DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, DC 20350

IN REPLY REFER TO
Ser 981TD/2176
22 March 1983

MEMORANDUM FOR DIRECTOR, DEFENSE NUCLEAR AGENCY
(ATTN: Lt. Col. Lynn Reese, BE)

Subj: Operation CROSSROADS, First Draft Comments, Chapters 8 and 12

Encl: (1) Marked-up copy of Chapters 8 and 12
(2) Revised ships histories (Kaman Tempo only)
(3) REECo letter dated March 18, 1983

1. Comments on Chapters 8 and 12 are contained in enclosure (1). Enclosures (2) and (3) support comments on the marked pages.

2. General comments in addition to those previously submitted follow:

a. It is recommended that target ships be identified by use of an asterisk at least in Chapter 8, but possibly throughout the report. It is important to a reader to be able to readily differentiate between target and support ships. Reference to a table or list everytime a ship is named is very time consuming.

done on 2nd Draft

b. The ship histories are not consistent as to the period of time covered. Some go all the way to San Francisco or Pearl Harbor while others stop at departure from Bikini. All ships should be handled the same way.

Will be done in 2nd draft

c. The ATA and ATR histories are incomplete. Please provide more detail on their activities with target ships.

will be done

d. Many of the histories appeared to use only one source: the deck log, Navy history or final reports. All three must be used and integrated to provide complete histories.

will be done

e. The Navy is completing the analysis of various groups who had the highest potential for radiation exposure. Some of the results are provided in the Chapter 12 marked up copy. The remainder will be provided when complete. It is essential that those groups with highest potential and a high percentage of badging be discussed and listed in table form in this Chapter. The Navy is also completing an analysis of the personnel with the highest recorded exposures. It appears that exposures for some personnel may have resulted from multiple badging. For example, it appears that about 3.6 R of the 4.01 exposure for Krasnow, the Army monitor, actually is composed of one badge for him and 3 others left on the deck of the SEARAVEN, and the 14.0 R beta for

Can be done in 2nd draft

LT Lenz is actually two 7.0 R badges issued the same day. The results of this analysis will also be provided when complete and should be included in Chapter 12.

3. The REECo letter concerning beta readings is attached and should be worked into Chapter 12.

4. The Navy would like to discuss our comments and findings for Chapter 12 with DNA and Kaman Tempo before it is rewritten.

W. H. LOEFFLER
CAPTAIN USN

Copy to:
Kaman Tempo

SUMMARY OF CROSSROADS TARGET SHIPS

UNMANNED TARGET VESSELS	ABLE	BAKER	SUNK AT BIKINI	TOWED TO KWAJ.	RETURN TO U.S.
AFLOAT					
ANDERSON (DD-411)	X		X		
APOGON (SS-308)	X	X	X		
ARDC-13	X	X	X		
ARKANSAS (BB-33)	X	X	X		
BANNER (APA-60)	X	X		X	
BARROW (APA-61)	X	X		X	
BRACKEN (APA-64)	X	X		X	
BRISCOE (APA-65)	X	X		X	
BRULE (APA-66)	X	X		X	
BUTTE (APA-68)	X	X		X	
CARLISLE (APA-69)	X		X		
CARTERET (APA-70)	X	X		X	
CATRON (APA-71)	X	X			
CRITTENDEN (APA-77)	X	X		X	X
DAWSON (APA-79)	X	X			
FALLON (APA-81)	X	X		X	
GASCONADE (APA-85)	X	X		X	X
GILLIAM (APA-57)	X		X		
HUGHES (DD-410)	X	X			X
INDEPENDENCE (CVL-22)	X	X			X
LAMSON (DD-367)	X		X		
LCI-327	X	X		X	
LCI-332	X	X		X	
LSM-60		X	X		
LST-52	X	X		X	
LST-220	X	X		X	
LST-545	X	X		X	
LST-661	X	X		X	
MAYRANT (DD-402)	X	X		X	
MUGFORD (DD-389)	X	X		X	
MUSTIN (DD-413)	X	X		X	
NAGATO	X	X	X		
NEVADA (BB-36)	X	X			X PH
NEW YORK (BB-34)	X	X			X PH
PENNSYLVANIA (BB-38)	X	X		X	
PENSACOLA (CA-24)	X	X			X
PILOTFISH (SS-386)	X	X	X		
PRINZ EUGEN	X	X		X	
RALPH TALBOT (DD-390)	X	X		X	
RHIND (DD-404)	X	X		X	
SAKAWA	X		X		
SALT LAKE CITY (CA-25)	X	X			X

UNMANNED TARGET VESSELS	ABLE	BAKER	SUNK AT BIKINI	TOWED TO KWAJ.	RETURN TO U.S.
AFLOAT					
SARATOGA (CV-3)	X	X	X		
SKATE (SS-305)	X	X			X
SKIPJACK (SS-184)	X	X			X
STACK (DD-406)	X	X		X	
TRIPPE (DD-403)	X	X		X	
WAINRIGHT (DD-419)	X	X		X	
WILSON (DD-408)	X	X		X	
YO-160	X	X	X		
YOG-83	X	X		X	
LCT-746	X	X		X	
LCT-816	X	X		X	
LCT-818	X	X		X	
LCT-874	X	X		X	
LCT-1013	X	X		X	
LCT-1078	X	X		X	
LCT-1112	X	X		X	
LCT-1113	X	X		X	
LCT-1114	X	X	X		
LCT-1115	X	X	X		
BEACHED					
LCT-414	X	X			
LCT-812	X	X			
LCT-845	X				
LCT-1175		X			
LCT-1187		X			
LCT-1237		X			
LCM-1		X			
LCM-2	X	X			
LCM-3	X	X			
LCM-4	X	X			
LCM-5	X	X			
LCM-6	X	X			
LCM-7		X			
LCVP-7	X	X			
LCVP-8	X	X			
LCVP-9	X	X			
LCVP-10	X	X			
LCVP-11	X	X			
LCVP-12	X	X			
LCI(L)-615	X	X			
LCI(L)-620	X	X			
LST-133	X	X			
LST-125		X			

REMANNED TARGET VESSELS	ABLE	BAKER	SUNK AT BIKINI	TOWED TO KWAJ.	RETURN TO U.S.
AFLOAT					
BLADEN (APA-63)	X	X			X
CONYNGHAM (DD-371)	X	X			X
CORTLAND (APA-75)	X	X			X
DENTUDA (SS-335)	X	X			X
FILMORE (APA-83)	X	X			X
GENEVA (APA-86)	X	X			X
LCI-329	X	X		X	
LCI(L)-549	X	X			X
NIAGARA (APA-87)	X	X			X
PARCHE (SS-384)	X	X			X
SEARAVEN (SS-196)	X	X			X
TUNA (SS-203)	X	X			X
BEACHED					
LCI(L)-615	X	X			X
TOTAL AFLOAT	72	68	15	37	22
TOTAL BEACHED	19	23	--	--	--
TOTAL	90	91	15	37	22

CONTENTS (continued)

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 10, Cap. Plate XI). With this in mind, he had the nuclear test operation designated CROSSROADS. Operation CROSSROADS was the largest U.S. peace-time military operation ever conducted. It involved 42,000 personnel, 240 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 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

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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.

The Navy's response to this proposal was that such a test should also include a few modern U.S. naval units in the target array (Reference 4, p. 10). In effect, this broadened the ~~exercise~~ test of the effects of a nuclear detonation on naval vessels from a mere demonstration to a scientific test whose results could be used in future ~~of potential use in the~~ design of naval vessels and naval tactics. The JCS established a subcommittee to prepare a detailed proposal in November and it worked over a period of 6 weeks.

The secondary purpose of CROSSROADS was to afford training for Army Air Forces personnel in attack techniques using atomic bombs against ships and to determine the effects upon military equipment and installations. Such information was not available from the Trinity test nor the Hiroshima and Nagasaki bombings (Reference 1, XIII).

On 10 December 1945, the President announced that the United States would explore further the capabilities of atomic energy. ~~and that~~ This exploration would be in the form of scientific atomic bomb tests and would come 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 ~~the officer who was to be Commander Joint Task Force One (CJTF1)~~ a Naval officer who had commanded large Army-Navy operations in the Pacific during the war and who had also been Chief of the Navy Bureau of Ordnance to serve as Commander Joint Task Force One (CJTF1).

CROSSROADS, as proposed, was to ~~have had~~ consist of three nuclear events. ~~shots.~~ In approving the plans, the President committed the detonation of three nuclear weapons, one-third of the U.S. stockpile, surely a measure of the importance given the operation (Reference 3).

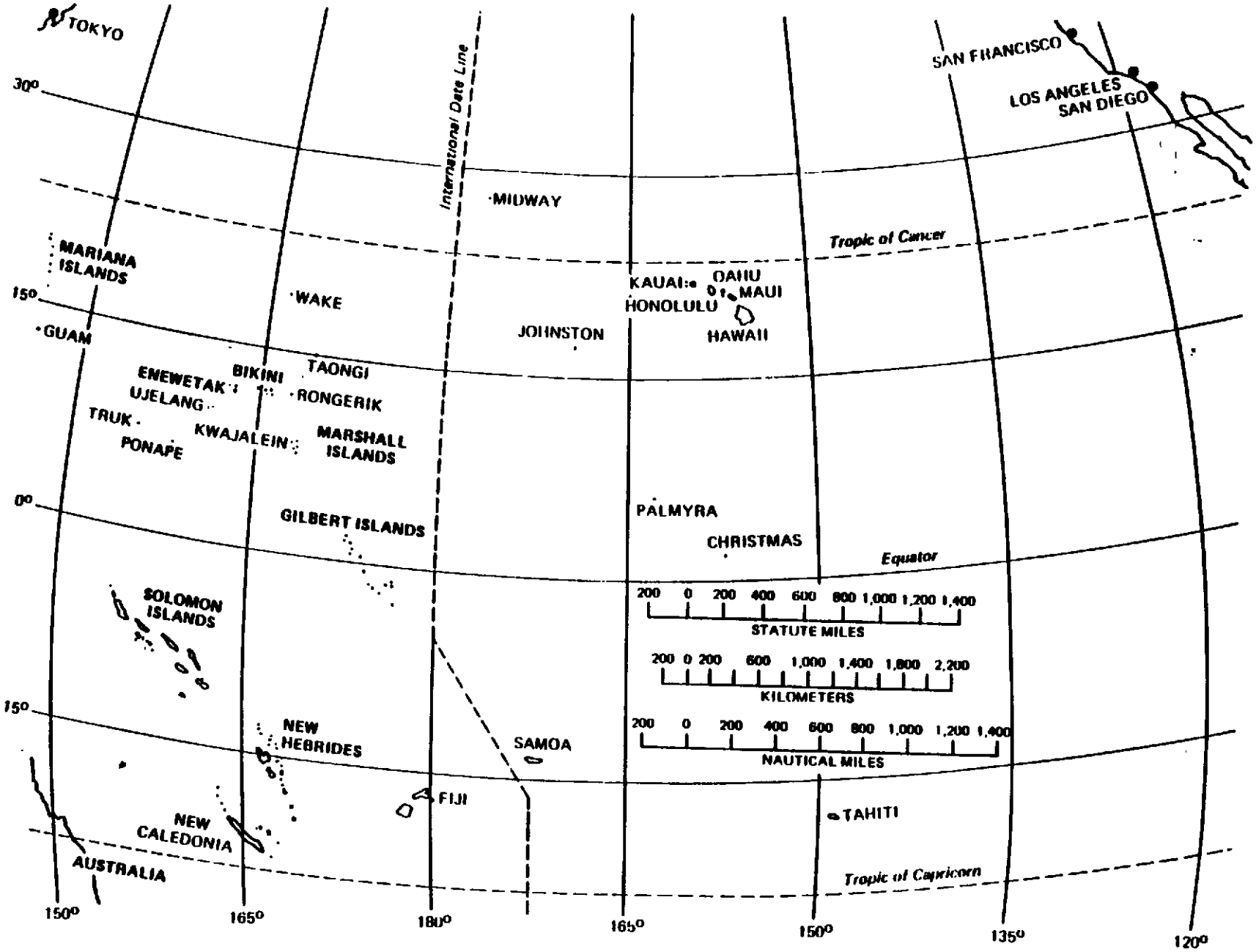


Figure 1.1. The Central Pacific.

protect participants from potential radiation exposure~~, inherent in test operations~~.

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, Navy, Army Air Forces, 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 1963 ~~usually~~ 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 underground, placed atop a tower, suspended underwater, supported by a balloon, dropped from an airplane, or flown on a rocket fired from cannon or rocket launchers. CROSSROADS employed operational weapons: one was dropped from an aircraft and detonated in the air, and the other was detonated underwater~~, and another~~.

In theory, personnel can be exposed either by 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; ~~to be close enough for initial radiation exposure would place an observer within the area swept by lethal blast and thermal effects.~~ - not true - many test participants have received initial radiation.

The neutron component of initial radiation did indirectly contribute to later exposure the ~~possibility~~ of personnel ~~exposure~~. Neutrons are emitted in large numbers

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

In a nuclear airburst in which 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 small, 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 6). Areas in which this fallout material will be deposited will appear on maps as bands following the wind's direction. ~~Larger detonations (yields equivalent to megatons of TNT) will have cloud stabilization altitudes in the stratosphere (above about 10 miles [16 km] in the tropics). The radioactive material from such altitudes will not return to Earth for many months and its distribution will be much wider.~~ Thus, airbursts result in have less contribute little potential for residual radiation exposure to personnel at the testing area, although there may be some residual 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, and from the debris cloud and from rapid settling of large fallout particles.

Delete- why discuss MTs when R was so small.

Rework this section- one can also get localized fallout.

try to rework

the nuclear detonations. 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 documentation so that the response could be properly understood. This necessitated an environmental experiment along with the systems response experiment. It was often not enough to know whether the system survived, but rather what effects were on the component parts and their interactions required throughout the test area. This ~~created~~ the extensive placement of instrumentation and recording devices.

While the potential radiological exposure for these systems' response experiments was governed primarily by the closeness in space or time to the detonation, an additional problem arose. Often, when the subject of the exposure itself was recovered for closer examination, it could be contaminated by device debris or even be radioactive itself due to neutron activation.

Delete - this sentence is not relevent to this section.

Reboarding parties who inspected vessels, aircraft, and equipment after each detonation were given published guidelines for radiological safety.

Examples of measurements taken at CROSSROADS included static (crushing) and dynamic (blast) pressure, and air pressure in blast waves. The measurement techniques varied with the effects being measured, and measuring devices included ball crushers and airblast and water shock gauges placed on aircraft, target ships, and islands. In the Wave Motion and Oceanography Program some of the instrumentation was placed on the bottom of the lagoon.

Also measured were Radioactivity, electrical effects, heat, light, etc. - needs to be discussed here.

This section needs amplification

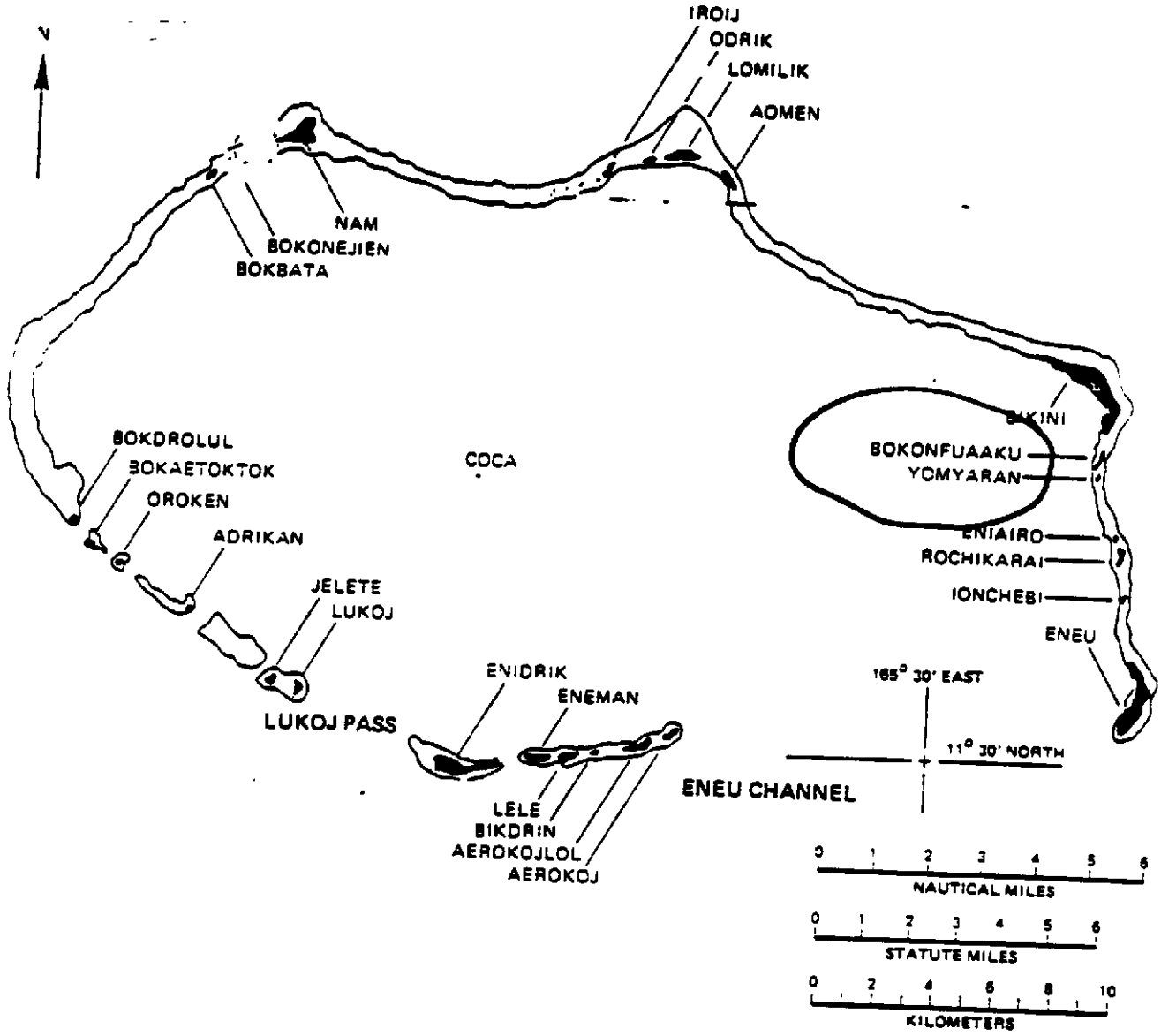


Figure 1.2 Bikini Atoll

A target array circle on this chart would be very helpful to the reader. MARKED WITH ABLE/BAKER SUFFIX ZERO's

The land areas of Bikini Atoll, its lagoon, and the water within 3 miles (4.8 km) of their seaward sides constituted the Pacific Proving Ground (PPG). During CROSSROADS the Marshall Islands were under a U.S. military governor who reported to the Chief of Naval Operations and ultimately 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 5, pp. 507-551).

In order to prepare Bikini Atoll for test operations, a considerable amount of work had to be done 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 meager data recorded on the available Japanese charts. After the survey it was necessary to blast out a number of coral heads to permit safe navigation of ships of considerable size and to permit proper location 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, recording stations, recreational facilities, and landing facilities were erected. This work was started on 20 March with the arrival of the 53rd Special Naval Construction Battalion (Seabees) and by the Survey Unit and elements of the service groups, assisted by minesweeping units (Reference XRD 206, p. V-(B)-4).

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 for the transport of nuclear weapons from the United States to the test area. However, there was

maintained liaison with the War and Navy Departments, the Manhattan Engineer District, and other government agencies. JTF 1 was subdivided into 8 task groups and 37 task units, each of which performed some specific function. Figure 1.3 details JTF 1, which was headquartered on USS Mount McKinley (AGC-7).

CJTF 1 maintained liaison with two boards of special interest, the Joint Chiefs of Staff's Evaluation Board and the President's Evaluation Commission. The Evaluation Board was to advise CJTF 1 during preparation for the tests and evaluate the 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 submit their observations to the President along with findings, conclusions, and recommendations (Reference XRD 206, pp. VI-(B)-1 and VI-(B)-2).

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 properly record all data. The primary mission of its Drone Boat Unit was to obtain early samples of contaminated water from both tests and make 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.

TG 1.2 was composed of eight task units; their respective ships are listed below. Not all the ships listed were actual target ships, although most were. The nontarget ships listed supported preparation, placement, and salvage of the actual targets. These nontarget ships are noted with an asterisk. Flagships are noted with (F)

TG 1.2 (Target Vessel Group)

USS Fall River (CA-131)* (F)

TU 1.2.1 (Battleship and Cruiser Unit)

Battleship Division 7

USS Arkansas (BB-33) (F)

USS New York (BB-34)

Nagato (captured Japanese battleship)

Battleship Division 9

USS Nevada (BB-36)

USS Pennsylvania (BB-38) (F)

Cruiser Division 23

USS Pensacola (CA-24)

USS Salt Lake City (CA-25) (F)

Sakawa (captured Japanese cruiser)

Prinz Eugen (captured German cruiser)

TU 1.2.2 (Aircraft Carrier Unit)

Carrier Division 31

USS Independence (CVL-22) (F)

USS Saratoga (CV-3)

TU 1.2.3 (Destroyer Unit)

Destroyer Division 1

USS Anderson (DD-411)

USS Hughes (DD-410) (F)

USS Lamson (DD-367)

USS Rhind (DD-404)

USS Ralph Talbot (DD-390)

TU 1.2.5 (Landing Craft Unit) (continued)

LCT Group 15

LCT-816
LCT-818
LCT-874
LCT-1078
LCT-1112
LCT-1113
LCT-1114*] target ships
LCT-1115*]
LCT-1116*
LCT-1130*
LCT-1132*
LCT-1155*

LCT Group 21 —>

LCT-412
LCT-414
LCT-812
LCT-705 —>
LCT-1013
LCT-1175* — target ship
LCT-1187* — target ship
LCT-1237
LCT-1268*
LCT-1341*
LCT-1377*
LCT-1415*

Miscellaneous Group

ARDC-13
YO-160
YOG-83

TU 1.2.6 (Merchant Type Unit)

Transport Division 91

USS Banner (APA-60)
USS Brule (APA-66)
USS Carlisle (APA-69)
USS Carteret (APA-70)
USS Fallon (APA-81)
USS Gilliam (APA-57)

Transport Division 92

USS Barrow (APA-61)
USS Butte (APA-68)
USS Cortland (APA-77)
USS Crittenden (APA-77)
USS Dawson (APA-79)

Transport Division 93

USS Bladen (APA-63)
USS Bracken (APA-64)
USS Briscoe (APA-65)
USS Catron (APA-74)
USS Fillmore (APA-83)
USS Geneva (APA-86)
USS Niagara (APA-87)

Task Group 1.3 (Transport Group)

TG 1.3 transported personnel and equipment to Bikini Atoll as well as evacuated personnel of the Target Vessel Group. It also furnished boats and boat crews to the boat pool and furnished 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)

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 point of detonation to measure the bombs' radii of effectiveness. Each of the operating task units exposed its respective Army equipment on certain ships and on Bikini Island. Each unit had inspection teams. Figure 1.4 shows the TG 1.4 organization. These teams were assigned to target ships and were responsible for loading, securing, maintaining and inspecting test items assigned. They also instructed crews of

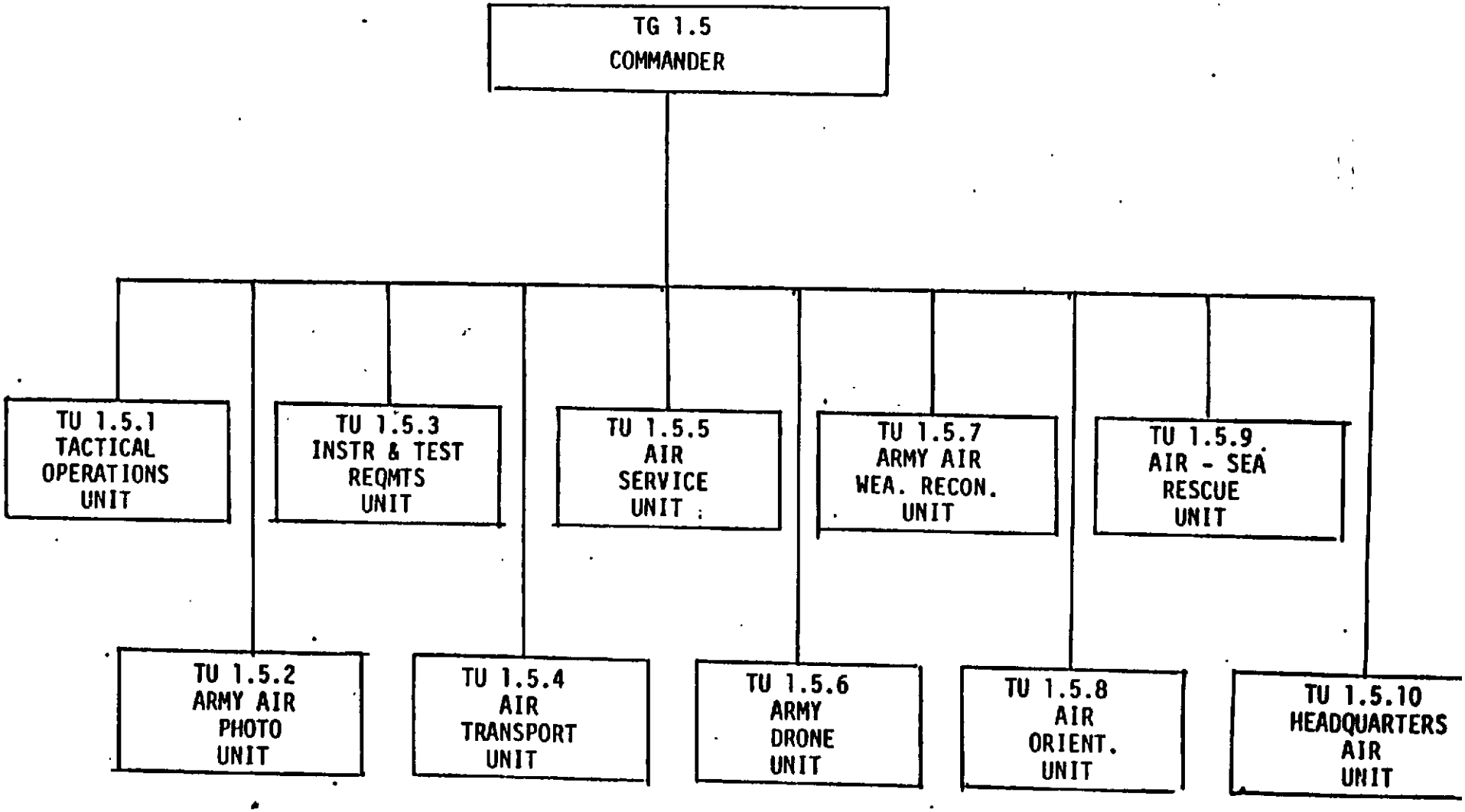
each target ship on which test items were exposed. These teams were to reboard ships after the tests when radiologically cleared and safe for boarding (Reference XRD-149, p. 3). TG 1.4 was composed of a headquarters and the following six operating task units:

- o TU 1.4.1 (Engineer Unit)
- o TU 1.4.2 (Signal Unit)
- o TU 1.4.3 (Ordnance Unit)
- o TU 1.4.4 (Chemical Unit)
- o TU 1.4.5 (Quartermaster Unit)
- o 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 Force Units, was assigned the mission of dropping the atomic bomb ABLE 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 1.1 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 (and shown in Figure 1.5).

TASK UNIT 1.5.1 (TACTICAL OPERATION UNIT). TU 1.5.1 trained crews, prepared equipment for the tests, airdropped shot ABLE, set up the airsearch radar in the Bikini area, and provided radar analyses of practice bomb runs. It also operated two B-29s that dropped pressure gauges during each test. In



NOTE: TU 1.5.3 and TU 1.5.6 were combined and became one unit.

Figure 1.5. Task Group 1.5, Army Air Force Organization

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 supporting visitors, observers, the press, and news broadcasters. They flew these groups in two B-29s and two borrowed C-54s to witness CROSSROADS detonations. This unit was located on Kwajalein Island.

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 9).

Task Group 1.6 (Navy Air Group)

TG 1.6 furnished aircraft and facilities during tests for aerial photography and collection of physical data, drone boat control, air transportation, patrol, and air-sea rescue. It was prepared to evacuate hospital patients by seaplane from Bikini Atoll and Roi Island, Kwajalein, to Ebeye Island, Kwajalein. In addition, it provided mooring and servicing for six seaplanes and assisted in drone recovery by providing radio interceptors and tracking services. TG 1.6 was composed of four task units based as follows:

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, handling 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 XRD 206, pp. V-(B)-6-12; Reference 7)

TU 1.8.5 (Survey Unit)

USS John Elish (AGS-10)

USS Bowditch (AGS-4)

USS James M. Gillis (AGS-13)

YMS-354

YMS-358

YMS-413

YP-636

TU 1.8.6 (Construction Unit)

53rd Constuction Battalion

TU 1.8.7 (Rongerik Evacuation Unit)

USS LST-871

USS LST-989

JOINT CROSSROADS COMMITTEE

JTF 1 was dissolved on 1 November 1946 and its successor was a JCS committee, the Joint CROSSROADS Committee, whose task was to oversee the final test activities, ~~including~~ publish the final reports and supervise the Bikini Resurvey Operation of summer 1947 described in Chapter 6. Later, - when? the Joint CROSSROADS Committee became a permanent agency of the Armed Forces Special Weapons Project (Reference 4, p. 172).

Decontamination activities at Kwajalein and U.S. shipyards following the tests were under the jurisdiction of the Commander in Chief, Pacific Fleet (Reference XRD 206, p. Q-(V)-6). ←?

The relationship between COMWESTSEAFRON, BuMED, and NAVSHIPS in decontamination standards and control needs to be explained briefly here even though it is covered later.

CHAPTER 2

RADIOLOGICAL SAFETY

INITIAL PLANS

Proposals to test atomic weapons against ships were made in the late stages of World War II, but the first discussion of radiological safety appears to have occurred at a meeting held 8 December 1945, as detailed planning for Operation CROSSROADS gathered momentum. Among those attending were the Commanding General of the Manhattan Engineering 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 officer who was a medical doctor, became radiological safety (radsafe) advisor to CJTF 1 and headed the task force Radiological Safety Section within the safety organization (Reference 37, pp. 9 and 48-49; Reference 3; Reference XRD 206).

By 15 December medical officers from the Army, Navy, and Public Health Service had been selected for training in radiological safety. The Manhattan Engineering District took responsibility for radiological safety as the result of a meeting on 7 January 1946 between the joint task force commander designate and Commanding General of the Manhattan Engineering District. The Safety Advisor, Radiological Safety Advisor and the Radiological Safety Section were part of the joint task force from its formal establishment on 11 January. By April 15 a radsafe plan was submitted to CJTF 1. The plan was

purposes of technical advice and instrumentation, it reported to the Technical Director. This dual chain of command caused no difficulty during CROSSROADS (Reference 50, p. VII-(C)-2).

The mission of the Radiological Safety Section was (Reference 3, 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 3, 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 Unit.

Figure 2.1 shows the section's organization in the field.

The section chief and his staff 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 the CJTF 1 on the location and severity of possible hazards. They were also to predict the path of the radioactive cloud and water patch before shot ABLE.

what is a water patch?

The Radiological Safety Advisory Board consisted of officers of the Radiological Safety Section and nationally recognized experts in radiological

safety. The board advised the section chief on the use of oceanographic and aerological data in predicting the movement of radioactivity away from the shot sites after the detonations. The board also assisted the section chief in preparing his reports of the operation (Reference 3, E-II-1).

Although not mentioned in the Operation Plan, a Medical-Legal Board to advise the section chief is mentioned in the section's major after-action report. Its membership appears to have been similar to or the same as the Radiological Safety Board. After ABLE it considered such problems as the use of drinking water in the tanks of the target ships, use of distilled water produced on target and nontarget ships, the safety of sleeping on deck, the safety of the lagoon and beaches for swimming, personnel exposure, and contamination of nontarget ships (Reference XRD 206, VII-(C)-16).

Each radsafe reconnaissance unit consisted of a monitor and designated assistants. The units were assigned as follows: two for the Martin Patrol Bombers (PBMs), two for the HOS-1 helicopters, six for the destroyers downwind of the detonations, three for destroyers upwind of the detonations, six for the gunboats (PGMs) on lagoon patrol; twenty for the large personnel landing craft (LCPLs) on lagoon patrol, six for the cloud-tracking aircraft, and two for the drone boats. The monitors were to be in contact with the section chief through the control unit (Reference 3, E-II-1).

Radsafe monitor-advisors were assigned to commands and aircraft likely to encounter radiological hazards. The major function of these monitors was to advise their commands and pilots on radiological safety. In addition, however, they had a reconnaissance function; thus, they could quickly communicate with

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 that the saltwater to be used was radiologically safe. If the equipment had to be operated before radiological clearance had been given, special monitoring action was required (Reference 3, E-IV-10).

Certain general safety precautions applied to all air operations. With the exception of the delivery aircraft, the pressure drop aircraft, and a few others designated by CJTF 1, all planes aloft from 2 hours before the planned time of detonation (H-2) until 30 minutes after the detonation (H+0.5) were to carry a monitor with radiac equipment. 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. For 6 minutes after ABLE, no plane was to approach closer than 6 nmi (11 km) from the cloud column. From H+6 to H+0.5 no aircraft was to approach closer than 8 nmi (15 km) from the point of detonation or the radiation danger (radex) sector. It was to be considered hazardous for any aircraft without a radiation detection instrument to be within 20 nmi (37 km) of the visible column or the visible downwind clouds. From H+0.5 to H+30 hours after the detonation, no plane was to be within 30 nmi (56 km) of surface zero, other than those required for radsafe work, those cleared by the Deputy Commander for Aviation, or unless the Radiological Safety Control Unit declared the area safe (Reference 3, F-XII-3).

see page 4-5

All aircraft, manned and drone, airborne from detonation time (H-hour) until H+30 were monitored upon landing. Aircraft oil filters and any surface oil spots were to be especially suspect of harboring radioactive

is this 0.5 OR REALLY 30 HRS?

Each monitor unit or monitor-advisor was equipped with a geiger counter, (Model Number 263) and an ionization meter (Model Number 247). They also carried other equipment, depending on the nature of the mission (Reference 3, E-II-2 through 8). According to one monitor, the geiger counters proved too sensitive and were saturated by radiation much short of that considered dangerous. Then the less sensitive ionization meters were used to determine radiation levels (Reference 2, 7-8).

How much short?

THE RANGE OF INSTRUMENTS SHOULD BE DISCUSSED.

re what were their ranges?

Eye protection from the ABLE flash was a major concern. Approved goggles were provided to all personnel on ships 25 miles or less from the ABLE detonation and to all observers on the press and observer ships. ~~Shipboard personnel looking at the flash from a distance of 25 nmi (46 km) or less were goggles~~. Men without goggles within 30 nmi (56 km) were to turn away from ground zero, look down at the deck, close their eyes, and cover their eyes with their arm (Reference 3, E-I-1, E-I-2, and E-IV-2). All personnel airborne at the time of the detonation were to wear approved goggles and turn their heads away from the blast. 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 3, F-XII-5).

In order to gain access to classified or hazardous areas the leader of a work party had 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 18).

STAFFING AND TRAINING

When the Radiological Safety Section was established in January 1946, its leaders believed that 50 to 60 monitors would be needed. Between 20 and 30

would be experienced radsafe practitioners from the Manhattan Engineering District. Thirty would be doctors from the Army, Navy, and U.S. Public Health Service. This 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 plant 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 instructions (Reference XRD 206, VII-(C)-4; Reference 11, V-22).

what is this? - cannot be a power plant.

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 and that these would not be available in sufficient numbers from the Manhattan Engineering District. To fill this gap, the section chief called on a number of scientists 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 11, V-23; Reference XRD 206, VII-(C)-4).

On 22 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 40, 1). As a result the second test also was delayed. These changes raised the prospect that personnel from colleges and universities would not be back on campus for the start of the

Training for the entire section began aboard Haven on 1 June as the ship steamed for Bikini. It consisted of lectures and work with radiation detection instruments. Among other subjects, the lectures dealt with Navy rules and regulations, security procedures, nuclear physics, human radiation tolerance, and communications. After about a week, 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 2, 7; Reference 206, VII-(C)-6 and 7).

Haven arrived at Bikini on 12 June, and a major radsafe rehearsal, called Queen Day, was held on 14 June. Two problems 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, 24 landing craft assigned to the Radiological Safety Section were in very poor repair and their radios were worse yet. 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 XRD 206, VII-(C)-8).

Apparently lectures or other formal radsafe procedure indoctrination were not provided to the most of the officers and men of the task force (Reference 2, 110-114). 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 Engineering District. Units designated to

maintained. Clouds 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 a sudden wind shift did not present a hazard. 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 XRD 207, VII-(O)-17).

One of the task force's two senior weather experts saw the prospect of a nuclear detonation under unexpectedly undesirable weather conditions as ~~an all too possible nightmare.~~ potentially dangerous. He noted that (Reference 9, 136-138):

> We are dealing with an all too possible nightmare when we consider the equivalent of tons of radium floating loose in the atmosphere in deadly concentrations. To guarantee that the tests would not be suicidal, it was necessary for aerologists to make sure that the winds at all levels up to the base of the stratosphere would be in such a direction as to carry the contaminated atmosphere away from personnel participating in the tests.

The task force commander put it more bluntly: "Our weather forecast . . . was not just a matter of 'fair and warmer'; it was a matter of life and death" (Reference 9, 136-138).

morning's decision or alter it (Reference XRD 207, VII-(0)-9, 11, 13, 14, 17-19).

RADIOLOGICAL EXCLUSION AREAS

To reduce the chance of exposing task force personnel to radiation hazards, several geographic areas were defined to which access was forbidden or restricted (Reference XRD 206, VII-(C)-9).

1. Radiological Danger Sector (radex). This was the forbidden airspace above a sector bounded by two bearings drawn from the target and by an arc whose radius increased with time after the detonation.

2. Surface Survey Sector. This was a forbidden surface area outside the lagoon. It was bounded by two bearings drawn from the target, by the islands of atoll on the side toward the target, and by a radius that increased with time after the detonation.

3. Red Line. This line ~~bounded~~ surrounded the lagoon area within which no vessels were allowed to operate. It was defined by 1 R/day radiological measurements.

4. Blue Line. The blue line was defined by 0.1 R/day radiological measurements. Vessels could operate in the lagoon area between the Blue and Red Lines only for ~~specific~~ specified periods of time with permission from the Radiological Safety Control Unit. Any ship could operate outside the Blue Line.

5. Anchorage Area Able. An area in which ships could anchor, provided they were ready to get underway on 1-hour notice.

6. Anchorage Area Baker. An unrestricted anchorage area.

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 3, E-X-16):

> . . . frequently check radioctivity 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.

Because the cloud was not expected to rise above 15,000 feet, the definitions of radex and Surface Survey Sector were changed so that no real difference between them existed (Reference 3, 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 would be 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 XRD 206, 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 hands. Daily communication drills were held from the Radiological Safety Control Unit using the PGM, LCPL, and drone boat circuits. On July 16 the Radiological Safety Control Unit held a drill on Mount McKinley to train new members of the unit's expanded staff. On 19 July the entire radsafe

THIS WHOLE SECTION REQUIRES MAJOR REWORK.

organization participated in William Day, the joint task force's 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 XRD 206, 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 XRD 206, VII-(C)-18).

Big transition jump

TARGET VESSEL DECONTAMINATION AT BIKINI

USS CONGHAM (DD-877)

Five target vessels, the attack transports USS Bladen (APA-63), USS Cortland (APA-75), USS Fillmore (APA-83), USS Geneva (APA-86), and USS Niagra (APA-87), were on the outer fringes of the target array and were not heavily contamined by the base surge. Within a few days those crews were able to reboard and begin decontamination work (Reference XRD-185, 4 and 10; References 14, 15, 16, 17).

what about beached ships?

provide specific days and times

some of these crews were on transports that did not return until B+5 or B+6.

Big transition jump again - provide more info regarding what happened between Baker day and this later period.

Although the contamination on these ships' weather surfaces was not sufficient to prevent reboarding and cleanup work, they were found to have ~~considerable degree of~~ contamination on the outside of their hulls at the waterline. The rust and marine growth there offered many crevices in which radioactive particles could lodge, and chemical reactions bonded the contamination to the hull and the marine growth.

this was not found out until later. B+8 to B+15 or 60?

great majority of activity due to biological organisms

when did this occur?

On Geneva, this contamination caused radiation levels in excess of 0.1 R per day inside the ship at the waterline and prevented continuous occupation of those spaces. Radsafe monitors told the Niagara's crew that no one was permitted closer than 5 feet to the ship's hull in compartments below the

this should be in chapter 4 or 8

accumulations of particles on the ships if any below the water line - were likely pieces of rust with absorbed radioactivities

This section should discuss D and D+1 only

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 yielded only incomplete results, a search for better methods proceeded apace (Reference XRD-185, 5-6).

At a meeting on 27 July, the DSM apparently asked the radsafe group to study the decontamination problem. They 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 80-plus vessels of the target fleet (Reference XRD-185, 6-7).

Observation had revealed that most radioactivity stemmed from radioactive material collecting on painted or rusty surfaces, or on exposed porous materials, such as canvas, liferafts, manila lines, swabs, brooms, wood decks, and tar and chalk 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 XRD-185; Reference 2, 109).

From 28 through 30 July large-scale experiments were conducted on USS Tuna (SS-203), a submarine used as a target vessel. The submarine was sprayed first

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

7. Radiologically dangerous areas were to be clearly marked and, if necessary, roped off.

IS THIS TRUE? WHAT QUANTITY? THIS MUST BE FULLY DEALT WITH!

~~The issue was complicated further~~ On 9 August when alpha emitters were found in samples taken from the Prinz Eugen (IX-300) wardroom. Further investigation revealed widely distributed alpha emitters in the target area. Alpha emitters are not only a souce of radiation but may be toxic and were believed likely to remain in a person's body once they had entered. ~~These yet.~~ They could be detected only by special equipment on Haven, rather than by the monitors' portable radiation detectors. (provide reference).

aren't they toxic because of radiation? also heavy metal poisoning

Special clothing and intensive training would have been required if work on the ships ~~were~~ WAS to continue. ~~Even if the clothing had been available, training hundreds of sailors of widely varying education and intelligence in these cleaning procedures would have been overwhelming.~~ The head of the radsafe section recommended, and a decision was made at a meeting on 10 August, ceasing decontamination work on the target ships. Only recovery of instruments, limited surveys, salvage work, and towing preparations were to be allowed (Reference XRD-185, 13; Reference 5, 2).

this is an editorial remark and should be deleted.

This section needs to be expanded. Decont. started again about 13 Aug. and continued until ships were towed 19-25 Aug.

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 31 ships to Kwajalein beginning 19 August. By 5 September the last of the target ships afloat had left Bikini (Reference 53; Reference 41, 1; Reference 42, 1).

LIST the # of ships that sank at Bikini and were not towed to Kwaj.

approved rate was 75 or 80 percent (Reference XRD-185, 19; Reference 24). To remove some of the contaminated scale, ships were to use the "cold-shock" treatment (Reference 24). To decrease the formation of new scale, ships were ordered to introduce a mixture of boiler compound and cornstarch continuously into the evaporators (Reference 7).

These measures reduced the radiation level inside most ships to 0.1 R/day gamma radiation or less. To keep the levels down, the ships, where possible, were kept in water showing 0.001 R/day gamma or less. Numerous exceptions, however, were necessary 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. The contamination processes led, on occasion, to evacuation and idling of a ship until the internal radiation decreased to the permitted 0.1 R per day (Reference XRD-185, 20).

On 11 August, CJTF 1 asked the Chief of Naval Operations for permission to shift the task force's base to Kwajalein. He asserted 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 57).

On 19 August the task force was ordered to shift base to Kwajalein. Nontarget ships that had reentered the lagoon were monitored before departure and given conditional operational clearances, subject to safety procedures to meet each ship's condition. Most were restricted on the time personnel could

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 20).

CJTF 1 concurred with the position of ComServPac. He argued, however, that ships in the western Pacific should return to Guam for radiological examination. 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 same precautions be applied to small boats carried on the ships as to the ships themselves (Reference XRD-185, 22). The Chief of Naval Operations (CNO) on 28 August directed compliance with these recommendations and two days later ordered all small boats found radiologically unsafe sunk in deep water (Reference XRD-185, 22-23; Reference 21, 1).

OTHER RADSAFE ACTIVITIES

Although monitoring the radiological situation of the target and support ships was the focus of radsafe work at Bikini after BAKER, the radsafe section had other work also. Monitoring the radiation level in lagoon water was a major effort (Reference 2, 100). Monitors accompanied scientists collecting fish, coral, and samples of the bottom. Information is not available on the radiation levels of these samples; however, a monitor with a collection party on 9 August found the first bottom sample so radioactive that in panic he ordered it pitched over the side (Reference 2, 108).

→ WHAT LEVEL?

This needs to be reworked or deleted - the bottom was very radioactive but what about the many cases of low radioactivity. This GOD

on 10 August to secure approval from the CNO, Navy Bureau of Personnel, and the Navy Surgeon-General for the program to train 100 new monitors. JTF 1 would set it up. He also indicated that these new radsafe personnel might be needed to help monitor drydocking of task force ships returning to the United States (Reference 54). Most of the radsafe personnel left Bikini for the United States on 16 August aboard USS Henrico (APA-45), leaving a much reduced radsafe organization on Haven at Bikini to continue radsafe work there (Reference XRD 206, 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 of West Point's class of 1946 to the group to undergo monitor training (Reference 55). The first training program was held from 9 September to 10 October 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 were assigned to JTF 1 (Reference 33). The potential radsafe needs created by test CHARLIE disappeared, however, when President Truman cancelled that test on 7 September.

→ NNTPR doubts this - no TDY orders ever located - a 30 day course is too short for such much travel and activities. AFTER GRADUATION SOME PERSONNEL WENT TO KWAJ. BUT NOT ALL.

RADIOLOGICAL CLEARANCE OF NONTARGET SHIPS

CJTF 1 dispatched his Chief Medical Officer to head the program for giving radiological clearance to nontatget vessels. On 26 August the medical officer established his headquarters in the offices of the District Medical Officer for the 12th Naval District at the San Francisco Navy Yard. He encountered immediate difficulties. Radsafe monitors were not available at San Francisco in numbers sufficient to check the many ships expected to arrive in 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

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 underwater body or saltwater plumbing had to await the arrival of sufficient monitors. A decontamination center was established for yard employees working on the ships (Reference XRD-185, 28 and 32; Reference 36, 84-85).

In late August and early September concern increased in command circles that unless a means could be found to service the underwater hulls and salt water plumbing of the nontarget vessels, they would eventually be rendered useless. On 9 September 1946, the CJTF 1 sent a message (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 XRD-185, 125-145). His message, however, did not:

1. Establish 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.

ComWestSeaFron on 11 September recommended to CNO that highest priority be given to providing staff for the JTF 1 Medical Officer, BuShips have the responsibility for developing decontamination methods, and 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

reasonably well by checking its fission contamination with a geiger counter. Taking samples for laboratory analysis was unnecessary. Analysis of the filter samples taken while sandblasting portions of Laffey's bottom showed no detectable plutonium. Using the ratio of plutonium to fission products to calculate the amount of plutonium there led to an estimate that a worker using a respirator would have to spend 100 million days 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. These preliminary findings appeared to show the nontarget ships of JTF 1 could be decontaminated and overhauled without radiological hazard to personnel (Reference XRD-185, 32-33).

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 speed letter, it included authority and directions for decontamination of evaporators; heat-transfer apparatus, except condensers; underwater bodies; 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. Underbodies were to be cleaned using standard wet sandblasting methods at the time of a ship's next scheduled drydock period. Debris from cleaning the evaporators and

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 per day or less assured protection from the plutonium hazard. Consequently, although sailors on the affected ships and shipyard workers in the four naval districts presumably were to begin decontaminating and servicing the nontarget vessels, the criteria for when they should start and when they should stop were not firm (Reference XRD-185, 41). In addition, more and more task force ships were reaching the west coast each day, and no work whatever had been authorized for the decontamination of suspect vessels scheduled for deactivation or disposal.

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). It was 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 would pass before the results would be available (Reference XRD-185, 41 and 45-46).

Apparently unwilling to await the results of the work on Rockbridge, BuShips in Washington, D.C., on 10 October proposed a set of contamination limits. After negotiations between naval and civilian radsafe experts on the west coast and BuShips and BuMed in Washington, the final clearance standard

3. For underwater body - .05 R per day, gamma plus beta.

During the ~~controversy over~~ development of clearance standards, work had continued at the San Francisco Naval Ship Yard on removing radioactivity from condensers and satisfactory methods had been worked out. On 22 November, BuMed and BuShips jointly issued a letter giving agreed-upon decontamination methods and clearance standards that superseded all previous directives (Reference XRD-185, 57-58; 49 Reference XRD 187, 30-51). Minor changes were made on 17 December (29). 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, which meant that exposures would be less than previously expected. This apparently led to some revision of the clearance instructions, but just what happened is ~~obscure. One source describing this development is available, but the author does not make his meaning clear~~ not clearly indicated in the sources. (Reference XRD-185, 60-61).

By 1 January 1947, 80 of 159 nontarget ships had been granted final radiological clearance (Reference XRD-185, 59). On 28 February, the statistics on clearance of non-target ships were as follows (Reference 29, 3): — This reference is dated Dec. 17, 1946 — how can it provide info regarding 1947 events?

Ships with final clearance, including 15 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
TOTAL	159

In late February 1948, four nontarget ships were still without final clearance.

Identify these vessels and their location(s). When did they finally get their clearance?

BELIEVE WE HAVE SUCH DATA

FOLLOWUP TESTING OF PERSONNEL

On 19 May 1947, complete blood counts (CBC) were ordered for all Navy personnel still on active duty who had taken part in CROSSROADS. All those who had abnormal counts were to be ~~subject to~~ retested. The assistant chief of BuMed characterized the testing as "a routine follow-up of naval personnel for information only" (Reference 59). Prior medical studies involving radiologist exposures in the U.S. to ionizing radiation had indicated that hematological studies could provide early evidence of excessive exposures, if any. Add this statement here.

Chapters 5 and 8 discuss in detail the return of target and support ships to Kwajalein and/or the U.S., subsequent decontamination procedure

10. Despatch 032309Z
CJTF-1
3 August 1946

NA, MMB, 374-51-241

11. "Nuclear Warfare and Radiation Safety: The Opening Scenes"
Chapter Five of Elements of Controversy: A History of Radiation Safety in the Nuclear Weapons Testing Program (A Draft)
B.C. Hacker
27 June 1982

12. Heads of Components under the Technical Director

NA, MMB, 374-47

13. Memorandum for the Record: Activity at Kwajalein 1 September - 31 December 1946 as a Result of Operation CROSSROADS
H.M. Highland
NNTPR
12 June 1979

Delete this source - this is a memo for NNTPR use only. AND IS SO EARLY THAT IT IS INCORRECT BASED ON WHAT WE KNOW NOW.

NNTPR

14. History of USS Cortland (APA-75) during Operation CROSSROADS (1946)
NNTPR
April 1981

NNTPR

15. History of USS Fillmore (APA-83) during Operation CROSSROADS (1946)
NNTPR
October 1981

NNTPR

16. History of USS Geneva (APA-86) during Operation CROSSROADS (1946)
NNTPR
August 1981

NNTPR

17. History of USS Niagara (APA-87) during Operation CROSSROADS (1946)
NNTPR
May 1981

NNTPR

These histories have all been revised and have later dates.

26. Memorandum: Personnel for Radiological Safety Section
G.M. Lyon
4 April 1946

NA, MMB, 374

August 1947—

27. Photodosimetry Report for the Month of July 1948
B.O. Pollard
Radiological Safety Section
Kwajalein
August 1948 - 26 July 1948

NNTPR also has this report for August 1947— THROUGH JULY 48 (14-MONTHS)

NNTPR

28. Despatch 0909532
CJTF-1
9 August 1946

NA, MMB, 374-51-242

29. Radiological Clearance and Decontamination Procedures for CROSSROADS Non-Target Vessels
T.A. Solberg and C.A. Swanson
BuShips and BuMed
17 December 1946

NA, MMB, 374-47-115

30. Enclosure A to Radiological Status of Bikini Non-Target Vessels as of 28 Febuary 1947
ComWestSeaFron
San Francisco, CA
4 March 1947

NRC, MMD, 313, Red Box 4237

31. Radiological Safety
F.T. Winant
Ammunition Disposal Unit
Kwajalein
11 November 1946

NA, MMB, 374-47-115

32. Radiological Safety Section: Weekly Report of Activities
R.T. Hadeer
Radiological Safety Section
Kwajalein
7 April 1947

41. Weekly Report for Week Ending 24 August 1946
F.G. Fahrion
Advance Echelon JTF-1
25 August 1946

NA, MMB, 374-47-101

42. Weekly Report for Week Ending 7 September 1946
F.G. Fahrion
Advance Echelon JTF-1
8 September 1946

NA, MMB, 374-47-101

43. Weekly Report for Week Ending 14 September 1946
F.G. Fahrion
Advance Echelon JTF-1
15 September 1946

NA, MMB, 374-47-101

44. Weekly Report for Week Ending 21 September 1946
F.G. Fahrion
Advance Echelon JTF-1
21 September 1946

NA, MMB, 374-47-101

45. Weekly Report for Week Ending 5 October 1946
F.G. Fahrion
Advance Echelon JTF-1
6 October 1946

NA, MMB, 374-47-101

46. Weekly Report for Week Ending 12 October 1946
F.G. Fahrion
Advance Echelon JTF-1
13 October 1946

NA, MMB, 374-47-101

47. Weekly Report for Week Ending 19 October 1946
F.G. Fahrion
Advance Echelon JTF-1
20 October 1946

NA, MMB, 374-47-101

48. See XRD 85

49. See XRD 187

59. "New Blood Tests Ordered For Men Who Were at Bikini"
Washington Post
28 May 1947

CHAPTER 3

CROSSROADS EXPERIMENTAL PROGRAM

INTRODUCTION

In late 1945 and early 1946 several conferences were held by the Manhattan District Project with the military services. It was agreed that the experimental program should do the following:

- Gather data on the nature, range, and duration of radiation danger
- Gather data on bomb efficiency, burst location, wave formation, and ship movement
- Gather data useful to ship designers and ordnance designers in assessing damage from and designing protection against, nuclear weapons
- Gather data helpful in providing counterintelligence means.

As a result, CROSSROADS had two experimental programs. The first was meant to determine nuclear weapon effects on military equipment such as ships, planes, supplies, and on animals. The second was meant 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 very similar to the one dropped on Nagasaki, Japan.

The Deputy Task Force Commander for Technical Direction had responsibility for the experimental program and to accomplish this had two major elements

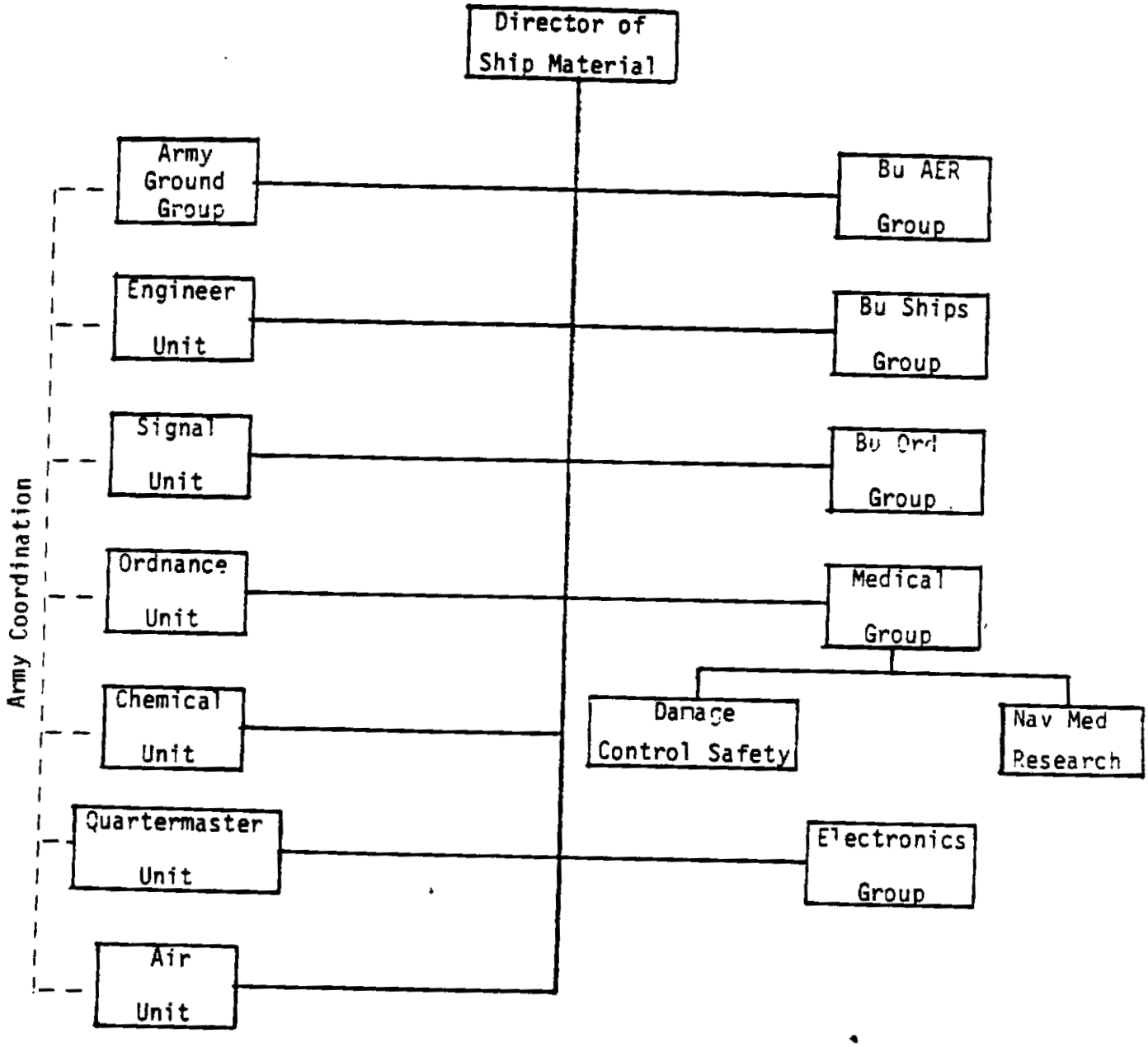
under his supervision. The Instrumentation Division was responsible for measuring and recording weapon diagnostic data (blast, heat, radiation, etc.). The plan to measure and record the weapon's effects was broken down into numbered programs, categorized and described in Table 3.1. The Ship Material and Inspection Division under the Director of Ship Material (DSM) was responsible for determining the weapon's effects on military equipment. The program to determine weapon's effects on military equipment was not organized into numbered programs. It will be discussed by addressing the responsibilities of the various groups within the Ship Material and Inspection Division (Reference XRD 206, Part II, p. C1).

EFFECTS ON MILITARY EQUIPMENT

This program was supervised by the DSM. Figure 3.1 depicts his organization, the Ship Material and Inspection Division, containing both Army and Navy elements. Responsibilities included preparing the ships, aircraft, equipment, supplies, and animals for each test; determining the exact cause and extent of damage; and decontaminating the ships and material after the second test. Duties included distinguishing between damage caused by the direct effects of the explosion and damage caused by indirect effects such as fires and flooding.

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

Figure 3.1. Organization-Ship Material and Inspection Division



Source: (1, IVB fig. 4)

only. Sample kits of food and clothing were stored in normal storage spaces aboard Nevada, USS Arkansas (BB-33), USS Carteret (APA-70), and USS Saratoga (CV-3). 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 air equipment items were exposed on BAKER test (Reference XRD 208, p. 7.10).

Navy Bureau of Aeronautics Group

This 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 group was berthed on Wharton and USS Avery Island (AG-76). They were evacuated the day before each shot and returned to the lagoon the afternoon after each shot. Inspection of equipment commenced on 2 July for ABLE and 30 July for BAKER. Radioactive samples from the four ABLE and three BAKER F6F drone aircraft ~~exposed to the detonations~~ were removed from the aircraft after they landed at Roi Island, Kwajalein, and aircraft were inspected for damage (Reference XRD 208, pp. 3.51 and 7.8).

Navy Bureau of Ships Group

This Bureau of Ships (BuShips) group was responsible for preparing target ships (and certain nontarget ships) to determine effects of the bursts on the

Explain the effects that non-target ships were prepared for.

Navy 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 burst. 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.

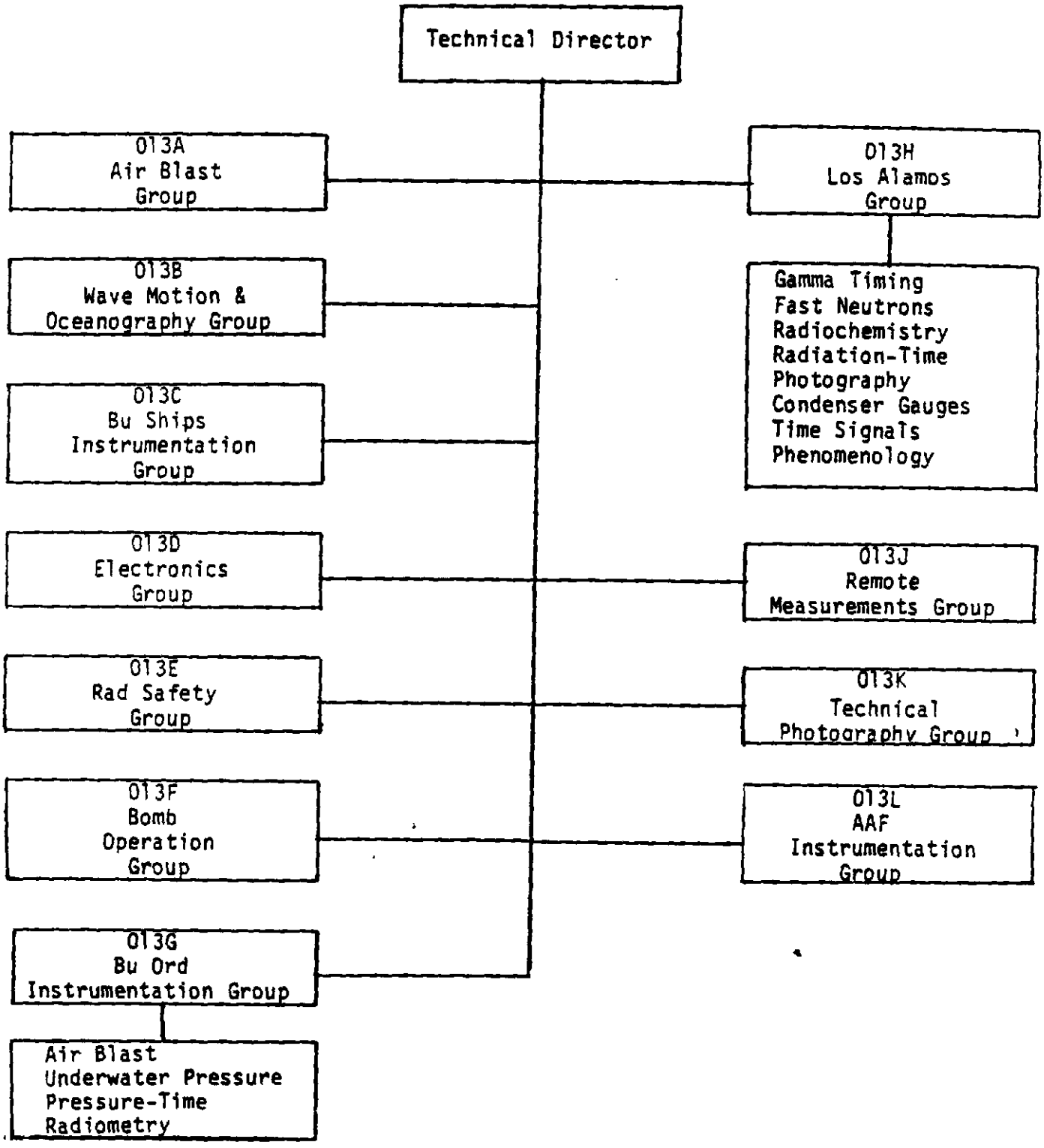
Its personnel were evacuated from Bikini Lagoon the day before each shot and reentered the afternoon after each shot. Inspection of equipment after ABLE shot was easily and quickly accomplished, but excessive radioactivity after BAKER severely restricted activities (Reference XRD 208, pp. 3.52 and 7.10).

Medical Group

DAMAGE CONTROL SAFETY SECTION. This was one of the two sections in the Medical Group. Its personnel 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 mechanical (falling objects, slippery decks, weak ladders) drowning, fires, steam, electrical shock, chemical hazards, and ammunition hazards. The section trained extensively and then 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 (AFH-2/12) (Reference XRD 208, p. 3.52).

MEDICAL RESEARCH SECTION. This 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.

Figure 3.2. Instrumentation Division
(Administrative Organization)



Source (8, W138B)

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 XRD 208, p. 3.43; Reference XRD 189-191, pp. 192-225).

GIVE LOCATION.

Army Air Group (Task Group 1.5)

In addition to its several missions as Task Group (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. Indicating accelerometers were used in a television-telemetering 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.

Ship Material and Inspection Division Personnel Exposures

Table 3.2 shows the exposure received by personnel in each of the groups. The Medical Group was separated into two sections, the Damage Control Safety Section and the Naval Medical Research Section. The highest exposure in the Directorate for Ship Material was 0.650 R, which was recorded by a Bureau of Navy Ships civilian (Reference XRD 208, p. 3.48).

provide badging dates OR DELETE SINCE NOT REPRESENTATIVE OF FULL PERIOD.

NUCLEAR WEAPON EFFECTS

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. For control reasons the Technical Director set up an administrative organization (Figure 3.2) and a functional organization (Figure 3.3). The adminstrative organization was used for

personnel assignments. Rosters of personnel were maintained using organizational breakdown. The functional organization was used for grou experimental projects. Table 3.1 and the functional organization in Fig 3.3 show the similarity between the programs. Over 130 projects w associated with Programs II through IX. Appendix D lists these projects title and shows which group, by number, in the Instrumentation Division responsible.

Table 3.3 presents exposure information for the groups in Instrumentation Division. The total of three personnel assigned to Director's Office appears to be incomplete; however, the others app complete. The reason for the total of one in the Army Air Forces (A Instrumentation Group is that its personnel came from TG 1.5, Army Air Gro The Remote Measurements Group is not shown in the table because its person were not present in the Bikini area and had no one badged during CROSSROA The highest exposures recorded were for personnel in the Radiological Saf Group. These were the personnel who monitored the contaminated ships and ot areas to determine danger levels. The high exposure in this group was recor by a Army 1st Lt monitor badged for 23 days 4.01 lieutenant whose total exposure was 3.6 R. Most of this was recei between 6 and 9 August while he was on board USS Searaven (SS-196) as monitors and ~~one~~

see memo

Program I -- Bomb Preparation

Agency:

Los Alamos Laboratory

SPECIAL ISSUE: TITE NNTPR IS ALMOST COMPLETELY CONVINCED THAT ON 1 OF TITE 5 BADGES FOR KRASNOW, ON 6 AUG ABOARD SEARAVEN, WAS HIS PERSONAL BI OTHER 4 WHICH READ .860, .70 .990 & .980 WERE LEFT ON DE OF SEARAVEN FOR 18 HRS. THUS HIS ACTUAL EXPOSURE PRIOR ONLY 0.550. WE NEED TO DISCUSS.

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 under the LSM.

Staffing: Seventy Los Alamos Laboratory employees worked on this program. The radioactivity of the nuclear components of the bombs was very low. 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 3.3).

Program II -- Pressure, Blast and Shock

Agencies: Los Alamos Laboratory

Navy Bureau of Ordnance (BuOrd)

Navy Bureau of Ships

Army Air Force

Navy Air Group

Air Blast Group (013A)

Operations: This program had 29 projects, some of them with several subprojects (see Appendix D). Except for Project II-12, which measured fireball growth using cameras, all these projects were associated with pressure, blast, and shock measurements. Airblast gauges used included TMB, free-piston, DeJuhasz, aluminum foil, blast pipes, 5-gallon cans, 55-gallon drums, chronograph recorders, ball crushers, and airborne condenser gauges. The condenser gauges were dropped from two B-29 aircraft

just before each detonation. They transmitted readings to recorders in the two B-29 aircraft. Other air blast gauges were placed on Bikini islands, in the lagoon, on target ships and on aircraft in flight in the area. Water-shock gauges used were ball crushers, Hilliar, piezoelectric, pot, diaphram-strain, and aluminum diaphram. Large numbers of airblast and water-shock gauges were used. For example, over 300 5-gallon cans and 850 ball crushers were used on ABLE and over 2,000 ball crushers were used on BAKER. Most of the target ships had airblast gauges on them or water-shock gauges under them. All B-29, F-13, and B-17 aircraft participating in either shot carried Hathaway flight analyzers. B-17 drones had TV cameras with the TV receivers located in the B-17 controllers.

Staffing: Personnel from the Air Blast Group, Los Alamos Laboratory Group, Electronics Group, and the BuOrd Group worked on projects in Program 11. Although there were probably more, 51 personnel have been identified with this project from existing records. The highest exposure of these 51 was 0.99 R from an individual working on Project II-18. - how many were badged? provide exposure dates

Emplacement 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 dissipated rapidly. BAKER, however, contaminated the islands, the lagoon, and most of the target ships. Gauge removal was closely controlled by radsafe monitors. ~~Exposures shown in Table 3.3 for all except radsafe personnel are less than 1 R.~~ - this is misleading since no one was badged for the entire operation.

Project Report: Enclosure C, XRD 209, XRD 210.

Program IV -- Propagation of Electromagnetic Waves

Agencies: Los Alamos Laboratory

Army Air Force (AAF)

Electronics Group

National Bureau of Standards (NBS)

Federal Communications Commission (FCC)

Operations: There were 19 separate projects in Program IV. Radars and radios, some operating at detonation time, were emplaced on selected islands at Enewetak, Kwajalein, Bikini, and on selected target ships. Television cameras were installed on B-17 drones and B-17 controllers. Two of the projects provided for timing and firing signals for BAKER test. 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 the Avery Island. One project measured ABLE infrared radiation at burst time.

Staffing: Personnel from the Electronics Group of the Instrumentation Division accomplished all the projects in this Program except for IV-9 through IV-13. These were done by Los Alamos Laboratory and the AAF. 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. Exposures for everyone in this groups were less than 0.5 R, see Table 3.3.

angle indicators. Project 12 measured total gamma intensity on several target ships using gamma-ray intensimeters.

Staffing: Most of those who were badged were military personnel performing monitoring duties. Most of those who were not badged presumably were civilians, working in the badge processing area.

Personnel in all 12 projects in the Radsafe Program had a high potential for exposure because of their duties. Monitors who reboarded ships with boarding parties after BAKER accumulated the highest exposures. Of the 180 personnel in this group, 91 were badged one or more times. As previously mentioned, the highest exposure was 3.6 R for a monitor who got most of his exposure on Searaven. Those who were not badged were probably working in badge processing and recording.

Project Report: Enclosure J, XRD 209, XRD 210.

Program VI -- Radiometry

Agencies: Navy Bureau of Ordnance (BuOrd)

Army Air Force (AAF)

Operations: Measurement of bomb radiant energy was attempted from several locations. On ABLE, thermocouples were installed on one ship and on an aircraft flying 18 nmi (33 km) from the detonation. Spectograms were taken of the ABLE bomb flash from a ship located 18 nmi (33 km) from the detonation. Photocells were also used on an aircraft flying 18 nmi (33 km) from the burst. On BAKER thermocouples were installed on a ship positioned 10.9 nmi (20 km) from the detonation and spectroscopes were placed on an aircraft flying at 7.2 nmi (13 km) from the burst.

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 zero point of the detonation (Sakawa [ex-Japanese cruiser], USS Crittenden [APA-77], USS Carlisle [APA-69], USS Arkansas [BB-33]). Measurement of gamma rays on BAKER should not have created any radiation exposure whatsoever. Removal of radioactive air and water samples from planes and boats was a very sensitive operation with a high exposure potential. Only 12 of 60 personnel in the Los Alamos Laboratory Group were badged and their exposures were very low (see Table 3.3). The radioactive air and water samples procedures obviously were handled very carefully.

Project Report: Los Alamos Laboratory Report No. 613, November 1946.

Program VIII -- Remote Measurements

Agencies: U.S. Coast & Geodetic Survey (USCS)

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

BAKER. Projects 18 and 19 required recovery of film from Eneu and Bikini, which were lightly contaminated after BAKER. Nine personnel were badged out of thirty-six assigned to this program. The highest exposure was 0.970 R. — provide badging date(s) —

DON'T BELIEVE YOU CAN ACCURATELY IDENTIFY WHO WAS BADGED IN THIS LARGE PROJECT.

Program IX -- Technical Photography

Agencies: Los Alamos Laboratory

Army Air Force (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 16 high speed cameras to record the rate of growth of the ABLE shot fireball. Half of the cameras were in a tower on Bikini Island and half in a tower on Eneu Island. The late timing signal on ABLE shot resulted in all film being used before the detonation so the project was unsuccessful. ~~caused this project to have no success~~ Projects 2 through 7 consisted of 63 cameras mounted in six camera towers to observe water waves, ship motion, burst location (ABLE only), light intensity, and damage assessment. Each of three islands had two camera towers. There were 24 cameras on Bikini, 20 on Eneu, and 19 on Aomen. These 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, in C-54s, and in F-13s. Pictures were taken of fireball development, the 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, and F6F and FM for drones [redacted] to photograph wave motion, target array, target damage, and detonation effects on ships in real time. Project 15 consisted of [redacted] placing 20 cameras on target ships and nearby islands for ABLE shot and 24 cameras on target ships and nearby islands for BAKER shot. The purpose was

aircraft equipped with radiation detectors, a determination of when a safe reentry by the main body into the lagoon could be made.

Preparations for the tests began in January 1946 when the atoll was surveyed by the crews of USS Allen M. Sumner (DD-692) and USS Bowditch (AGS-4). The only charts available were Japanese and were inadequate. The survey was finished in April.

On 6 March 1946, 166 Bikinians embarked aboard USS LST-1108 and were taken to Rongerik Atoll, EDITORIAL - DELETE. 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, and 5 naval mines were discovered and disposed of during March.

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

The target ships also required special preparation. This 84-unit fleet, led by older U.S. capital ships like the famous USS Saratoga (CV-3), the German battle cruiser Prinz Eugen, and two major captured Japanese ships, the battleship Nagato and the cruiser Sakawa, had to be accurately moored and made ready for the tests. This latter involved a great deal of work by

30 JUNE?

clear of the lagoon by early afternoon. Most of the support ships of Task Group (TG) 1.2 were out of the lagoon shortly thereafter except 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 then 20 nmi (37 km) northeast of Bikini Atoll. Small craft had evacuated personnel from Enidrik and Eneman islands and transferred them to Fall River. Fall River then left the lagoon along with the smaller ships of TG 1.2. Ten ships remained in the lagoon after 1800.

Preparations ashore had included the removal of the roofs of buildings to prevent blast damage and the 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. Small boats were anchored off Eneu.

JUST SAID ON 4-1.
691 WERE EVACUATED BY CHILTON. SEE ENCLOSURE ADD

Provision had been made to evacuate U.S. personnel and Marshallese on Enewetak to the west of Bikini 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.

THIS MUS... HAVE BEE... FOR EITHER PERS. NOT EVAC... BY SHIP

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 which would land at Roi following the shot.

At 0512 on 1 July, PGM-23 had all personnel from Iroij, Nam, and Aomen islands embarked and was underway for the fleet assembly area. At 0524

Army and Navy aircraft involved with photography, and cloud sampling accomplished their missions before 1000. B-17 sampler drones penetrated the nuclear cloud about 20 minutes after the detonation, obtained their samples and were guided back to Enewetak Island. Three Navy F6F drones (a fourth was lost at 0850 when it crashed in the sea) sampled the nuclear cloud between 0906 and 0920 at altitudes ~~from~~ of 10,000 to 20,000 feet (3.048 to 6.096 km). All three drones were guided back to Roi and ~~were~~ landed without incident. C-54 aircraft at Enewetak and Roi transported the cloud samples (air bags and filters) to Kwajalein for analysis as soon as they were removed from the drones by Los Alamos Laboratory ~~radiation~~ chemical 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 which were sent back to Begor from the drone boats. Both drones departed the ~~lagoon~~ target array before 1200. Begor met the two drones in the anchorage area in the lee of Eneu and removed the samples. These were then transferred to Moale, which steamed to Kwajalein at 1255 (Reference XRD 206, Part VII, p. R19-22).

Reentry into the lagoon commenced at H+2 when six manned motor gunboat patrol vessels (PGMs) and 20 LCPLs entered to conduct radiological reconnaissance. They carefully ~~crossed~~ approached the area around the target vessels measuring for radiation. Information Boarding teams and salvage units for the target vessels entered the lagoon at H+4 and proceeded with operations as the radiological situation permitted. 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 ships had been boarded and ~~cleared~~ reported radiologically safe and by the evening of 2 July that number had increased to 47 ships. The Red line was eliminated early in the morning of 2 July indicating the maximum intensity of the water fell below 1 R/day during the night. The Blue line was eliminated at 1008 on 2 July.

From these boats was used to define the Red and Blue lines (1 R and 0.1 R/

the total of all these ships should equal the # of target ships used at ABLE.

- o 8 ships seriously impaired efficiency
- o 9 ships moderately damaged
- o 41 ships negligible damage — ships beached at Bikini Island no damage (provide the # of ships in this category)

Aircraft aboard target ships:

- o 14 ~~aircraft~~ missing
- o 30 ~~aircraft~~ seriously damaged
- o 10 ~~aircraft~~ lightly damaged
- o 19 ~~aircraft~~ no damage.

How many target ships? (Ask)

In general all ships within 500 yards (457 meters) of actual ~~ground~~ surface zero were sunk or ~~severely~~ seriously damaged. Those beyond 1,500 yards (1.371 km) received minor damage (Reference XRD 206, Part V, p. C6). Figure 4.2 shows the location of most of the target ships (Reference XRD 208, Fig. 10.1). Those ships outside about 750 yards received such a small amount of radiation that boarding was possible on 1 July and crews ~~gradually~~ returned to live aboard by 2-3 July.

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 (0.914 and 1.828 km), and between 5 and 15 percent died outside 2,000 yards (1.828 km). Airblast was the principal cause of injury and death. However, gamma radiation was the principal cause of death for those animals who died after the first few hours. This section needs to be expanded. Discuss what happened between 2-24 July. Provide info on the reboarding and inspection activities.

PREPARATION FOR BAKER

As soon as the extent of damage from ABLE had been determined, CJTF 1 tentatively set 25 July for BAKER. The press ship USS Appalachian (AGC-1) returned to Pearl Harbor to allow some press people to depart and others to join the group. Nonparticipating observers were taken on a cruise to Ponape, Truk, Majuro, and Guam Islands while the task force prepared for BAKER (Reference XRD 206, Part V, p. C7).

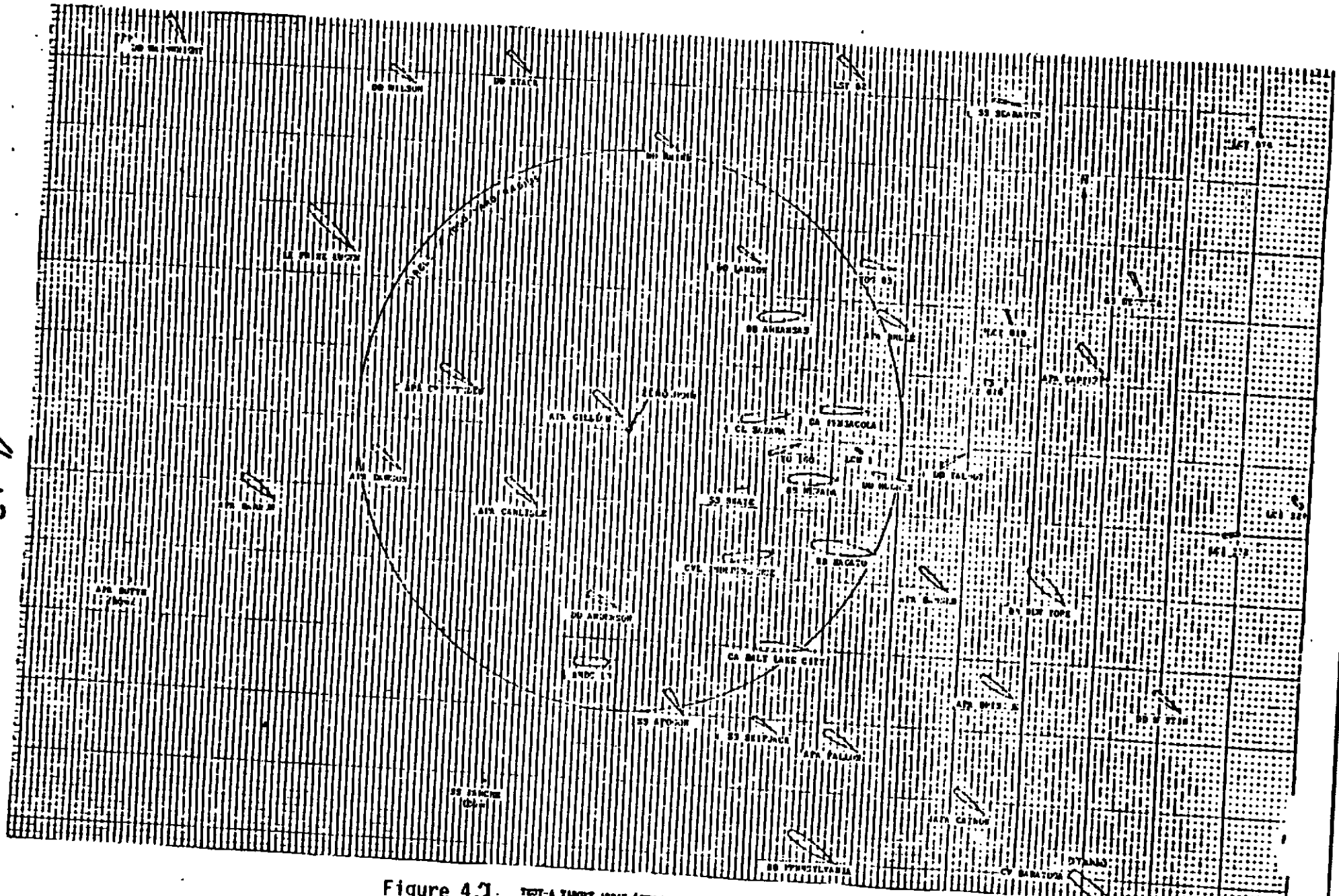


Figure 4.1. TEST-4 TARGET ARRAY (INNER PORTION) SHOWING POSITIONS OF TARGET VESSELS RELATIVE TO PROJECTED ZEROPOINT ON 4-DAY AT H1X1 HOUR.

This map is difficult to read - provide 1000 yard circles for all ships. Delete

evacuated to Rongelap Atoll instead of Kwajalein because it was closer to Bikini.

607 WERE EVACUATED BY ST CROIX. SEE ATTACHMENT ADD

The day before BAKER shot, 24 July, 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 standing by at Enewetak in case evacuation was necessary. Except for minor changes the aircraft missions were similar to the ABLE shot missions. Table 4.2 shows the aircraft that participated in BAKER shot.

By 1735 on 24 July all but 13 support ships were clear of the lagoon. These cleared the lagoon by 0700 the following morning. 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 evacuated by USS Conserver (ARS-39) at 0530 on 25 July (Reference XRD 206, Part VII, pp. H5-H7).

The bomb had been suspended 90 feet (27.4 meters) beneath the surface of the lagoon, from 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 the medium landing ship (LSM-60), leaving the bomb at 0545 on 25 July (Reference XRD 206, p. 5.12).

There were 70 target vessels in the array for BAKER Test. Nineteen other target ships were beached on Bikini Island. Their positions are shown in Figure 4.3. The submarine USS Searaven (SS-196), which had been submerged on 24 July, partially surfaced later in the day. It was finally

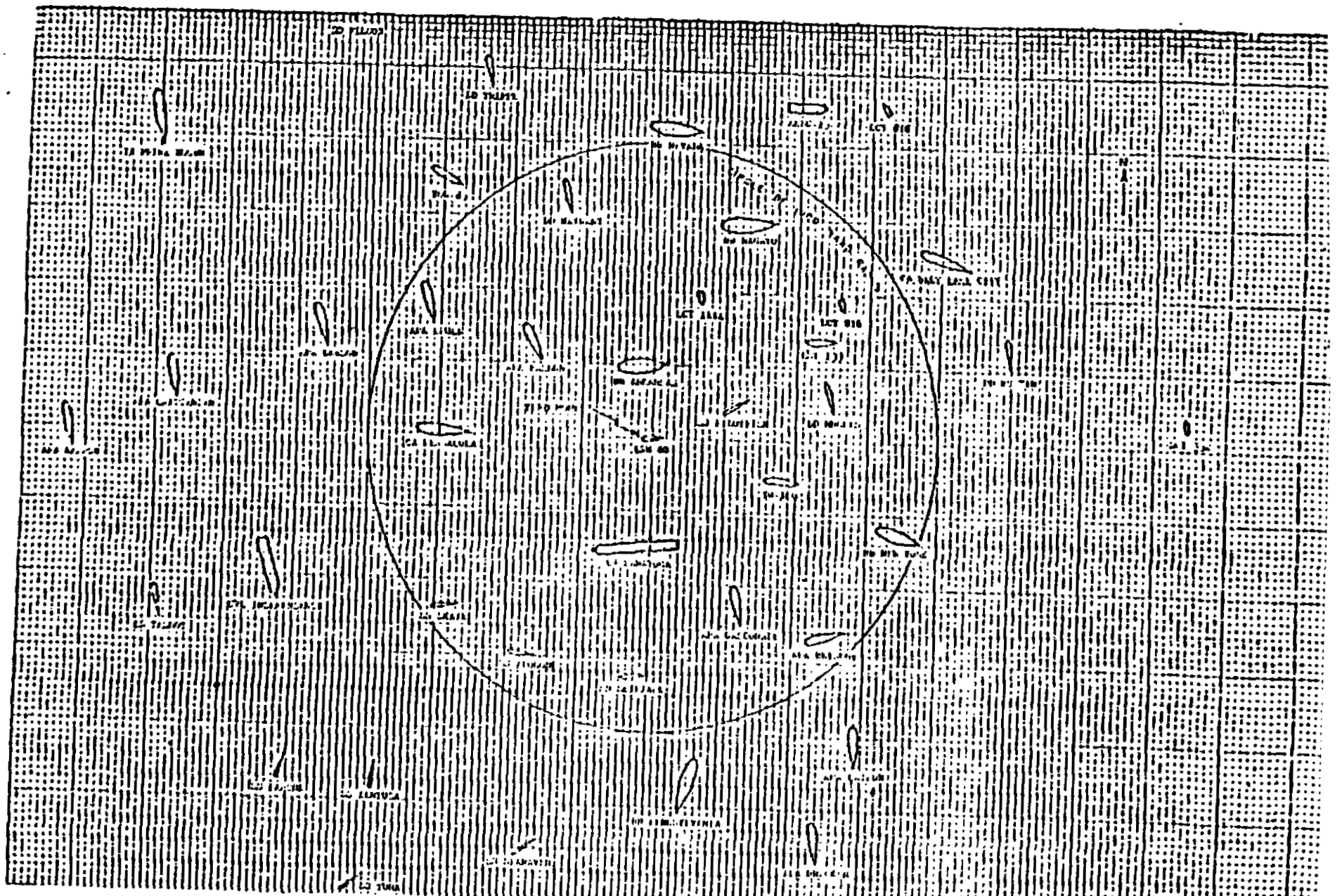


Figure 4.3 TEST 8 TARGET ARRAY (INNER PORTION) SHOWING POSITIONS OF TARGET VESSELS RELATIVE TO PROJECTED ZERO POINT ON 8 DAY AT MIKE HOUR.

This is difficult to read - eliminate grid and smooth

4-16

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 XRD 206, Part VI, p. D9). When the air over the fleet cleared, USS Arkansas (BB-33) and four LCTs were not in sight. Saratoga was listing to starboard and her stern was low.

The underwater burst inflicted heavy damage on the target fleet. Nine ships were sunk or capsized. Eight ships were immobilized or seriously damaged. Generally, ships beyond 1,500 yards (1.372 km) were undamaged. Those between 1,100 and 1,500 yards (1.006 and 1.372 km) suffered slight damage. Those between 900 and 1,100 yards (0.823 and 1.006 km) suffered moderate damage (Reference XRD 208, p. 23.3).

At 0912, the drone control ~~boat~~ ship Begor, began moving two drone boats from the lee of Eneu towards the target array using ~~the keyed~~ directions from the orbiting drone control TBMs the same as in ABLE shot. Each boat took 10 samples of lagoon water and by 1030 ~~were~~ was en route back to ~~their~~ its anchorage. The drone boats were ~~so "hot"~~ contaminated radiologically that boarding parties from Begor could not go aboard. The drone boats were taken to USS Albermarle (AV-2) 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 Albermarle about 1800. Albermarle then headed for Kwajalein with the samples. Four more runs were made on 26 July and two 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

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. They reported on cloud cover and other weather phenomena north and east of Bikini until 0500 and then returned to Bikini to provide up-to-the-minute weather reports at that location. The three C-54 and eight F-13 Army aircraft were involved with transporting observers and photography (Reference XRD 206, Part VII, p. E195-E207).

Early reports from the drone boats and the radiological reconnaissance PBMs indicated that the lagoon and surrounding atmosphere was intensely radioactive. The three PBMs were used for radiological reconnaissance of the lagoon. One by one they made passes over the lagoon starting at 4,000 feet (1.22 km), then 3,000, 2,000, 1,000 and 500 feet (914, 610, 305, and 152 meters). The first reconnaissance was at 0915 and the last of the day at 1615. All aircraft had radsafe monitors aboard. Reentry of the task force ships ~~would be~~ was delayed. The preshot radex bearings of 260° to 360° was modified slightly at 0940 to 270° to 360°. As on ABLE shot, the F6F pilots had earphones to monitor radioactivity (Reference XRD 206, Part VII, p. C19).

Reentry into the lagoon commenced at 0916 when the radiological ~~(PBMs)~~ with monitors aboard entered. They were closely followed by TU 1.2.8 and Whiting. Fall River took up position at the lagoon entrance at 0947 to control entry and exit. The Salvage Unit entered the lagoon at 1015 and began checking and boarding target vessels. Several other vessels entered the afternoon of 25 July. Film and other data were recovered from Bikini and Eneu islands during the afternoon. Several target ships were boarded and declared radiologically safe before nightfall on 25 July. However, ~~the vast majority of the~~ 46 of the 88 target

Hughes. This could not be accomplished until the following day, however. The islands at Bikini remained too radioactive to station personnel there.

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 XRD 206, Part VII S Encl 13-14).

On 28 July the 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 (1R/day) was eliminated at 1455 on 28 July. One ship, Sumner, reported readings of 0.156 R per day on outboard bunks and 0.204 R per day at the evaporators. It was sent out of the lagoon and into the open sea in an attempt to decontaminate the hull. ~~Some of the (provide the records of these ships) test animals were recovered from target ships on this date.~~ Also on 28 July, attempts were begun to surface the submarines that had been submerged. (Source?)

It was recognized at this time that the work of the Technical Director and the Director of Ship Material (DSM), the inspection and documentation of the effects of shot BAKER on the target fleet, could not proceed if the target ships were too heavily contaminated for the teams to inspect. Therefore, decontamination of the target ships began, although the techniques had to be developed. The techniques mainly involved washing the ships with saltwater and various detergent agents from other ships followed by scrubbing and washing by personnel. The evolution of the techniques is been discussed in Chapter 2 of this report.

Animals were removed from BRACKENRIDGE, CATRON and FILLMORE on 28 July. The next day more animals were removed from CATRON, BRISTOL and CASCADE.

On July 30 the last of the animals were removed from the target ships. 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. Many of the fish in the northeast corner of the lagoon were killed by the explosion. All but nine of the target vessels were heavily contaminated by the radioactive rainout and base surge following the burst. This contamination resisted removal. — yes, but it did decay thereby reducing the levels of contamination — this should be so indicated.

On 31 July, the island of Bikini was declared safe and personnel were permitted to go ashore. The beaches were declared off limits, however, because of contaminated items that may have washed up. Many target vessels still remained too contaminated to board and the persistent radioactivity on these ships made the propect of reboarding "very discouraging" (Reference XRD 206, Part VI, p. D48). Three submarines remained on the bottom of the lagoon. The lagoon water, except near the bottom, had reached safe levels by the morning of 30 July. Complete recovery of instrumentation and records was not completed until 7 August (Reference XRD 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 at Bikini 38 target vessels. He argued the ships were in such radiological condition that with available monitors, decontamination personnel, and materials they could not all be made absolutely safe for the work needed either to prepare them for movement to Pearl Harbor or to assess fully their damage (Reference 19).

By mid-August it was recognized that post-BAKER shot contamination was a continuing and increasing problem for ships remaining in Bikini Lagoon. Plans were made to move target and support ships to a better location where natural

CHAPTER 5

POST-BAKER OPERATIONS

After Test BAKER, the support ships left Bikini as soon as their services could be spared and they were found to be radiologically safe. However, in early August it became apparent that although the radiation levels in the water and on the land areas were within tolerance levels the accumulation of radioactivity in the ship's evaporators and marine growth on their hulls presented a growing hazard and that the base of operation of the task force had to be moved from Bikini. Kwajalein Atoll was selected for the new base of operation (Reference 1, 1). On 19 August 1946, movement of all ships to Kwajalein was initiated. By 26 September 1946, Bikini Atoll was completely evacuated.

The experience and problems associated with the radiological decontamination of the ships and their solution are described in detail in Chapter 2. This chapter addresses radiological and other problems associated with the task of offloading ammunition from the target ships, securing the ships at Kwajalein and decontaminating the ships at U.S. shipyards.

TARGET VESSEL OPERATIONS AT KWAJALEIN — SEE GENERAL COMMENT ON TARGET NUMBERS, 37

Of the 84 (88) target vessels, 58 (48) were towed from Bikini to Kwajalein, and 40 remained there (and were later sunk during 1947-48.) (Reference 23). Until higher authority decided what to do with them, the target ships had to be kept afloat. This required pumping and plugging leaks. Twelve target ships were so lightly contaminated that the crews were able to safely sail them to the U.S. Ten target ships were towed to the U.S. later for special research.

BAKER had 78 targets - 70 floating and 1 beached at Bikini. Tables show 64+12 targets only (76)

Ammunition Removal and Disposal

All target vessels at Bikini had some ammunition on board to serve as test material. Some of the ships had a great deal, placed there to determine the effects of the atomic bomb on warships having different loading conditions. For example, Nevada 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 of the service ammunition had been flooded. There was a presumption that ammunition on certain ships was, or would soon become, unstable and pose a considerable and growing hazard. 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 hazard would be reduced, but the explosive hazard increased (Reference 2). Because the ships were contaminated, work parties had to wear special clothes and be accompanied by radiological safety (radsafe) monitors when aboard. When working below deck, the men were required to wear rescue breathing apparatus.

For work on the target vessels, Task Unit (TU) 1.2.12 was formed on 28 August 1946 (Reference 4). The flagship was USS Haven (AH-12), on which the radsafe unit had its headquarters and laboratories. USS 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 had several smaller vessels for towing, ammunition disposal, and personnel transportation (Reference 1, 4-5). LIST PLEASE.

Personnel were transported to and from work in LCM type boats. Five of these were each equipped with a gasoline-engine-driven air compressor and a gasoline-engine-driven 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.

Initially radsafe procedures were strict. 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 (RBA), intended to prevent inhalation of radioactive particles. Members of the working party then boarded an LCM on the dirty 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 18, 143-144; Reference 4, 1-2).

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 belowdecks without a topside break for air. The breathing apparatus restricted their vision, and lighting inside of the dead ships was poor. ~~Lumps on the head from unseen bulkheads probably were common, and the danger of falling down open deck hatch was ever present. Worse yet, the ammunition might have exploded~~ the danger of exploding ammo has already been discussed.

(Reference 18, 147). During the week ending 6 October, 36 badges were overexposed but urine tests on the affected men proved negative (Reference 20, 3-4). This same concern, but from another quarter, manifested itself on 14 September in instructions from the Commander-in Chief, Pacific (CINCPAC) prohibiting all hoisting and underwater repairs on boats at Kwajalein. Apparently TU 1.2.12 was able to get permission to follow instead the 9 September message from the CJTF to commanders of nontarget ships suspected of being contaminated (Serial 079). It allowed scraping of underwater portions of the hulls as long as the working area was kept wet (Reference 13, 136). Because no copy of the directive could be found, boat repairs at Kwajalein were temporarily curtailed for the time being (Reference 4, 2).

Pensacola posed the most urgent removal problem due to the deteriortion of the gunpowder for its 8-inch guns in its forward magazines, with resultant concentration of ether-alcohol fumes, believed to be within explosive limits (Reference 1, 4). The same conditions, in a lesser degree, were felt possible in some of the other target vessels. So critical was the problem that on 13 August 1946 CTG 1.2 issued supplementary orders to the officer-in-charge of the Ammunition Disposal Unit covering Pensacola. In early September ammunition breakout was started on New York, Carteret, and Wainwright. The progressive opening up of Pensacola preparatory to removal of ammunition was initiated following procedures laid down by CTG 1.2 (Reference 5, 4).

By mid-September because of the acute shortage of radiological monitors, questions were raised as to the advisability of continuing with ammunition disposal at the rate of progress imposed earlier (Reference 6, 4). At this time questions were also raised by CTG 1.2 regarding the dangers attendent to

Concurrent with the completion of this disposal, the Chief of Naval Operations (CNO) ordered Gasconade, Fallon, Crittenden, Brule, and Mayrant be towed to San Francisco and Hughes, Pensacola, Salt Lake City, New York, Rhind, 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 seven of these ships were ultimately towed to the U.S. plus Independence.

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 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, but that removal of the large-caliber projectiles, especially the 14-inch 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 8, 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 in accordance with all requirements.

USS Nevada (BB-36) (Pearl Harbor)	Two-thirds of the normal allowance remained aboard
USS Hughes (DD-410)	No ammunition aboard.
USS SKIPJACK (SS-184)	

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 unanswered lingering fears and ~~doubts~~ about the effects of radiation and fatigue due to the long uninterrupted arduous and hazardous duty. SOURCE PLEASE. ? The officer-in-charge dispatched a letter dated 11 November 1946 to the Chief of the Bureau of Medicine and Surgery (Reference 9) detailing the concerns of personnel in his unit regarding radiation hazards. He described the failure in the use of the rescue breathing apparatus and the added hazards in handling heavy ammunition when wearing it 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 10) 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 Radiological Safety 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

persons boarding ships was to be kept at a minimum, and their exposure was to be appropriately interrupted to reduce the chance of injury. All persons who were to board and who might encounter radiation were to have a preduty physical examination. All personnel connected with work on target ships were to have a monthly physical examination with special attention to changes in their hands. Each individual was to have a weekly urine analysis, including a 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 for work, in hard hats, coveralls fastened at the neck, canvas or rubber gloves, canvas bootees 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 vessels, 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 belowdecks, 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 to have codified existing practice (Reference 34, 1-8). — there is no reference 34 listed in reference section.

The fact that the # of personnel with the ship security detail has been greatly reduced by now should be discussed here

In a letter to the Chief BuMed dated 9 April 1947, a 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

Jet w/ NTPR

NNTPR HAS SOME PERSONNEL FIGURES. REF. 29.

his apprehension. He wrote that "our instruments are still very unreliable and I felt unsafe in boarding without proper equipment. I told [the doctor] that I thought operations should cease because we knew so little about the dangers we were dealing with." (Reference 25)

Either as the result of the monitor's letter or for some other reason, 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 26). 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 27).

Until at least July 1948, ~~a unit~~ existed at Kwajalein caring for the target ships. ~~During that month six personnel are recorded as receiving radiation exposure.~~ Among the ~~nine~~ men, the ~~longest period of work in radiologically suspect areas was 117 hours and 6 minutes over a period of 29 days~~ (Reference 28).

Maintenance Operations

By the end of September 1946 when the evacuation of Bikini Atoll was completed, the Kwajalein Maintenance Force was activated as TU 1.2.12. It consisted of about 1,500 officers and men and the ships Haven, Geneva, Conserver, Current, LCI-329, LCI(L)-549, LCI(L)-615, APL-27, YF-753 and assorted small craft (Reference 1, 4).

All survey and construction activities at Bikini were rapidly brought to a close, and the atoll was completely evacuated on 26 September 1946. For safety

provide this data in a much better format. OR

Banner (APA-60)	Not required for further study
Barrow (APA-61)	Not required for further study
Bracken (APA-64)	Not required for further study
Briscoe (APA-65)	To be retained at Kwajalein for decontamination studies
Brule (APA-66)	To be retained at Kwajalein for decontamination studies
Butte (APA-68)	Not required for further study
Carteret (APA-70)	Not required for further study
Catron (APA-71)	Not required for further study
Dawson (APA-79)	To be retained at Kwajalein for decontamination studies
Fallon (APA-81)	To be retained at Kwajalein for decontamination studies. See CNO 211422, December 1946. Heavy underwater damage. Final disposition not yet determined.
Independence (CVL-22)	Scheduled for further study at San Francisco. ETD 15 April 1947.
LCI-327	Beached at Meck Island. Not required for study.
LCI-329	Being used as patrol vessel. To be placed in caretaker status. See CNO 231552, January 1947.
LCI-332	Beached at Meck Island. Not required for study.
LCI(L)-549	Being used as patrol vessel. Not required for study.
LCI(L)-615	Being used as patrol vessel. Not required for study.
LST-133	Not required for further study.
LST-220	Not required for further study.
LST-52	Not required for further study.
LST-545	Not required for further study.
LST-661	Not required for further study.

avoid overtaxing the facilities at San Francisco the ComServPac, CJTF 1, and CNO issued orders that established decontamination and clearance centers at Bremerton, San Diego, Los Angeles
San Francisco, Pearl Harbor, Guam and other selected shipyards (Reference XRD 185, 22). This culminated in the ultimate dispersal of ships to the various shipyards as follows (Reference 14):

SAN FRANCISCO (San Francisco NSY or Mare Island NSY)

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 (AO-54)
* USS Conyngham (DD-371)
* USS Cortland (APA-75)
USS Crittenden (APA-77)
USS Deliver (ARS-23)
* USS Dentuda (SS-335)
USS Dixie (AD-14)
USS Enoree (AO-69)
* USS Filmore (APA-83)
USS Fulton (AS-11)
* USS Gasconade (APA-85)
* USS Geneva (APA-86)
USS Henrico (APA-45)
* USS Independence (CVL-22)
USS James M. Gillis (AGS-13)
USS John Rodgers (AGS-10)
USS Laffey (DD-724)
USS Lowry (DD-770)
* LCI(L)-549
* LCI(L)-615
USS LST-388
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 (ARST-3)
* USS Parche (SS-384) - Mare Island
USS Rockbridge (APA-228)
USS Rockingham (APA-229)
USS Rockwall (APA-230)
USS San Marcos (LSD-25)
* USS Searaven (SS-196)
* USS Skate (SS-305)
* USS Skipjack (SS-189)
* USS Tuna (SS-203)
* USS Walke (DD-723)
USS Widgeon (ASR-1)

Guam

Mare Island NSY

* Target ships

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. Peary (DD-883)
USS Rolette (AKA-99)
USS Saidor (CVE-117)
USS St. 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 (PCS-1396)
USS Fall River (CA-131)
USS Furse (DD-882)
USS Gunston Hall (LSD-5)
USS Haven (AH-12)
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 (AGD(W)-61)
USS Sioux (ATF-75)
USS Sphinx (ARL-24)
USS Telamon (ARB-8)
USS Tombigbee (AOG(W)-11)
USS Kenneth Whiting (AV-14)

KWAJALEIN

APL-27

PHILIPPINES

PGM-32

NORFOLK, VIRGINIA

USS Burleson (APA-67)

DECONTAMINATION AT SHIPYARDS

Little information is available on the procedure and problems experienced in the decontamination and clearance of ships at shipyards other than San Francisco. However, all procedures were issued by COMWESTSEAFRON at San Francisco using information gained from San Francisco decontamination.

DID NOT RETURN TO YARDS?

presumption.

THIS HAS NOTHING TO DO WITH SHIPYARD DECONTI

CTG 1.2, however, requested that restoration work on Carteret, Conyngham 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 the alpha emitters from becoming airborne or being picked up on the men's clothing or skin (Reference 29). In the end, however, only Conyngham was decontaminated sufficiently to reman. On 28 August, it departed Kwajalein for Pearl Harbor under its own power, arriving there on 6 September (Reference 30, 3 ; Reference XRD 206, 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 shipped home on 20 August because of possible overexposure to radiation (Reference 30, 3).

this is speculative — provide more info, i.e. readings, regarding overexpos

if subsequent to 10 August then this is incorrect — see comment on pg 2-25.

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 (Reference 13, 13). At this time both the Radiological Safety Advisor and the CJTF 1 Safety Advisor became concerned about the ingestion or introduction of alpha emitters into the bodies of personnel from exposure to fumes and dust emanating from contaminated surfaces. Accordingly, ComServPac promulgated special precautions for personnel who could be exposed to fumes resulting from welding or cutting and dust originating from contaminated surfaces (Reference 13, 21).

Laboratory Analysis of Radioactive Materials

By mid-September, information from the laboratory analysis of the first radioactive materials removed from non-target ships became available. Since plutonium was not directly detectable by available field instruments, it was desirable to determine the fluctuation of the ratio of plutonium to fission

delete - this has already been covered.

thus appeared entirely feasible to decontaminate and repair CROSSROADS nontarget vessels without exposing personnel to radiological hazards (Reference 13, 32-33).

A 22 November 1946 Bureau of Ships and Bureau of Medicine and Surgery letter states (Reference 15, 1-2):

> 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.

A few days later at a conference on Radiological Safety on 27 November 1946 in Washington, D.C., a University of California scientist echoed these feelings concerning the scrapping of non-target ships and expressed his opinion that much authoritative information was available to prove that plutonium in the form contained in nuclear weapons is not absorbed by the digestive tract or through the lungs unless quantities as large as a gram are being dealt with [This is considered to refer to insoluble forms of plutonium]. He also believed that the health hazards from long-life fission products are far greater than from plutonium. The amounts of these dangerous fission products to be found in the tons of scrap would be on the order of 50 millicuries. This quantity is on the order of the amounts of radium found in ordinary rock. He therefore stated positively that

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.

Thus, it appears that the procedures used in 1946 to dispose of sand and acid solutions produced no greater radiological hazard than is currently acceptable from commercial nuclear reactor operations.

Table 5.1 summarizes the post-BAKER history of all the target and support ships in Test BAKER. Where possible, it indicates the date the ship departed Bikini, the date it arrived and departed Kwajalein, the location of decontamination and clearance or final disposition, and the dates of operational and final clearances.

Clearances were defined as follows (Reference 16, 32):

1. Operational Clearance indicates that all normal operations, repairs and maintenance can be carried out without radiological hazard provided the precautions set forth in the General Radiological Safety Precautions for handling contaminated materials are observed. This is the clearance required for the normal operation of active ships.

2. Final Clearance indicates that no radiological hazard of any type, no matter how remote, exists on the ship and that further monitoring is not required. It will apply in like manner to operating ships and to ships destined for inactivation or disposal. Before final clearance can be granted the monitors' reports and recommendations for such clearance must be forwarded to Chief of the Bureau of Medicine and Surgery and the Chief of the Bureau of Ships.

SMALL SUPPORT SHIPS

Operation CROSSROADS had 32 small support ships and yard craft in addition to the 121 large support ships. Information on these vessels is scarce because most did not have deck logs or permanently assigned crews. Because some of these ships and craft (marked with an asterisk) were at Bikini for a long enough time to become contaminated, they are of special interest. They were:

LCT-581	LCT-1377	YF-754
LCT-1116	LCT-1415	*YF-990
LCT-1130	*LCT-1420	YF-991
LCT-1132	*LCT-1461	YF-992
LCT-1155	Limestone (IX-158)	*YO-132
*LCT-1184	YC-1009	*YO-199
LCT-1268	YF-385	*YOG-63
LCT-1341	*YF-733	*YOG-70
*LCT-1359	YF-735	*YP-636
*LCT-1361	YF-753	*YW-92

SHIP	DATE LEFT BIKINI	DATE ARRIVED KWAJALEIN	DATE LEFT KWAJALEIN	DESTINATION	U.S. LOCATION	DATE	DISPOSITION LOCATION
NON-REMANNED TARGET SHIPS					all Kwajalein targets NA		
LCI-329	UNK	UNK	N/A	Kwajalein	~~UNK~~ NA	16 MAR 48	Sunk at Kwajalein
LCI-332	1 SEP 46	3 SEP 46	N/A	Kwajalein	~~UNK~~ NA	SEP 47	Sunk at Kwajalein
LCI-620	UNK	N/A	N/A	N/A	N/A	10 AUG 46	Sunk at sea off Bikini
LSM-60	X	N/A	N/A	N/A	N/A	25 JUL 46	Sunk at Bikini Shot BAKER
LST-52	After 28 AUG 46	UNK	N/A	Kwajalein	~~UNK~~ NA	APR 48	Sunk by gunfire Kwajalein 8°-47N 167°-52E
LST-125	UNK	N/A	N/A	N/A	N/A	14 AUG 46	Sunk at sea off Bikini 11°-25N 165°-25E
LST-133	29 AUG 46	30 AUG 46	N/A	Kwajalein	UNK NA	11 MAY 48	Sunk at Kwajalein 8°-48N 167°-10E
LST-220	After 27 AUG 46	UNK	N/A	Kwajalein	UNK	12 MAY 48	Sunk at Kwajalein 8°-44N 167°-25E
LST-545	28 AUG 46	30 AUG 46	N/A	Kwajalein	UNK	12 MAY 48	Sunk at Kwajalein 8°-48N 167°-21E
LST-661	23 AUG 46	25 AUG 46 (E)	N/A	Kwajalein	UNK	25 JUL 48	Sunk at Kwajalein 8°-51N 167°-20.3E
USS Mayrant (DD-402)	After 25 AUG 46	UNK	N/A	Kwajalein	UNK	4 APR 48	Sunk by gunfire Kwajalein 8°-49N 167°-23E
USS Mugford (DD-389)	19 AUG 46	21 AUG 46	N/A	Kwajalein	UNK	22 MAR 48	Scuttled-Kwajalein
USS Mustin (DD-413)	After 23 AUG 46	UNK	N/A	Kwajalein	UNK	28 APR 48	Sunk by gunfire Kwajalein 8°-47.8N 167°-11.5E
Nagato (Ex-Jap BB)	X	N/A	N/A	N/A	N/A	29-30 JUL 46	Sunk at Bikini Shot BAKER
USS Nevada (BB-36)	19 AUG 46	22 AUG 46	UNK	Pearl Harbor	Pearl Harbor	31 JUL 48	Sunk by gunfire ~~Kwajalein~~ Pearl Harb 20°-58N 159°-17W
USS New York (BB-34)	22 AUG 46	25 AUG 46 (E)	UNK	Pearl Harbor	Pearl Harbor	8 JUL 48	Sunk 40 nmi Southwest of Pearl Harbor
USS Pennsylvania (BB-38)	21 AUG 46	26 AUG 46	N/A	Kwajalein	~~UNK~~ N/A	10 FEB 48	Sunk at Kwajalein
USS Pensacola (CA-24)	24 AUG 46	27 AUG 46 (E)	UNK	Bremerton, WA	Bremerton, WA	10 NOV 48	Sunk off WA coast 48°-12N 127°-01W
USS Pilotfish (SS-386)	X	N/A	N/A	N/A	N/A	25 JUL 46 16 OCT 48	Sunk from Shot Baker ~~Decommissioned~~ Inspected reserve at Bikini
Prinz Eugen (Ex-German CA)	UNK	UNK	N/A	Kwajalein	~~UNK~~ N/A.	12 DEC 46	Sunk at Kwajalein

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LCT-1078	UNK	UNK	N/A	Kwajalein	~~UNK~~ NA	SEP 47	Sunk at Kwajalein
LCT-1112	1 SEP 46	3 SEP 46	N/A	Kwajalein	~~UNK~~ NA	SEP 47	Sunk at Kwajalein
LCT-1113	UNK	UNK	N/A	Kwajalein	~~UNK~~ NA	JUN 47	Sunk at Kwajalein
LCT-1114	X	N/A	N/A	N/A	N/A	Shortly after 25 JUL 46	Sunk at Bikini, demolition
LCT-1115	UNK	UNK	N/A	Kwajalein	~~UNK~~ NA	SEP 47	Sunk at Kwajalein
LCT-1175	X	N/A	N/A	N/A	N/A	Shortly after 25 JUL 46	Sunk at Bikini Shot BAKER
LCT-1187	X	N/A	N/A	N/A	N/A	Shortly after 25 JUL 46	Sunk at Bikini Shot BAKER
LCT-1237	X	N/A	N/A	N/A	N/A	Shortly after 25 JUL 46	Sunk at Bikini Shot BAKER

* NOTE: ~~Target~~ Non-remanned target ships returned to the U.S. were not decontaminated or repaired. The ships were only examined and inspected for damage.

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SHIP	DATE LEFT BIKINI	DATE ARRIVED KWAJALEIN	DATE LEFT KWAJALEIN	DESTINATION	U.S LOCATION DECONTAMINATION	DATE OPERATIONAL CLEARANCE	DATE FINAL CLEARANCE
SUPPORT SHIPS							
*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	1 JAN 47	UNK
USS Albermarle (AV-5) Second Shot Only	25 JUL 46	26 JUL 46	30 JUL 46	Pearl Harbor San Pedro 12 AUG 46	Los Angeles	UNK	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	UNK
*APL-27	UNK	UNK	UNK	UNK	Kwajalein	25 FEB 47 (8) ?	10 JAN 47
USS Appalachian (AGC-1)	29 JUL 46	30 JUL 46	30 JUL 46	Pearl Harbor San Francisco 16 AUG 46	San Francisco	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 5 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 Second Shot Only	25 AUG 46	26 AUG 46	9 SEP 46	Pearl Harbor Puget Sound 25 NOV 46	Puget Sound	UNK	18 DEC 46
*ATA-180	1 SEP 46	3 SEP 46	8 SEP 46	Pearl Harbor Puget Sound 25 NOV 46	Puget Sound	24 FEB 47	UNK
*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 Francisco	6 NOV 46	by 22 NOV 46

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All ships went through Pearl Harbor-de

SHIP	DATE LEFT BIKINI	DATE ARRIVED KWAJALEIN	DATE LEFT KWAJALEIN	DESTINATION	LOCATION DECONTAMINATION	DATE OPERATIONAL CLEARANCE	DATE FINAL CLEARANCE
SUPPORT SHIPS							
*USS Burleson (APA-67)	5 AUG 46	---	---	Pearl Harbor San Pedro 22 AUG 46	Norfork, VA	UNK	14 OCT 46
*USS Cebu (ARG-6)	23 AUG 46	24 AUG 46	29 AUG 46	Pearl Harbor San Diego (E)	San Francisco	16 DEC 46	21 DEC 46
USS Charles P. Cecil (DD-835)	25 JUL 46	25 JUL 46	28 JUL 46	Pearl Harbor San Diego 9 AUG 46	NOT REQUIRED None	UNK	by 22 NOV 46
*USS Chickasaw (ATF-83) First Shot Only	25 AUG 46	UNK	7 SEP 46	Guam	San Francisco UNK	13 JAN 47	18 JAN 47
*USS Chickaskia (AO-54)	23 AUG 46	24 AUG 46	24 AUG 46	Pearl Harbor San Francisco 17 SEP 46	PUGET Sound San Francisco	31 DEC 46	4 JAN 47
*USS Chowanoc (ATF-100)	28 AUG 46	UNK	UNK	Pearl Harbor (E)	Pearl Harbor	UNK	1 FEB 47
*USS Clamp (ARS-330)	28 AUG 46	30 AUG 46	5 SEP 46	Pearl Harbor San Francisco 22 OCT 46	Los Angeles	UNK	by 22 NOV 46
*USS Coasters Harbor (AG-74)	15 AUG 46	16 AUG 46	17 AUG 46	Pearl Harbor San Diego (E)	Los Angeles	7 DEC 46	13 DEC 46
*USS Conserver (ARS-39)	5 SEP 46	7 SEP 46	12 FEB 46	Wake Island Pearl Harbor 22 FEB 47	Pearl Harbor UNK	4 MAR 47 UNK	11 MAR 47 UNK
*USS Coucal (ASR-8)	4 SEP 46	6 SEP 46 (E)	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	UNK	UNK	Los Angeles (E)	Los Angeles	3 DEC 46	13 DEC 46
*USS Current (ARS-22)	25 AUG 46	UNK	UNK	Pearl Harbor (E)	Pearl Harbor	6 FEB 47	17 FEB 47
*USS Deliver (ARS-23)	20 AUG 46	22 AUG 46	8 SEP 46	Pearl Harbor (E) 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 (E) San Francisco 22 SEP 46	San Francisco	2 OCT 46	by 22 NOV 46
*USS Dutton (PCS-1396)	14 SEP 46	15 SEP 46	25 SEP 46	Pearl Harbor 4 OCT 46	Los Angeles	18 DEC 46	10 JAN 47

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SHIP	DATE LEFT BIKINI	DATE ARRIVED KWAJALEIN	DATE LEFT KWAJALEIN	DESTINATION	LOCATION DECONTAMINATION	DATE OPERATIONAL CLEARANCE	DATE FINAL CLEARANCE
SUPPORT SHIPS							
*LCI-1067	22 AUG 46	23 AUG 46	9 SEP 46	Guam	Guam	24 FEB 47	UNK
*LCI-1091	25 AUG 46	26 AUG 46	UNK	Guam	Guam	UNK	11 DEC 46 (E)
*USS Lowry (DD-770)	10 AUG	--	---	Pearl Harbor San Diego 22 AUG 46	San Francisco	6 NOV 46	by 4 JAN 47
*LST-388	25 AUG 46	26 AUG 46	UNK	Caroline Islands	San Francisco	5 DEC 46	13 DEC 46
*LST-817	23 AUG 46	24 AUG 46	31 AUG 46	Pearl Harbor Port Chemene 5 OCT 46	San Francisco	21 NOV 46	22 NOV 46
*LST-861	24 AUG 46	25 AUG 46	2 SEP 46	Pearl Harbor 12 SEP 46	San Francisco	6 DEC 46	13 DEC 46
LST-871	25 JUL 46	27 JUL 46	9 AUG 46	Pearl Harbor 30 AUG 46	San Francisco	UNK	by 22 NOV 46
*LST-881	22 AUG 46	27 AUG 46	31 AUG 46	Pearl Harbor 10 SEP 46	San Francisco	13 DEC 46	23 DEC 46
LST-989	25 JUL 46	31 JUL 46	9 AUG 46	Pearl Harbor 20 AUG 46 (R)	San Francisco	19 NOV 46	22 NOV 46
*USS Mender (ARSD-2) Second Shot Only	4 SEP 46	6 SEP 46	8 SEP 46	Pearl Harbor 19 SEP 46 (R)	Los Angeles	Decommissioned 3 JAN 47	UNK
*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) Flagship	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 Marshall Islands	San Francisco	18 NOV 46	APR 47
*USS Newman K. Perry (DD-883)	4 AUG 46	---	---	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	Pearl Harbor	11 DEC 46	UNK
*USS Orca (AVP-49)	12 AUG 46	13 AUG 46	14 AUG 46	Guam Caroline Islands	Pearl Harbor	11 DEC 46	13 DEC 46

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SHIP	DATE LEFT BIKINI	DATE ARRIVED KWAJALEIN	DATE LEFT KWAJALEIN	DESTINATION	LOCATION DECONTAMINATION	DATE OPERATIONAL CLEARANCE	DATE FINAL CLEARANCE
SUPPORT SHIPS							
*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 Huemene 13 SEP 46	San Francisco	17 DEC 46	27 DEC 46
*USS Rolette (AKA-99)	26 AUG 46	---	---	Port Huemene 13 SEP 46	San Diego	28 JAN 47	1 FEB 47
*USS Saidor (CVB-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 Huemene	San Diego	by 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-(W)-61)	31 JUL 46	1 AUG 46	1 AUG 46	Pearl Harbor Bikini Atoll	Los Angeles	UNK	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)	24 JUL 46	25 JUL 46	UNK	UNK	None not required	UNK	by 22 NOV 46
*USS Sioux (ATF-75)	25 AUG 46	26 AUG 46	3 SEP 46	UNK	Los Angeles	28 NOV 46	4 DEC 46
*USS Sphinx (ARL-24)	19 AUG 46	20 AUG 46	UNK	Pearl Harbor	Los Angeles	14 FEB 47	23 APR 47 (E)
*USS Suncook (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	UNK
*USS Telamon (ARB-8) Second Shot Only	15 AUG 46	---	---	Pearl Harbor San Francisco 7 SEP 46	Los Angeles	12 DEC 46	21 DEC 46
*USS Tombigbee (AOG-(W)-11) First Shot Only	21 AUG 46	UNK	5 SEP 46	UNK	Los Angeles	31 DEC 46	4 JAN 47

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6. Weekly Report for Week Ending 14 September 1946

Commander Advance Echelon JTF-1 to Commander JTF-1

7. Weekly Report for Week Ending 12 October 1946

Commander Advance Echelon JTF-1 to Commander JTF-1

8. Weekly Report for Week Ending 19 October 1946

Commander Advance Echelon JTF-1 to Commander JTF-1

9. Letter Officer-in-Charge, Ammunition Disposal Unit, to Chief of Bureau of Medicine and Surgery, 11 November 1946

Subject:

Radiological Safety

10. Memorandum Capt. G.M. Lyon, Safety Advisor, 29 November 1946

Subject:

Comments on letter of Officer-in-Charge of Ammunition Disposal Unit of 11 November 1946

11. See XRD 206

12. Memorandum OP-33 to OP-414, 28 April 1947

Subject:

Summary of ships involved in CROSSROADS Operations

13. See XRD 185

20. Weekly Report for Week Ending 5 October 1946

F.G. Fahrion

Advance Echelon JTF 1

6 October 1946

NA, MMB, 374-47-101

21. Radiological Safety

F.T. Winant

Ammunition Disposal Unit

Kwajalein

11 November 1946

NA, MMB, 374-47-115

22. Dosimetry Matrix Report, 1946 Pacific Records

Reynolds Electric & Engineering Co., Inc.

7 September 1982

NNTPR

23. Memorandum for the Record: Activity at Kwajalein 1 September - December 1946 as a Result of Operation CROSSROADS

H.M. Highland

NNTPR

12 June 1979

NNTPR

Delete - this is an old memo

August 1947 through

28. Photodosimetry Report for the Month of July 1948

~~R.C. Tolbert~~ Atoll Commander et al

Radiological Safety Section

Kwajalein
2 Sept 1947 —
26 July 1948

NNTPR

29. Despatch 1207062

CTG 1.2

12 August 1946

30. Weekly Report for Week Ending 24 August 1946

F.G. Fahrion

Advance Echelon JTF 1

25 August 1946

NA. NMB. 374-47-101

31. ADD CTG 1.2 Naval message 180134Z of 18 Oct 1946 Re ammo disposal XRDS (COPY ATTACHED)

NOT ACCURATE JOINT CROSSROADS COMMITTEE NOT FORMED TILL NOV 4 MONS. AFTER

CHAPTER 6

BIKINI SCIENTIFIC RESURVEY

delete summary page - other chapters do not have one.

SUMMARY

Immediately following the conclusion of Operation CROSSROADS, the Joint Crossroads Committee gave preliminary consideration to the possibility of a Bikini Scientific Resurvey to assess the impact which the CROSSROADS test had on both target ships and the Bikini Atoll.

On 16 May 1947 the Joint Chiefs of Staff 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 (AFSWP) undertake technical supervision of the resurvey.

The Bikini Scientific Resurvey was conducted by Task Group (TG) 10.12. Onsite operations were conducted between 15 July and 29 August 1947.

This chapter focuses on the radiological safety aspects of this operation. It initially outlines the background of the operation and operations before, during, and immediately after the resurvey. It has parallel discussions of radiological safety during these operational phases.

From the standpoint of radiological safety, one point stands out clearly in available documentation. None of the personnel involved in the Bikini Scientific Resurvey was exposed to radiation levels exceeding 0.1 R per 24 hours. This level was the so called "tolerance limit" set for the operation.

BACKGROUND

~~Immediately~~ 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 ONE on potential studies and the logistics support that would be required for the operation. A Joint Crossroads Committee subcommittee was formed to analyze proposed operational details and make recommendations (1, 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 National Museum. A target date of 15 July 1947 was proposed (1, 75).

The objectives of the Bikini Scientific Resurvey, as formulated by JCS, were to (1, 75):

- Collect biological samples
- Carry out diving operations to recover instrumentation from target ships and conduct structural examinations of these vessels
- Collect water and bottom samples and cores

- 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 cruiser), USS Pilotfish (SS-386), USS Apogon (SS-308), and perhaps USS Arkansas (BB-33) and USS Gilliam (APR-57) if time permitted. Detailed structural inspections were to be made to determine the exact cause of sinking and to identify minor structural failures such as bent, warped, or ruptured plating and scantling - define this term / or misspelled.

- 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 if time permitted, which was believed to have been identified in photographs, and to inspect this section for type of rupture, heat effects, and radioactivity.

PREMISSION ACTIVITIES

Organization

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:

Geology

- Island and Reef Geology (5 personnel)
- Submarine Geology (2 personnel)
- Contractor Support Team (8 personnel)

Radiobiology

- One group (11 personnel)

Fisheries

- Reef and Lagoon Fishes (4 personnel)
- Pelagic Fishes (6 personnel)
- Population and Taxonomic Studies (1 person)

Biology

- Experimental Biology (6 personnel)
- Ecology and Morphology (3 personnel)

Radiochemistry and Radiophysics

- Fission Products Chemistry (5 personnel)
- Plutonium Chemistry (3 personnel)
- Soils Chemistry (1 person)
- Radiophysics (2 personnel)

Radiological Safety

- One group (8 personnel; 7 were TG 10.12 staff officers)

Radiological Health

- One group (4 personnel drawn from the staff of TG 10.12)

Diving, Underwater Photography and Television

- One group (6 personnel)

Army Engineers

- One group (2 personnel)

Aerology (Weather Observation)

- One group (1 person from 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 staff of TG 10.12), the War Department, and (1, 8):

- o Atomic Energy Commission

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 onloaded between 23 June 1947 and the departure of the ship on 1 July 1947 (1, 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 (1, 17).

Coucal departed Pearl Harbor en route for Bikini on 7 July 1947. LCI(L)-615 loaded supplies at Kwajalein and arrived on-station at Bikini on 17 July (1, 17).

An operation plan was prepared, while Chilton was en route from San Diego to Pearl Harbor. This plan, published on 30 June 1947, stated that the mission was to (1, 20):

> Observe, measure, and record all significant effects of Operation CROSSROADS on the organisms of Bikini Atoll and surrounding waters, on the atoll itself, and on ships and equipment remaining from Operation CROSSROADS; and to contribute to the body of fundamental science by observation, measurement, and report on those aspects of oceanography, geology, biology, and nuclear physics that are of particular significance in this locale.

The operation plan annexes covered the operational, scientific, and radiological safety-oriented aspects of the mission. Information concerning

- Issuance of special clothing for personnel working in contaminated areas was provided for.
- Regulations covering shore operations were established. Restrictions were placed on eating foods and drinking water from the islands. Swimming in the area was prohibited. Provision was made for a Radiological Safety Officer to accompany all initial trips to onshore areas.
- Radiological safety 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 encountering significant radiation would wear Type K film badges and an individual would not be allowed to reengage in the same activity if total body radiation of 0.1R/day had been exceeded the previous day.

Rasafe 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 area to be visited was free from hazardous contamination by radioactive materials (2, 94).

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 R/24 hours 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 (356) (2, 94).

Two types of underwater survey meters/probes were tested during deep-water diving operations conducted from Coucal (2, 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 (2, 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

After chemical analyses of lagoon water and edible fruits indicated that no physiological hazards existed, the bans on swimming in Bikini Lagoon and on eating fruits were lifted. The prohibition against consumption of any marine life continued in effect for the duration of the operation (2, 95).

While no major problems were encountered with the Victoreen Model 263 survey meters, these devices were a continous 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 (2, 95).

Monitoring data were collected by radiological safety 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 (2, 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 per 24 hours, the general level of beta and gamma radiation throughout the atoll was well within this limit. Debris along the beach that continued to produce radiation was almost entirely of material that was assumed to have been blown

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.

- o 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 operation gave evidence of exposure to beta or gamma radiation in excess of the specified tolerance limit of 0.1 R per 24 hours.
- o 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.
- o 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 that 10-12 caries per liter of water.
- o On the basis of radiochemical analysis of edible fruits, the original ban on the consumption of such fruits was lifted on 24 July 1947 by the task group commander acting

WRITE OUT SO LAYMAN

10^{-11} NOT 10 TO 11.

10^{-12} (0.000 000 000 0010 OR SO) NOT 10 TO 12

> 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 (2. 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.

Personnel dosimetry data has not yet been identified. Once located, it will be included in a subsequent draft of this chapter.

NEITHER HDS NNTRR. PROB. WILL NOT BE FOUND.

PAGES 71-77 of Proving Ground has excellent summary of resurvey findings. Please include

CHAPTER 6 REFERENCES

1. Bikini Scientific Resurvey, Volume I. Operations. Technical Report prepared for the Project Director by the Technical Reports Section, Armed Forces Special Weapons Project. December 1947. Short title: Operations.

2. Bikini Scientific Resurvey, Volume II. Report of the Technical Director. Prepared for the Project Officer by the Technical Reports Section. Armed Forces Special Weapons Project. December 1947.

3. Bikini Scientific Resurvey, Annex IV. Report of the Technical Director. Prepared for the Project Officer by the Technical Reports Section. Armed Forces Special Weapons Project. December 1947. (Supplement to Volume II.)

These are all XRD-212 — Here are 6 citations

212-V-1
" V-2
" V-3
" A-1
" A-2
" A-3
" A-4 add to XRD references

add: Proving Ground an account of the Radiobiological Studies of the Pacific 1946-61. Neal O. Hines, U of Wash. Wash Press, Seattle, 1962

CHAPTER 7

U.S. ARMY GROUND FORCES PARTICIPATION

TASK GROUP 1.4 (ARMY GROUND GROUP)

The Army Ground Group was designated Task Group (TG) 1.4 and had two assigned missions: to determine damage to selected Army equipment exposed at varying distances from point of detonation and to measure the bomb's radius 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 014 B. Senior representatives of each of the technical services under TG 1.4 were at one time in command of a task unit and also a member of the technical staff (1, 3).

TG 1.4 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 normal ones implied by their respective designations. The Technical Section was

1.4.1 operating strength called for 12 officers, 2 civilians and 53 enlisted personnel. Ten officers, two civilians, and three enlisted personnel have been identified, and one was badged with a 0.050 R reading (2, 15.3-10-11).

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 (Ex-German CA), 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 the Arkansas, Nevada, Saratoga, and Prinz Eugen. The operating strength called for nine officers, nine civilians from Signal Corp Engineer Laboratory, and 27 enlisted personnel. Eight officers, twenty-five enlisted men,and nine civilians have been identified. Two individuals were badged and had zero readings (4, 1, 3).

Task Unit 1.4.3 (Ordnance Unit)

To facilitate control and preclude duplication it was agreed that the ordnance unit would handle all explosions and demolition materials for the Corp of Engineers. The objectives of the TU 1.4.3 tests were to determine whether changes in design of ordnance materials, ammunition and/or packaging was necessary to minimize the effects of a nuclear detonation and to collect technical data which might aid in future designs. Items were displayed on the Arkansas, Nevada, USS Pennsylvania (BB-38), Saratoga, YOG-83, USS LST-52, USS LST-661, USS LST-220, and USS LST-545 for both tests as well as some items located on Bikini Island. Operating strength called for 17 officers and 72

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 Force equipment at varying distances on shot ABLE. Navy vessels used to expose items were Nevada, Independence, and New York. After radsafe personnel declared each target vessel safe, Army Air Force inspections teams went aboard. Reboarding was as follows:

New York	1030	2 July	H+25
Nevada	0830	4 July	H+71
Independence	0800	5 July	H+93

The operating strength of this unit called for seven officers and nine enlisted personnel. Reboarding teams were composed of ship's personnel and Army personnel. Seven officers and six enlisted personnel have been identified and none were badged. The only traces of radioactivity appeared in the methyl bromide, which was displayed in cylinders (3; 8, 8 & 23 & 218).

MAKES NO SENSE HERE.

CHECK TIME CO + TEAM "A" - INITIAL BOARDING TEAM, DID NOT GO ON NY TILL 1142 OR SO.

Check w/ Navy