide, usually with neutrons.

AD. Destroyer tender (Navy).

AEC. Atomic Energy Commission, Washington, D.C. Independent agency of the Federal government with statutory responsibilities for atomic energy matters. No longer exists; its functions have been assumed by the Department of Energy and the Nuclear Regulatory Commission.

AF. Store ship (Navy); also Air Force.

AFSWP. Armed Forces Special Weapons Project.

AG. Miscellandous auxilliary ship (Navy).

AGC. Amphibious force flagship (Navy).

AGS. Surveying ship (Navy).

AH. Hospital ship (Navy).

airburst. The detonation of a nuclear device in the air at a height such that the expanding fireball does not touch the Earth's surface when the luminosity (emission of light) is at a maximum.

air particle trajectory. The velocity and rate of descent of windblown radioactive particles.

AK. Cargo ship (Navy).

AKA. Attack cargo ship (Navy).

AKS. Stores issue ship (Navy).

allowable dose. See MPL.

alpha emitter. A radionuclide that undergoes transformation by alpha-particle emission.

alpha particle. A charged particle emitted spontaneously from the nuclei of some radioactive elements. It is identical with a helium nucleus, having a mass of 4 units and an electric charge of 2 positive units. See also radioactivity.

alpha rays. A stream of alpha particles. Loosely, a synonym for alpha particles.

AMS. Army Map Service, Washington, D.C.

AN. Net laying ship (Navy).

AO. Oiler (Navy).

AOC. Air Operations Center.

AOG. Gasoline tanker (Navy).

AP. Transport ship (Navy).

APA. Attack transport (Navy).

APD High speed transport (Navy).

APG. Aberdeen Proving Ground, Maryland.

APH. Evacuation transport (Navy).

APL. Barracks craft; nonself-propelled (Navy).

APO. Army Post Office.

ARB. Battle damage repair ship (Navy).

ARD. Auxiliary floating drydock (Navy).

ARDC. Auxiliary floating drydock, concrete (Navy).

ARG. Internal combustion engine repair ship (Navy).

ARL. Landing craft repair ship (Navy).

arming. The changing of a nuclear device from a safe condition (that is, a condition in which it cannot be detonated without intent) to a state of readiness for detonation.

ARS. Salvage ship (Navy).

ARSD. Salvage lifting ship (Navy).

ARS[T]. Salvage craft tender (Navy).

ASR. Submarine rescue ship (Navy).

ASW. Anti-submarine Warfare.

ATA. Auxiliary ocean tug (Navy).

ATF. Fleet ocean tug (Navy).

ATR. Rescue ocean tug (Navy).

atoll. A ring of coral reefs, usually with small islets, that surrounds a lagoon. Most are isolated reefs rising from the deep sea that have built up on submerged volcanoes. They vary considerably in size; the largest atoll, Kwajalein in the Marshall Islands, has an irregular shape that extends for 84 miles (135 km). See also coral reef.

atomic bomb (or weapon). A term sometimes applied to a nuclear weapon utilizing fission energy only. See also fission, nuclear device.

atomic explosion. See nuclear explosion.

attenuation. The process by which radiation is reduced in intensity when passing through some material. It is due to absorption or scattering or both, but it excludes the decrease of intensity with distance from the source (inverse square law, which see).

AV. Seaplane tender (Navy).

AVP. Small seaplane tender (Navy).

AVR. Aircraft rescue vessel (Navy).

AW. Distilling ship (Navy).

B-17. Four-engine, propeller-driven bomber developed by Boeing Airplane Company and widely used in World War II. Used as radio-controlled, unmanned drone cloud sampler in atmospheric nuclear weapon tests.

B-29. A 4-engine, propeller-driven bomber developed by Boeing, used for weather reconnaissance, cloud tracking, aerial sampling and photography, and aerial refueling at the PPG. These versions designated RB-29, WB-29, and KB-29.

background radiation. The radiation of man's natural environment, consisting of that which comes from cosmic rays and from the naturally radioactive elements of the Earth, including that from within man's body. The term may also mean radiation extraneous to an experiment.

base surge. The particulate dust cloud that rolls out from the bottom of the cloud column produced by the detonation of a nuclear device. For underwater bursts, the base surge is a cloud of water droplets, and the flowing properties are those of a homogeneous liquid.

bathythermograph (B/T). A device for obtaining a record of temperature with depth in the upper 1,000 feet (300 meters) of the ocean from a ship underway.

BB. Battleship (Navy).

becquerel (Bq). See curie (Ci).

beta burns. Beta-emitting particles that come into contact with the skin and remain for an appreciable time can cause a form of radiation injury sometimes referred to as "beta burn." In an area of extensive early fallout, the whole surface of the body may be exposed to beta particles.

beta emitter. A radionuclide that disintegrates by beta particle emission. All beta-active elements existing in nature expel negative particles, i.e., electrons or, more exactly, negatrons. Beta-emitting particles are harmful if inhaled or ingested or remain on the skin.

beta particle (ray). A charged particle of very small mass emitted spontaneously from the nuclei of certain radioactive elements. Most, if not all, of the direct fission products emit negative beta particles (negatrons). Physically, the beta particle is identical to an electron moving at high velocity.

bhangmeter. A device that measures bomb yield based on light generated by the explosion.

blast. The detonation of a nuclear device, like the detonation of a high explosive such as TNT, results in the sudden formation of a pressure or shock wave, called a blast wave in the air and a shock wave when the energy is imparted to water or Earth.

blast wave. An air pulse propagated from an explosion in which the pressure increases sharply at the front and then decreases, followed by winds.

blast yield. That portion of the total energy of a nuclear explosion that manifests itself as blast and shock waves.

boiler compound. A chemical in powder form that is inserted into boiler water to decrease the formation of scale in boiler tubes.

bomb debris. See weapon debris.

BRL. Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland (Army).

BuAer. Bureau of Aeronautics (Navy).

BuDocks. Bureau of Yards and Docks (Navy).

BuMed. Bureau of Medicine and Surgery (Navy).

burst. Explosion; or detonation. See also airburst, high-altitude burst, surface burst.

BuShips. Bureau of Ships (Navy).

C-46. A twin-engine transport plane developed and manufactured for the Army Air Forces by Curtiss-Wright Aircraft Company.

C-47. A twin-engine transport aircraft manufactured by Douglas Aircraft Company (Army Air Forces version of the DC-3).

C-54. A 4-engine military cargo and personnel transport manufactured by Douglas Aircraft Company (Army Air Forces version of the DC-4).

CA. Heavy cruiser (Navy).

cab. The shelter that covers a nuclear device being prepared for test. May be located on a tower, on the Earth's surface, or on a barge.

cathode-ray tube. A vacuum tube in which cathode rays (electrons) are beamed upon a fluorescent screen to produce a luminous image. The character of this image is related to, and controlled by, one or more electrical signals applied to the cathode-ray beam as input information. The tubes are used in measuring instruments such as oscilloscopes and in radar and television displays.

cave. A heavily shielded enclosure in which radioactive materials can be remotely manipulated to avoid radiation exposure of personnel.

CDC. Centers for Disease Control.

Ci; c. Abbreviation for curie, which see. Ci is preferred now but c was the abbreviation used in the 1950s.

CIC. Counter-Intelligence Corps (Army); Combat Information Center (Navy).

CINCPAC. Commander in Chief, Pacific.

Circle William fittings. The closing of certain closures, designated "Circle William" fittings, hinders the movement of outside air into the interior spaces of naval ships. This sealed state is also called Circle William condition.

CJTF 1. Commander, Joint Task Force 1.

closed area. The land areas of Bikini and Enewetak and the water areas within 3 miles of them that the United States closed to unauthorized persons.

cloud chamber effect. See Wilson cloud.

cloud column (funnel). The visible column of weapon debris (and possibly dust or water droplets) extending upward from the point of a nuclear burst.

cloud phenomena. See fallout, fireball, radioactive cloud.

CNO. Chief of Naval Operations.

collimate. To align nuclear weapon radiant outputs within an assigned solid angle through the use of baffles in order to enhance measurements.

Co. Chemical symbol for cobalt.

cobalt. Metallic element with radioisotope ^{60}Co used as a calibration source for gamma instruments.

ComAirPac. Commander Naval Air Force Pacific (Navy).

ComServPac. Commander Service Forces Pacific (Navy).

Condition "Purple". See Purple conditions.

contamination. The deposit of radioactive material on the surfaces of structures, areas, objects, and personnel following a nuclear detonation. This material generally consists of fallout in which fission products and other device debris have become incorporated with particles of dust, vaporized components of device platforms, etc. Contamination can also arise from the radioactivity induced in certain substances by the action of neutrons from a nuclear explosion. See also decontamination, fallout, weapon debris.

coral reef. A complex ecological association of bottom-living and attached shelled marine animal fossils that form fringing reefs, barrier reefs, and atolls. The lagoons of barrier reefs and atolls are important places for the deposition of fine-grained calcium carbonate mud.

CPM, or cpm. Counts per minute, a measure of radioactive material disintegration.

Cs. Chemical symbol for cesium.

C/S. Chief of Staff.

CTG. Commander, Task Group.

curie (Ci). A unit of radioactivity; it is the activity of a quantity of any radioactive species in which 3.700×10^{10} (37 billion) nuclear disintegrations occur per second (approximately the radioactivity of 1 gram of radium). The gamma curie is sometimes defined correspondingly as the activity of material in which this number of gamma-ray photons is emitted per second. This unit is being replaced by the becquerel (Bq), which is equal to one disintegration per second.

CV. Aircraft carrier (Navy).

CVE. Escort aircraft carrier (Navy).

CVL. Small aircraft carrier (Navy).

D-day. The term used to designate the unnamed day on which a test takes place. The equivalent rule applies to H-hour (which see). Time in plans is indicated by a letter which shows the unit of time employed in figures, with a

minus or plus sign to indicate the amount of time before or after the reference event, e.g., D+7 means 7 days after D-day, H+2 means 2 hours after H-hour.

DD. Destroyer (Navy).

DDE. Escort destroyer (Navy).

DE. Destroyer escort (Navy).

debris (radioactive). See weapon debris.

decay (radioactive). The decrease in activity of any radioactive material with the passage of time due to the spontaneous emission from the atomic nuclei of either alpha or beta particles, sometimes accompanied by gamma radiation, or by gamma photons alone. Every decay process has a definite half-life.

decontamination. The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by (1) treating the surface to remove or decrease the contamination; (2) letting the material stand so that the radioactivity is decreased as a result of natural decay; and (3) covering the contamination in order to attenuate the radiation emitted.

device. Nuclear fission and fusion materials, together with their arming, fuzing, firing, chemical-explosive, and effects-measuring components, that have not reached the development status of an operational weapon.

diagnostic measurements or experiments. Experiments whose purpose is to study the explosive disassembly of a nuclear device as opposed to effects measurements (which see).

DM. Minelayer destroyer (Navy). Converted destroyers designed to conduct high-speed minelaying operations.

dose. A general term denoting the quantity of ionizing radiation energy absorbed. The unit of absorbed dose is the rad (which see). In soft body tissue the absorbed dose in rads is essentially equal to the exposure in roentgens. The biological dose (also called the RBE dose) in rems is a measure of biological effectiveness of the absorbed radiation. Dosage is used in older literature as well as exposure dose and simply exposure, and care should be exercised in their use. See also exposure.

dose rate. As a general rule, the amount of ionizing (or nuclear) radiation energy that an individual or material would receive per unit of time. It is usually expressed as rads (or rems) per hour or multiples or divisions of these units such as millirads per hour. The dose rate is commonly used to indicate the level of radioactivity in a radioactive area. See survey meter.

dosimeter. An instrument for measuring and registering the total accumulated dose of (or exposure to) ionizing radiation. Instruments worn or carried by individuals are called personnel dosimeters.

dosimetry. The measurement and recording of radiation doses and dose rates. It is concerned with the use of various types of radiation instruments with which measurements are made. See also dosimeter, survey meter.

DPM, or dpm. Disintegrations per minute, a measure of radioactivity, literally atoms disintegrating per minute. Difficult to directly compare with roentgens per hour for unknown mixtures of radionuclides.

DTMB. David Taylor Model Basin, Carderock, Maryland (Navy).

DUKW. Two-and-one-half-ton amphibious truck (Navy).

dynamic pressure. Air pressure that results from the mass air flow (or wind) behind the shock front of a blast wave.

effects measurements or experiments. Experiments whose purpose is to study what a nuclear explosion does to material, equipment and systems. Includes also measurement of the changes in the environment caused by the detonation such as increased air pressures (blast), thermal and nuclear radiation, cratering, water waves, etc.

electromagnetic radiation. Electromagnetic radiations range from X-rays and gamma rays of short wavelength (high frequency), through the ultraviolet, visible, and infrared regions, to radar and radio waves of relatively long wavelength.

electron. A particle of very small mass and electrically charged. As usually defined, the electron's charge is negative. The term negatron is also used for the negative electron and the positively charged form is called a positron. See also beta particles.

exposure. A measure expressed in roentgens of the ionization produced by gamma rays (or X-rays) in air. The exposure rate is the exposure per unit time (e.g., roentgens per hour). See dose, dose rate, roentgen.

exposure rate contours. Lines joining points that have the same radiation intensity that define a fallout pattern, represented in terms of roentgens per hour.

F-13. Photo version of B-29 bomber.

F-6F. Single-engine propeller-driven fighter developed for the Navy by Grumman Aircraft Company.

fallout. The process or phenomenon of the descent to the Earth's surface of particles contaminated with radioactive material from the radioactive cloud. The term is also applied in a

collective sense to the contaminated particulate matter itself. The early (or local) fallout is defined, somewhat arbitrarily, as particles reaching the Earth within 24 hours after a nuclear explosion. The delayed (or worldwide) fallout consists of the smaller particles, which ascend into the upper troposphere and stratosphere and are carried by winds to all parts of the Earth. The delayed fallout is brought to Earth, mainly by rain and snow, over extended periods ranging from months to years.

fathometer. A depth-sounding instrument. The depth of water is measured by noting the time the echo of a sound takes to return from the bottom.

film badges. Used for the indirect measurement of ionizing radiation. Generally contain two or three pieces of film of different radiation sensitivities. They are wrapped in paper (or other thin material) that blocks light but is readily penetrated by gamma rays. The films are developed and the degree of fogging (or blackening) observed is a measure of the gamma-ray exposure, from which the absorbed dose is calculated. Film badges can also measure beta and neutron radiation and x-rays.

fireball. The luminous sphere of hot gases that forms a few millionths of a second after a nuclear explosion as the result of the absorption by the surrounding medium of the thermal X-rays emitted by the extremely hot (several tens of millions of degrees) device residues. The exterior of the fireball in air is initially sharply defined by the luminous shock front and later by the limits of the hot gases themselves.

fission. The process of the nucleus of a particular heavy element splitting into two nuclei of lighter elements, with the release of substantial amounts of energy. The most important fissionable materials are uranium-235 and plutonium-239; fission is caused by the absorption of neutrons.

fission detectors. Radiation pulse detector of the proportional counter type in which a foil or film of fissionable materials is incorporated to make it respond to neutrons.

fission products. A general term for the complex mixture of substances produced as a result of nuclear fission. A distinction should be made between these and the direct fission products or fission fragments that are formed by the actual splitting of the heavy-element nuclei into nuclei of medium atomic weight. Approximately 80 different fission fragments result from roughly 40 different modes of fission of a given nuclear species (e.g., uranium-235 or plutonium-239). The fission fragments, being radioactive, immediately begin to decay, forming additional (daughter) products, with the result that the complex mixture of fission products so formed contains over 300 different radionuclides of 36 elements.

fixed alpha. Alpha radioactivity that cannot be easily removed as evidenced by no activity removed on a swipe of a 100-cm^2 area.

fluorescence. The emission of light (electromagnetic radiation) by a material as a result of the absorption of energy from radiation. The term may refer to the radiation emitted, as well as to the emission process.

FPO. Fleet Post Office (Navy).

fusion. The combination of two light nuclei to form a heavier nucleus, with the release of the difference of the nuclear binding energy of the fusion products and the sum of the binding energies of the two light nuclei.

gamma rays. Electromagnetic radiations of high photon energy originating in atomic nuclei and accompanying many nuclear reactions (e.g., fission, radioactivity, and neutron capture). Physically, gamma rays are identical with X-rays of high energy; the only essential difference is that X-rays do not originate from atomic nuclei of high energy. Gamma rays can travel great distances through air and can penetrate considerable thickness of material, although they can neither be seen nor felt by human beings except at very high intensities, which cause an itching and tingling sensation of the skin. They can produce harmful effects even at a long distance from their source.

Geiger-Mueller (GM) counter. A gas discharge pulse counter for ionizing radiation. See also ion-chamber-type survey meter.

GMT. Greenwich Mean Time.

gray (Gy). A recently introduced ICRP term; 1 Gy equals 100 rad.

ground zero (GZ). See surface zero.

gunk. A viscous commercial preparation that is soluble both in water and petroleum derivatives. It acts as a wetting agent in removing grease and particulate matter from metal and other nonporous surfaces.

H-hour. Time zero, or time of detonation. When used in connection with planning operations it is the specific time at which the operation event commences. H-1 indicates 1 hour before the detonation, and H+1 indicates 1 hour after detonation, etc. Minutes and seconds may also be indicated using this system, but the units used must then be shown, e.g., H-30 minutes, H+55 seconds. See also D-day.

half-life. The time required for a radioactive material to lose half of its radioactivity due to decay. Each radionuclide has a unique half-life.

HE. High explosive.

hodograph. A common hodograph in meteorology represents the speed and direction of winds at different altitude increments.

hot; hot spot. Commonly used colloquial term meaning a spot or area relatively more radioactive than some adjacent area.

ICRP. International Commission on Radiological Protection.

initial radiation. Nuclear radiations of high energy emitted from both the fireball and the radioactive cloud within the first minute after a detonation. It includes neutrons and gamma rays given off almost instantaneously (usually defined as prompt radiation, which see), as well as the gamma rays emitted by the fission products and other radioactive species in the rising cloud. Initial neutrons from ground or near-ground bursts react with both earth materials and device debris to create activation products.

inverse square law. The decrease in radiation intensity with distance from a single-point source is proportional to the square of the distance removed.

ion-chamber-type survey meter. A device for measuring the amount of ionizing radiation. Consists of a gas-filled chamber containing two electrodes (one of which may be the chamber wall) between which a potential voltage difference is maintained. The radiation ionizes gas in the chamber and an instrument connected to one electrode measures the ionization current produced.

ionization. The process of adding electrons to, or knocking electrons from, atoms or molecules, thereby creating ions. High temperatures, electrical discharges, and nuclear radiation can cause ionization.

ionizing radiation. Any particulate or electromagnetic radiation capable of producing ions, directly or indirectly, in its passage through matter. Alpha and beta particles produce ion pairs directly, while gamma rays and X-rays liberate electrons as they traverse matter, which in turn produce ionization in their paths.

ionosphere. The region of the atmosphere, extending from roughly 40 to 250 miles (about 65 to 400 km) above the Earth, in which there is appreciable ionization. The presence of charged particles in this region profoundly affects the propagation of radio and radar waves.

irradiation. Exposure of matter to radiation.

isodose lines. Dose or dose-rate contours. In fallout, contours plotted on a radiation field at which the dose rate or the total accumulated dose is the same.

isotopes. Atoms with the same atomic number (same chemical element) but different atomic weight; i.e., the nuclei have the same number of protons but a different number of neutrons.

IX. Unclassified miscellaneous ship (Navy).

JTF 1. Joint Task Force 1 was a combined force of personnel of the Department of Defense (Army, Navy, Marine Corps), the Manhattan Engineer District, and their contractors. JTF 1 was responsible for all aspects of nuclear weapon tests in the Pacific during 1946.

kiloton convention. Relates nuclear explosion energy to TNT explosion energy by using the approximate energy release of 1,000 tons of TNT as the measuring unit.

kinetic energy. Energy associated with the motion of matter.

LCI. Infantry landing craft (Navy).

LCI(L). Infantry landing craft (large) (Navy).

LCM. Mechanized landing craft (Navy).

LCP(L). Personnel landing craft (large) (Navy).

LCP(R). Personnel landing craft (ramp) (Navy).

LCT. Tank landing craft (Navy).

LCU. Utility landing craft (Navy).

LCVP. Vehicle and personnel landing craft (Navy).

LML. Lookout Mountain Laboratory, Hollywood, California (Air Force).

Loran. Long-range aid to navigation system. Loran stations were maintained by the U.S. Coast Guard Station on Enewetak Island and Johnston Atoll.

LSD. Dock landing ship (Navy).

LSIL. Infantry landing ship (large) (Navy).

LSM. Medium landing ship (Navy).

LST. Tank landing ship (Navy).

LSU. Utility landing ship (Navy).

magnetometer. An instrument for measuring changes in the geomagnetic field.

megaton (energy). Approximately the amount of energy that would be released by the explosion of one million tons of TNT.

microcurie. One-millionth of a curie.

micron. One-millionth of a meter (i.e., 10^{-6} meter or 10^{-4} centimeter); it is roughly four one-hundred-thousandths (4×10^{-5}) of an inch.

milliroentgen. One-thousandth of a roentgen.

MPL. Maximum Permissible Limit. That amount of radioactive material in air, water, foodstuffs, etc. that is established by authorities as the maximum that would not create undue risk to human health.

mR; mr. Abbreviation for milliroentgen.

mushroom cap. Top of the cloud formed from the fireball of a nuclear detonation.

MV. Motor vessel.

NAB. Naval Air Base.

NAS. Naval Air Station.

NBS. National Bureau of Standards.

NCO. Noncommissioned officer.

NCRP. National Committee on Radiation Protection and Measurements. Before 1956 simply the National Committee on Radiation Protection.

NEL. Naval Electronics Laboratory.

neutron. A neutral elementary particle (i.e., with neutral electrical charge) of approximately unit mass (i.e., the mass of a proton) that is present in all atomic nuclei, except those of ordinary (light) hydrogen. Neutrons are required to initiate the fission process, and large numbers of neutrons are produced by both fission and fusion reactions in nuclear explosions.

neutron flux. The intensity of neutron radiation. It is expressed as the number of neutrons passing through 1 cm^2 in 1 second.

NML. Naval Materials Laboratory.

NMRI. Naval Medical Research Institute.

NOB. Naval Operating Base.

NOL. Naval Ordnance Laboratory.

NRDL. Naval Radiological Defense Laboratory.

NRL. Naval Research Laboratory.

NTPR. Nuclear Test Personnel Review.

nuclear device (or weapon or bomb). Any device in which the explosion results from the energy released by reactions involving atomic nuclei, either fission or fusion, or both. Thus, the A- (or atomic) bomb and the H- (or hydrogen) bomb are both nuclear weapons. It would be equally true to call them atomic weapons, since the energy of atomic nuclei is involved in each case. However, it has become more or less customary, although it is not strictly accurate, to refer to weapons in which all the energy results from fission as A-bombs. In order to make a distinction, those weapons in which part of the energy results from thermonuclear (fusion) reactions of the isotopes of hydrogen have been called H-bombs or hydrogen bombs.

nuclear explosion. Explosive release of energy due to the splitting, or joining, of atoms. The explosion is observable by a violent emission of ultraviolet, visible, and infrared (heat) radiation, gamma rays, neutrons, and other particles. This is accompanied by the formation of a fireball. A large part of the energy from the explosion is emitted as blast and shock waves when detonated at the Earth's surface or in the atmosphere. The fireball produces a mushroom-shaped mass of hot gases and debris, the top of which rises rapidly. See also radiation, gamma rays, fireball, nuclear weapon, fission, fusion, blast.

nuclear fusion. See thermonuclear fusion.

nuclear radiation. Particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important nuclear radiations, from the weapons standpoint, are alpha and beta particles, gamma rays, and neutrons. All nuclear radiations are ionizing radiations, but the reverse is not true; X-rays, for example, are included among ionizing radiations, but they are not nuclear radiations since they do not originate from atomic nuclei.

nuclear tests. Tests carried out to supply information required for the design and improvement of nuclear weapons and to study the phenomena and effects associated with nuclear explosions.

nuclide. Any species of atom that exists for a measurable length of time. The term nuclide is used to describe any atomic species distinguished by the composition of its nucleus; i.e., by the number of protons and the number of neutrons. Isotopes of a given element are nuclides having the normal number of protons but different numbers of neutrons in these nuclei. A radionuclide is a radioactive nuclide.

off-scale. Radiation (or other physical phenomena) greater than the capacity of a measuring device to measure.

ONR. Office of Naval Research, Washington, D.C.

ORNL. Oak Ridge National Laboratory, Tennessee.

oscilloscope. The name generally applied to a cathode-ray device.

overpressure. The transient pressure, usually expressed in pounds per square inch, exceeding the ambient pressure, manifested in the shock (or blast) wave from an explosion.

PB2Y-5. Four-engine seaplane patrol bomber developed for the Navy by Consolidated Aircraft. Called the Coronado.

PB4Y-2. Four-engine patrol bomber developed by Consolidated Aircraft for the Navy by modifying the USAAF B-24. Called the Privateer.

PBM. Twin-engine, patrol-bomber flying boat, developed by Martin for the U.S. Navy.

PC. Patrol craft (Navy).

peak overpressure. The maximum value of the overpressure (which see) at a given location.

permissible dose. That dose of ionizing radiation that is not expected to cause appreciable bodily injury to a person at any time during his lifetime. See also MPL.

PGM. Motor gunboat (Navy).

phantom. A volume of material closely approximating the density and effective atomic number of tissue. The phantom absorbs ionizing radiation in the same manner as tissue, thus radiation dose measurements made within the phantom provide a means of approximating the radiation dose within a human or animal body under similar exposure conditions. Materials commonly used for phantoms are water, masonite, pressed wood, beeswax, and plexiglas.

pig. A heavily shielded container (usually lead) used to ship or store radioactive materials.

POL. Petroleum, oil, and lubricants. The storage area for these products is referred to as a POL farm.

prompt radiation. Neutrons and gamma rays emitted almost instantaneously following a nuclear fission or fusion.

proton. A particle carrying a positive charge and physically identical to the nucleus of the ordinary hydrogen atom.

Purple conditions. A shipboard warning system used in radiological defense. Various numbered conditions were sounded when radioactive fallout was to be encountered. Responses to the sounded warnings included closing of various hatches and fittings, turning off parts of the ventilation system, and removing personnel from a ship's open decks. The higher the Purple condition number, the more severe the radiological situation.

QB-17. Radio-controlled version of the B-17.

R; r. Symbol for roentgen.

Ra. Chemical symbol for radium.

rad. Radiation absorbed dose. A unit of absorbed dose of radiation energy. It represents the absorption of 100 ergs of ionizing radiation per gram (or 0.01 J/kg) of absorbing material, such as body tissue. This unit is presently being replaced in scientific literature by the Gray (Gy), numerical equal to the absorption of 1 joule of energy per kilogram of matter.

RadDefense. Radiological defense. Defense against the effects of radioactivity from atomic weapons. It includes the detection and measurement of radioactivity, the protection of persons from radioactivity, and decontamination of areas, places, and equipment. See also radsafe.

radex area. Radiological exclusion area. Following each detonation there were areas of surface radioactivity and areas of air radioactivity. These areas were designated as radex areas. Radex areas were used to chart actual or predicted fallout and also used for control of entry and exit.

radiac. Radiation detection, indication, and computation.

radiation. The emission of any rays, electromagnetic waves, or particles (e.g., gamma rays, alpha particles, beta particles, neutrons) from a source.

radiation decay. See decay (radioactive).

radiation detectors. Any of a wide variety of materials or instruments that provide a signal or indication when stimulated by the passage of ionizing radiation; the sensitive element in radiation detection instruments. The most widely used media for the detection of ionizing radiation are photographic film and ionization of gases in detectors (e.g., Geiger counters), followed by materials in which radiation induces scintillation.

radiation exposure. Exposure to radiation may be described and modified by a number of terms. The type of radiation is important: alpha and beta particles, neutrons, gamma rays and X-rays, and cosmic radiation. Radiation exposure may be from an external radiation source, such as gamma rays, X-rays, or neutrons, or it may be from radionuclides retained within the body emitting alpha, beta, or gamma radiation. The exposure may result from penetrating or nonpenetrating radiation in relation to its ability to enter and pass through matter -- alpha and beta particles being considered as nonpenetrating and other types of radiation as penetrating. Exposure may be related to a part of the body or to the whole body. See also whole body irradiation.

radiation intensity. Radiation rate. Measured and reported in roentgens (R), rads, rems, and multiples and divisions of these units as a function of exposure time (per hour, day, etc.).

radioactive cloud. An all-inclusive term for the cloud of hot gases, smoke, dust, and other particulate matter from the weapon itself and from the environment, which is carried aloft in conjunction with the rising fireball produced by the detonation of a nuclear device.

radioactive nuclide. See radionuclide.

radioactive particles. See radioactivity.

radioactivity. The spontaneous emission of nuclear radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nuclei of an (unstable) nuclide. As a result of this emission the radioactive nuclide a different (daughter) element, which may (or may not) also be radioactive. Ultimately, as a result of one or more stages of radioactive decay, a stable (nonradioactive) end product is formed.

radiological survey. The directed effort to determine the distribution and exposure rate of radiation in an area.

radionuclide. A radioactive nuclide (or radioactive atomic species).

radiosonde. A balloon-borne instrument for the simultaneous measurement and transmission of meteorological data, consisting of transducers for the measurement of pressure, temperature, and humidity; a modulator for the conversion of the output of the transducers to a quantity that controls a property of the radiofrequency signal; a selector switch, which determines the sequence in which the parameters are to be transmitted; and a transmitter, which generates the radiofrequency carrier.

radiosonde balloon. A balloon used to carry a radiosonde aloft. These balloons have daytime bursting altitudes of about 80,000 feet (25 km) above sea level. The balloon measures about 5 feet (1.5 meters) in diameter when first inflated and may expand to 20 feet (6 meters) or more before bursting at high altitude.

radium. An intensely radioactive metallic element. In nature, radium is found associated with uranium, which decays to radium by a series of alpha and beta emissions. Radium is used as a radiation source for instrument calibration.

radsafe. Radiological safety. General term used to cover the training, operations, and equipment used to protect personnel from unnecessary exposures to ionizing radiation.

rainout. Removal of radioactive particles from a radioactive cloud by rain.

rawin. Radar wind sounding tests that determine the winds aloft patterns by radar observation of a balloon.

rawinsonde. Radar wind sounding and radiosonde (combined).

RBE. Relative biological effectiveness. A factor used to compare the biological effectiveness of absorbed radiation doses (i.e., rads) due to different types of ionizing radiation. For radiation protection the term has been superseded by Quality Factor.

rem. A special unit of biological radiation dose equivalent; the name is derived from the initial letters of the term "roentgen equivalent man (or mammal)." The number of rems of radiation is equal to the number of rads absorbed multiplied by the RBE of the given radiation (for a specified effect). The rem is also the unit of dose equivalent, which is equal to the product of the number of rads absorbed multiplied by the "quality factor" and distribution factor for the radiation. The unit is presently being replaced by the sievert (Sv).

rep. An obsolete special unit of absorbed dose.

residual nuclear radiation. Nuclear radiation, chiefly beta particles and gamma rays, that persists after 1 minute following a nuclear explosion. The radiation is emitted mainly by the fission products and other bomb residues in the fallout, and to some extent by Earth and water constituents, and other materials, in which radioactivity has been induced by the capture of neutrons.

R-hour. Recovery or reentry hour.

roentgen. (R; r) A special unit of exposure to gamma (or X-) radiation. It is defined precisely as the quantity of gamma (or X-) rays that will produce electrons (in ion pairs) with a total charge of 2.58×10^{-4} coulomb in 1 kilogram of dry air under standard conditions. An exposure of 1 roentgen results in the deposition of about 94 ergs of energy in 1 gram of soft body tissue. Hence, an exposure of 1 roentgen is approximately equivalent to an absorbed dose of 1 rad in soft tissue.

roll-up. The process for orderly dismantling of facilities no longer required for nuclear test operations and their transfer to other areas.

sampler aircraft. Aircraft used for collection of gaseous and particulate samples from nuclear clouds to determine the level of radioactivity or the presence of radioactive substances.

SAR. Search and rescue operations.

SB-17. SAR version of the B-17.

scattering. The diversion of radiation (thermal, electromagnetic and nuclear) from its original path as a result of interactions (or collisions) with atoms, molecules, or larger particles in the atmosphere or other media between the source of the radiations (e.g., a nuclear explosion) and a point some distance away. As a result of scattering, radiations (especially gamma rays and neutrons) will be received at such a point from many directions instead of only from the direction of the source. See also skyshine.

SCEL. Signal Corps Engineering Laboratories, Ft. Monmouth, New Jersey (Army).

scintillation. A flash of light produced by ionizing radiation in a fluor or a phosphor, which may be crystal, plastic, gas, or liquid.

seamount. A submarine mountain rising above the deep sea floor, commonly from 3,000 to 10,000 feet (1 to 3 km) and having the summit 1,000 to 6,000 feet (0.3 to 1.8 km) below sea level.

shear (wind). Refers to differences in direction (directional shear) of wind at different altitudes.

shielding. Any material or obstruction that absorbs (or attenuates) radiation and thus tends to protect personnel or equipment from the effects of a nuclear explosion. A moderately thick layer of any opaque material will provide satisfactory shielding from thermal radiation, but a considerable thickness of material of high density may be needed for gamma radiation shielding. See also attenuation.

shock. Term used to describe a destructive force moving in air, water, or earth caused by detonation of a nuclear detonation.

shock wave. A continuously propagated pressure pulse (or wave) in the surrounding medium, which may be air, water, or earth, initiated by the expansion of the hot gases produced in an explosion.

sievert (Sv). A recently introduced ICRP measure of "dose equivalent" that takes into account the "quality factor" of different sources of ionizing radiation. One sievert equals 100 rem.

skyshine. Radiation, particularly gamma rays from a nuclear detonation, reaching a target from many directions as a result of scattering by the oxygen and nitrogen in the intervening atmosphere.

slant range. The straight-line distance of an aircraft at any altitude from ground zero or the distance from an airburst to a location on the surface.

SS. Submarine (Navy).

stratosphere. Upper portion of the atmosphere, approximately 7 to 40 miles (11 to 64 km) above the Earth's surface, in which temperature changes but little with altitude and cloud formations are rare.

streamline. In meteorology, the direction of the wind at any given time.

surface burst. A nuclear explosion on the land surface, an island surface or reef, or on a barge.

surface zero. The point on the ground or water surface directly above or below the detonation point of a nuclear device.

survey meters. Portable radiation detection instruments especially adapted for surveying or inspecting an area to establish the existence and amount of radiation present, usually from the standpoint of radiological protection. Survey instruments are customarily powered by self-contained batteries and are designed to respond quickly and to indicate directly the exposure rate conditions at the point of interest. See Geiger-Mueller counter and ion-chamber-type survey meter.

survey, radiation. Evaluation of the radiation levels associated with radioactive materials or areas.

T-AP. Personnel transport (Military Sea Transportion Service).

TBM. Single-engine torpedo bomber developed by Grumman Aircraft for the Navy but manufactured by Glenn L. Martin Company.

TDY. Temporary duty assignment.

TG. Task Group. Subordinate element of the Joint Task Force.

TD. Task Detachment.

thermal radiation. Electromagnetic radiation emitted in two pulses from a surface or airburst from the fireball as a consequence of its very high temperature; it consists essentially of ultraviolet, visible, and infrared radiation. In the first pulse, when the temperature of the fireball is extremely high, ultraviolet radiation predominates; in the second pulse, the temperatures are lower and most of the thermal radiation lies in the visible and infrared regions of the spectrum.

TNT equivalent. A measure of the energy released as the result of the detonation of a nuclear device or weapon, expressed in terms of the mass of TNT that would release the same amount of energy when exploded. The TNT equivalent is usually stated in kilotons (1,000 tons) or megatons (1 million tons). The basis of the TNT equivalence is that the explosion of 1 ton of TNT is assumed to release 1 billion calories of energy. See also megaton, yield.

trapped radiation. Electrically charged particles moving back and forth in spirals along the north-south orientation of the Earth's magnetic field between mirror points, called conjugate points. Negatively charged particles drift eastward as they bounce between northern and southern conjugate points and positively charged particles drift westward, thus forming shells or belts of radiation above the Earth. The source of the charged particles may be natural, from solar activity (often called Van Allen belts), or artifical, resulting from high-altitude nuclear detonations.

tropopause. The boundary dividing the stratosphere from the lower part of the atmosphere, the troposphere. The tropopause normally occurs at an altitude of about 25,000 to 45,000 feet (7.6 to 13.7 km) in polar and temperate zones, and at 55,000 feet (16.8 km) in the tropics. See also stratosphere, troposphere.

troposphere. The region of the atmosphere, immediately above the Earth's surface and up to the tropopause, in which the temperature falls fairly regularly with increasing altitude, clouds form, convection is active, and mixing is continuous and more or less complete.

Trust Territory. The Marshall Islands were included in the Trust Territory of the Pacific Islands under the jurisdiction of the United Nations. Assigned by the United Nations to the United States in trust for administration, development, and training.

TU. Task Unit.

type commander. The officer or agency having cognizance over all Navy ships of a given type. This is in addition to the particular ship's operational assignment in a task force, fleet, or other tactical subdivision.

UCLA. University of California, Los Angeles.

UK. United Kingdom.

ultraviolet. Electromagnetic radiation of wavelengths between the shortest visible violet (about 3,850 angstroms) and soft X-rays (about 100 angstroms).

USFS. U.S. Forest Service.

USNS. United States Navy Ship; vessels of this designation are manned by civilian crews.

VA. Veterans' Administration.

VC. Fleet composite squadron (formerly VU).

Versene. A detergent.

VR. Naval air transport squadron.

WADC. Wright Air Development Center, Wright-Patterson AFB, Ohio (Air Force).

warhead. The portion of the missile or bomb containing the nuclear device.

WB-29. Weather reconnaissance version of B-29 used for cloud tracking and sampling.

weapon debris. The radioactive residue of a nuclear device after it has been detonated, consisting of fission products, various products of neutron capture, weapon casing and other components, and uranium or plutonium that has escaped fission.

whole body irradiation. Exposure of the body to ionizing radiation from external radiation sources. Critical organs for the whole body are the lens of the eye, the gonads, and the red-blood-forming marrow. As little as only 1 cm^3 of bone marrow constitutes a whole-body exposure. Thus, the entire body need not be exposed to be classed as a whole-body exposure.

Wilson cloud. A mist or fog of minute water droplets that temporarily surrounds a fireball following a nuclear detonation in a humid atmosphere. This is caused by a sudden lowering of the pressure (and temperature) after the passing of the shock wave (cloud chamber effect) and quickly dissipates as temperatures and pressures return to normal.

worldwide fallout. Consists of the smaller radioactive nuclear detonation particles that ascend into the upper troposphere and the stratosphere and are carried by winds to all parts of the Earth. The delayed (or worldwide) fallout is brought to Earth, mainly by rain and snow, over extended periods ranging from months to years.

WT. Prefix of Weapon Test (WT) report identification numbers. These reports were prepared to record the results of scientific experiments.

XRD. An abbreviation for CROSSROADS.

YC. Open lighter, nonself-propelled (Navy).

YF. Covered lighter, self-propelled (Navy).

YFN. Covered lighter, nonself-propelled (Navy).

yield. The total effective energy released in a nuclear detonation. It is usually expressed in terms of the equivalent tonnage of TNT required to produce the same energy release in an explosion. The total energy yield is manifested as nuclear radiation (including residual radiation), thermal radiation, and blast and shock energy, the actual distribution depending upon the medium in which the explosion occurs and also upon the type of weapon. See TNT equivalent.

yield (blast). That portion of the total energy of a nuclear detonation that is identified as the blast or shock wave.

yield (fission). That portion of the total energy released by a nuclear explosion attributable to nuclear fission, as opposed to fusion. The interest in fission yield stems from the interest in fission product formation and its relationship to radioactive fallout.

YMS. Auxiliary motor minesweeper (Navy).

YO. Fuel oil barge; self-propelled (Navy).

YOG. Gasoline barge; self-propelled (Navy).

YOGN. Gasoline barge; nonself-propelled (Navy).

YP. Patrol craft (Navy).

YW. Water barge, self-propelled (Navy).

ZI. Zone of Interior (conterminous United States).

APPENDIX F

RADIATION READINGS ABOARD TARGET VESSELS

Date[a]	Radiation Level (R/24 hours)									
	USS Banner (APA-60)	USS Barrow (APA-61)	USS Bladen (APA-63)	USS Bracken (APA-64)	USS Briscoe (APA-65)	USS Brule (APA-66)	USS Butte (APA-68)	USS Carteret (APA-70)	USS Catron (APA-71)	USS Conyngham (DD-371)
25 Jul[b]										
26 Jul										
27 Jul				**9.5(A)**						
28 Jul				**9.1(A)**					**15.0(A)**	
29 Jul					**13.0(A)**					
30 Jul										
31 Jul							1.0(A) 1.6(M)			
1 Aug				**3.0(A)**			0.8(A) 1.2(M)			
2 Aug				1.5(A)	3.0(A)			**1.3(A)** **1.5(M)**	3.0(A) 10.0(M)	
3 Aug				**1.5(A)**				**0.7(A)** **1.5(M)**		
4 Aug					2.5(A) 3.0(M)			**0.3(A)** **0.9(M)**		
5 Aug	1-2(E)	1.5-2.5(E)	**BT**			4-10(E)				
6 Aug								**0.4(TA)**	4.0(TA)	0.045(TA)
7 Aug							**0.5(A)**	**0.3(TA)**		**0.045(TA)**
8 Aug								**0.13(TA)**	2.5(TA)	
9 Aug		**1.0**					**0.08(TA)**	**0.215(TA)**		
10 Aug				**1.0(M)** **0.003(BA)**				**0.098(TA)**		
11 Aug								**0.098(TA)**		
12 Aug							0.12(TA)		**1.5(TA)**	
13 Aug										
14 Aug										
15 Aug										
16 Aug					**0.7(TA)**					
17 Aug										
18 Aug										
19 Aug										
20 Aug								0.1		
21 Aug										
22 Aug									**0.87(TA)**	
23 Aug	0.33(TA)	0.30(TA)				2.7(TA)				
24 Aug										
25 Aug										
26 Aug										
27 Aug										
28 Aug										

NOTES:

[a]Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc., or indicates clearance for continuous habitation.

[b]BAKER was detonated at 0835.

LEGEND: (A) Average; (BA) Below Deck Average; (BT) Below Tolerance; (E) Estimated; (M) Maximum; (TA) Topside Average.

Date[a]	Radiation Level (R/24 hours)									
	USS Cortland (APA-75)	USS Crittenden (APA-77)	USS Dentuda (SS-335)	USS Fallon (APA-81)	USS Fillmore (APA-83)	USS Gasconade (APA-85)	USS Geneva (APA-86)	USS Hughes (DD-410)	USS Independence (CVL-22)	LCI-327
25 Jul[b]										
26 Jul								7.0(A)		
27 Jul			4.0(A)							**2.5(A)**
28 Jul										1.5(A)
29 Jul			**2.5**							
30 Jul			1.2(A) 1.5(M)			**22.0(A)** **200.0(M)**				
31 Jul										
1 Aug										
2 Aug										
3 Aug		1.5-2.5(E)	**0.7(A)**							
4 Aug			**0.5(A)**					3.0(A) 4.0(M)		
5 Aug			**0.4(A)**	5-20(E)	**BT**		**BT**	1.5(A) 50(M)	2-3(E)	
6 Aug			**0.24(TA)**							
7 Aug			**0.15**			6-8(TA)				
8 Aug			**0.12**			6(TA)				
9 Aug			**0.07**			5(TA)				
10 Aug			**BT**			1(TA)				
11 Aug										
12 Aug										
13 Aug			**0.07**							
14 Aug										
15 Aug						8(TM)				
16 Aug						0.6(TA)				
17 Aug						1				
18 Aug										
19 Aug								**0.4(TA)**	**7(M)**	
20 Aug									**0.65(TA)**	
21 Aug										
22 Aug		**7(M)**								
23 Aug										
24 Aug										
25 Aug										
26 Aug		**0.75**								
27 Aug										
28 Aug										

NOTES:

[a]Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc., or indicates clearance for continuous habitation.

[b]BAKER was detonated at 0835.

LEGEND: (A) Average; (BT) Below Tolerance; (E) Estimated; (M) Maximum; (TA) Topside Average; (TM) Topside Maximum.

Date[a]	Radiation Level (R/24 hours)									
	LCI-329	LCI-332	LCI(L)-549	LCI(L)-615	LCT-705	LCT-816	LCT-818	LCT-874	LCT-1013	LCT-1078
25 Jul[b]										
26 Jul										
27 Jul										
28 Jul							4.0(A)			
29 Jul							2.0(A)	11.0(A)	0.6(A)	0.9(A)
30 Jul										
31 Jul										
1 Aug										
2 Aug									0.35(A)	
3 Aug										
4 Aug										
5 Aug		2-3(E)				2-3(E)				
6 Aug										
7 Aug										
8 Aug										
9 Aug										
10 Aug										
11 Aug										
12 Aug										
13 Aug										
14 Aug										
15 Aug										
16 Aug										
17 Aug										
18 Aug										
19 Aug										
20 Aug										
21 Aug										
22 Aug										
23 Aug										
24 Aug										
25 Aug										
26 Aug										
27 Aug										
28 Aug										

NOTES:

[a] Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc., or indicates clearance for continuous habitation.

[b] BAKER was detonated at 0835.

LEGEND: (A) Average; (E) Estimated.

Date[a]	Radiation Level (R/24 hours)							
	LCT-1112	LCT-1113	LCT-1115	USS LST-52	USS LST-125	USS LST-220	USS LST-545	USS LST-661
25 Jul[b]								
26 Jul								
27 Jul							2.0(A)	
28 Jul								
29 Jul	0.6(A)	0.55(A)				3.0(A) 3.0(M)		"Sour"
30 Jul								
31 Jul								
1 Aug								
2 Aug		0.15(A)						
3 Aug								
4 Aug								
5 Aug			BT	1.5-2.5(E)				
6 Aug								
7 Aug								
8 Aug				**7(TA)**			0.7(TA)	
9 Aug								
10 Aug								
11 Aug								
12 Aug								
13 Aug								
14 Aug					**S**			
15 Aug								
16 Aug								
17 Aug								
18 Aug								
19 Aug								
20 Aug								
21 Aug				**3.9(TA)**		**0.27(TA)**	0.096(TA)	
22 Aug								
23 Aug								
24 Aug								
25 Aug								
26 Aug								
27 Aug								
28 Aug								

NOTES:

[a] Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc., or indicates clearance for continuous habitation.

[b] BAKER was detonated at 0835.

LEGEND: (A) Average; (BT) Below Tolerance; (E) Estimated; (S) Sunk off Bikini Atoll; (TA) Topside Average.

Date[a]	Radiation Level (R/24 hours)								
	USS Mayrant (DD-402)	USS Mugford (DD-389)	USS Mustin (DD-413)	USS Nevada (BB-36)	USS New York (BB-34)	USS Niagara (APA-87)	USS Parche (SS-384)	USS Pennsylvania (BB-38)	USS Pensacola (CA-24)
25 Jul[b]									
26 Jul									
27 Jul									
28 Jul									
29 July					7.0(A)				
30 July		7.0(A)							
31 July									
1 Aug		4.5(A)		7.0(A) 200.0(M)	4.0(A) 15.0(M)				
2 Aug		3.5(A) 17.0(M)							20.0(TA) 30.0(TM)
3 Aug		3.0(A)							
4 Aug		2.2(A) 22.0(M)							
5 Aug	3-4(E)	2.0(A)	2-3(E)		2.5(A) 5.0(M)	BT	2-3(E)	3-4(E)	
6 Aug							1.6(TA)		
7 Aug	0.7-4.0(T)				2.0(M)		0.86(TA)		
8 Aug	4.0(TA)		1.5(TA)		1.3(M)		0.71(TA)	2.0-0.4(T)	
9 Aug				1.9(Q) 1.5(F)	0.7(M)		0.50(TA)		
10 Aug					0.6(M)		0.80(TA)		
11 Aug									
12 Aug							0.40(TA)		
13 Aug									
14 Aug			0.25(TA)				0.27(TA)		
15 Aug							0.322(TA)		
16 Aug									
17 Aug							0.211(TA)		
18 Aug							0.236(TA)		
19 Aug									
20 Aug							0.2(TA)		
21 Aug					0.4(TA)			0.7(TA)	
22 Aug									1.0(TA)
23 Aug									
24 Aug									
25 Aug									
26 Aug									
27 Aug				0.6(TA)					
28 Aug		0.18(TA)							

NOTES:

[a]Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc., or indicates clearance for continuous habitation.

[b]BAKER was detonated at 0835.

LEGEND: (A) Average; (E) Estimated; (F) Forecastle (M) Maximum; (Q) Quarterdeck; (T) Topside; (TA) Topside Average; (TM) Topside Maximum.

Date[a]	Radiation Level (R/24 hours)									
	Prinz Eugen	USS Ralph Talbot (DD-390)	USS Rhind (DD-404)	USS Salt Lake City (CA-24)	USS Searaven (SS-196)	USS Skate (SS-305)	USS Stack (DD-406)	USS Tuna (SS-203)	USS Wainwright (DD-419)	USS Wilson (DD-408)
25 Jul[b]										
26 Jul										
27 Jul								6.0(A)		
28 Jul										
29 Jul									2.5(A) 3.5(M)	
30 Jul					1.5(T)				1.7(A) 2.0(M)	
31 Jul				4.5(A) 15.0(M)		5.5(A) 12.0(M)				
1 Aug	5.5(A) 14.0(M)					3.6(A) 8.6(M)	9.5(A)	1.0(A)	1.0(A) 2.0(M)	
2 Aug	2.6(A) 14.0(M)							0.8(A)	0.7(A) 2.0(M)	
3 Aug	0.3(BA) 0.5(BM)	3.0(A) 8.0(M)	4.0(A) 6.0(M)	3.0(A) 8.0(M)			6.0(A)	0.5(A)	0.6(A) 2.0(M)	
4 Aug	1.6(A)						4.3(A)	0.4(A)	0.5(A)	
5 Aug	2.0(A) 6.0(M)				0.5(A) 1.0(M)	2.0(A)				2-3(E)
6 Aug	1.5(A) 3.5(M)			100(TM)		1.72(A) 2.5(M)		0.07(TA)	0.5(A) 0.85(M)	
7 Aug	0.8(A)			4(TA)	0.50(A)	1.27(A)		0.36(TA)	0.08(A)	16.0(M)
8 Aug	0.9(A) 1.5(M)	1.5(A) 4.0(M)		1.5(TA)	0.25(A) 0.30(M)	0.08(A) 1.4(M)		0.10(TA)	0.06(A) 0.45(M)	
9 Aug	0.9(A) 8.0(M)				0.20(A) 0.37(M)	0.77(A) 1.4(M)		0.27(TA)	0.004(A) 0.6(M)	
10 Aug	0.7(A) 1.2(M)		1.2(A) 2.5(M)		0.27(A) 0.35(M)	1.07(A) 2.0(M)		0.05(TA)	0.04(A) 0.15(M)	
11 Aug								0.05(TA)		
12 Aug			1.1(A)		0.2(A)	1.01(A)		0.11(TA)		1.95(TA)
13 Aug		8(M)			0.2(A)	0.72(A)		<0.1(A)		
14 Aug	0.45(A)				0.21(M)	1.00(M)		<0.1(A)		
15 Aug					0.14(A)	0.62(A)				
16 Aug					0.16(A)	0.63(A)				
17 Aug					0.35(M)	0.3(M)				
18 Aug					0.08(A)					
19 Aug							0.6(TA)			
20 Aug										
21 Aug						0.33(A)				
22 Aug										
23 Aug		0.3(A)								
24 Aug										
25 Aug										
26 Aug										
27 Aug										
28 Aug										

NOTES:

[a]Shaded dates indicate some boarding activity either directly reported in logs or other reports, inferred from reports of towing, anchoring, etc, or indicates clearance for continuous habitation.

[b]BAKER was detonated at 0835.

LEGEND: (A) Average; (BA) Below Decks Average; (BM) Below Decks; (E) Estimated; (M) Maximum; (T) Topside; (TA) Topside Average.

APPENDIX G

SAMPLE TARGET SHIP DOSE RECONSTRUCTION

Chapter 12 discusses the scientific dose reconstruction and lists the calculated film badge equivalent exposures for the crewmembers of the support and target ships. A sample target ship crew dose reconstruction is provided in this appendix. A detailed discussion of the reconstruction methodology is contained in Analysis of Radiation Exposure for Naval Units of Operation CROSSROADS, R. Weitz et al., Science Applications Inc., SAI 83-714-WA, DNA TR-82-5, 3 March 1982. Schematically, the reconstruction methodology is shown in Figure G-1.

Target ship crew dose reconstruction was chosen for this sample because target ship crew exposures typically were higher than support ship crew exposures, and their reconstruction involves all the elements of a support ship reconstruction as well as those unique to target ship crews. Target ship crews had the potential for receiving radiation exposures in the following radiological environments during CROSSROADS:

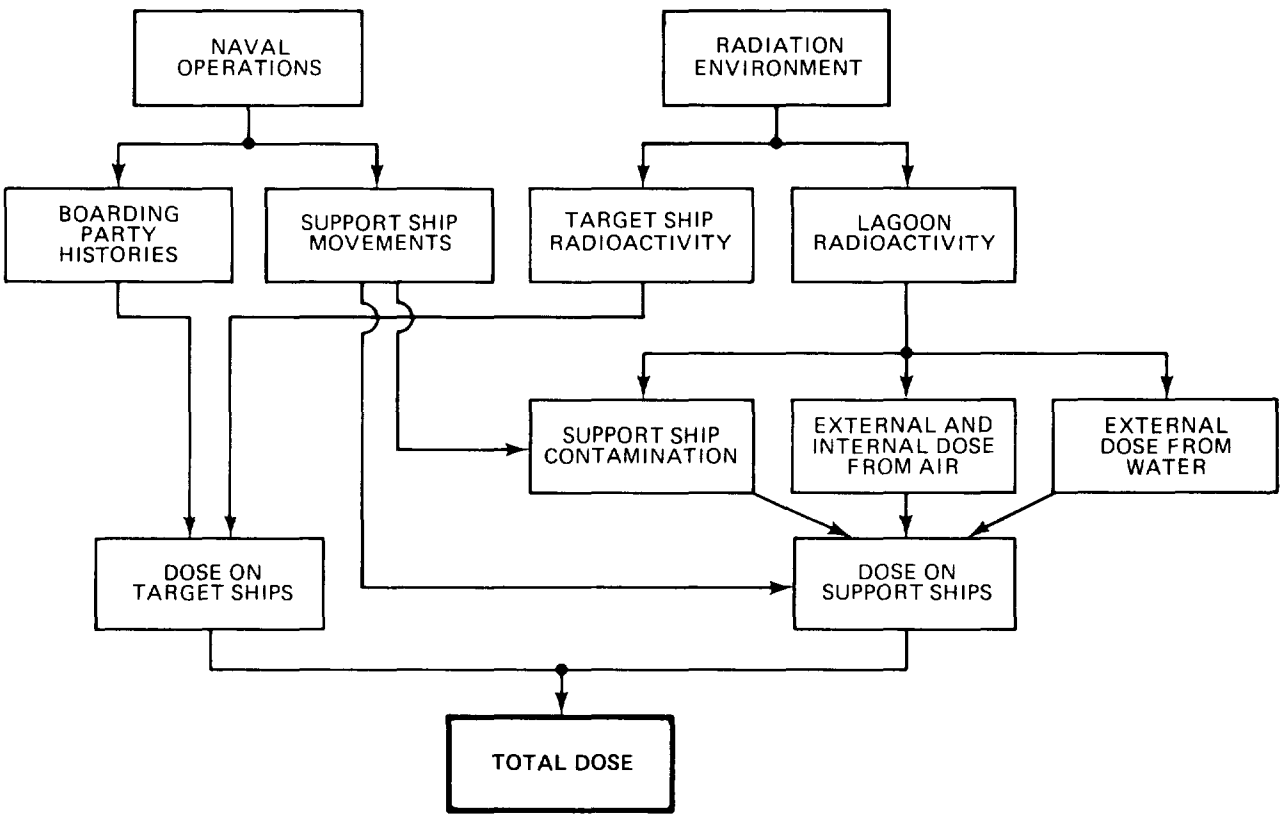


Figure G.1. CROSSROADS ships' crew dose reconstruction methodology.

- Exposure to the low level of radioactivity in the lagoon water following Tests ABLE and BAKER
- Exposure while reboarding target ships for inspection and salvage after Test ABLE
- Exposure while living aboard those target ships that were remanned after Tests ABLE and BAKER
- Exposure while reboarding target ships for decontamination, inspection, and preparation for towing after Test BAKER
- Exposure while living aboard support ships, which accumulated low-level radioactivity on their external hulls below the waterline and inside the saltwater piping systems after Test BAKER.

Each target ship requires individual research to determine the crew's activities. The primary sources of information are ship deck logs, decontamination reports, commanding officer damage reports, radiological safety (radsafe) monitor reports, participant letters and comments, dosimetry reports, and CROSSROADS historical and technical reports.

The potential radiation exposure while aboard target ships after BAKER is the major contributor to total dose for target ship crews. Fortunately, the radiation intensities aboard target ships after BAKER are well documented. Often, the names of personnel who actually boarded the target ships are listed in deck logs. In those cases where names are not available, it is assumed in these reconstructions that all crewmembers, normally divided into four reboarding teams, had an equal opportunity for exposure and that the teams rotated when the ship was not boarded by its full crew.

USS Independence (CVL-22) is used as a representative case because it had a relatively large crew, was significantly radioactive after Test BAKER, and clearly shows all the steps taken in calculating a reconstructed dose. After being evacuated just before ABLE, its crew was housed aboard USS Rockwall (APA-230) from 30 June through 12 August. Independence was first reboarded after Test ABLE on 4 July. It was reboarded daily from 5 to 11 July by several teams, and the entire crew worked aboard from 12 to 24 July. An unidentified number of personnel remained aboard at night except for the Test BAKER rehearsal on 18 July. From 13 to 23 August, the crew berthed aboard USS Ajax (AR-6). Independence was boarded between 18 and 21 August for some decontamination and inspection. Beginning on 17 August, the crew began to be transferred to other support ships for transport back to the United States. About half of the crew returned to the United States aboard USS Artemis (AKA-21), and this ship is the one on which the calculated exposure during the return trip is based. Each contribution to the total exposure in the reconstruction is discussed separately below.

POST-ABLE REBOARDING

The Independence crew commenced reboarding the ship on 4 July, after which the ship was boarded daily until 24 July. On 4 through 7 July, only two of the four reboarding teams came aboard. After 7 July, the number of teams reboarding

is not clear so it has been assumed the entire crew was aboard. Beginning on 11 July, a small security team remained aboard each night. Since they are not identified by name, the potential exposure has been assigned to the entire crew.

The calculation assumes that the radioactivity on board the target ships following ABLE was due almost entirely to neutron activation of ship materials themselves. Since the detected radioactivity levels were rather low, it was necessary to calculate the radiation environments aboard the ships. This involved the analysis of the composition of each ship type. The amount of iron, aluminum, magnesium, copper, etc. in each ship type was ascertained and was assumed to be in a homogeneous mixture. This mixture was then assumed to be subjected to the ABLE weapon neutron output. The radioactive isotopes produced by the neutrons were then determined. The radioactive environment was then assumed to be the sum of the radiation from these isotopes as they decayed with the passing of time. This environment was used to derive the doses for the post-ABLE Independence reboarding shown in Table G.1.

Table G.1. USS Independence (CVL-22) post-ABLE reboardings.

Date	Parties Aboard	Calculated Intensity (R/24 hours)	Time Aboard (hours)	Percent of Day	Computed Dose[a] (rem gamma)
4 July	Teams A and B	0.070	3.5	0.145	0.007
5 July	Teams A and B	0.030	7.25	0.302	0.007
6 July	Teams A and B	0.015	7.5	0.312	0.004
7 July	Teams A and B	0.008	8.25	0.343	0.002
8 July	All	0.007	8.5	0.354	0.002
9 July	All	0.006	9.0	0.375	0.001
10 July	All	0.006	8.5	0.354	0.001
11 July	All	0.006	8.75	0.365	0.001
12 July	All	0.006	24	1.0	0.055
Total					0.081

Note:
[a]Dose = percent of day x intensity x 0.7 (film badge correction factor).

POST-BAKER REBOARDING

After Test BAKER, Independence was boarded on four days by the crew, 18 through 21 August. The names of all personnel who were in these boarding parties are contained in the Independence deck log. The number of Independence personnel aboard were 30, 44, 46, and 44, respectively, for each of the four days. There were two radsafe monitors with them on 18 and 19 August, three on 20 August, and one on 21 August. The number of recorded film badges for each

day was 32, 44, 42, and 35, respectively; however, some of these badges were issued to non-Independence personnel. Therefore, a reconstructed dose was assigned to 24 personnel who were not badged on one or more of the boarding days. The contamination of most target ships following BAKER, including Independence, was extensive. For all target ships, detailed documentation of measured intensity levels was analyzed and summarized in the cited report and the results for Independence are shown in Figure G.2. This is the environment used to derive the doses shown in Table G.2. Table G.2 also shows the readings from the film badges issued to the reboarding parties.

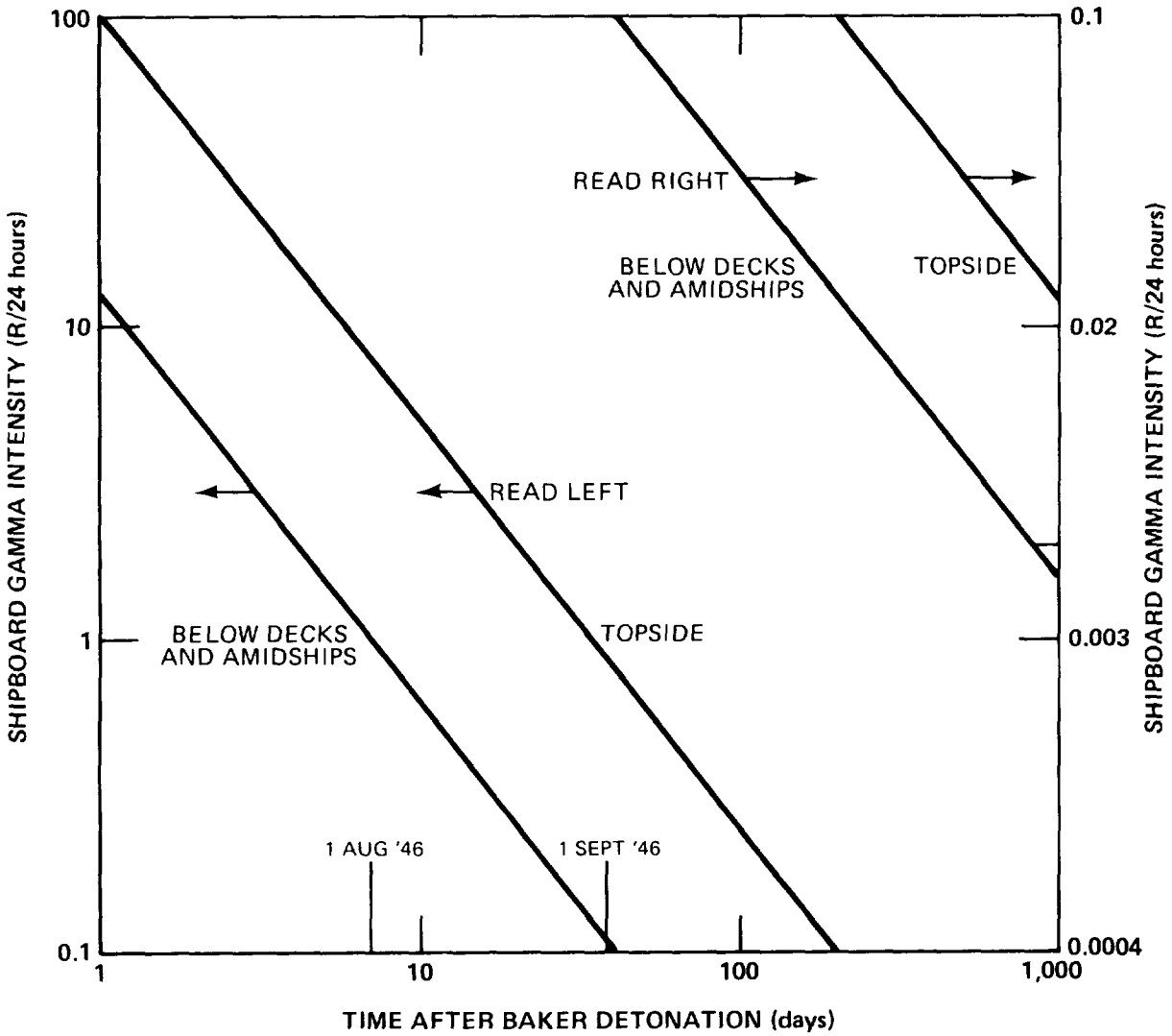


Figure G.2. Gamma radiation intensity aboard USS Independence (CVL-22) following Test BAKER, CROSSROADS. Note that the scales of this chart are not linear but are logarithmic and each division represents a tenfold change. Linear interpolation between divisions shown is not possible. Use the dates shown and the values entered in the tables as a guide in interpolating.

Table G.2. Post-BAKER reboarding dose reconstruction, USS Independence (CVL-22) crew.

Date	Teams	Hours Aboard (total)	Intensity From Figure G.2 (R/24 hours)	Percent of Day	Computed Dose[a] (rem gamma)	Issued Film Badge Readings		
						No.	Avg	High
18 Aug	A	4.2	1.6	0.175	0.196	32	0.044	0.090
19 Aug	A/B	3.9	1.5	0.162	0.170	44	0.048	0.160
20 Aug	A/B	5.2	1.4	0.216	0.212	42	0.033	0.090
21 Aug	Anchor Detail	4.0	1.3	0.166	0.151	35	0.052	0.180

Note:
[a]Dose = percent of day x intensity x 0.7 (film badge correction factor).

Calculated exposures are higher or about equal to maximum film badge exposure because all target ship calculations use the topside intensity curves shown in Figure G.2. The ship inspections required personnel to be below deck much of the time, thereby resulting in lower film badge exposures. Exposures were individually assigned to the 24 personnel who were not badged.

SUPPORT SHIP DOSE

The Independence crew was evacuated to Rockwall on 30 June and continued to berth aboard this transport through 12 August. The crew transferred to Ajax for the period 13 through 23 August. There was no contribution to the total dose of the crew while on the support ships due to ABLE. However, the BAKER detonation contaminated portions of the Bikini Lagoon. Support ships returning to these areas became contaminated on their exterior hulls and internal water lines.

Modeling this environment was based on what information was available concerning the movement of the Red and Blue Lines (see main text) and other data about levels of lagoon water radioactivity. In developing the support ship model, time-dependent, external hull gamma intensities for all ships were derived from hull intensity readings taken on 12 of the support ships after departure from the lagoon, and from the individual ship movements in the contaminated water environment. The external hull gamma intensity was derived from measurements for 16 of the support ships and the geometric mean of this value was used for the remaining ships, including Rockwall and Ajax.

The external hull gamma environment and an additional gamma emission from interior piping were used in the cited report to calculate a dose for the crews while aboard the support ships. For the Independence crew while aboard Rockwall
until 12 August, this amounted to 0.035 rem (gamma); and for their dose while aboard Ajax from 13 August to 23 August, it was 0.012 rem (gamma).

POST-BIKINI DOSE

The final portion of the calculated exposure covers the period of time personnel were aboard a support ship en route back to the United States. This resulted from the retention of low-level contamination on most support ships after Test BAKER.

The Independence crew was transferred to ten different ships between 17 and 28 August. About half the crew returned on Artemis and nearly a quarter on Ajax. This contribution was calculated based upon Artemis because the largest percentage of the crew was aboard it, and Artemis was more contaminated when it left Bikini Lagoon than was Ajax.

A number was determined for each support ship that characterized its radiological condition when it left Bikini. This number, called the ship departure factor, was based on the exposure history of each ship during its stay in the lagoon, and represents the hull intensity on the day of departure. For Artemis the number is 5. A nomogram (Figure G.3) is used to correct for the decrease in shipboard radiation because of decay of the radioactive emitters during the trip from Bikini and the observed decontamination effects of steaming in the open ocean. The nomogram is entered at the Bikini departure date (BAKER + 28 days) and read at the intersect with the San Francisco arrival date (BAKER + 43 days). The factor obtained (4) is multiplied by the ship departure factor (5) to determine the reconstructed badge exposure in millirem (20).

SUMMARY OF RECONSTRUCTION

These values were then used to assign uniquely determined, scientifically calculated doses for Independence personnel. Assignments were made to several clearly defined groups: those personnel who were at ABLE and BAKER but did not reboard Independence after BAKER, those personnel who did reboard after BAKER but were badged for all four days, and those personnel who did reboard after BAKER but did not wear a film badge every day. The calculated exposures are in addition to any recorded film badges that were worn. The total calculated and recorded film badge exposures for the crewmembers of Independence ranged from 0.148 rem gamma to 0.448 rem gamma.

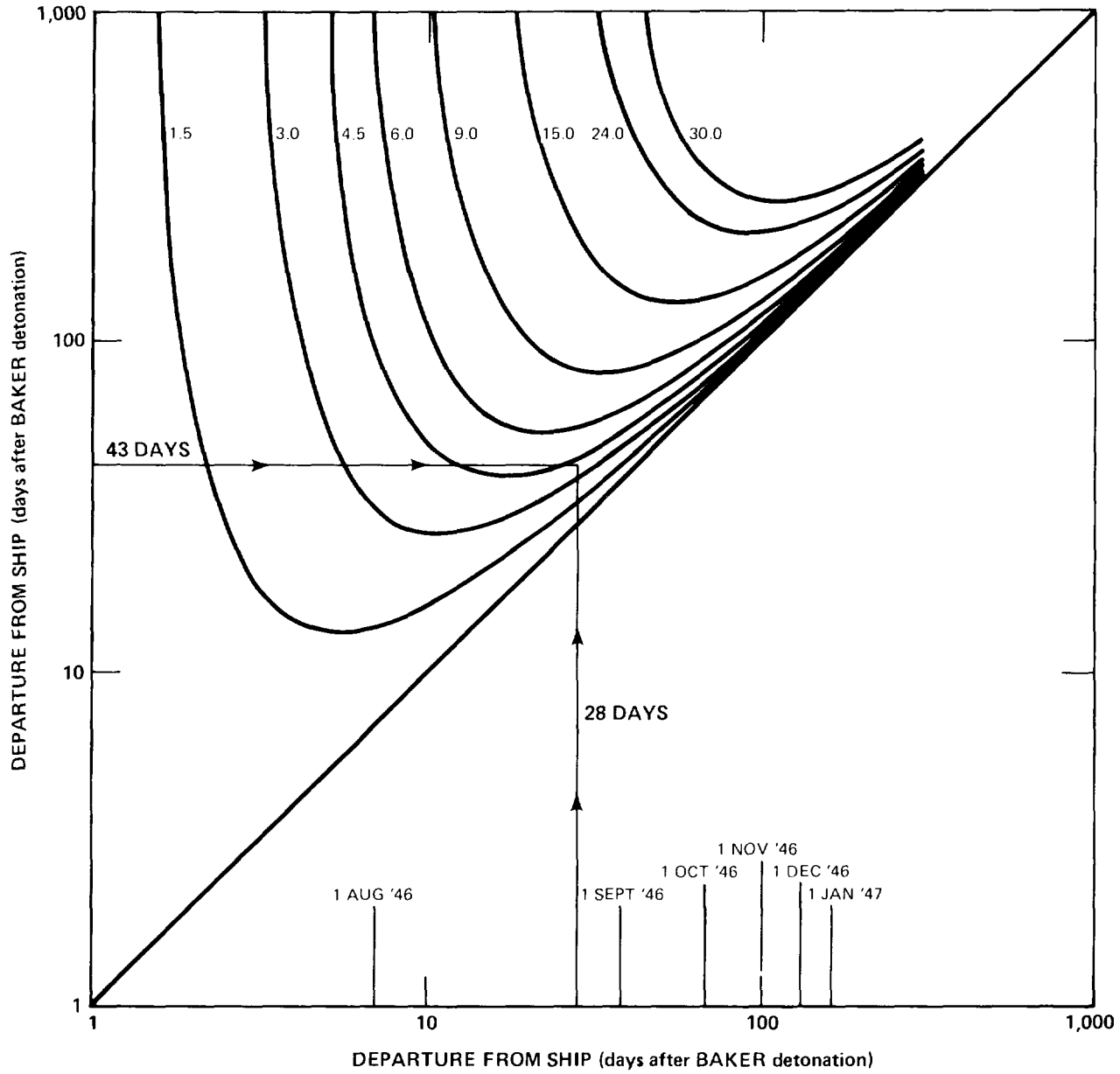


Figure G.3. Nomogram for reconstruction of dose for personnel returning from Bikini after CROSSROADS. Arrows illustrate example from text.

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ATTN: Librarian

Dayton & Montgomery City Pub Lib
ATTN: Librarian

University of Dayton
ATTN: Librarian

OTHER (Continued

Decatur Public Library
ATTN: Librarian

Dekalb Comm Coll So Cpus
ATTN: Librarian

Delaware Pauw University
ATTN: Librarian

University of Delaware
ATTN: Librarian

Delta College Library
ATTN: Librarian

Delta State University
ATTN: Librarian

Denison Univ Library
ATTN: Librarian

Denver Public Library
ATTN: Documents Div

Dept of Lib & Archives
ATTN: Librarian

Detroit Public Library
ATTN: Librarian

Dickinson State College
ATTN: Librarian

Drake Memorial Learning Resource Ctr
ATTN: Librarian

Drake University
ATTN: Cowles Library

Drew University
ATTN: Librarian

Duke University
ATTN: Public Docs Dept

Duluth Public Library
ATTN: Documents Section

Earlham College
ATTN: Librarian

East Carolina University
ATTN: Library Docs Dept

East Central University
ATTN: Librarian

East Islip Public Library
ATTN: Librarian

East Orange Public Lib
ATTN: Librarian

East Tennessee State Univ Sherrod Lib
ATTN: Documents Dept

OTHER (Continued)

East Texas State University
ATTN: Library

Eastern Branch
ATTN: Librarian

Eastern Illinois University
ATTN: Librarian

Eastern Kentucky University
ATTN: Librarian

Eastern Michigan University Lib
ATTN: Documents Libn

Eastern Montana College Library
ATTN: Documents Dept

Eastern New Mexico Univ
ATTN: Librarian

Eastern Oregon College Library
ATTN: Librarian

Eastern Washington Univ
ATTN: Librarian

El Paso Public Library
ATTN: Documents & Geneology Dept

Elko County Library
ATTN: Librarian

Elmira College
ATTN: Librarian

Elon College Library
ATTN: Librarian

Enoch Pratt Free Library
ATTN: Documents Office

Emory University
ATTN: Librarian

Evansville & Vanderburgh County Pub Lib
ATTN: Librarian

Everett Public Library
ATTN: Librarian

Fairleigh Dickinson Univ
ATTN: Depository Dept

Florida A & M Univ
ATTN: Librarian

Florida Atlantic Univ Lib
ATTN: Div of Public Documents

Florida Institute of Tech Lib
ATTN: Federal Documents Dept

Florida Intl Univ Library
ATTN: DLCS Section

OTHER (Continued)

Florida State Library
ATTN: Documents Section

Florida State University
ATTN: Librarian

Fond Du Lac Public Lib
ATTN: Librarian

Fort Hays State University
ATTN: Librarian

Fort Worth Public Library
ATTN: Librarian

Free Pub Lib of Elizabeth
ATTN: Librarian

Free Public Library
ATTN: Librarian

Freeport Public Library
ATTN: Librarian

Fresno County Free Library
ATTN: Librarian

Gadsden Public Library
ATTN: Librarian

Garden Public Library
ATTN: Librarian

Gardner Webb College
ATTN: Documents Librn

Gary Public Library
ATTN: Librarian

Georgetown Univ Library
ATTN: Govt Docs Room

Georgia Inst of Tech
ATTN: Librarian

Georgia Southern College
ATTN: Librarian

Georgia Southwestern College
ATTN: Director of Libraries

Georgia State Univ Lib
ATTN: Librarian

University of Georgia
ATTN: Dir of Libraries

Glassboro State College
ATTN: Librarian

Gleeson Library
ATTN: Librarian

OTHER (Continued)

Government Publications Library-M
ATTN: Director of Libraries

Graceland College
ATTN: Librarian

Grand Forks Public City-County Library
ATTN: Librarian

Grand Rapids Public Library
ATTN: Director of Libraries

Greenville County Library
ATTN: Librarian

Guam RFK Memorial University Lib
ATTN: Fed Depository Collection

University of Guam
ATTN: Librarian

Gustavus Adolphus College
ATTN: Library

Hardin-Simmons University Library
ATTN: Librarian

Hartford Public Library
ATTN: Librarian

Harvard College Library
ATTN: Director of Libraries

University of Hawaii Library
ATTN: Government Docs Collection

Hawaii State Library
ATTN: Federal Documents Unit

University of Hawaii at Monoa
ATTN: Director of Libraries

University of Hawaii
ATTN: Librarian

Haydon Burns Library
ATTN: Librarian

Henry Ford Comm College Lib
ATTN: Librarian

Herbert H. Lehman College
ATTN: Library Documents Division

Hofstra Univ Library
ATTN: Documents Dept

Hollins College
ATTN: Librarian

Hoover Institution
ATTN: J. Bingham

OTHER (Continued)

Hopkinsville Comm College
ATTN: Librarian

University of Houston, Library
ATTN: Documents Div

Houston Public Library
ATTN: Librarian

Hoyt Public Library
ATTN: Librarian

Humboldt State College Library
ATTN: Documents Dept

Huntington Park Library
ATTN: Librarian

Hutchinson Public Library
ATTN: Librarian

Idaho Public Lib & Info Center
ATTN: Librarian

Idaho State Library
ATTN: Librarian

Idaho State University Library
ATTN: Documents Dept

University of Idaho
ATTN: Documents Sect
ATTN: Dir of Libraries

University of Illinois, Library
ATTN: Documents Section

Illinois State Library
ATTN: Government Documents Branch

Illinois Univ at Urbana Champaign
ATTN: P. Watson, Documents Library

Illinois Valley Comm Coll
ATTN: Library

Indiana State Library
ATTN: Serial Section

Indiana State University
ATTN: Documents Libraries

Indiana University Library
ATTN: Documents Department

Indianapolis Marion Cty Pub Library
ATTN: Social Science Div

Iowa State University Library
ATTN: Govt Documents Dept

Iowa University Library
ATTN: Government Documents Dept

OTHER (Continued)

Butler University, Irwin Library
ATTN: Librarian

Isaac Delchdo College
ATTN: Librarian

James Madison University
ATTN: Librarian

Jefferson County Public Lib
ATTN: Librarian

Jersey City State College
ATTN: Librarian

Johns Hopkins University
ATTN: Documents Library

John J. Wright Library, La Roche College
ATTN: Librarian

Johnson Free Public Lib
ATTN: Librarian

Kahului Library
ATTN: Librarian

Kalamazoo Public Library
ATTN: Librarian

Kansas City Public Library
ATTN: Documents Div

Kansas State Library
ATTN: Librarian

Kansas State Univ Library
ATTN: Documents Dept

University of Kansas
ATTN: Director of Libraries

Kent State University Library
ATTN: Documents Div

Kentucky Dept of Library & Archives
ATTN: Documents Section

University of Kentucky
ATTN: Governments Publication Dept
ATTN: Director of Libraries

Kenyon College Library
ATTN: Librarian

Lake Forest College
ATTN: Librarian

Lake Sumter Comm Coll Lib
ATTN: Librarian

Lakeland Public Library
ATTN: Librarian

OTHER (Continued)

Lancaster Regional Library
ATTN: Librarian

Lawrence University
ATTN: Documents Dept

Lee Library, Brigham Young University
ATTN: Documents & Map Section

Library & Statutory Distribution & Svc
2 cy ATTN: Librarian

Little Rock Public Library
ATTN: Librarian

Long Beach Publ Library
ATTN: Librarian

Los Angeles Public Library
ATTN: Serials Div U.S. Documents

Louisiana State University
ATTN: Government Doc Dept
ATTN: Director of Libraries

Louisville Free Pub Lib
ATTN: Librarian

Louisville Univ Library
ATTN: Librarian

Lyndon B. Johnson Sch of Pub Affairs Lib
ATTN: Librarian

Maine Maritime Academy
ATTN: Librarian

Maine University at Oreno
ATTN: Librarian

University of Maine
ATTN: Librarian

Manchester City Library
ATTN: Librarian

Mankato State College
ATTN: Govt Publications

Mantor Library
Univ of Maine at Farmington
ATTN: Director of Libraries

Marathon County Public Library
ATTN: Librarian

Marshall Brooks Library
ATTN: Librarian

University of Maryland
ATTN: McKeldin Libr Docs Div

University of Maryland
ATTN: Librarian

OTHER (Continued)

University of Massachusetts
ATTN: Government Docs College

McNeese State Univ
ATTN: Librarian

Memphis Shelby County Pub Lib & Info Ctr
ATTN: Librarian

Memphis State University
ATTN: Librarian

Mercer University
ATTN: Librarian

Mesa County Public Library
ATTN: Librarian

University of Miami, Library
ATTN: Government Publications

Miami Public Library
ATTN: Documents Division

Miami Univ Library
ATTN: Documents Dept

Michel Orradre Library
University of Santa Clara
ATTN: Documents Div

Michigan State Library
ATTN: Librarian

Michigan State University Library
ATTN: Librarian

Michigan Tech University
ATTN: Library Documents Dept

University of Michigan
ATTN: Acq Sec Documents Unit

Middlebury College Library
ATTN: Librarian

Millersville State Coll
ATTN: Librarian

Milne Library
State University of New York
ATTN: Docs Librn

Milwaukee Pub Lib
ATTN: Librarian

Minneapolis Public Lib
ATTN: Librarian

Minnesota Div of Emergency Svcs
ATTN: Librarian

Minot State College
ATTN: Librarian

Mississippi State University
ATTN: Librarian

OTHER (Continued)

University of Mississippi
ATTN: Director of Libraries

Missouri Univ at Kansas City Gen
ATTN: Librarian

Missouri University Library
ATTN: Government Documents

M.I.T. Libraries
ATTN: Librarian

Mobile Public Library
ATTN: Governmental Info Division

Moffett Library
ATTN: Librarian

Montana State Library
ATTN: Librarian

Montana State University, Library
ATTN: Librarian

University of Montana
ATTN: Documents Div

Moorhead State College
ATTN: Library

Mt Prospect Public Lib
ATTN: Librarian

Murray State Univ Lib
ATTN: Library

Nassau Library System
ATTN: Librarian

Natrona County Public Library
ATTN: Librarian

Nebraska Library Comm
ATTN: Librarian

Univ of Nebraska at Omaha
ATTN: Librarian

Nebraska Western College Library
ATTN: Librarian

Univ of Nebraska at Lincoln
ATTN: Director of Libraries

Univ of Nevada at Reno
ATTN: Governments Pub Dept

Univ of Nevada at Las Vegas
ATTN: Director of Libraries

New Hampshire University Lib
ATTN: Librarian

New Hanover County Public Library
ATTN: Librarian

Nebraska University Library
ATTN: Acquisitions Dept

OTHER (Continued)

New Mexico State Library
ATTN: Librarian

New Mexico State University
ATTN: Lib Documents Div

University of New Mexico
ATTN: Director of Libraries

University of New Orleans Library
ATTN: Govt Documents Div

New Orleans Public Lib
ATTN: Library

New York Public Library
ATTN: Librarian

New York State Library
ATTN: Doc Control, Cultural Ed Ctr

New York State Univ at Stony Brook
ATTN: Main Lib Doc Sect

New York State Univ Col at Cortland
ATTN: Librarian

State Univ of New York
ATTN: Library Documents Sec

State Univ of New York
ATTN: Librarian

New York State University
ATTN: Documents Center

State University of New York
ATTN: Documents Dept

New York University Library
ATTN: Documents Dept

Newark Free Library
ATTN: Librarian

Newark Public Library
ATTN: Librarian

Niagara Falls Pub Lib
ATTN: Librarian

Nicholls State Univ Library
ATTN: Docs Div

Nieves M. Flores Memorial Lib
ATTN: Librarian

Norfolk Public Library
ATTN: R. Parker

North Carolina Agri & Tech State Univ
ATTN: Librarian

Univ of North Carolina at Charlotte
ATTN: Atkins Library Documents Dept

Univ of North Carolina at Greensboro, Library
ATTN: Librarian

OTHER (Continued)

North Carolina Central University
ATTN: Librarian

North Carolina State University
ATTN: Librarian

North Carolina University at Wilmington
ATTN: Librarian

University of North Carolina
ATTN: BA SS Division Documents

North Dakota State University Lib
ATTN: Docs Librarian

University of North Dakota
ATTN: Librarian

North Georgia College
ATTN: Librarian

North Texas State University Library
ATTN: Librarian

Northeast Missouri State University
ATTN: Librarian

Northeastern Illinois University
ATTN: Library

Northeastern Oklahoma State Univ
ATTN: Librarian

Northeastern University
ATTN: Dodge Library

Northern Arizona University Lib
ATTN: Government Documents Dept

Northern Illinois University
ATTN: Librarian

Northern Iowa University
ATTN: Library

Northern Michigan Univ
ATTN: Documents

Northern Montana College Library
ATTN: Librarian

Northwestern Michigan College
ATTN: Librarian

Northwestern State Univ
ATTN: Librarian

Northwestern State Univ Library
ATTN: Librarian

Northwestern University Library
ATTN: Govt Publications Dept

Norwalk Public Library
ATTN: Librarian

OTHER (Continued)

University of Notre Dame
ATTN: Document Center

Oakland Comm College
ATTN: Librarian

Oakland Public Library
ATTN: Librarian

Oberlin College Library
ATTN: Librarian

Ocean County College
ATTN: Librarian

Ohio State University
ATTN: Libraries Documents Division

Ohio University Library
ATTN: Docs Dept

Oklahoma City University Library
ATTN: Librarian

Oklahoma City University Library
ATTN: Librarian

Oklahoma Dept of Libraries
ATTN: U.S. Govt Documents

Oklahoma University Library
ATTN: Govt Doc Collection

Old Dominion University
ATTN: Doc Dept Univ Library

Olivet College Library
ATTN: Librarian

Omaha Pub Lib Clark Branch
ATTN: Librarian

Oregon State Library
ATTN: Librarian

University of Oregon
ATTN: Documents Section

Ouachita Baptist University
ATTN: Librarian

Pan American University Library
ATTN: Librarian

Passaic Public Library
ATTN: Librarian

Paul Klapper Library
ATTN: Documents Dept

Pennsylvania State Library
ATTN: Government Publications Section

OTHER (Continued)

Pennsylvania State University
ATTN: Library Document Sec

University of Pennsylvania
ATTN: Director of Libraries

Penrose Library
University of Denver
ATTN: Penrose Library

Peoria Public Library
ATTN: Business, Science & Tech Dept

Free Library of Philadelphia
ATTN: Govt Publications Dept

Philipsburg Free Public Library
ATTN: Library

Phoenix Public Library
ATTN: Librarian

University of Pittsburg
ATTN: Documents Office G 8

Plainfield Public Library
ATTN: Librarian

Popular Creek Public Lib District
ATTN: Librarian

Association of Portland Lib
ATTN: Librarian

Portland Public Library
ATTN: Librarian

Portland State University Library
ATTN: Librarian

Prescott Memorial Lib
Louisiana Tech Univ
ATTN: Librarian

Princeton University Library
ATTN: Documents Division

Providence College
ATTN: Physics Dept

Providence Public Library
ATTN: Librarian

Cincinnati & Hamilton County Public Library
ATTN: Librarian

Public Library of Nashville and Davidson County
ATTN: Library

University of Puerto Rico
ATTN: Doc & Maps Room

Purdue University Library
ATTN: Librarian

OTHER (Continued)

Quinebaug Valley Community Col
ATTN: Librarian

Ralph Brown Draughon Lib
Auburn University
ATTN: Microforms & Documents Dept

Rapid City Public Library
ATTN: Librarian

Reading Public Library
ATTN: Librarian

Reed College Library
ATTN: Librarian

Reese Library
Augusta College
ATTN: Librarian

University of Rhode Island Library
ATTN: Govt Publications Office

University of Rhode Island
ATTN: Director of Libraries

Rice University
ATTN: Director of Libraries

Richard W. Norton Mem Lib
Louisiana College
ATTN: Librarian

Richland County Pub Lib
ATTN: Librarian

University of Richmond
ATTN: Library

Riverside Public Library
ATTN: Librarian

University of Rochester Library
ATTN: Documents Section

Rutgers University, Camden Library
ATTN: Librarian

Rutgers State University
ATTN: Librarian

Rutgers University
ATTN: Govt Documents Dept

Rutgers University Law Library
ATTN: Federal Documents Dept

Salem College Library
ATTN: Librarian

Samford University
ATTN: Librarian

San Antonio Public Library
ATTN: Bus Science & Tech Dept

OTHER (Continued)

San Diego County Library
ATTN: C. Jones, Acquisitions

San Diego Public Library
ATTN: Librarian

San Diego State University Library
ATTN: Govt Pubs Dept

San Francisco Public Library
ATTN: Govt Documents Dept

San Francisco State College
ATTN: Govt Pub Collection

San Jose State College Library
ATTN: Documents Dept

San Luis Obispo City-County Library
ATTN: Librarian

Savannah Pub & Effingham Libty Reg Lib
ATTN: Librarian

Scottsbluff Public Library
ATTN: Librarian

Scranton Public Library
ATTN: Librarian

Seattle Public Library
ATTN: Ref Doc Asst

Selby Public Library
ATTN: Librarian

Shawnee Library System
ATTN: Librarian

Shreve Memorial Library
ATTN: Librarian

Silas Bronson Public Library
ATTN: Librarian

Simon Schwob Mem Lib
Columbus College
ATTN: Librarian

Sioux City Public Library
ATTN: Librarian

Skidmore College
ATTN: Librarian

Slippery Rock State College Library
ATTN: Librarian

South Carolina State Library
ATTN: Librarian

University of South Carolina
ATTN: Librarian

OTHER (Continued)

University of South Carolina
ATTN: Government Documents

South Dakota Sch of Mines & Tech
ATTN: Librarian

South Dakota State Library
ATTN: Federal Documents Department

University of South Dakota
ATTN: Documents Librarian

South Florida University Library
ATTN: Librarian

Southdale-Hennepin Area Library
ATTN: Government Documents

Southeast Missouri State University
ATTN: Librarian

Southeastern Massachusetts University Library
ATTN: Documents Sec

University of Southern Alabama
ATTN: Librarian

Southern California University Library
ATTN: Documents Dept

Southern Connecticut State College
ATTN: Library

Southern Illinois University
ATTN: Librarian

Southern Illinois University
ATTN: Documents Ctr

Southern Methodist University
ATTN: Librarian

University of Southern Mississippi
ATTN: Library

Southern Oregon College
ATTN: Library

Southern University in New Orleans, Library
ATTN: Librarian

Southern Utah State College Library
ATTN: Documents Department

Southwest Missouri State College
ATTN: Library

Southwestern University of Louisiana, Libraries
ATTN: Librarian

Southwestern University School of Law Library
ATTN: Librarian

OTHER (Continued)

Spokane Public Library
ATTN: Reference Dept

Springfield City Library
ATTN: Documents Section

St. Bonaventure University
ATTN: Librarian

St. Joseph Public Library
ATTN: Librarian

St. Lawrence University
ATTN: Librarian

St. Louis Public Library
ATTN: Librarian

St. Paul Public Library
ATTN: Librarian

Stanford University Library
ATTN: Govt Documents Dept

State Historical Soc Lib
ATTN: Docs Serials Section

State Library of Massachusetts
ATTN: Librarian

State Library of Ohio
ATTN: Librarian

State University of New York
ATTN: Librarian

Stetson Univ
ATTN: Librarian

University of Steubenville
ATTN: Librarian

Stockton & San Joaquin Public Lib
ATTN: Librarian

Stockton State College Library
ATTN: Librarian

Superior Public Library
ATTN: Librarian

Swarthmore College Lib
ATTN: Reference Dept

Syracuse University Library
ATTN: Documents Div

Tacoma Public Library
ATTN: Librarian

Tampa, Hillsborough County Public Lib
ATTN: Librarian

Temple University
ATTN: Librarian

Tennessee Technological University
ATTN: Librarian

OTHER (Continued)

University of Tennessee
ATTN: Dir of Libraries

Terteling Library
College of Idaho
ATTN: Librarian

Texas A & M University Library
ATTN: Librarian

University of Texas at Arlington
ATTN: Library Documents

University of Texas at San Antonio
ATTN: Library

Texas Christian University
ATTN: Librarian

Texas State Library
ATTN: U.S. Documents Sect

Texas Tech University Library
ATTN: Govt Docs Dept

Texas University at Austin
ATTN: Documents Coll

Texas University at El Paso
ATTN: Documents and Maps Lib

University of Toledo Library
ATTN: Librarian

Toledo Public Library
ATTN: Social Science Dept

Torrance Civic Center Library
ATTN: Librarian

Traverse City Public Library
ATTN: Librarian

Trenton Free Public Library
ATTN: Librarian

Trinity College Library
ATTN: Librarian

Trinity University Library
ATTN: Documents Collection

Tufts University Library
ATTN: Documents Dept

Tulane University
ATTN: Documents Dept

University of Tulsa
ATTN: Librarian

UCLA Research Library
ATTN: Public Affairs Svc/US Docs

OTHER (Continued)

Uniformed Svcs Univ of the Hlth Sci
ATTN: LRC Library

University Libraries
ATTN: Dir of Libraries

Upper Iowa College
ATTN: Documents Collection

Utah State University
ATTN: Librarian

University of Utah
ATTN: Special Collections

University of Utah
ATTN: Dept of Pharmacology
ATTN: Director of Libraries

Valencia Library
ATTN: Librarian

Vanderbilt University Library
ATTN: Govt Docs Sect

University of Vermont
ATTN: Director of Libraries

Virginia Commonwealth University
ATTN: Librarian

Virginia Military Institute
ATTN: Librarian

Virginia Polytechnic Inst Lib
ATTN: Docs Dept

Virginia State Library
ATTN: Serials Section

University of Virginia
ATTN: Public Documents

Volusia County Public Libraries
ATTN: Librarian

Washington State Library
ATTN: Documents Section

Washington State University
ATTN: Lib Documents Section

Washington University Libraries
ATTN: Dir of Libraries

University of Washington
ATTN: Documents Div

Wayne State University Library
ATTN: Librarian

Wayne State University Law Library
ATTN: Documents Dept

Weber State College Library
ATTN: Librarian

Wagner College
ATTN: Librarian

OTHER (Continued)

Wesleyan University
ATTN: Documents Librarian

West Chester State Coll
ATTN: Documents Dept

West Covina Library
ATTN: Librarian

University of West Florida
ATTN: Librarian

West Hills Community Coll
ATTN: Library

West Texas State University
ATTN: Library

West Virginia Coll of Grad Studies Lib
ATTN: Librarian

University of West Virginia
ATTN: Dir of Libraries

Westerly Public Library
ATTN: Librarian

Western Carolina University
ATTN: Librarian

Western Illinois University Lib
ATTN: Librarian

Western Washington Univ
ATTN: Librarian

Western Wyoming Community College Lib
ATTN: Librarian

Westmoreland Cty Comm Coll
ATTN: Learning Resource Ctr

Whitman College
ATTN: Librarian

Wichita State Univ Library
ATTN: Librarian

William & Mary College
ATTN: Docs Dept

William Allen White Library
Emporia Kansas State College
ATTN: Govt Documents Div

William College Library
ATTN: Librarian

Willimantic Public Library
ATTN: Librarian

Winthrop College
ATTN: Documents Dept

University of Wisconsin at Whitewater
ATTN: Governments Documents Library

OTHER (Continued)

Wisconsin Milwaukee University
ATTN: Librarian

Wisconsin Oshkosh University
ATTN: Librarian

Wisconsin Platteville University
ATTN: Librarian

Wisconsin University at Stevens Point
ATTN: Docs Section

University of Wisconsin
ATTN: Govt Pubs Dept

University of Wisconsin
ATTN: Acquisitions Dept

Worcester Public Library
ATTN: Librarian

OTHER (Continued)

Yale University
ATTN: Director of Libraries

Yeshiva University
ATTN: Librarian

Yuma City County Library
ATTN: Librarian

Wright State Univ Library
ATTN: Govts Documents Dept

Wyoming State Library
ATTN: Librarian

University of Wyoming
ATTN: Documents Div