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A HISTORY of OPERATION REDWING:
The Atomic Weapons Tests in the Pacific, 1956

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a history of

Operation REDWING

R. C. BILES
Chief, [illegible]

1956 . . .

UNCLASSIFIED

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Headquarters
Joint Task Force SEVEN
Washington 25, D. C.
1 December 1956

A HISTORY OF OPERATION REDWING:

The Atomic Weapons Tests in the Pacific, 1956

by

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Captain, USA

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Joint Task Force SEVEN

Classification (Cancelled) (Changed to ______)
By Authority of JT Rev ______
By ______
G. NILES
Chief, ISCM
Date ______

OFFICIAL:

PERRY B. GRIFFITH
Brigadier General, USAF
Chief of Staff

[redacted]

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Illustrative Material

[redacted]

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Foreword

The code name REDWING identifies an operation executed in 1956 by Joint Task Force SEVEN to test certain nuclear and thermonuclear devices and weapons.

The cost of REDWING was nearly $170,000,000, but this sum does not include the expense of the nuclear materials involved, normal service expenses, or the design and production of the devices tested. Of the total figure, about $120,000,000 covered the participation of the organizations involved. The remainder represents the experimental expenses, including about $24,000,000 for expendable scientific construction.

This was the price of an operation designed for the advancement of knowledge in a particular field of atomic development and conducted in a remote area with particular emphasis on the safety of inhabitants of the Marshall Islands and members of the command.

Such an operation required many people and much equipment. To relate how Joint Task Force SEVEN assembled, organized, and directed the components of this vast and complex effort -- in short, how Operation REDWING became a reality -- is the purpose of this account, a non-technical narrative that seeks to provide a general view of the activities and relationships that made the testing possible. The technical aspects of the operation have been summarized in the Commander's Final Report to the Joint Chiefs of Staff; many other special reports record in more specific terms the activities and the scientific results of the tests.

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REDWING is significant not only because certain atomic weapons were tested, but also because the operation was executed by a unique organization. Personnel of all three military Services as well as groups of civilians were members of Joint Task Force SEVEN. In this relatively new atomic age, the ability of the three military Services and of civilian persons to work together in harmony within a single framework of command is not the least important achievement of the operation.

B. HALL HANLON
Rear Admiral, USN
Commander, Joint Task Force SEVEN

[redacted]

[redacted]

Key Personnel, Operation REDWING

Rear Admiral B. Hall Hanlon, Commander, Joint Task Force SEVEN

Rear Admiral Leonard B. Southerland, Chief of Staff

Major General John C. Macdonald, Deputy for Army

Rear Admiral Joseph H. Wellings, Deputy for Navy

Brigadier General Perry B. Griffith, Deputy for Air

Doctor William E. Ogle, Deputy for Scientific Matters

Colonel Edmund T. Bullock, USA, Deputy Chief of Staff

Colonel Elzia Ledoux, USAF, ACofS, J-1

Commander Thomas E. McCormick, Jr., USN, ACofS, J-2

Colonel David O. Byars, Jr., USA, ACofS, J-3

Captain Marshall H. Cox, USN, ACofS, J-4

Colonel Hugh A. Vest, USA, ACofS, J-5

Commander Alfred P. Boileau, USN, Comptroller

Doctor Gaelen L. Felt, Commander, Task Group 7.1

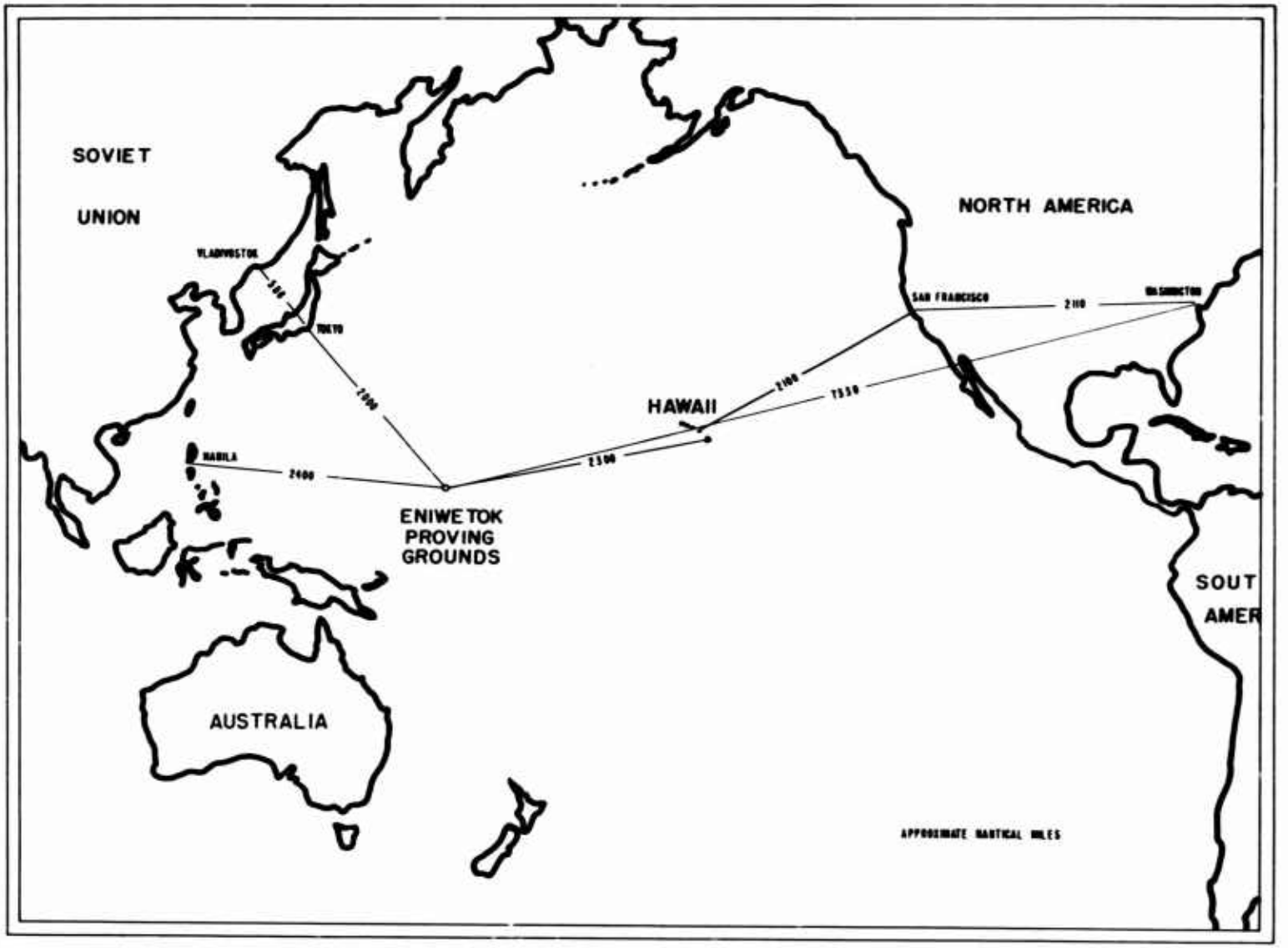
Colonel Roger M. Lilly, USA, Commander, Task Group 7.2

Rear Admiral Joseph H. Wellings, USN, Commander, Task Group 7.3

Colonel John S. Samuel, USAF, Commander, Task Group 7.4

Mister James E. Reeves, Commander, Task Group 7.5

[redacted]


SOVIET
UNION
NORTH AMERICA
SAN FRANCISCO
2110
HAWAII
2100
7330
2590
2400
ENIWETOK
PROVING
GROUNDS
AUSTRALIA
SOUT
AMER
APPROXIMATE NAUTICAL MILES

[redacted]

PART I. ORGANIZATION

Tests of weapons (armament in production and stockpiled) and of devices (potential weapons) are part of an effort by the United States to maintain an efficient and modern military establishment in defense of the security of the free world. In the absence of effective international agreement to limit or control armament, the United States, in the words of an Atomic Energy Commissioner, acts on the conviction that "a superior weapons capability in the hands of a nation dedicated to peace provides the maximum assurance that a breach of the peace will not be attempted."

Since atomic armament is an important element of the United States military capability, the development of new d improved atomic weapons would seem to be a constant endeavor. sea h develops devices that are refined into serviceable weapons that ar produced in quantity and stockpiled for military use. Before new a proved weapons can be manufactured for stockpiling, their performance and suitability must be

[redacted]

proved, the theories and designs responsible for their development must be tested. Though tests of the various components of devices and weapons occur at various stages of the development process, periodic testing of the assembled, or complete, weapon or device is necessary.

1.

Purpose

The tests embodied in REDWING comprised but one series. Since the first nuclear weapon prototype was detonated in New Mexico on 16 July 1945 to prove a capability that was strikingly demonstrated several weeks later at Hiroshima and Nagasaki, the United States has conducted twelve test operations. (See Figure A).

Each test operation contributed to and was itself the result of a growing fund of knowledge concerning atomic weapons. To a large extent the data obtained from one series determined the objectives of the next. Although CROSSROADS and SANDSTONE were single entities conceived as virtually non-related efforts, GREENHOUSE inaugurated a testing continuity that has resulted in a progressive sequence of experiments. GREENHOUSE, in general, demonstrated the feasibility of thermonuclear detonation, IVY detonated a thermonuclear device, and CASTLE tested less awkward devices.

A detonation releases a certain amount of energy, called the yield. This is measured and expressed in terms of the effect created by the explosion of a specific number of tons of TNT. A one-megaton yield, for

NATION	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
UNITED STATES											
IN NEVADA						JAN-FEB RANGER 5 SHOTS OCT-NOV BUSTER-JANGLE 7 SHOTS	APR-JUN TUMBLER-SNAPPER 8 SHOTS	MAR-JUN UPSHOT-KNOTHOLE 11 SHOTS		FEB-MAY TEAPOT 13 SHOTS	
IN PACIFIC	JULY CROSSROADS (JTF-1) 2 SHOTS		APR-MAY SANDSTONE (JTF-7) 3 SHOTS			APR-MAY GREENHOUSE (JTF-3) 4 SHOTS	NOV IVY (JTF-132) 2 SHOTS		MAR-MAY CASTLE (JTF-7)	MAY WIGWAM (PACIFIC OCEAN) 1 SHOT	MAY-JUL REDWING (JTF-7)
U. S. S. R. (ANNOUNCED BY U. S.)				SEP 1 SHOT		SEP-OCT 2 SHOTS		APR-MAY 2 SHOTS	SEP 1 SHOT		
GREAT BRITAIN											
IN AUSTRALIA							OCT 1 SHOT	OCT 2 SHOTS			

FIGURE A

[redacted]

example, is comparable to that of one million tons of TNT; a kiloton, a thousand tons. Relatively low yield detonations, posing fewer problems of safety, have generally taken place at the Nevada Test Site, near Las Vegas. Higher yield bursts -- accompanied by hazardous quantities of blast, heat, and radioactivity -- are tested in the Pacific.

Specially formed provisional joint task forces conducted the earlier overseas test operations. But in order to create an organizational continuity that would match the functional continuity of the testing, the Joint Chiefs of Staff (JCS), early in 1953, accorded permanent status to the command then planning CASTLE. Joint Task Force SEVEN (JTF7) thus received the mission of executing all subsequent overseas atomic weapons tests. By then, REDWING was tentatively projected for execution in the spring of 1956.

2.

Participants

The list of tests that comprised Operation REDWING was the result of decisions reached over a period of months by a variety of agencies.

By law, the development and control of atomic energy -- all forms of energy released in the course of nuclear fission or transformation -- are responsibilities of the Executive Branch of government. To help the President administer these responsibilities, Congress created the Atomic Energy Commission (AEC) in 1946. Through its Division of Military Application (DMA), the AEC develops, produces, and stores atomic weapons. The

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Director, DMA, a staff advisor who is also a unit commander, controls two operations offices, one at Albuquerque, New Mexico, the other at San Francisco, California. Insofar as research is concerned, the Albuquerque Operations Office (formerly the Santa Fe Operations Office) supervises the Los Alamos Scientific Laboratory (LASL) at Los Alamos, New Mexico; the San Francisco Operations Office oversees the University of California Radiation Laboratory (UCRL) at Livermore, California. Both laboratories are branches of the University of California, which administer them under AEC contracts, and the laboratory personnel are, consequently, university employees paid indirectly by the AEC.

LASL and UCRL perform the research to develop the nuclear components of atomic devices and weapons, and to this end they draw designs and specifications that other AEC facilities and certain civilian contractors fabricate. Research for the non-nuclear components of a device such as the ballistics case and fuse is the responsibility of a Western Electric subsidiary, the Sandia Corporation, which performs the necessary ordnance engineering under a non-profit contract with the AEC and under the supervision of the Albuquerque Operations Office. Other laboratories, both civilian and military, also participate in the research and development program.

When it becomes desirable or necessary to confirm the theoretical calculations of the laboratory, prototype devices and weapons are produced for detonation at Nevada or in the Pacific for experimental purposes. During detonation, function or malfunction is observed, measured, and recorded. Whether the device worked as predicted is the basic question that the research laboratories seek to answer, and this problem of what

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is termed diagnostics pertains primarily to the internal reaction of the components that comprise the device.

Since the desired result of research, development, and testing is the production of weapons to be stockpiled in war reserve, the devices must meet certain military requirements. Size, shape, weight, capability, and compatibility are some of the characteristics defined by the military establishment, which in the final analysis must be able to use the weapon. A device designed to be delivered by a specific airplane, for example, cannot exceed the size and weight capable of being carried by that craft. So that the armament developed will be practical, the Department of Defense (DOD) formulates atomic weapons criteria.

In order to provide liaison between the AEC, which produces the weapons, and the DOD, which uses them, an independent group exists. This is the Military Liaison Committee, composed of general and flag officers of all the military departments and a chairman appointed by the President. The committee insures effective co-operation and co-ordination between the two independent governmental agencies involved in the atomic weapons program.

Since the DOD must be ready to make operational use of atomic weapons, the military establishment also performs tests. Unlike the AEC laboratories, which are inclined toward basic as differentiated from applied science and which are fundamentally concerned with the internal reaction of a weapon, the DOD is interested in the external effects of the detonation on the enviroment -- the capability of the device or weapon. By agreement with the AEC, the DOD conducts what is known as the Weapons Effects Tests (WET).

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The specific DOD agency engaged in this activity is the Armed Forces Special Weapons Project (AFSWP), an interdepartmental headquarters. Not only does AFSWP furnish technical supervision of military research and development programs; it also co-ordinates the special requirements of the Army, Navy, and the Air Force. After suggesting certain test projects of primary interest to each Service, and after reviewing proposals that come from the Services, AFSWP draws up a program of tests for approval by the Assistant Secretary of Defense for Research and Development.

Though AFSWP sets the scope of the effects testing and budgets the projected tests, a subordinate unit, the Field Command (FC) of AFSWP, is the operating agent that prepares and executes the experiments. Specifically, the FC AFSWP Deputy Chief of Staff for WET, through his director of the Test Division, obtains and documents the data that measure effects of the weapons and devices detonated.

AEC and DOD interests in weapons testing thus are some what like the opposite sides of a coin, the AEC primarily concerned with the internal reaction of a device or weapon, the DOD primarily interested in its external effects. The coin that enables both agencies to reach their respective goals during overseas atomic weapons tests is Joint Task Force SEVEN. (See Figure B).

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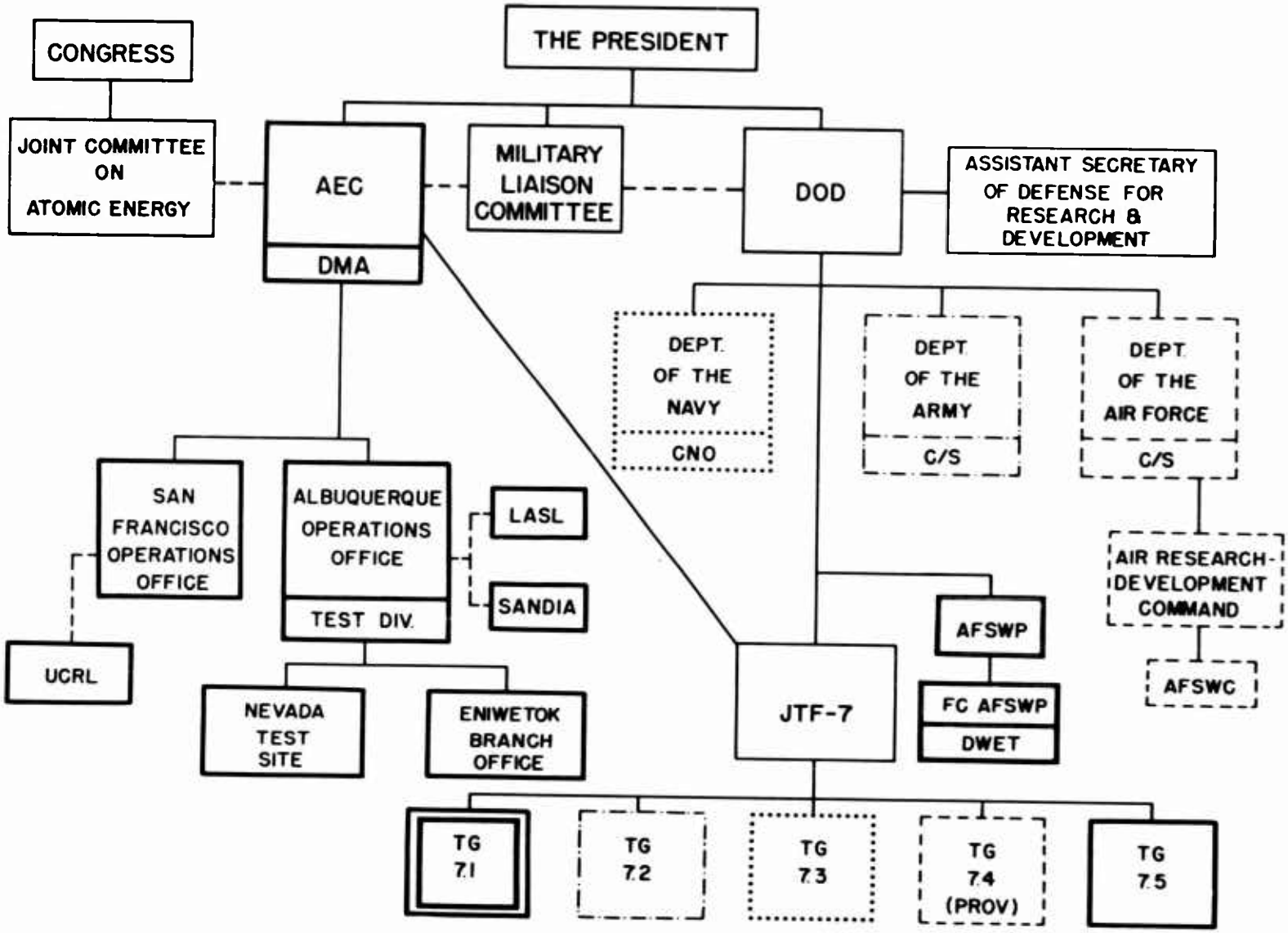
CONGRESS
THE PRESIDENT
JOINT COMMITTEE ON ATOMIC ENERGY
AEC
DMA
MILITARY LIAISON COMMITTEE
DOD
ASSISTANT SECRETARY OF DEFENSE FOR RESEARCH & DEVELOPMENT
DEPT. OF THE NAVY
CNO
DEPT OF THE ARMY
C/S
DEPT OF THE AIR FORCE
C/S
SAN FRANCISCO OPERATIONS OFFICE
ALBUQUERQUE OPERATIONS OFFICE
TEST DIV.
LASL
SANDIA
UCRL
NEVADA TEST SITE
ENIWETOK BRANCH OFFICE
JTF-7
AFSWP
FC AFSWP
DWET
AIR RESEARCH-DEVELOPMENT COMMAND
AFSWC
TG 7.1
TG 7.2
TG 7.3
TG 7.4 (PROV)
TG 7.5

FIGURE B

[redacted]

3.

Site

Immediately after World War II, as a result of the desire of the Navy to test atomic weapons effects on ships, CROSSROADS took place. The site selected was the Bikini Atoll in the Marshall Islands, chosen for its isolation from population centers and for its relatively shallow and sheltered lagoon waters. (See Figure C). To safeguard the 166 persons inhabiting Bikini, the Navy relocated them on another atoll in the Marshalls.

Soon after CROSSROADS, the AEC began to consider the desirability of establishing a somewhat permanent test site for atomic weapons and devices. Ideas had been developed suggesting more versatile and efficient weapons -- some of these were concepts that had been bypassed during the World War II atomic weapons program -- and they therefore needed testing. The AEC began to search for an outdoor laboratory that would serve not only to determine the validity of the new concepts and the reliability of theoretical calculations, but also to create conditions that might reveal additional principles.

Though a site within the continental United States was at first desired, it was recognized that the phenomena of radiation and fallout were not well understood. This led to the decision to seek an isolated ocean location in the interest of public safety. The Eniwetok Atoll of the Marshall Islands, about 200 miles west of Bikini, was selected. (See Figure D).

[redacted]

[redacted]

Eniwetok contained the characteristics needed for a test site. Its few inhabitants, 145 persons, could be relocated nearby and adequately cared for. A large space of open sea around the atoll could receive the deposit of radiological debris, and the ocean currents would carry radioactive particles hundreds of miles before affecting inhabited land masses. Violent storms were most unusual. The prevailing winds minimized radiological hazards for the small populations on neighboring islands. A number of outlying islands were suitable for weather stations. Eniwetok was convenient for logistical operations in support of the tests -- nearby air bases were in operation, anchorage for large cargo vessels was available, detonation sites were readily accessible to both medium landing craft and large vessels. Though the total land surface of the islands in the atoll was little more than two square miles, the configuration and size of the atoll made the ground adequate for housing, observation stations, instrumentation facilities, and remote firing points.

Before the AEC established a proving ground at Eniwetok, arrangements were made with the United Nations; for the Marshall Islands, a Japanese mandate after World War I until seized by United States troops during World War II, had become part of a United Nations trusteeship administered by the United States through the Department of Interior. (See Figure E).

Upon the completion of certain formalities, the President, in 1947, designated the Eniwetok Atoll as an atomic proving ground, to be maintained and operated by the AEC. The United States notified the United Nations Security Council of this action and declared the territorial waters of Eniwetok a "closed area" for security reasons; defined a larger "danger zone" in effect during actual testing periods and published warnings to advise vessels and aircraft to avoid the area.

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MAP OF BIKINI ATOLL

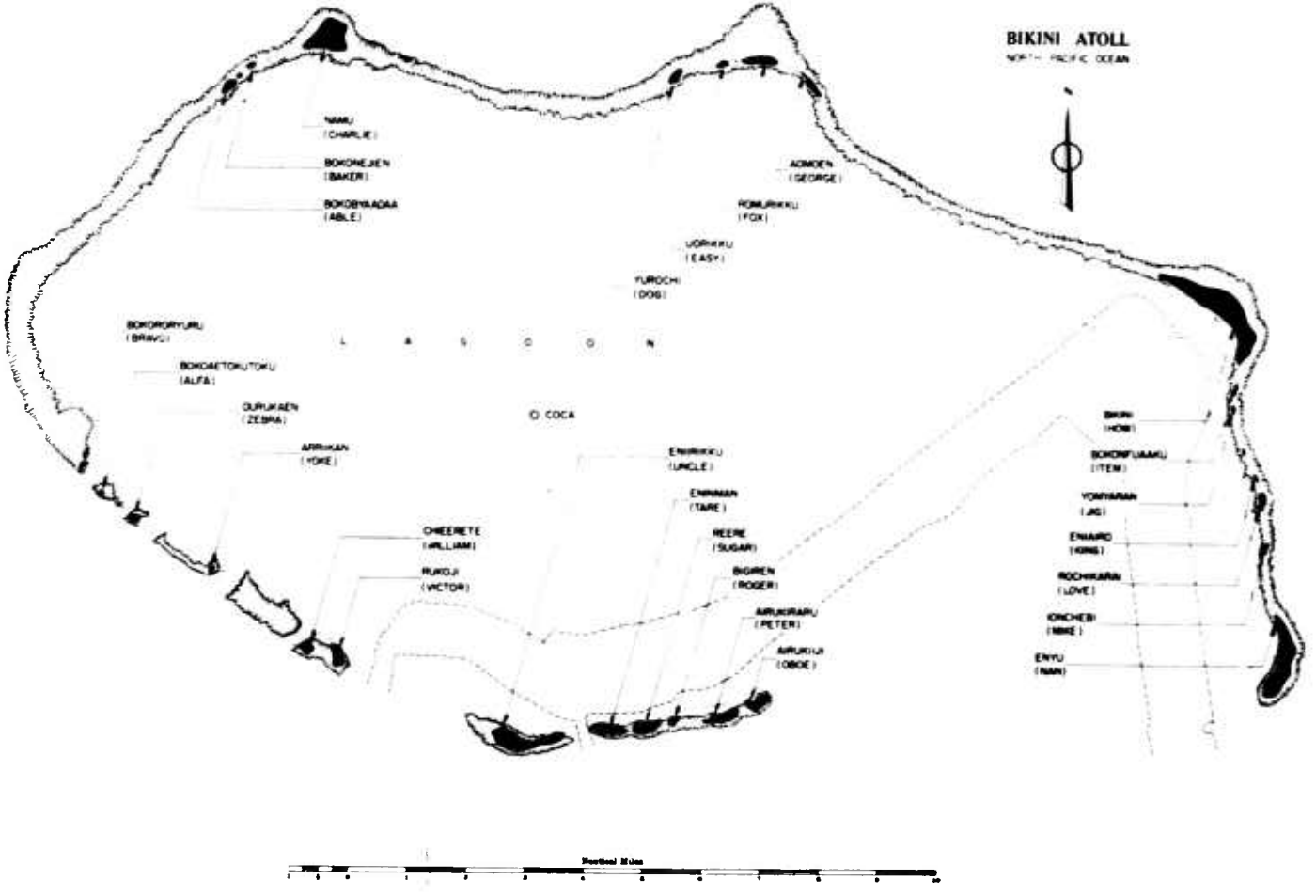

FIGURE C

MAP OF ENIWETOK ATOLL

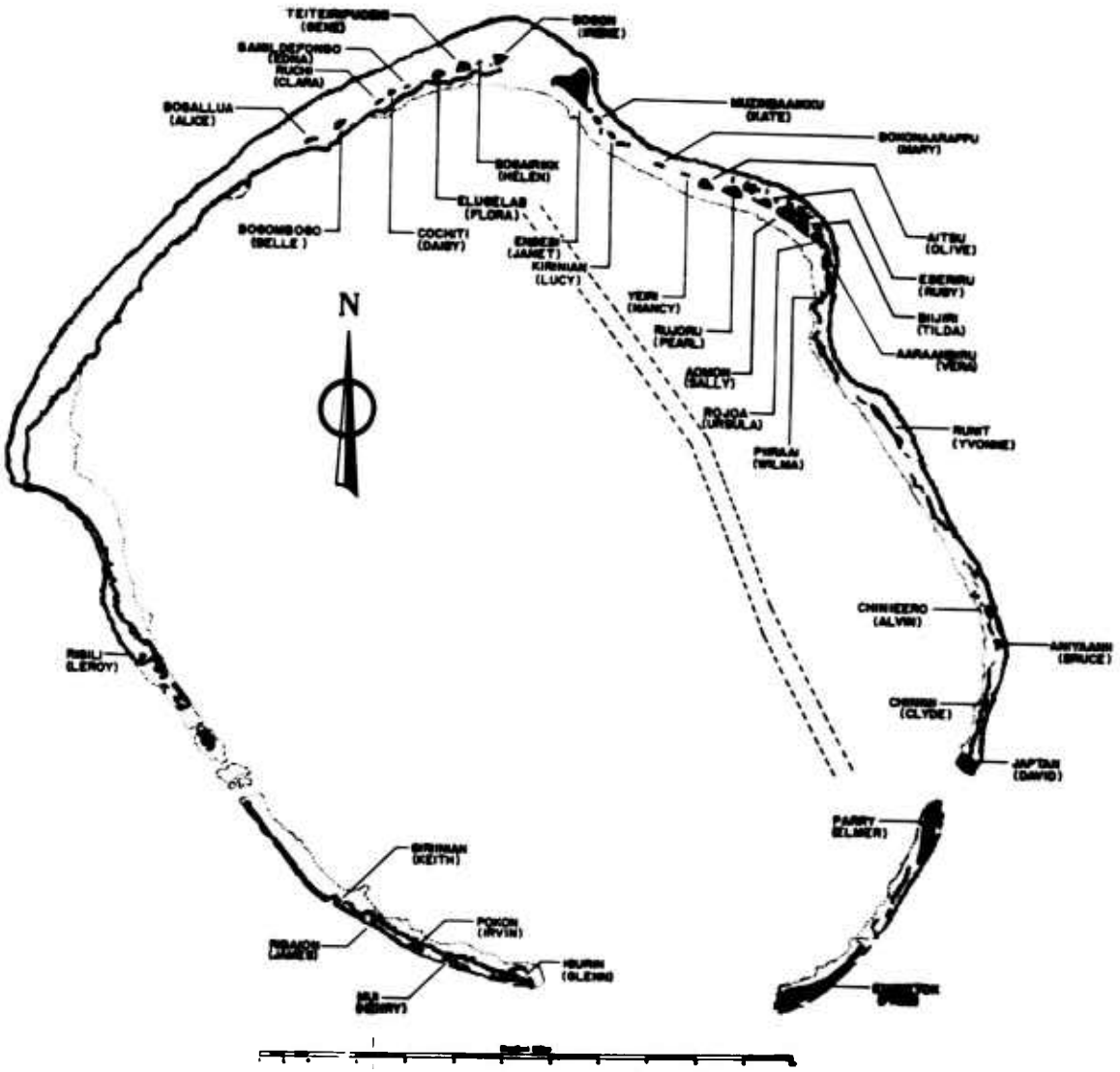

FIGURE D

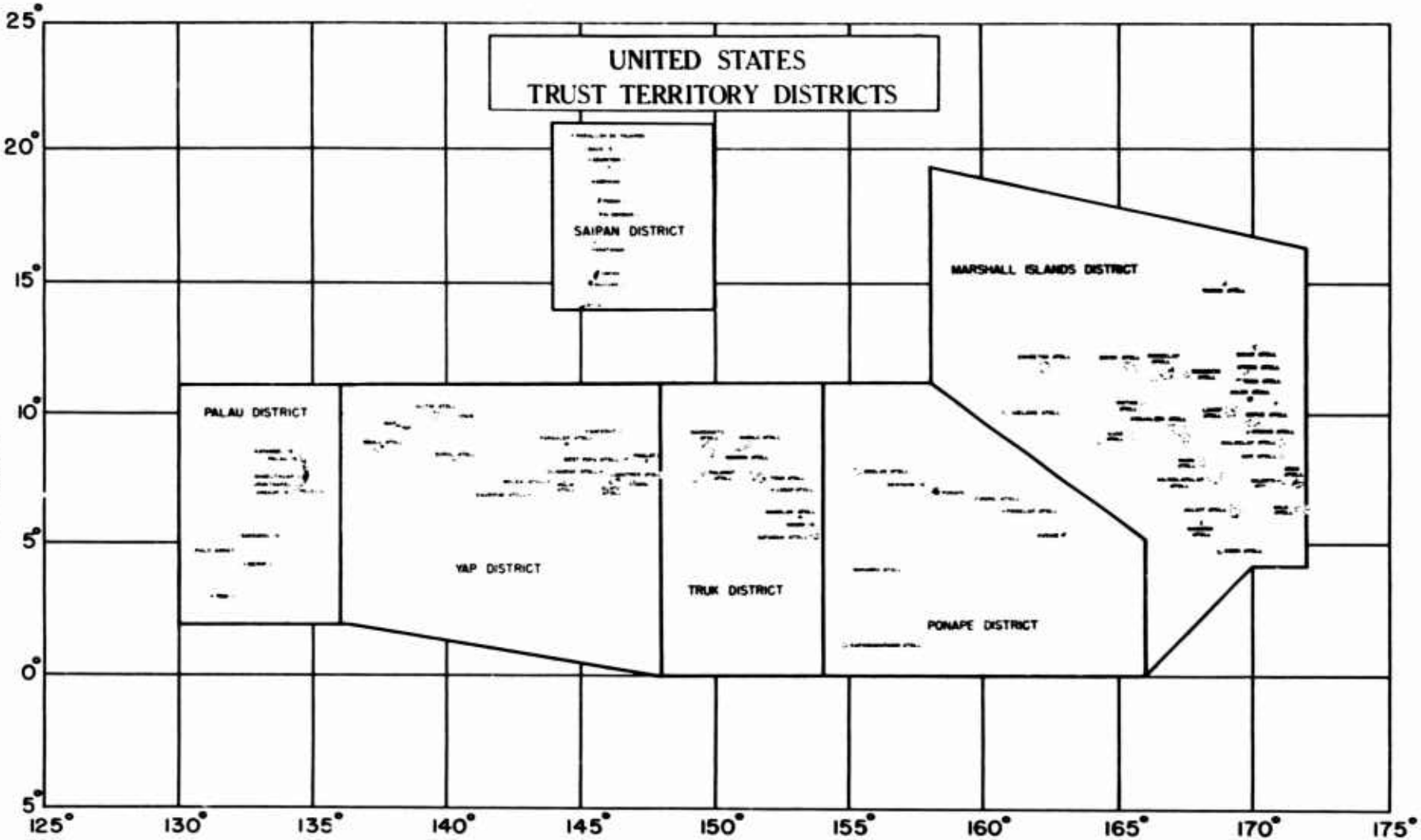
UNITED STATES
TRUST TERRITORY DISTRICTS
SAIPAN DISTRICT
MARSHALL ISLANDS DISTRICT
PALAU DISTRICT
YAP DISTRICT
TRUK DISTRICT
PONAPE DISTRICT
25°
20°
15°
10°
5°
0°
5°
125°
130°
135°
140°
145°
150°
155°
160°
165°
170°
175°

FIGURE E

[redacted]

The Eniwetok Atoll sufficed for the overseas atomic tests until the advent of thermonuclear detonations. Then, with high-yield weapons increasing the risks -- radiation to personnel and blast to base facilities -- the AEC, with the support of the DOD and the concurrence of the High Commissioner of the Pacific Island Trust Territory, expanded the proving ground in 1952. The Bikini Atoll, slightly more than two square miles of land, uninhabited and unused since CROSSROADS, became an auxiliary test site. Eniwetok was then regarded as the main base of operations and the normal site for relatively low yield detonations, Bikini the supplementary site for higher yields that might damage semi-permanent installations or require the evacuation of personnel. The land areas of these atolls, their lagoons, and the waters within three miles of their seaward sides comprised the Pacific Proving Ground (PPG).

The Test Division of the AEC/DMA Albuquerque Operations Office administers the test site through the Eniwetok Branch Office, which supervises engineering, construction, maintenance, operation, and management activities performed by a civilian contractor, Holmes and Narver, Inc., of Los Angeles. Though administered by the AEC, Eniwetok and Bikini are located in a larger area that comes under the surveillance and control of the Commander-in-Chief, Pacific (CINCPAC). Since CINCPAC bears the overall military responsibility in that area, he controls supply and personnel movements to the PPG for security reasons; he applies any emergency measures that the atomic tests may necessitate in order to safeguard health and safety within the limits of his command. From the viewpoint of CINCPAC, JTF7 is a unified command, a joint force under a single commander, who is responsible for a particular area and who is designated the Atoll Commander (ATCOM), Eniwetok. (See Figure F).

[redacted]

[redacted]

Within this organizational framework of complex relationships, JTF7 executes the atomic weapons tests.

4.

Test Cycle

Historically, an entire test cycle such as REDWING has usually lasted two years. It includes four phases: planning, buildup, operations, and rollup. The individual phases may overlap, and though dates can be, and generally are, assigned arbitrarily to denote the time periods for planning purposes, the activities that belong by function to a particular phase may be found in other phases. Planning for the specific tests of an operation, for example, continues through much of the operational period. Yet the various components of the test cycle may schematically be expressed as follows:

During the planning phase, the AEC laboratories and AFSWP determine the specific tests to be executed. On the basis of the nature and the scope of the tests, JTF7 decides the extent of the military support that will be necessary. During the buildup, the organizations involved, under the supervision of Headquarters, JTF7, assemble the actual quantities of personnel and materiel required for the tests. Subject to the movement control exercised by CINCPAC, they transport this personnel and materiel from the United States to the PPG. During the operational period, JTF7 detonates the weapons and devices, conducts the tests, and records the data secured. During the rollup, the personnel assembled at the PPG for

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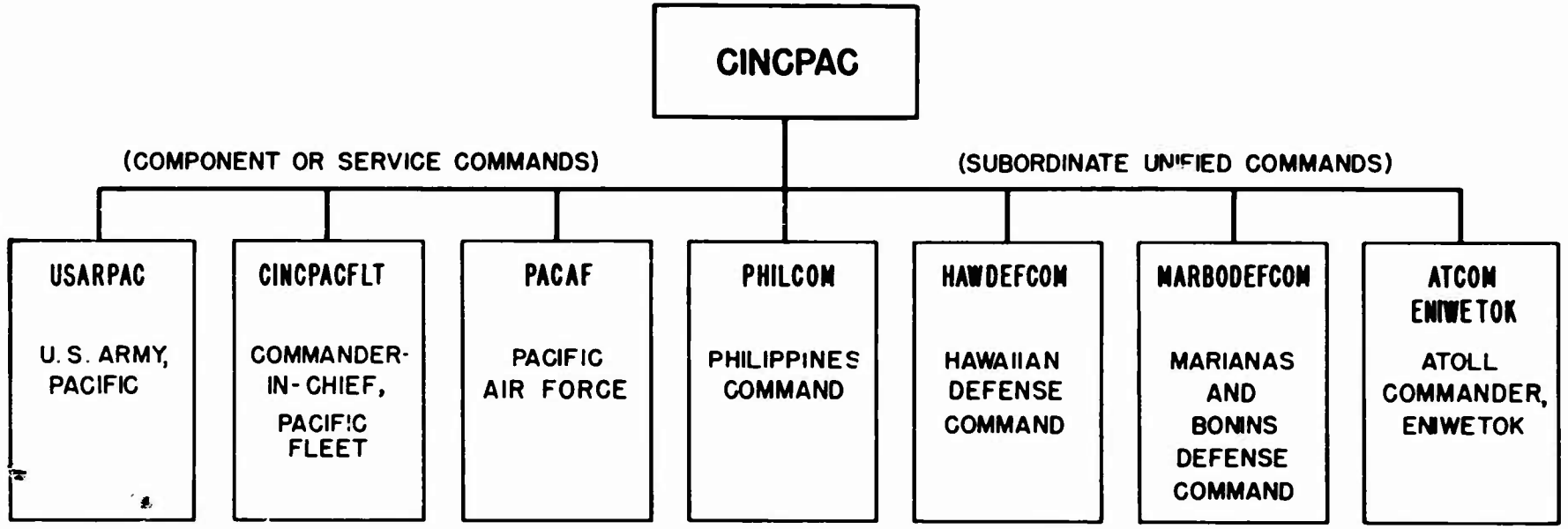

FIGURE F

(FUNCTION SOMEWHAT LIKE DEPUTY COMMANDERS OF CINCPAC)

(JOINT FORCES EACH UNDER A SINGLE COMMANDER & CONSTITUTED & DESIGNATED BY JCS OR BY A UNIFIED COMMAND ESTABLISHED BY JCS, SUCH AS CINCPAC)

[redacted]

the tests and large quantities of material and equipment return to the United States.

For REDWING, the start of the planning phase was set for 1 September 1954.

5.

Concept

If devices and weapons are to be tested, they must be detonated. Furthermore, they are detonated under a variety of conditions -- in the air, on the ground, and over and under water. Selecting the weapons or devices to be fired, deciding the order of detonation, and fixing the conditions of each shot comprise the basic ingredients of a test series. The schedule of detonations generates the framework for the concept of the operation. How this was determined for REDWING was a process that lasted two years.

Even before CASTLE came to an end, it had been informally agreed that REDWING would probably be an operation of approximately the same duration and magnitude. Yet final details depended to a certain extent on intervening operations scheduled at the Nevada Test Site for 1955 (TEAPOT). These continental tests were to exploit data secured from CASTLE and provide the basis for further empirical exploration during REDWING.

In the fall of 1954, within a few months after the termination of CASTLE, the two AEC laboratories, LASL and UCRL, knew in general the

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[redacted]

devices they wanted to test in REDWING. They could project a time when they would need to check their theoretical understanding by the actual detonation of certain devices. Thus, in the latter months of 1954, LASL, acting as the co-ordinating agency for UCRL, tentatively specified certain REDWING requirements -- detonation sites, technical facilities, military support items.

Meanwhile, AFSWP had been studying the laboratory proposals and planning the effects tests to be applied to the detonations. The Air Force wished to include in the test program a megaton yield weapon dropped from an aircraft. Such a drop would be the first attempted by the United States. Its purpose would be to determine how effectively a high yield weapon could be wedded to an inventory jet bomber. The laboratories agreed, and when JCS concurred, only the details remained to be decided -- where the burst would take place and at what height.

By this time, TEAPOT had taken place. Modifying certain ideas derived from CASTLE, TEAPOT contributed toward a firmer REDWING concept, a more definite shot schedule.

Each shot fulfilled a specific purpose and often several. In some instances, measuring the quantity of energy release alone was needed. In others, complex measurements were required for detailed histories of the reaction. In all cases, effects tests were programmed.

The purposes of each detonation determined the method of firing. For experiments that required precise alignment between the weapon and the measuring instruments, the detonation was to occur on land, either at ground surface or on a tower. For yield measurement that could be accomplished by cloud sampling or by wide angle fireball photography and for measuring the initial rate of gamma ray reaction, the detonation

[redacted]

[redacted]

could take place on a barge.

As individual proposals for specific detonations were being collected into a tentative series of shots, the scope of the operation emerged. Weapons and devices were to be detonated both at Bikini and Eniwetok. Low yield bursts would be fired at Eniwetok, high yield shots at Bikini. Many facilities such as existing instrumentation bunkers could be used again, but the larger effort posed construction complications and demanded more military resources than had been utilized during prior operations.

Though changes were to be made in the REDWING shot schedule even as late as the operational period, the concept was firmly enough fixed early in 1955 for appropriate directives to be issued. After the President approved, the AEC scheduled the REDWING tests for the spring and summer of 1956, and the JCS, on 8 July 1955, instructed the Commander, Joint Task Force SEVEN to execute the operation.

6.

Requirements

After CASTLE, scientists at LASL and UCRL prepared the diagnostic tests to be applied to the REDWING detonations, experiments designed to give a better understanding of the behavior of devices and weapons. The basic diagnostics measure the yield of the detonation and record the detailed behavior of the reaction, phenomena important to the theoretician

[redacted]

who designed the device, to the experimenter evaluating the detonation, and to the military interested in effects.

In all such tests the standard measurement, called the alpha, determines how rapidly the nuclear reactions take place. Experiments to compute the yield analyze the fission fragments produced -- by telemetering instruments that secure and read data many miles from the detonation and by radiochemical activity on atmospheric samples gathered from the mushroom cloud. Still other tests measure the yield by photographing the rate of growth of the fireball. High speed cameras record additional phenomena on oscilloscopes.

DOD scientists establishing the weapons effects tests seek to discover or derive information required by all the military Services for the most effective employment of nuclear resources and for the best defense against atomic attack. Though primarily concerned with the practical effects of atomic detonations, the DOD scientists are also interested in basic research data that help predict the effects of weapons and give better understanding of damage producing phenomena.

Effects tests primarily study three detonation phenomena: 1) blast and shock, 2) nuclear radiation, both prompt (neutron and gamma rays), and delayed (fallout), and 3) thermal radiation. The blast and shock resulting from the high air pressures and wind velocities created by a detonation are measured to determine their effects on certain shapes and structures, on potential water waves, and on the protection afforded by vegetation. Radiation experiments seek to discover the susceptibility of certain materials to contamination and the ease with which they may be decontaminated. Thermal radiation or the heat produced is studied in relation to flash blindness or retinal burn.

[redacted]

Other no less essential experiments concern the response of aircraft to thermal and blast effects, the effects of detonations on the ionosphere that might have application to long-range communications, basic research in electromagnetic radiation, thermal damage to certain materials, and photography of the development and movement of the mushroom cloud.

Much of the scientific planning consists of determining the specific tests to be applied to each detonation. On the basis of the data desired thought is given to positioning and locating the instrumentation and equipment required to measure the phenomena. With this comes the accompanying necessity for ground stations, ships, and planes where the actual measuring instruments are placed during the detonation.

The complexity of the scientific requirements involved in the testing is evident from the techniques of measurement alone. The procedure for measuring blast and shock effects, for example, requires canister drops from aircraft; telemetering instruments for remote recording of phenomena, detectors on the ground, in the air, and on ships -- both self-recording and communicating with distant recorders; smoke rockets to produce trails in order to grid the explosion so that the position of the shock wave is visible against an artificial background and can then be photographed; and a variety of close-in and distant stations for these and other measurements.

Nuclear radiation effects tests require a string of ground stations to record gamma radiation in time and distance; rockets with telemetering instrumentation; oceanographic equipment to study fallout at various distances and depths, not only to reconstruct the matter and the amount of radioactive material that strike the surface of the water but also to determine how ocean currents carry radioactive particles; collection in-

[redacted]

struments -- some collecting all radioactive matter that fall, others working automatically to give samplings at various times -- installed at various places, on land, on anchored barges, rafts, and plastic skiffs, on remote-controlled ships, on aircraft with survey meters that delineate the area of fallout, and on aircraft that can penetrate the bomb cloud to secure data pertinent to air crew exposure.

Documentation of thermal effects requires aircraft to establish delivery capabilities; bonded aircraft and structural materials; animals, cages, and cameras for studies of flash blindness.

To help measure yields, fast action cameras -- some taking photographs at the rate of eight million frames per second -- were to be placed on the ground; cameras capable of operating at the rate of several thousand frames per second were to be installed in planes.

Various stations were needed to measure gamma ray histories. Fallout was to be observed throughout the PPG and outside it, on the ground, in ships, and in planes. The Public Health Service was to collect fallout information and the Geodetic Service was to measure blast pressures. Oscilloscopes capable of resolving a time interval as small as one-tenth of a microsecond, were to be installed and triggered according to a master time sequence.

The scientific requirements were basic to the operation, for they determined the scope of the test series. They in turn engendered necessary supporting services -- the operation of airfields and of surface transportation facilities on water and on land; the maintenance of roads, vehicles, ships, and planes; the provision of food, shelter, and individual welfare services for the persons who would execute and assist in the testing.

[redacted]

The organization and direction of the activities to meet the numerous requirements of the operation were the responsibility of Joint Task Force SEVEN.

7.

Task Force

The Joint Chiefs of Staff, which created JTF7, directs it. By historical precedent and custom, one of the three Service heads acts as the JCS executive agent for a particular test operation. A rotating responsibility among the Services, the executive agent devolved upon the Chief of Naval Operations (CNO) for REDWING. This meant that during REDWING a Navy officer would command the task force. In August 1955, Rear Admiral B. Hall Hanlon replaced Rear Admiral Charles B. Momsen, who had commanded the task force since the termination of CASTLE.

Each military Service furnished men and materiel to JTF7 for REDWING in amounts fundamentally determined by the Commander, JTF7 (CJTF7). To assist the CJTF7 the Services assigned three military deputy commanders to the task force -- Major General John C. Macdonald of the Army, Rear Admiral Joseph H. Wellings of the Navy, and Brigadier General Perry B. Griffith of the Air Force. The deputies advised the CJTF7 on the effective use of the forces they represented and kept close and constant liaison with their respective arms. They were authorized and encouraged to deal directly with departmental agencies on higher echelons as well as with JTF7 subordinate units in order to expedite and simplify operations.

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In the absence of the commander, the senior deputy present for duty, no matter what his Service, was empowered to act. This was a new and radical departure from past operations, and proved to be of extreme value and importance to the success of REDWING.

The CJTF7 employed a joint staff headed by Rear Admiral Leonard B. Southerland, who replaced Captain William H. Ashford as Chief of Staff in September 1955. The Deputy Chief of Staff, the Assistant Chiefs of Staff for Personnel, Intelligence, Operations, Logistics, and Communications, and the Comptroller consisted of three Army Officers, three Navy, and one Air Force. The Headquarters of JTF7 was composed of 167 assigned individuals in approximately equal proportions among the Services -- 52 Army, 52 Air Force, and 63 Navy. (See Figure G).

Though the Department of Defense bears responsibility for the effects testing and furnishes the military support for the entire test series, the Atomic Energy Commission exercises test control of all atomic matters. In order to enable JTF7, a DOD command, to execute the testing without restriction, the AEC appoints the CJTF7 its agent at the PPG for the operational period of the overseas tests. Specifically, the AEC accords the CJTF7 full authority to act for the Commission during the test period.

By so doing, the AEC places upon the CJTF7 the responsibility for the tests and the accountability for the expenditure of nuclear elements. The AEC also authorizes the CJTF7 to exercise operational control of the AEC civilian components involved in the tests, components that become part of JTF7 during the operation. To aid the CJTF7 in a task outside the normal sphere of military cognizance was the role of a fourth deputy

HEADQUARTERS, JOINT TASK FORCE SEVEN

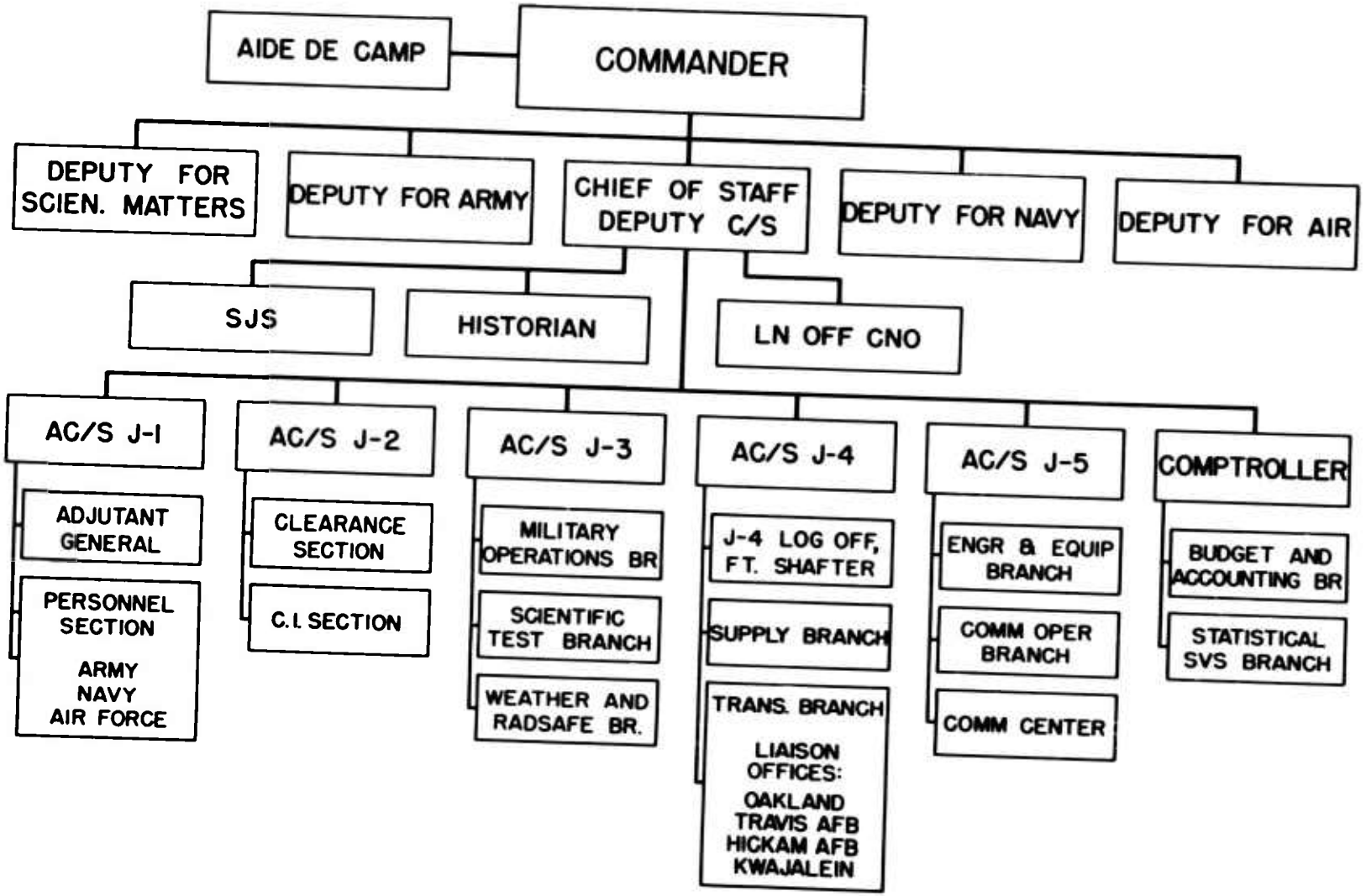

FIGURE G

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commander, the Deputy for Scientific Matters, Dr. William E. Ogle of LASL, who replaced Dr. Alvin C. Graves in this position early in 1956.

The task of JTF7, thus, is to integrate the efforts of the AEC and the DOD into one comprehensive endeavor, and the CJTF7, the senior representative in the PPG of the AEC and the DOD during the operational period, binds together in his person the AEC-DOD activities that comprise the test operation. Though the exercise of a military joint command is not unusual since World War II, the command unified in the person of the CJTF7 is unique by virtue of the organic presence of civilian groups during the operational phase.

As defined by the JCS for REDWING, the mission of the CJTF7 was to conduct tests of experimental weapons and devices as proposed by the AEC and AFSWP. The CJTF7 exercised co-ordination and control of the necessary planning. He had full authority to make, unilaterally, all decisions he considered necessary in the interests of safety, security, and the accomplishment of his overall mission. If changes in the operational concept necessitated modifying the military support requirements, the CJTF7 had authority to do so through direct action with each Service concerned.

From the viewpoint of the CJTF7, each test operation consists of interim and operational periods. The operational period begins with the delegation of authority from the AEC to the CJTF7 and ends with the relinquishment of that authority upon the conclusion of the testing. These dates coincide with the first important shipment of nuclear components from the United States to the PPG and the return of any unused nuclear materials after the operation.

During REDWING, the CJTF7 headed an organization consisting of a headquarters and five subordinate task groups, all united at the PPG only

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during the operational phase of the test cycle. Headquarters, JTF7 was located on Parry Island of the Eniwetok Atoll. Task Group (TG) 7.1, with headquarters on Parry Island, was the scientific unit, comprised mainly of persons from the Test Divisions of LASL and UCRL (who performed the diagnostic tests) and persons from FC AFSWP (who performed the effects testing). TG 7.2, an Army element stationed on Eniwetok Island, in addition to housekeeping, performed services pertaining principally to internal security and long range communications facilities. TG 7.3, a Navy force, with headquarters afloat, furnished naval support. TG 7.4, a provisional Air Force unit on Eniwetok Island, provided air support. TG 7.5, with headquarters on Parry Island and consisting of personnel of the AEC and of Holmes and Narver (the contractor at the PPG), constructed and maintained the base facilities and technical installations required for the tests. AFSWP was represented in the command structure by three officers who served as Assistant Deputy Commander for Scientific Matters of JTF7, Deputy Commander of TG 7.1, and Commander of Task Unit 3 of TG 7.1. (See Figure H).

The headquarters of JTF7 and of the subordinate units (except TG 7.3) functioned ashore except during detonations at Bikini when command posts were established aboard ships.

During the interim period between the CASTLE and REDWING test series, the elements of JTF7 were physically scattered, joined only by their common effort to prepare for the next projected operation. Headquarters, JTF7 was located in Washington, D.C. TG 7.1 maintained a small planning headquarters at Los Alamos, New Mexico. TG 7.2 remained at Eniwetok as a garrison force. TG 7.3, though usually virtually dissolved except for a small headquarters in Washington, D.C., retained forces to execute a

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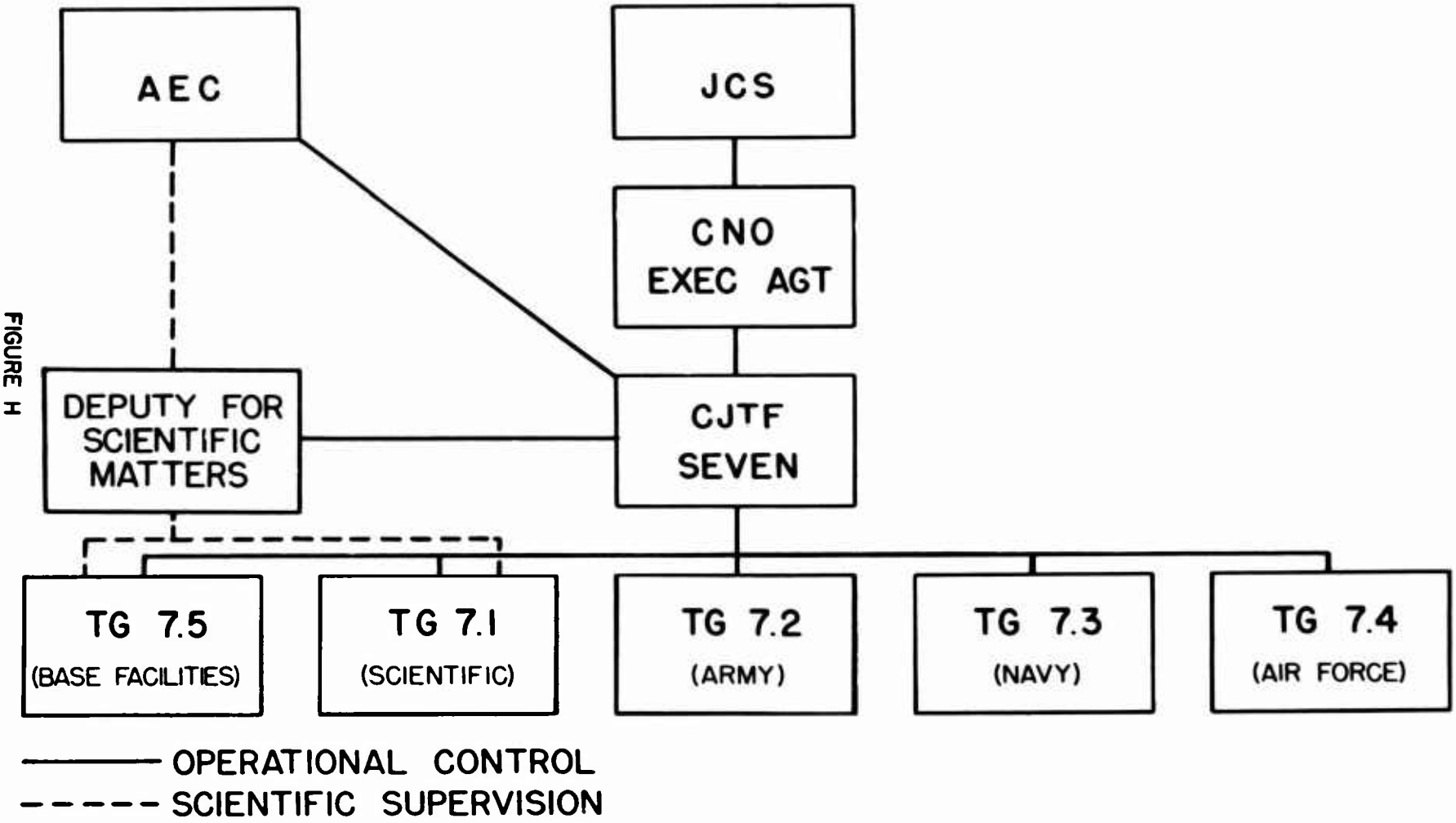
AEC
JCS
CNO
EXEC AGT
DEPUTY FOR
SCIENTIFIC
MATTERS
CJTF
SEVEN
TG 7.5
(BASE FACILITIES)
TG 7.1
(SCIENTIFIC)
TG 7.2
(ARMY)
TG 7.3
(NAVY)
TG 7.4
(AIR FORCE)
OPERATIONAL CONTROL
SCIENTIFIC SUPERVISION

FIGURE H

[redacted]

special atomic test (WIGWAM) in 1955. TG 7.4 disappeared, its personnel absorbed into the Air Force Special Weapons Center (AFSWC), Kirtland Air Force Base, New Mexico. TG 7.5 split its forces, some returning to the Albuquerque Operations Office, others remaining at Eniwetok to close down the CASTLE operation and commence construction for REDWING. (See Figure B).

This, then, was the organization that prepared and executed Operation REDWING.

PART II. PREPARATION

To transform REDWING from an operational concept to an operational reality, Headquarters, JTF7 acted mainly as a co-ordinating agency, bringing plans into focus and making certain that the necessities of the operation arrived at the required places in the needed amounts and ready for performance. Long before the JCS issued the directive to execute REDWING, since the termination of CASTLE, JTF7 was preparing for the REDWING test series.

8.

Fiscal

The AEC constructed and maintained virtually all the base facilities at the PPG. The DOD assumed responsibility for the fixed communications

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facilities on Eniwetok and Japtan Islands, a JTF7 communications center on Parry Island, and the military communications systems required in support of the test operation. Project costs for the experiments were borne by the interested agency; those of mutual interest were funded jointly, the percentage of each contribution determined in each case by agreement. Equipment reasonably available from the stocks of either agency was furnished to the other on loan at no cost except for operation and maintenance. The AEC in general requested no military equipment that was available from commercial sources.

Congress, through the Bureau of the Budget, provided the funds for REDWING. The Albuquerque Operations Office paid for AEC activity at the PPG. The DOD met budget obligations both of normal Service operational expenses and of extra-military costs.

Normal operational expenses, budgeted by each Service, included such items as costs of pay and allowances, medical and dental care, standard equipment and supplies. Extra-military expenses consisted of those specifically required by JTF7 for REDWING, the costs, for example, of special equipment or of modifying Service equipment.

JTF7 was involved in normal Service items to the extent of funding certain expenses of TG 7.2 as a matter of convenience, of transmitting planning information to the Services to facilitate their own budgeting action, and of making certain that the military forces placed under JTF7 operational control were properly trained and equipped by each Service to perform the duty assigned. In the matter of extra-military items, JTF7 prepared a budget of its own for a relatively small portion of the additional expenses incurred by the Services in specific support of REDWING.

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To eliminate the individual number of requests for funds at the DOD level, JTF7 submitted its budget to AFSWP. AFSWP added the JTF7 sum to its own budget before transmitting the consolidated request to the Department of the Army Comptroller. Funds received were made available directly to the CJTF7. AFSWP allocated research and development funds to subordinate groups of JTF7 performing military-sponsored weapons effects tests.

9.

Administration

At the conclusion of CASTLE, when the CNO became the JCS executive agent for overseas atomic testing, the newly-appointed CJTF7 activated an Advance Headquarters at Pearl Harbor. A small staff assisted him there, while the Chief of Staff (originally Rear Admiral Robert G. Goldthwaite) headed the Administrative Headquarters in Washington, D.C. When Admiral Hanlon took command of the task force, he consolidated the headquarters in Washington. A weather detachment remained at Hawaii to study tropical meteorology. A logistics detachment at Fort Shafter, Hawaii, assisted in liaison activities.

During the CASTLE-REDWING interim, JTF7 prepared tables of distribution as the basis for military personnel requisitions -- 160 for the Headquarters; 106 for TG 7.1; 831 for TG 7.2; 36 for TG 7.3, to be augmented later to a total of almost 6,000; and 806 for TG 7.4, to be augmented later to a total of about 2,300. (TG 7.5 would have about 2,800

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civilians employed by Holmes and Narver.) In addition to these strengths authorized on manning documents of the three Services, additional personnel were secured on a temporary duty basis -- 141 for the Headquarters, 148 for TG 7.1, and 311 for TG 7.2.

The Headquarters moved from Washington to the PPG in the spring of 1956. Members traveled as individual passengers of MATS, except for a small group of administrative personnel that accompanied the records required in the PPG. The CJTF7 departed Washington 14 April and raised his flag on Parry Island five days later.

Peak strength of JTF7 for REDWING was estimated at almost 13,700 individuals. Though it was impossible to secure completely accurate figures -- because of the temporary presence in the PPG of non-assigned persons -- the general accuracy of the forecast was realized in May 1956 with a peak population in the PPG of approximately 14,000 persons, of which about 9,500 were military.

In a location so remote as the PPG, mail is a vital morale factor. Postal service was considerably increased over previous operations, and complete postal services, including money orders and registry, were made available during REDWING at more locations. During the operational phase of REDWING, post offices functioned at Eniwetok and Parry Islands and at Enyu Island of the Bikini Atoll and handled bulk mail for task force fleet units.

JTF7 provided a unique postal service, believed to be without precedent, to the United Kingdom Colony of Tarawa where JTF7 had established a weather station. Since periodic logistical air flights from the PPG in support of this station were necessary, JTF7 planes picked up outgoing and delivered incoming mail for the colony. Instead of relying

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for their mail on slow surface transportation between the colony and New Zealand, British residents during three months, from 15 April to 15 July 1956, had their mail routed through the PPG to Honolulu. Greatly appreciated by the British, this service contributed to the excellent relations between the colony and the task force.

While JTF7 conducted the tests at the PPG, a small administrative unit maintained a Headquarters (REAR) in Washington, D.C. Under the command of Colonel Elzia Ledoux, AC of S, J-1, the headquarters served primarily as a liaison office with interested agencies of the DOD and the AEC. The unit maintained continuity in the Washington area, provided accommodations and services in support of the main task force body, performed administrative functions, issued necessary security clearances for personnel travelling to the Pacific Proving Ground, maintained a courier service for shipments of nuclear components, and rendered assistance in the conduct of the observer programs.

10.

Weather and RadSafe

Detonation of an atomic device produces radioactive particles that are carried aloft by the mushroom cloud. Heavier particles fall to earth soon after the explosion while their radioactivity is still high. Lighter particles are transported, dispersed, and diluted by winds and air currents before they fall to earth. Though radioactivity decreases rather rapidly (a decrease hastened by normal decay), even reduced amounts of

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radioactivity from fallout are a serious health hazard.

High yield weapons, with greater radioactivity, increase the danger. Though a megaton detonation during Operation IVY in 1952 gave no indication of the fallout magnitude (the fission products of that burst probably fell into the open sea northwest of Eniwetok and were never detected), a high yield shot during CASTLE unexpectedly contaminated a large area of the Pacific -- including task force personnel and Marshallese who were on the atolls of Rongerik, Rongelap, and Utirik. No one was seriously injured, but the incident drew considerable international attention.

To protect JTF7 members, nearby island populations, shipping and air traffic from a repetition of the incident, JTF7 emphasized safety precautions during REDWING to an extent beyond previous operations. To this end, JTF7 devoted more effort than ever before to the problems of meteorology and radiological safety (RadSafe).

In order to deposit radioactive debris in an area where it will be harmless, it is necessary to know how the particular winds of a particular time will act on the radioactive particles produced by a specific detonation. This demands, basically, a good system of weather forecasting.

Though meteorology is, at best, an inexact science, though tropical weather is not thoroughly understood and has been poorly documented in the past, and though weather stations in the central Pacific are meager in number, JTF7 needed for REDWING a weather service that could make accurate estimates of what could reasonably be expected to occur within 24 to 48 hours before and after each shot. To accomplish this, JTF7 devoted much effort to climatological research, technological improvement of weather collecting equipment, and expansion of the weather observation facilities.

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After CASTLE, JTF7 detailed several staff weather officers to Wheeler Air Force Base, Hawaii to study the specialized field of tropical meteorology with Professor C.E. Palmer of the University of California Institute of Geophysics who was under contract to the Air Force Cambridge Research Center. The JTF7 weather officers investigated the climatology and seasonal weather changes in the Marshall Islands, the effect of solar eruptions on the winds at the PPG, and the phenomenon of vertical wind motions. Vertical winds, usually neglected by meteorologists because they are so slight in comparison with horizontal air currents, were found to be significant at the PPG, particularly when applied to the problem of fallout. Descending winds deposit radioactive particles closer to the point of detonation, while ascending air currents carry them farther away. Yet since vertical motions cannot be observed directly or instrumentally, they must be calculated from observed horizontal winds at various altitudes. The JTF7 researchers devised a system for computing vertical motions daily and for presenting their computations in graphic form. But in order to secure the necessary data, they needed improved weather observation facilities.

With the advent of high yield devices and the attendant increase in the height of the bomb cloud, it was necessary to gather information on wind currents from the surface of the earth to altitudes in excess of 100,000 feet. Weather reconnaissance aircraft were capable of making observations up to 30,000 feet, and latex balloons released by surface weather stations could take and transmit readings up to about 55,000 feet. Above that altitude, however, rests the tropopause, a stratum of extreme cold with temperatures of from 75 to 90 degrees below centigrade; at these temperatures, latex balloons became brittle, shattered, and disintegrated.

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Upon the request of JTF7, the Army, the Air Force, and commercial balloon manufacturers brought into existence a plasticized balloon that survived the extreme cold of the tropopause. Weather readings as high as 90,000 and 100,000 feet became feasible. The balloon carried a small transmitter, a rawinsonde, which emitted signals that were tracked by a radio direction finding (RDF) system. As the balloon rose, the rawinsonde transmitted a continuous record of the pressures, temperatures, and relative humidities encountered. Though not new, this technique was used extensively during REDWING in connection with the newly developed plasticized balloon capable of high altitudes.

Though the free plasticized balloons constituted the chief means of securing atmospheric readings, several techniques supplemented them. JTF7 weather officers adapted for REDWING use the Navy 5-inch gun that fired a shell containing metal foil known as "window." Developed during World War II as a radar jamming method, the system worked for weather observation in conjunction with radar. The 5-inch gun fired a window shell; upon explosion of the shell around 30,000 or 35,000 feet, the window descended and drifted. Radar tracked the metal foil and thus disclosed the wind directions.

A new and unique piece of equipment developed for REDWING was the Window Aerological Sounding Projectile (WASP) attached to a LOKI rocket motor. Launched from a simple tube, the WASP reached altitudes around 100,000 feet and ejected a cloud of metal foil that could be tracked by radar. Experiments not completed before REDWING looked toward replacing the metal window foil eventually with a more easily tracked metallic parachute. (See Figure I).

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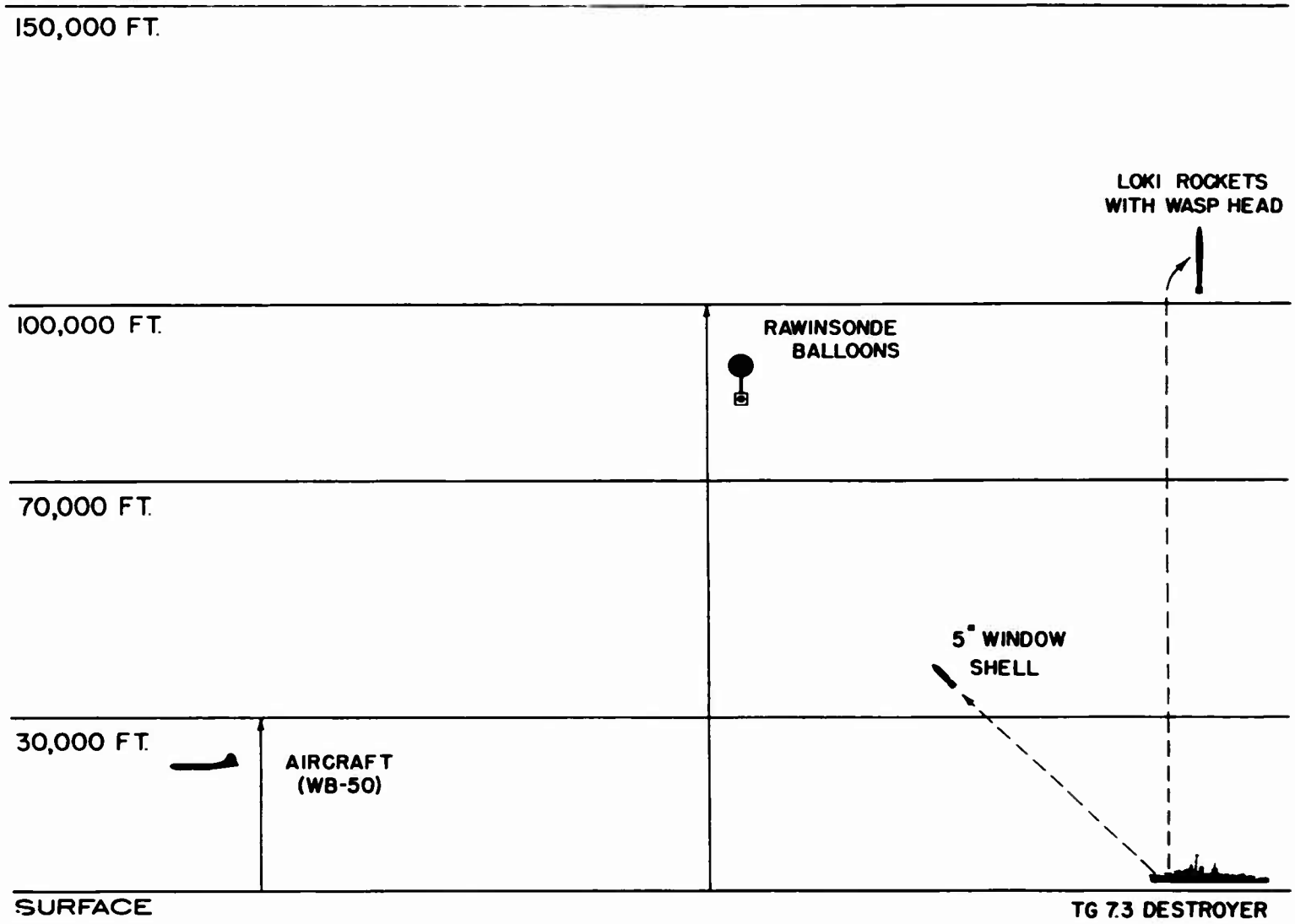
APPROXIMATE ALTITUDES
150,000 FT.
LOKI ROCKETS
WITH WASP HEAD
100,000 FT.
RAWINSONDE
BALLOONS
70,000 FT.
5" WINDOW
SHELL
30,000 FT.
AIRCRAFT
(WB-50)
SURFACE
TG 7.3 DESTROYER

FIGURE 1

As a result of the improved equipment available by the time of REDWING, JTF7 had the capability of securing weather readings from the surface of the earth to altitudes higher than 100,000 feet. Sites on which to employ the equipment, however, were not sufficiently numerous to give good area coverage. Weather stations at Eniwetok and at Kwajalein were the only ones in continuous operation that could function in direct support of the REDWING tests. A total of seven upper air observing stations existed in an area of the central Pacific the same size as the United States, where 88 weather stations are located. Additional sites for weather stations were thus urgently needed.

A group of persons representing Headquarters, JTF7, the Navy, the Air Weather Service (AWS), the Airways and Air Communications Service (AACS), and Holmes and Narver visited certain islands during the summer of 1955 to determine where additional weather stations for REDWING might profitably be located. As a result of the survey, JTF7 financed improvement of upper air observing facilities at Koror, Yap, Truk, and Ponape, and the re-opening of a station at Majuro; a station formerly operated at Rongerik was renovated, and new stations were built on Kusaie, Kapingamarangi, and Tarawa. Since the latter island is a British possession, an exchange of notes between the State Department and the Foreign Office preceded approval of the construction.

By the spring of 1956, military-staffed stations at Eniwetok and Kwajalein, JTF7-staffed stations at Rongerik, Tarawa, Kusaie, and Kapingamarangi, and Weather Bureau stations at Truk, Ponape, Majuro, and Wake Islands were ready to function in support of the operation. (See Figure J).

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But weather, at the PPG as elsewhere, is not a self-contained phenomenon. Conditions thousands of miles away influence it. To augment the relatively close-in stations about the PPG, JTF7 prepared to collect all the routine weather reports available -- including those from Australia, the Fiji Islands, New Guinea, Hawaii, Alaska, Japan, the Dutch East Indies, Hong Kong, Singapore, Marcus Island, Iwo Jima, Okinawa, Formosa, Guam, and the Philippines.

Despite this extensive weather coverage, blank spots existed. JTF7 therefore employed ships (able to operate the techniques of balloons, 5-inch window shells, and WASP rockets) and planes to collect weather information. The USS CURTISS, a modified seaplane tender, provided upper air observations at Bikini. Destroyers assigned to JTF7 for the operation were able to assume any of five designated locations northwest and northeast of Bikini, the particular location selected depending on the shot to be fired. All ships of the task force collected and reported information as a normal adjunct of their daily missions. Ten weather reconnaissance planes were on hand to fly at least two standard flights daily, each of fourteen hours duration and 2,500 miles in length, a capability of covering an area with a radius of 1,200 miles from Eniwetok. In addition, patrol and search aircraft sent routine reports of wind, cloud, and other weather conditions.

The employment of ships and planes in the weather network gave JTF7 mobility in collecting data. This advantage was particularly effective to investigate unusual conditions such as thunderstorms and typhoons.

To collect, analyze, and correlate all the weather information available, and to forecast conditions, JTF7 organized a Weather Central that served the CJTF7 through staff officers of the Weather and RadSafe

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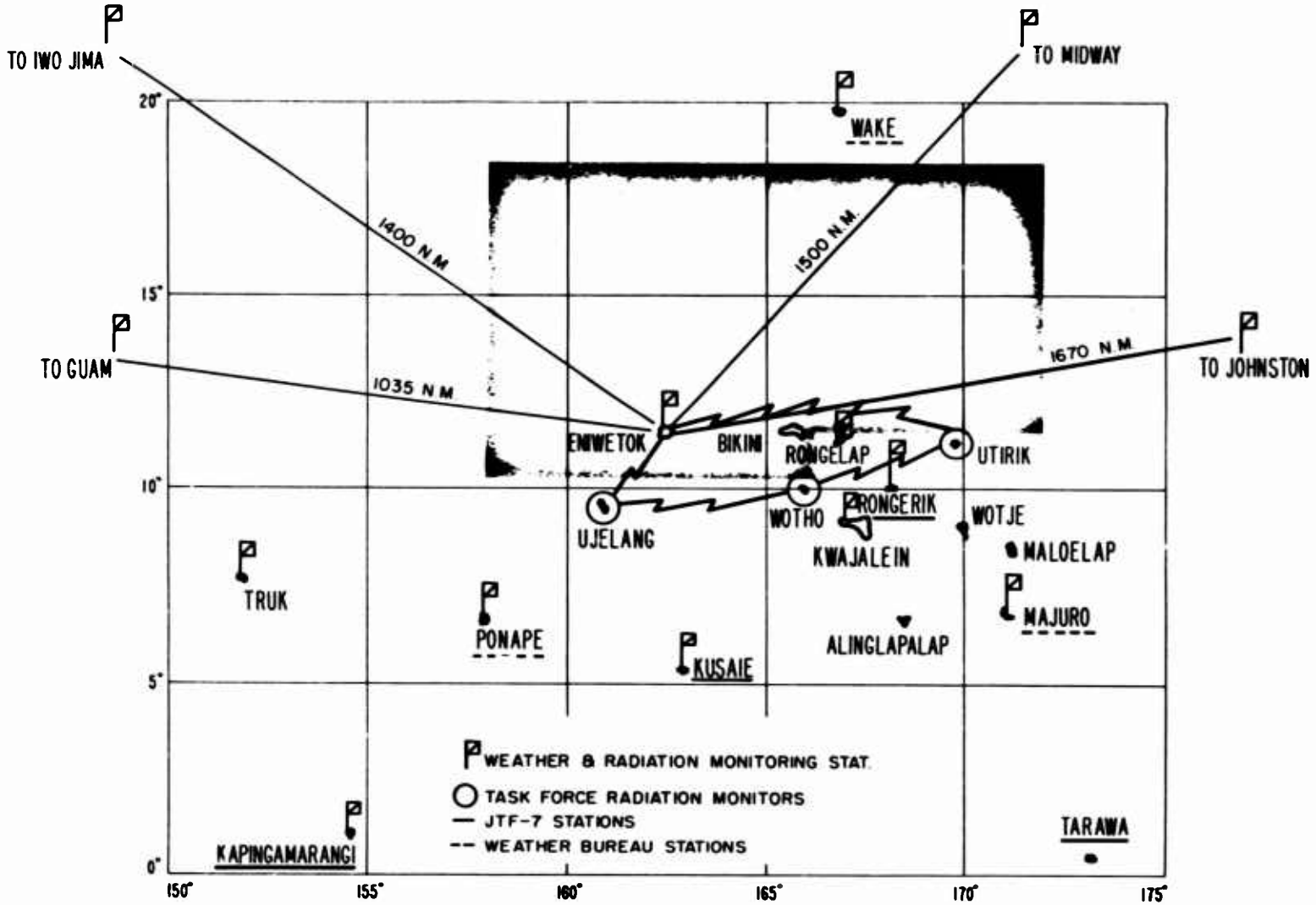

FIGURE J

RADIATION MONITORING AND WEATHER STATIONS

Branch of the JTF7 J-3 Section. Weather Central also served the subordinate units of JTF7.

Formed at Wheeler Air Force Base, Hawaii in January 1956, Weather Central contained Air Force and Navy weather service personnel and also civilians, twelve forecasters and sixteen observers trained by Professor Palmer. Under operational control of CJTF7, Weather Central came under the administration of a subordinate command of Task Group 7.4, which also controlled the aerial weather reconnaissance planes and a weather reporting element. The latter operated the JTF7 weather observing network and provided administrative support to the Weather Central, a service that enabled Weather Central to devote full time to purely meteorological matters. (See Figure K).

To reduce the time between observation and analysis of data, an extensive system of direct communications facilities was employed. Radioteletype intercepted weather broadcasts from Guam, Tokyo, Canberra, and Pearl Harbor and connected Weather Central with weather ships; continuous wave (Morse code) radio intercepted Fiji Islands weather broadcasts and connected Weather Central with the weather reconnaissance aircraft as well as with the JTF7 stations on outlying islands; radiofacsimile intercepted broadcasts from Pearl Harbor and Tokyo; landline (cable) circuits and telephone connected Weather Central with the Eniwetok weather stations.

After digesting a normal intake of 75,000 words per day, Weather Central transmitted its prognosis of conditions (particularly wind fields) to all using agencies. To avoid the necessity of having large plotting and analysis staffs at the receiving locations, Weather Central sent its forecasts by teletype and facsimile circuits. Thus, whether the CJTF7 was at his headquarters on Parry Island or at his command post afloat,

JTF7 staff weather officers were able to receive complete Weather Central charts and forecasts. Though primarily operating to provide a basis for predicting the area of fallout resulting from a projected detonation, the weather forecasts were also important for estimating the success of scientific photography, the ability of aircraft to fulfill such tasks as a bomb drop, proper sampling of the mushroom cloud, the effectiveness of search and rescue operations and security patrols, and normal air and naval operations.

In addition to the numerous persons throughout the Pacific Ocean who gathered and transmitted weather data eventually reaching the Weather Central, more than 500 men under the direct control of the CJTF7 were in direct support of JTF7 weather activities.

Weather forecasting is only half the story, for the weather forecast provides the basis of predicting where the fallout of a contemplated shot will occur.

As a result of experiments during CASTLE, weather and RadSafe experts constructed models of typical radioactive cloud formations resulting from megaton detonations. Study of the effect of weather on these clouds led to the creation of a Fallout Prediction Unit (FOPU), an organization staffed by personnel of the U.S. Weather Bureau, UCRL, LASL, the Sandia Corporation, and the Air Weather Service. Having operated successfully during the TEAPOT tests in Nevada, the FOPU applied its experience to REDWING. As part of the RadSafe Branch of the JTF7 J-3 Section, FOPU had the mission of using the weather forecasts before each detonation to estimate the probable pattern of fallout of a particular shot if fired at a particular time, a forecast that depended not only on the expected

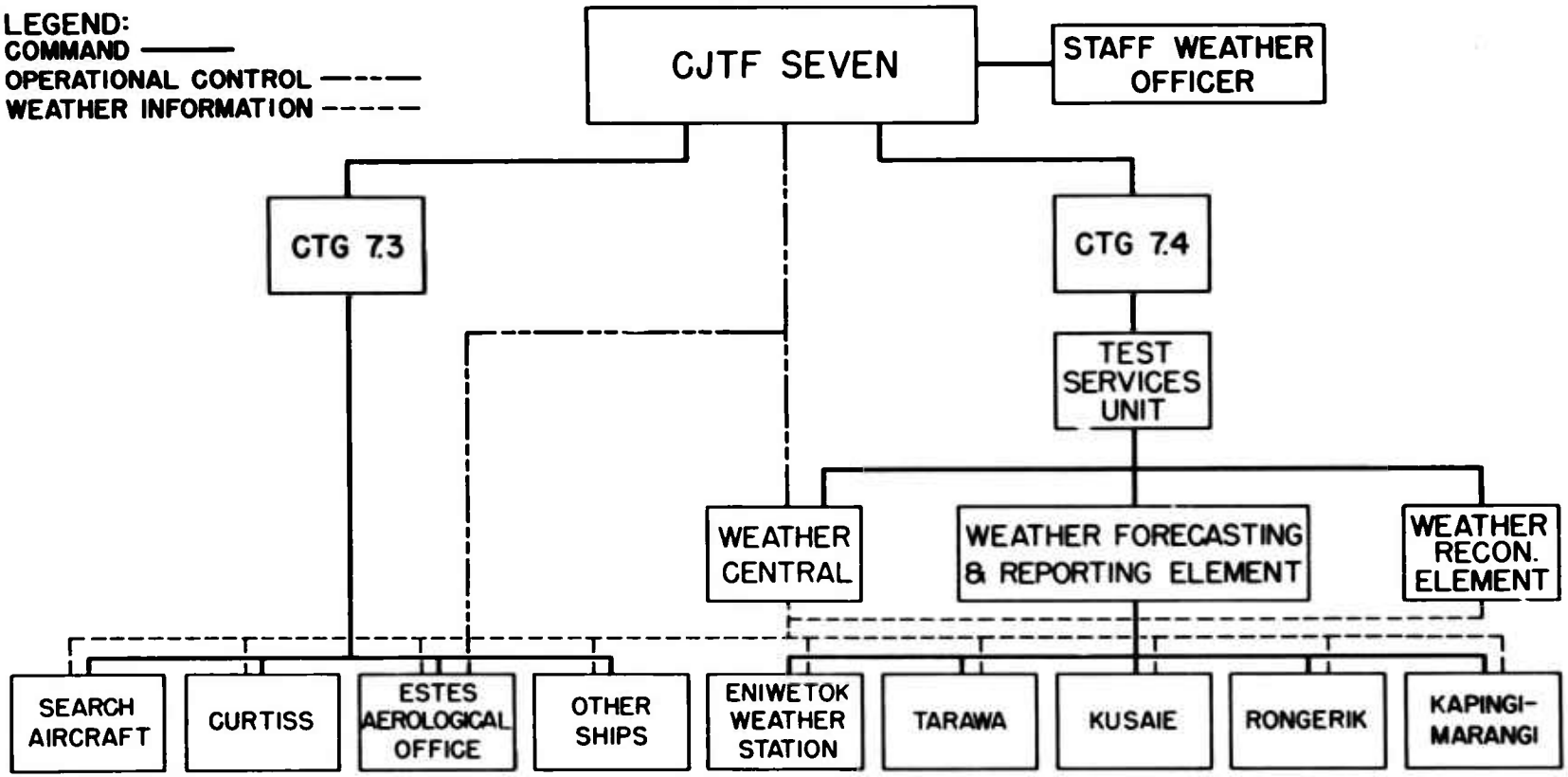

FIGURE K

CJTF SEVEN RETAINED OPERATIONAL CONTROL OF THE WEATHER CENTRAL.

CTG 7.4 HAD OPERATIONAL CONTROL OF THE ENIWETOK WEATHER STATION, THE FOUR OUTLYING WEATHER STATIONS, AND THE WEATHER RECONNAISSANCE UNIT.

CTG 7.3 HAD OPERATIONAL CONTROL OF THE AEROLOGICAL UNITS AFLOAT AND SEARCH AIRCRAFT, EXCEPT THE ESTES AEROLOGICAL OFFICE WHICH WAS UNDER THE TECHNICAL AND OPERATIONAL CONTROL OF CJTF SEVEN.

THE WEATHER CENTRAL COMMANDER HAD TECHNICAL SUPERVISION OF THE ENIWETOK WEATHER STATION, THE FOUR OUTLYING WEATHER STATIONS, AND THE WEATHER RECONNAISSANCE UNIT (FOR TIMES AND NUMBERS OF OBSERVATIONS, AND TRACTS FLOWN, AS APPLICABLE).

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wind fields but also on the amount of radioactive particles produced by the scheduled detonation and their expected rate of decay.

Correlating weather and radiation data by hand is a long and tedious process. Because the value of weather and RadSafe information is directly related to its timeliness, automatic computers were developed to reduce the time interval of calculation. JTF7 staff officers were thus better able to advise the CJTF7 on his decision on whether or not to fire a shot at a specific time.

The AEC made available to FOPU three types of automatic devices called analog computers. An electronic analog developed by the National Bureau of Standards, in conjunction with the Weather Bureau, took weather information and estimates of the diameter, height, and distribution of the anticipated atomic cloud and within one-twentieth of a second presented the prediction fallout pattern on the face of an electronic tube similar to a television screen. The varying brilliancy of the marking coincided with the radiation intensity at any point up to 250 miles (and sometimes more) from ground zero. Two such instruments were available to JTF7 during REDWING, located at JTF7 headquarters ashore and afloat.

An optical analog built by LASL -- projecting the fallout pattern on a film plate -- checked the electronic computer. A mechanical computer, developed by the Sandia Corporation, was on hand for emergency use.

To determine the accuracy of pre-shot fallout forecasts and also to learn after the shot of any sudden shifts in wind direction that would change the fallout pattern, JTF7 organized a radiation plotting program. At the core was a Fallout Plotting Unit composed of AEC (New York Operations Office) and Public Health Service personnel who provided CJTF7 with

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information on the actual location and intensity of the fallout for several days following a shot. For this task, the plotting unit secured data from a variety of sources located within an area with a 1,500 mile radius from the PPG.

Immediately after a detonation, reports came from early penetrating Air Force B-57s entering the radioactive cloud. Relatively soon after a shot but after some decay of the radioactive particles, cloud sampler F-84Gs made data available. Tracking aircraft then followed the drift of the dispersing radioactive cloud for 24 to 48 hours after a shot to measure the radiation in the air and to know if unexpected wind changes were carrying significant fallout into populated areas. Two specially modified liberty ships stationed in the densest fallout area immediately downwind from ground zero in connection with scientific effects programs (heavy shields protected the personnel who operated remote control equipment within the ships) later transmitted information that was used for correlation by the RadSafe plotters.

In addition to these sources of information that gave the location of radioactivity, RadSafe procedures utilized precautionary air sweeps. For shots detonated at Bikini, Navy P2V aircraft patrolled during the day of the detonation to provide an early warning for task force personnel and nearby populations. At the same time, weather reconnaissance B-50s flew continuous missions to warn of any clouds that might drift toward populated areas to the southwest. Other Air Force aircraft monitored the Pacific area as far west as the Marianas and as far east as Hawaii.

As a supplement to these measures, aircraft and ships at the PPG made routine radiation reports. JTF7 also staffed sixteen ground stations outside the PPG with persons trained in radiological detection.

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The function of personnel at these stations was to report periodic readings of monitoring equipment; in the event of contamination, they were qualified to assist in decontamination procedures.

RadSafe ground stations with radiation detection and measuring instruments were located at eight primary and eight auxiliary sites. Primary sites -- on the islands of Wotho, Ujelang, Uterik, Kwajalein, Rongerik, Tarawa, Kapingamarangi, and Kusaie -- were linked to the JTF7 RadSafe office by direct two-way radio; Wotho, Ujelang, and Uterik, regarded as perhaps more vulnerable to fallout, were staffed by Public Health Service radiologists. Auxiliary stations at Wake, Majuro, Ponape, Truk, Guam, Midway, Johnston, and Iwo Jima, where weather stations were located, employed the weather reporting net for their communications. (See Figure K).

For radiological protection at the PPG, each member of JTF7 wore a film badge or dosimeter. TG 7.1 maintained the individual dosimetry records, provided laboratory services and technical assistance to the entire task force (including a newly developed automatic film badge reader that speeded the task of computing individual radiation doses), established RadSafe centers ashore and afloat, furnished decontamination facilities, and manned monitoring stations at the PPG. In comparison to the fifty persons used for monitoring during CASTLE, about one hundred were available for REDWING. As replacements for monitors who might become incapacitated by overexposure, about fifty persons in the United States were on alert for possible duty at the PPG.

At a meeting at JTF7 headquarters in 1955, representatives of the Offices of the Surgeon General of the Army and Air Force, of BUMED (Navy), and the AEC Division of Biology and Medicine decided to establish the

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maximum permissible exposure at 3.9 roentgens (gamma only) per thirteen-week period. This relatively low exposure, authorized without limitation on the rate and without reference to previous exposure, was to be exceeded only if specifically authorized by the CJTF7.

If, despite all precautions, radiological disaster occurred during the operation, JTF7 readied an emergency evacuation and medical plan. The capability of the task force to evacuate all possible areas that might be affected by fallout reduced the hazard of serious contamination. Nevertheless, all the known DOD radiological medical specialists in the United States were alerted to the possibility of their being ordered by air to the PPG in the event of an emergency; special laboratory equipment to treat radiation sickness was marked at various medical centers for special air transport to the PPG if such action became necessary.

But where was the radioactive debris produced by the detonations to fall? JTF7 defined a danger zone, an area of open and uninhabited ocean roughly 375,000 nautical square miles in size. The danger zone contained no populated atolls except those occupied by JTF7 personnel. To promulgate the danger zone was a complicated procedure. JTF7 made the recommendation. The AEC Division of Biology and Medicine checked it. The State Department studied the international implications of the boundaries. Transportation control agencies of the Department of Commerce investigated the effect of the zone on established sea and air routes. After approval by all agencies involved, the AEC made a public announcement designating the limits; the State Department notified certain foreign governments; the CNO arranged for the Hydrographic Office to publish warning notices to mariners and airmen; and the REDWING danger zone became effective 20 April 1956 for the duration of the tests. (See Figure L).

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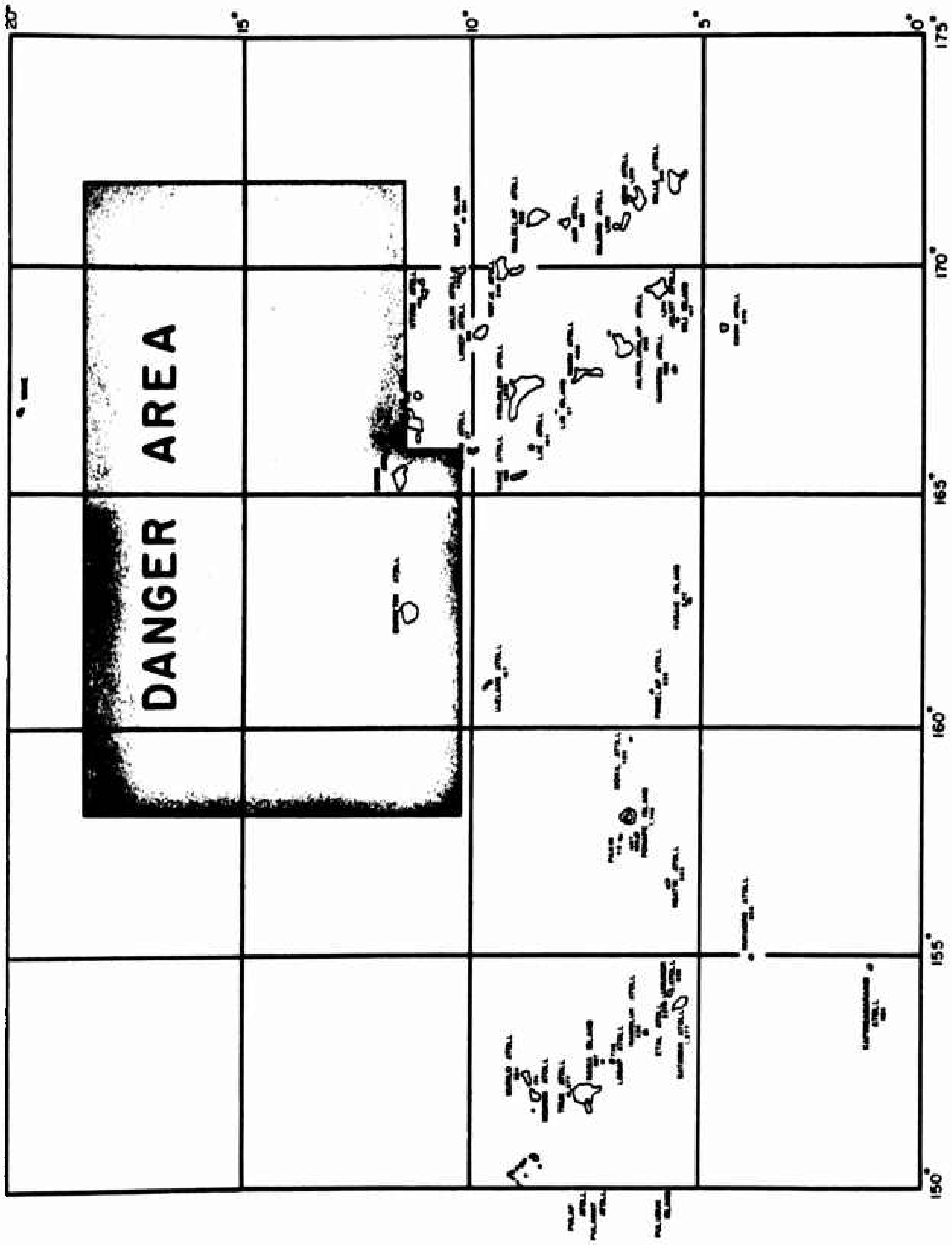

FIGURE L

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To make certain that vessels had not ventured into the danger zone, a squadron of task force patrol aircraft based at Kwajalein made frequent flights over the area. Immediately before each shot, these planes were to make an intensive aerial search of the area of anticipated fallout so that unauthorized vessels encountered could be warned and requested to clear. If there was not enough time before the scheduled detonation for the vessel to depart, the CJTF7 was to postpone the shot. If radioactive cloud trajectories seemed to be headed outside the danger zone, the CJTF7 was to inform CINCPAC and the Civil Aeronautics Administration so that water and air traffic could be diverted.

In order to measure the long range effect of contamination on the Pacific Ocean, fast ships were to enter the fallout area as quickly as possible after a detonation to take water and plankton samples for analysis at various depths. The Scripps Institution of Oceanography, under contract to the AEC, was to conduct continuous oceanographic analyses of fallout areas. At the request of the AEC Division of Biology and Medicine, the Navy was to furnish a ship to make two cruises near the PPG, one about a month after the first shot, another soon after the last detonation, in order to collect samples of water, plankton, and fish every twenty-five nautical miles at varying depths. The International North Pacific Fisheries also planned a large operation in the summer of 1956 employing Japanese, Canadian, and American Commercial and scientific vessels to attempt to discover the effects of radiation on marine life.

The preparations to insure safety by means of the extensive weather and RadSafe programs were useless unless conscientiously applied. But the assertion of the CJTF7 left little doubt as to his intent. He would detonate the REDWING devices and weapons only when the weather conditions

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were favorable for safety. Not until the winds were such as to carry fallout away from populated areas and away from test sites within the PPG was each shot to be fired. In the final analysis, then, the weather was the decisive factor in the command decision to execute each test detonation.

11.

Security

The security precautions taken during REDWING sought to protect the atomic weapons tests from potential enemy activity. Overt attack or reconnaissance by a hostile power were judged remote possibilities. Thus, espionage, sabotage, and the collection of information inadvertently disclosed by task force personnel were the principal security hazards of the operation.

The Army garrison at Eniwetok (TG 7.2) provided a measure of physical security during the interim period. A small military police detachment stationed on an island of the Bikini atoll upon the approach of the operational period performed the same function. Periodic air and ground sweeps checked the security of other islands in the PPG. Anti-submarine patrols by destroyers and aircraft during the actual testing provided further protection.

Since the PPG, a closed area, was open only to those persons whose official duties required their presence, CINCPAC acted to prevent undesirable individuals from entering. Only those persons considered good

security risks were admitted. Determination of such clearance was based on the stability, integrity, discretion, and past record of each individual. The task of certifying to CINCPAC that a task force member was a good security risk belonged to the agency originating the orders authorizing an individual's presence in the PPG; MATS and MSTS did the same for crew members of ships and planes entering the PPG. JTF7 liaison officers at Travis and Hickam Air Force Bases, at the Kwajalein Naval Station, and at the Oakland, California Naval Supply Center acted as movement control agents to make certain that all persons proceeding to the PPG were properly cleared for entrance.

CINCPAC also listed potential instruments of sabotage and espionage as prohibited items, forbidden to be brought into the PPG. These items consisted of photographic, optical, electronic and visual communications equipment; explosives and weapons; drugs and intoxicating beverages.

Since the presence of an individual at the PPG exposed him to some sensitive information, each person was required to be cleared, by the AEC or the DOD, for access to certain types of classified material. During past operations, the minimum requirement of AEC "Q" or DOD "Secret" clearance had placed a burden on the various investigating agencies in the United States. To relieve the burden, JTF7 secured AEC agreement to relax the requirement. For REDWING, military personnel ashore and key naval officers needed Secret clearance; naval personnel afloat only "Confidential;" civilians assigned to TG 7.1 "Q" clearance. To facilitate the recruitment of civilian personnel by TG 7.5 for the diverse construction projects preceding the tests, a "P" approval, which could be secured rapidly on a provisional basis and which authorized access to

classified information, sufficed until an agreed-upon date in the spring of 1956, when all contractor personnel were required to hold "L" or "Q" clearances.

Before REDWING, the co-existence of two independent systems of clearance -- those of the AEC and DOD -- had been a complicating factor. Congress had imposed, and the AEC applied, security controls to protect, specifically, the manufacture or utilization of atomic devices, the production of fissionable material, and the release of atomic energy -- in large part by classifying atomic information as "Restricted Data." This information had been available only to those persons -- military as well as civilian -- who had been cleared by the AEC. Thus, military personnel without AEC clearance could not receive Restricted Data directly from AEC personnel.

The Atomic Energy Act of 1954 modified this system. The AEC began to accept DOD clearance if accompanied by certification that the individual required access to Restricted Data for the performance of his duty. The authority to make such certification was granted to certain major commands, among them JTF7.

The importance of security at the personal level was reflected by an extended indoctrination program in effect during REDWING. Each individual associated with the task force was required to familiarize himself with a pamphlet setting forth the security responsibilities of the individual. Most persons then took an examination on the material studied; others signed a certificate of understanding and of compliance.

Personnel arriving at the Eniwetok port of entry received a security lecture while their baggage was being checked for contraband. For the duration of his stay at the PPG, each person was constantly reminded of

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his security responsibilities by conspicuously placed posters. More than 150 types of posters had been selected by the JTF7 CIC detachment after a survey of sources in Washington. The posters chosen were reproduced by the Raritan Arsenal in New Jersey and distributed by JTF7 headquarters to all task groups for display.

Badges issued to each person at the PPG -- with the exception of those stationed on Eniwetok Island -- permitted individual access to sensitive areas in the PPG. Entering a "controlled" area, such as much of Eniwetok Island, required no badge. All other islands of both atolls (except most of Japtan Island, a recreation area) were regarded as "limited" areas and required a badge. An "exclusion" area, such as a shot site or a weapon assembly area, was reserved for relatively few persons who needed to wear a special badge issued just before entry, or to have been named on an authorized access list.

Military police, assigned or attached to TG 7.2, guarded sensitive areas and limited entry to authorized persons. During the interim phase, the MP detachment consisted of 3 Army officers and 38 enlisted men. For the operational phase, estimating that an additional 8 officers and 252 enlisted men would be needed, JTF7 requested the Army to furnish these troops for 120 days of TDY. A shortage of MP's created difficulty for the Department of the Army in supplying them in this number. But when the task force then requested personnel for specific duties, gate guards, for example, the Army took emergency action and provided a company of the 505th MP Battalion (from Sixth Army headquarters) augmented by a complement of basic soldiers who had not received MP training and four second lieutenants to fulfill the REDWING requirements. These troops

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arrived in the PPG by increments early in 1956 and reached maximum strength by the beginning of the operational phase.

For material originating in the task force, a classification guide was desirable. JTF7 had prepared a temporary guide for CASTLE. During TEAPOT the AEC had issued a permanent General Classification Guide for Continental Test Operations. Using the latter as a model, the Director of Classification for the AEC, the Security Division of AFSWP, and JTF7 produced an AEC/DOD guide for overseas test operations. The AEC issued this late in 1955, the first permanent published guide for an operation such as REDWING

To make certain that AEC and DOD regulations were followed during the testing, the CJTF7, through his J-2 Division, promulgated security policy for the entire task force. Frequent liaison assured that the subordinate units complied with the established procedures.

12.

Logistics

From a logistical point of view, Headquarters JTF7 acts somewhat like a regulating agency, a co-ordinating organization as it were, welding together in a common effort all the component parts of the task force. The J-4 Division thus is a collecting station that gathers requirements and consolidates requests for equipment and supplies and arranges for the movement of cargo and personnel to and from the PPG. Liaison officers of the three services at key air and sea transportation points expedite the logistical flow.

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The military Services, through their existing supply and service elements, furnish logistical support for the military elements of JTF7; the AEC, through appropriate field agencies but with the assistance of the military, provide the same for AEC elements, including the construction and technical materials needed for the scientific testing. The Service Force, Pacific Fleet (COMSERVPAC), furnishes petroleum, oil, and lubricants (POL) for JTF7, and provisions for military units of the task force. The Military Sea Transportation Service (MSTS) provides reefer cargo space for Holmes and Narver. Headquarters, U.S. Army, Pacific, (USARPAC) assists JTF7 at the PPG with postal service, property accountability, and emergency technical supply. The Joint Military Transportation Committee allocates air lift space via Military Air Transportation Service (MATS) to JTF7 for the air movement of personnel and cargo. MSTS allocates water lift for personnel and cargo lift.

The task groups were responsible for the timely submission to Headquarters, JTF7 of the logistical requirements that enabled them to be basically self-sufficient. In addition, each task group fulfilled certain functions for the entire task force. TG 7.1, in co-ordination with TG 7.5, provided certain technical equipment and materials required for the scientific test programs. TG 7.2 furnished on a reimbursable basis the housekeeping equipment supplies and performed cargo handling on Eniwetok and Japtan Islands, supplied Army items, provided hospital facilities on Eniwetok, and acted as the central transportation agency for the task force in the PPG by consolidating air and water requirements originating at the PPG. TG 7.3 operated and maintained boat pools at both atolls in the PPG, controlled harbor traffic, provided surface lift to establish and, if necessary, helped to maintain the outlying weather and RadSafe

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stations. TG 7.4 furnished Air Force items, operated intra-atoll and inter-atoll air transportation service, supplied most of the weather and RadSafe island complements, and consolidated JTF7 POL requirements. TG 7.5 provided subsistence, quarters, laundry, medical, recreation, and other camp services (except military communications) on all islands in the PPG except Eniwetok and Japtan and to the islands of Ujelang, Wotho, and Uterik; it provided construction materials for the test programs and base facilities, operated a boat pool at Parry Island, performed stevedoring and cargo handling, and, with the exception of certain communications equipment, maintained the fixed plant facilities.

The movement from the United States to the PPG of the components of the devices to be tested was a special logistic requirement. MSTS vessels carried cargo classified as high as Secret-Restricted Data; U.S. Navy ships transported all categories of cargo, including basic weapons and accountable special nuclear materials. MATS aircraft carried all types of freight regardless of security classification.

More devices and special nuclear materials were moved by air than during previous operations, primarily because late design changes made by the laboratories delayed production. Quick delivery time by air gave the laboratories more flexibility in operations and also got the devices to the PPG on schedule. In certain cases, the time between production and testing was only a few days.

Because Air Force technical orders did not specify the procedures for carrying source and special nuclear materials, JTF7 established flight safety provisions. Technical advisers (some with RadSafe monitors) and armed JTF7 courier guards accompanied each flight. The pilot of an escort plane remained in visual or radio contact with the aircraft carrying such

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cargo at all times so that he could report any incident. The cargo plane followed special routes over non-populated or lightly populated areas. Each time the aircraft took off or landed, various emergency facilities were alerted for standby action -- fire trucks, air and military police. No incidents occurred during the operation that necessitated use of the emergency facilities.

The AEC delivered special nuclear materials to ports of embarkation in the United States and there transferred custodial responsibility to JTF7. At the PPG JTF7 delivered the materials to representatives of TG 7.5. Each task group had specific functions in the process. TG 7.1 marked, packaged, and classified all such cargo and provided technically qualified personnel to accompany shipments for the purpose of advising in the matter of handling en route. TG 7.2 provided guards during unloading at the PPG and maintained exclusion areas to store classified components. TGs 7.3 and 7.4 assisted in loading and unloading procedures. TG 7.3 provided escort ships if necessary. TG 7.5 acted as the JTF7 agent for accountability of the special atomic materials expended during the tests at the PPG.

A scientific requirement placed another special responsibility on the J-4 Division -- the return to laboratories in the United States of certain radioactive specimens. Since analysis of the bomb debris, of radioactive chemical and nuclear detectors, and of other similar materials recovered after each shot determined the success or failure of many test experiments, special flights expedited the return of such samples to the United States for scientific processing. TG 7.1 collected surface samples, and was responsible for packaging all samples. TG 7.4 collected cloud samples by use of specially equipped aircraft. MATS lifted the radioactive

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cargoes to the United States within a few hours after each detonation. JTF7 provided a Sample Return Director, who supervised the loading and release of aircraft, and Sample Return Project Officers, who accompanied each shipment to its final destination. Destinations in the United States where the analysis was performed included, among others, LASL, UCRL, the New York Operations Office, and the Army Chemical Center.

A perhaps peculiar arrangement existed in the matter of POL storage at the PPG. TG 7.5 maintained and operated storage tanks at Parry Island for AEC elements. TG 7.4 operated storage tanks at Eniwetok Island (maintained by TG 7.5) for the shore based military components of the task force. Until mid-1955 POL storage at Eniwetok had been the function of TG 7.2, the Army group, but because the Air Force element of JTF7 was the largest user of POL, the facility was transferred to TG 7.4. When inspection at the time of transfer revealed that deficiencies prevented the installation from meeting Air Force standards, repair and reconstruction became necessary -- to correct inadequate safety practices due to erosion of dikes, machinery corrosion, and defective marine lines. At the same time it became apparent -- on the basis of increased Air Force requirements for REDWING and inconvenience to the Petroleum Office, Hawaii, which furnished Navy tankers for POL supply of shore based activities in the PPG -- that expanding the storage space was desirable.

As a result of construction performed before the inception of the REDWING operational period, the POL farm on Eniwetok covered five acres instead of two and had a tripled fuel storage capacity for motor and aviation gasoline, diesel and jet fuel. The expanded POL farm at Eniwetok permitted oiler fueling operations to take place about once a month rather than every ten days as had formerly been necessary. Because the facility

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could distribute POL only inland, the COMSERVPAC supply tankers refueled the TG 7.3 elements during their regular visits to the PPG and pumped Navy Special fuel oil for storage into a barge. TG 7.3 had operational control of a fleet oiler that replenished a diesel barge maintained and operated by TG 7.5 at Bikini.

Aside from the special requirements resulting from the nature of the operation and the site, JTF7 logistic activity was routine. Procedures established by SOPs were generally adequate. Unexpected or sudden needs were fulfilled by improvised or expedient action.

One example occurred when doubt existed as to the efficacy of a component part of a bomb. A SAC B-47 flew the questionable part from Eniwetok to Kirtland AF Base. LASL tested the part at Albuquerque and found it acceptable. A message from LASL to JTF7 reassured the command, a like part was inserted into the bomb, and the test proceeded as scheduled.

13.

Communications

The conditions imposed by the operation and the site made the achievement of reliable, secure, rapid, and flexible communications for REDWING a difficult task. All three Services and civilian agencies were involved. Large numbers of land stations, ships, and aircraft participated. Segments of JTF7 were dispersed throughout the Pacific and as far away as the United States. The use of both Eniwetok and Bikini as detonation sites

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dictated command posts ashore and afloat and communication systems land based and shipboard. The distances within the PTG as well as the remote site itself posed special difficulties.

To provide the complicated communications arrangements necessary for the operation was the responsibility of the JTF7 J-6 Division. The task involved arrangements for personnel and equipment, planning and budgeting, installation of certain networks, proving communication security monitoring service, the assignment and control of frequencies, call signs, routing indicators, and address groups.

The communications needed for the operational phase consisted of a variety of facilities. Submarine cable connected certain of the islands within the Eniwetok and Bikini Atolls. Buoy cable was available to major ships in the Eniwetok lagoon for ship-to-shore communications. Multichannel voice and teletype radio equipment linked the Eniwetok and Bikini Atolls. A 400-line dial telephone system on Eniwetok Island and a 270-line manual telephone system on Parry Island served the Eniwetok Atoll; a 100-line manual switchboard on Enyu Island was available at Bikini; smaller telephone boards were installed on other islands of both atolls. High frequency, very high frequency, and ultra high frequency radiotelephone linked all the major land areas and ships in the PTG with Hawaii and the United States. Radioteletype, facsimile, and continuous wave facilities permitted the collection of weather and RadSafe information; these facilities and voice radio enabled the CJTF7 to receive weather data aboard his command ship during Bikini shots. A radio link connected the command ships with the firing bunker at Bikini, cable facilities fired devices at Eniwetok. The Combat Information Center aboard the JTF7 command ship, with the Deputy for Air or the CTG 7.4 present at all

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times, controlled and positioned aircraft for Bikini events; the Air Operations Center at Eniwetok Island did the same for Eniwetok shots. A joint relay crypto center at Eniwetok Island, with tributaries on Parry Island and on major ships, and with terminals at Kwajalein and Hawaii, handled the greater part of the military traffic between the United States and the PPG; and an AEC communication center on Parry provided direct facilities for traffic within the PPG (both atolls and major ships) and to the United States.

To provide security without impeding delivery, cable circuits were employed to the maximum, and radio-teletype, with automatic on-line encryption and decryption equipment, was used whenever possible in lieu of voice. An Army Security Agency detachment of 4 officers and 38 enlisted men monitored circuits in the PPG to insure compliance with security measures.

Planning for REDWING had begun nearly a month before the completion of the CASTLE series, when JTF7 communications officers met at Parry Island to discuss how they might improve the communications service. They agreed on a number of conclusions: that it was desirable to continue the work already under way of converting the tactical installations to permanent fixed plant type; that in order to reduce interference, the task force receiver station should be relocated from Eniwetok Island to Japtan; that the joint relay center on Eniwetok should be expanded; that in order to reduce shipboard interference problems the scientific task group (7.1) ought to have a command ship of its own; that multi-channel radio equipment should be procured to link Parry Island and the JTF7 command ship; and that radiotelephone service be provided between the PPG and the United States. The Signal Corps Plant Engineering Agency, upon

JTF7 request, studied the facilities at the PPG and substantiated these conclusions.

The construction and installation based on these recommendations occurred during the interim period in time for the REDWING operational phase. A new building and antennas for the receiver station at Japtan, camp facilities for twenty men, and Signal equipment were secured. The latest type of improved relay center equipment was incorporated into the joint relay station on Eniwetok. Newly developed multi-channel twin-sideband radio equipment for voice and teletype became available as a means of consolidating shipboard facilities. JTF7 tested the latter equipment early in 1956 between San Diego, California and Fort Monmouth, New Jersey -- the first transcontinental use of the equipment; its employment during REDWING was the first operational use by any organization. Of almost four hundred frequencies used in the PPG, JTF7 assigned all frequencies above 30 megacycles; the U.S. Frequency Allocation Board, Joint Communications Electronic Committee authorized allocations below 30 megacycles.

TG 7.5 operated the wire circuits and cable systems for the timing, telemetering, and communications required by the scientific task group, the inter-atoll radiotelephone and radioteletype (RATT) facilities, the land-based VHF radio links to major ships at Eniwetok and Bikini and communications centers aboard two ships, terminal equipment at communications centers on Parry Island and Los Alamos, New Mexico for a RATT circuit, its own boat pool communications, and all telephone systems except on Eniwetok Island.

TG 7.2 was responsible for virtually all the other land-based communications at the Eniwetok Atoll. With Air Force participation, TG 7.2

operated radio transmitting and receiver equipment and the joint relay and cryptography center on Eniwetok Island that served the entire task force. TG 7.3 operated its own shipboard installations, provided aircraft control facilities for Air Force scope operators in the CIC aboard the command ship, and maintained a shore-based communications center on Parry Island. TG 7.4 operated facilities for its own internal traffic, air-ground, weather, and AOC messages -- facilities operated by the Airways and Air Communication Service (AACS).

The elaborate communications preparations and the introduction of new and improved equipment made for a high degree of communications efficiency during REDWING. The volume of traffic totaled more than 65,000 messages handled by the Eniwetok joint relay center during one month. Yet messages flowed so expeditiously that the average handling time of high precedence traffic was approximately 1.8 minutes per message. (See Figure M).

14.

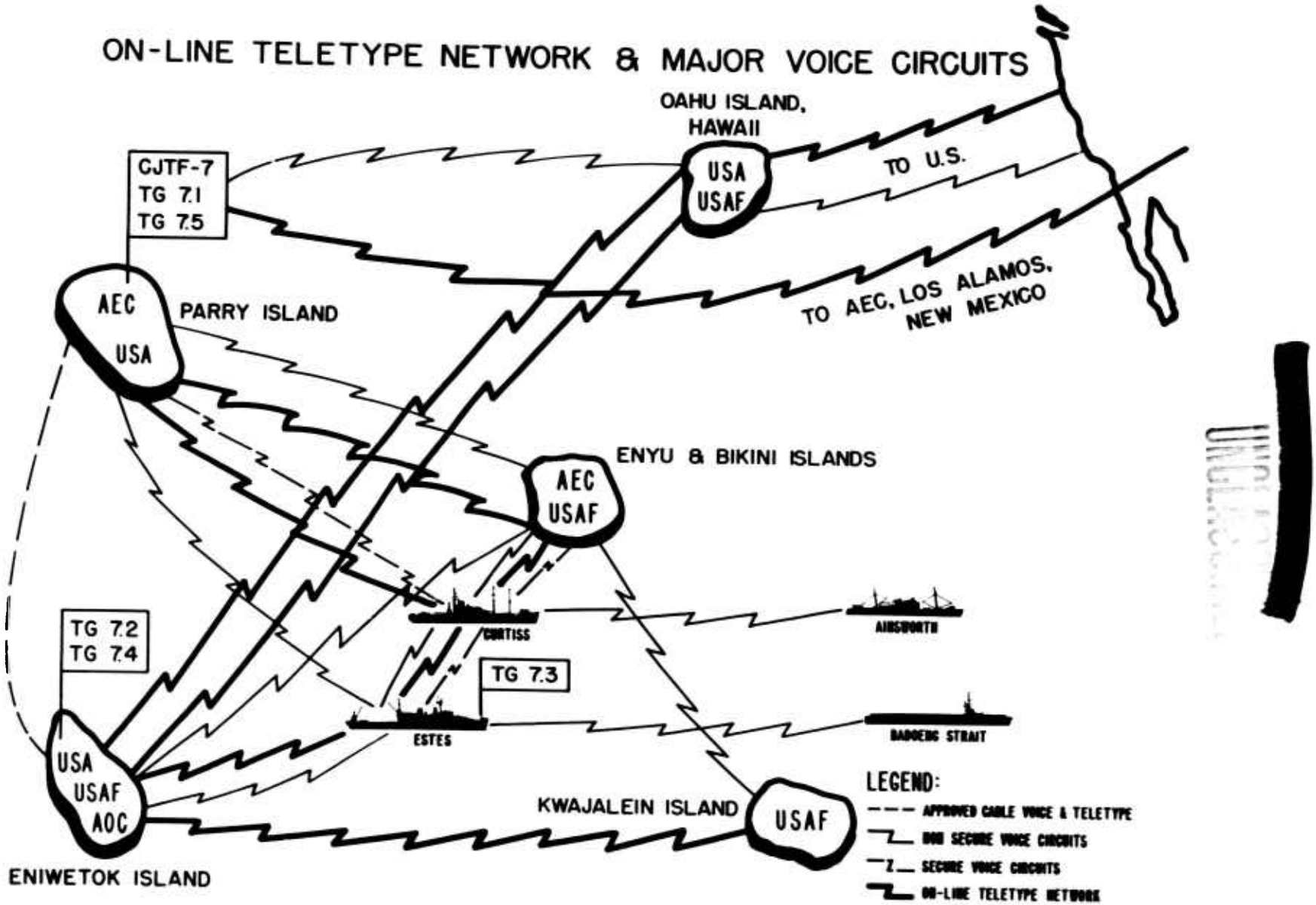
Scientific

The JTF7 effort for REDWING was determined fundamentally by the test programs formulated by the civilian and military scientists organized into TG 7.1. Diagnostics were prepared by the AEC laboratories, LASL and UCRL, by the Sandia Corporation, and by other experimental groups, notably Edgerton, Germeshausen, and Grier, Incorporated. DOD weapons effects tests were readied by AFSWP, assisted by a variety of diverse agencies --

including the Ballistics Research Laboratories, the Naval Ordnance Laboratory, the Air Force Cambridge Research Center, the Engineer Research and Development Laboratories, the Evans Signal Laboratory, the Chemical and Radiological Laboratories, the Naval Radiological Defense Laboratory, the Air Force Special Weapons Center, the Wright Air Development Center, the Air Force School of Aviation Medicine, the California Forest and Range Experimental Station, the Scripps Institution of Oceanography, the Bureau of Ships, the Bureau of Aeronautics, and certain industrial firms. The groups directly involved in the tests were organized into task units of TG 7.1. (See Figure N).

The LASL programs, eight in number, and the UCRL programs, three in number, included, among other projects, fireball and cloud photography, radio telemetering, study of shock waves, neutron flux, the energy spectrum, fission reactions, electromagnetism, spectroscopy, and short half-life activities, and analysis of bomb debris. The Sandia Corporation, responsible for one program, was interested in measuring strains, accelerations, pressures, and temperatures on structures, the function or malfunction of fusing and firing mechanisms, the response of ballistics cases to shock wave, heat, and blast, fireball effects on certain materials, sound refraction phenomena, and certain nuclear reactions. The AFSWP was responsible for eight test programs containing approximately forty-five experimental projects.

Project leaders assembled personnel and equipment in the United States. Task Unit Commanders administered the preparations for movement. The task group co-ordinated and supported such activities as packaging and shipping.


ON-LINE TELETYPE NETWORK & MAJOR VOICE CIRCUITS
OAHU ISLAND, HAWAII
USA USAF
TO U.S.
CJTF-7 TG 7.1 TG 7.5
AEC USA
PARRY ISLAND
TO AEC, LOS ALAMOS, NEW MEXICO
ENYU & BIKINI ISLANDS
AEC USAF
CURTISS
AINSWORTH
TG 7.2 TG 7.4
TG 7.3
ESTES
BADOENG STRAIT
USA USAF AOC
KWAJALEIN ISLAND
USAF
ENIWETOK ISLAND
LEGEND:
APPROVED CABLE VOICE & TELETYPE
DOD SECURE VOICE CIRCUITS
SECURE VOICE CIRCUITS
ON-LINE TELETYPE NETWORK

TASK GROUP 7.1

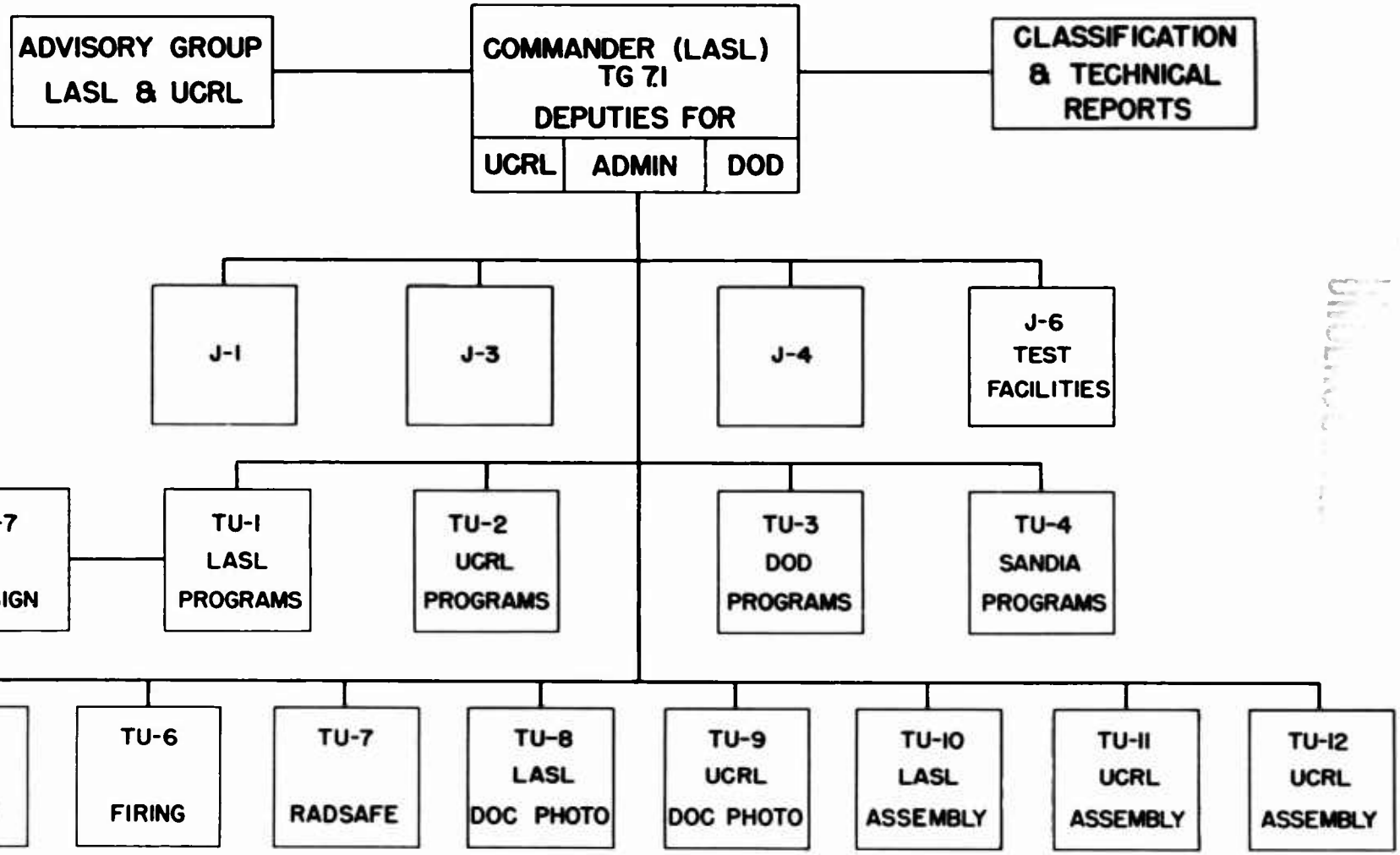


FIGURE N

Early in 1956, the components of Task Group 7.1 began to gather at the PPG. More than 1,600 persons, most of whom were civilians, belonged to the task group. Upon activation there under the command of Dr. Gaelen L. Felt of LASL, TG 7.1 was ready to position, arm, and detonate the weapons and devices, perform the projected measurements, conduct post-shot damage and radiological contamination surveys, furnish before each detonation an immediate pre-shot voice count-down for all elements of JTF7, and provide technical services as required by the task force.

15.

Army

Upon the termination of CASTLE, while most of JTF7 returned to the United States, TG 7.2 assumed garrison duties on Eniwetok Island and not only performed the normal base functions necessary to maintain the communications, port, depot, and housing installations and facilities at the PPG, but also enforced CINCPAC security regulations.

With the departure of the JTF7 headquarters after CASTLE, the commander of TG 7.2 became the Atoll Commander (ATCOM), Eniwetok, a responsibility he exercised until the commencement of the REDWING operational period in 1956. During this interim period, the ATCOM had under his supervision more than a thousand persons who inhabited the island of Eniwetok to maintain the test site. More than half were Army personnel of TG 7.2. An LST performed shuttle service between Eniwetok and Bikini. A large Air Force contingent operated the air field. Civilians working

for Holmes and Narver performed a variety of tasks. A small Coast Guard detachment, unrelated to the atomic test operations, operated a Loran station as a navigational aid to ships.

TG 7.2 performed a variety of routine activities. Army personnel surveyed the major supply items in stock, inventoried depots, requisitioned replacement materials for REDWING, removed tent slabs and frames to make way for new buildings, converted an Officers' Beach Club into guest quarters for VIPs, and performed other like duties.

Lack of covered storage space on Eniwetok and the climate combined to make corrosion of equipment an annoying problem that demanded constant inspection and remedial measures. In the case of Army vehicles received during the summer of 1955 for use during the operational period, personnel inspected the vehicles daily and scraped and retouched rusted areas and parts.

An AEC-DOD agreement that transferred the stevedoring function to TG 7.5 led to an internal reorganization of TG 7.2 in mid-1955 and eliminated the Signal and Port Detachments, thereby creating a positive military saving in manpower. The 7126th Army Unit, the administrative designation of the task group, became divided into four detachments: Headquarters, Service, Military Police, and Transportation.

As the REDWING operational period approached, increasing amounts of personnel and materiel arrived at Eniwetok. The island population, for example, doubled by February 1956, tripled by the end of March. This meant additional activity on the part of TG 7.2, which came to have about 1,200 Army personnel, which furnished JTF7 with 550 vehicles and about $2,800,000 worth of Signal equipment, which operated certain communications facilities, and which provided ground security. Under the command

of Col. Roger M. Lilly, who had replaced Col. F.M. McGoldrick in August 1955, TG 7.2 was ready to fulfill the operational tasks assigned by JTF7.

16.

Navy

After CASTLE, TG 7.3, the Navy task group, conducted Operation WIGWAM, a weapons effects test involving the underwater detonation of a nuclear weapon in the spring of 1955. At the end of this operation, TG 7.3 began to prepare for REDWING.

Commanded by Rear Admiral Joseph H. Wellings, the task group during the REDWING pre-operational period had components at three sites -- the headquarters at Washington, D.C., a boat pool in interim status at Coronado, California, and a boat pool detachment based at Eniwetok to provide inter-island lift. These elements were soon augmented as the CNO designated additional naval units for participation in REDWING.

Operation REDWING required the Navy to meet operational and logistic requirements. The operational demands included direct participation in and support of the scientific programs, and security and safety patrols; logistical demands included surface transportation for personnel and materiel at the PPG, accommodations afloat for key personnel of JTF7 during Bikini detonations, assistance to establish and support the weather and RadSafe stations, and the movement of certain cargo and personnel from the United States to the PPG.

In the interests of economy and efficiency, each naval unit of TG 7.3 performed several missions. Some assigned missions differed from the normal function for which the ship was designed. Consequently, additonal equipment and extensive modification were necessary for some vessels. In all cases, ships were equipped with water washdown systems for decontamination.

As constituted for the REDWING operational period, TG 7.3 consisted of nearly 5,000 men, more than twenty ships, more than thirty boats, a Marine helicopter squadron, and a squadron of P2Vs.

The USS ESTES, designed as a command ship and equipped with extensive communications facilities (including an augmented CIC for controlling aircraft by TG 7.4 as well as of ships by TG 7.3), served not only as the TG 7.3 flagship but during detonations at Bikini also as the Headquarters afloat of JTF7 and TG 7.4.

The USS CURTISS, a seaplane tender specially equipped to serve as a control and firing station for Bikini shots, had extensive shops, magazines, and office space and served as the scientific command ship, the headquarters of TG 7.1 afloat. Balloon inflation facilities installed aboard the CURTISS enabled the vessel to act as a weather gathering station at Bikini. A RadSafe center was also established on the ship.

The USNS AINSWORTH, an MSTS transport, provided a headquarters afloat for TG 7.5 and housed personnel evacuated from Bikini immediately before each detonation. Installation of a fueling-at-sea system permitted the AINSWORTH to operate at Bikini where POL storage ashore did not exist.

The USS BADOENG STRAIT, an escort aircraft carrier, provided a base for a Marine helicopter squadron at Bikini. The helicopters furnished intra-atoll transportation and also provided the most practical method

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for re-entering, soon after a detonation, an area near the shot site for the recovery of experimental equipment and samples. Trailers on the flight deck of the BADOENG STRAIT housed the master raydist station, special equipment for aiding in tracking and positioning planes participating in the Bikini shots. A RadSafe repair and issue facility, including tools, spare parts, and supplies for radiation detection instruments, was also located on the ship.

The USS CATAMOUNT, a landing ship, dock, serviced a naval boat pool at Bikini, carried shot barges from Eniwetok to Bikini detonation sites, and carried a telemetering station to receive information transmitted by instruments near ground zero. During the pre-operational period, the CATAMOUNT participated extensively in the construction of camps, weather stations, and other projects.

The USS KYES and SHELTON, destroyers, performed anti-submarine patrols, operated in co-ordination with patrol aircraft to keep the danger zone clear of unauthorized vessels, served as lifeguard ships to rescue crews of ditched planes, and took weather readings by means of WASP rockets, 5-inch window shells, and Rawinsonde balloons.

The USS McGINTY and SILVERSTEIN, destroyer escorts that were part of the safety and security force, carried special equipment to collect water samples and make various fallout measurements.

The USS KNUDSON, a fast destroyer transport, furnished rapid transportation for personnel and high priority material (such as water samples) from Bikini to Eniwetok, a mission potentially important in the event that the aircraft landing strip at Bikini became contaminated and unusable immediately after a shot. The vessel also had a telemetering station to

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receive information transmitted from rockets fired in connection with a detonation.

Four fleet tugs, the SIOUX, the CHICKASAW, the LIPAN, and the ABNAKI, tended barges, lighters, and rafts at Bikini. Special equipment on the SIOUX enabled it to handle skiffs and floats used as fallout collecting platforms.

Two LSTs, 306 and 618, obtained from MSTS and particularly suitable for loading and unloading equipment and supplies on beaches, provided surface lift between the Eniwetok and Bikini Atolls.

A third LST, 611, and two converted liberty ships, YAGs 39 and 40 (the GRANVILLE S. HALL and the GEORGE EASTMAN), were specially equipped to enter areas of heavy fallout. Heavy shields protected personnel aboard these ships from radiation and enabled them to operate remote control equipment. These vessels were floating radiation laboratories that had the mission of tracking and measuring the immediate post-shot fallout.

Aircraft of Patrol Squadron ONE, based at Kwajalein, conducted pre-shot patrol and search in forecasted fallout areas and performed post-shot tracking and measurement of fallout contamination.

Numerous other craft provided for REDWING by the Navy included covered barges, barges equipped for helicopter landings, and small boats carrying many different kinds of special instruments, equipment, and facilities. In accordance with an AEC-DOD agreement, the Navy also furnished a large number of boats to Holmes and Narver, which operated TG 7.5 boat pools at Eniwetok and Bikini. (See Figure 0).

The Naval Air Station, Kwajalein, 350 miles from Eniwetok and under the operational control of the Commander, Naval Air Bases, 14th Naval

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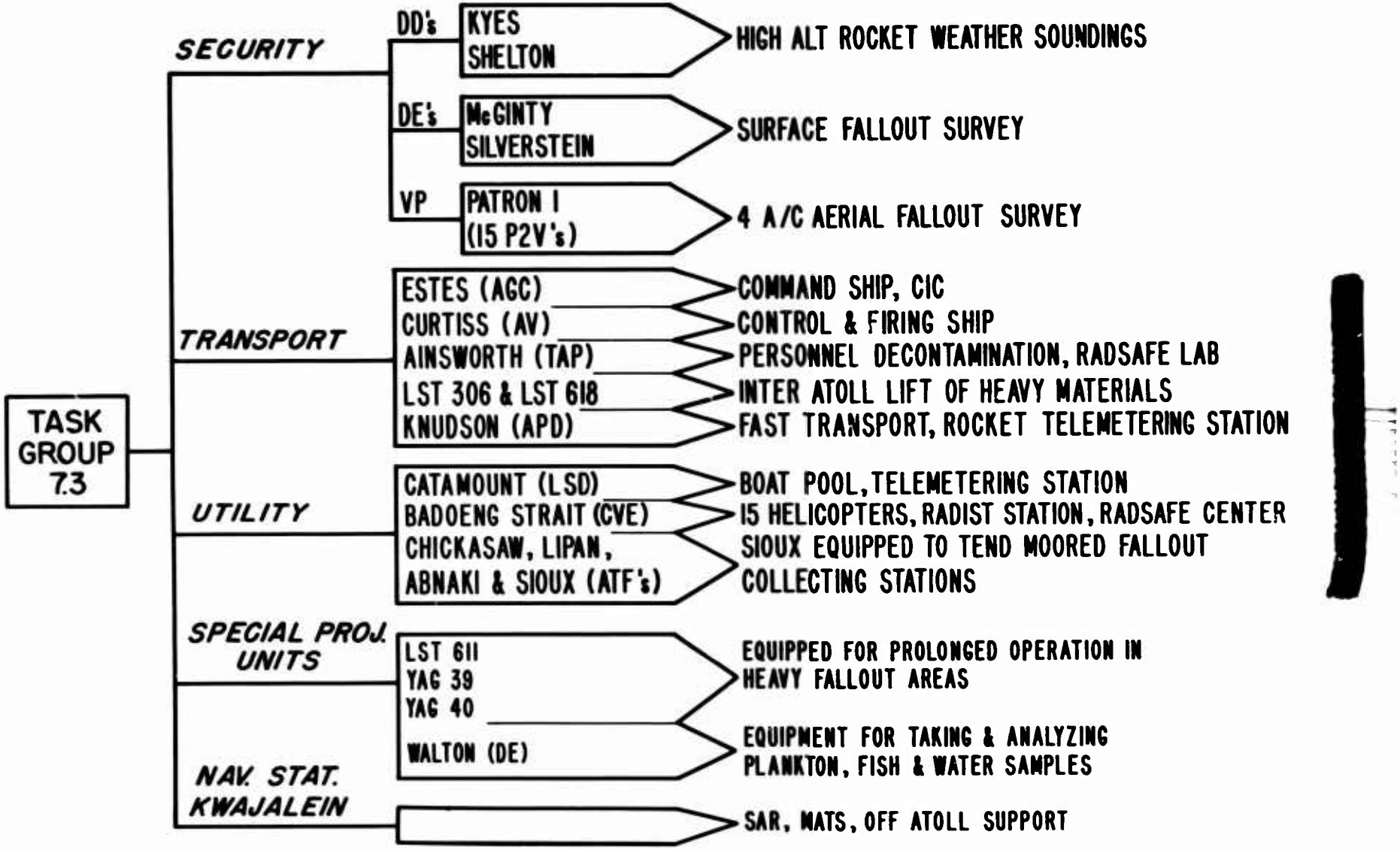
TASK GROUP 7.3
SECURITY
DD's
KYES
SHELTON
HIGH ALT ROCKET WEATHER SOUNDINGS
DE's
McGINTY
SILVERSTEIN
SURFACE FALLOUT SURVEY
VP
PATRON I
(15 P2V's)
4 A/C AERIAL FALLOUT SURVEY
TRANSPORT
ESTES (AGC)
COMMAND SHIP, CIC
CURTISS (AV)
CONTROL & FIRING SHIP
AINSWORTH (TAP)
PERSONNEL DECONTAMINATION, RADSAFE LAB
LST 306 & LST 618
INTER ATOLL LIFT OF HEAVY MATERIALS
KNUDSON (APD)
FAST TRANSPORT, ROCKET TELEMETERING STATION
UTILITY
CATAMOUNT (LSD)
BOAT POOL, TELEMETERING STATION
BADOENG STRAIT (CVE)
15 HELICOPTERS, RADIST STATION, RADSAFE CENTER
CHICKASAW, LIPAN, ABNAKI & SIOUX (ATF's)
SIOUX EQUIPPED TO TEND MOORED FALLOUT COLLECTING STATIONS
SPECIAL PROJ. UNITS
LST 611
YAG 39
YAG 40
EQUIPPED FOR PROLONGED OPERATION IN HEAVY FALLOUT AREAS
WALTON (DE)
EQUIPMENT FOR TAKING & ANALYZING PLANKTON, FISH & WATER SAMPLES
NAV. STAT. KWAJALEIN
SAR, MATS, OFF ATOLL SUPPORT

FIGURE 0

[redacted]

District, assisted JTF7 not only by providing base facilities for the TG 7.3 patrol squadron but also by making available an augmented Search and Rescue unit, increased facilities and services for JTF7 transient aircraft and their passengers and crews, and upon occasion amphibious aircraft for supply trips to outlying weather islands such as Tarawa and Kusaie.

As the REDWING testing period drew near, TG 7.3 assembled its units and facilities in the PPG and prepared to execute its numerous operational missions. (See Figure P).

17.

Air Force

A provisional unit, TG 7.4 was inactivated immediately after CASTLE and most personnel reassigned to the Air Force Special Weapons Center (AFSWC), Kirtland AF Base, New Mexico. A subordinate unit of the task group consisting of 240 officers and men remained at the PPG and as the 4930th Support Group (Test) maintained the Air Force facilities on Eniwetok Island during the interim period.

With no Air Force task group in existence to plan for REDWING, the Air Research and Development Command (ARDC) delegated the task to AFSWC. The Joint Field Test Operations Branch, under the AFSWC Deputy Chief of Staff for Operations, acted as the interim planning agency in place of the Field Test Office of the 4925th Test Group (Atomic), which, though normally charged with interim period planning, was occupied with the TEAPOT tests at Nevada. After TEAPOT, Field Test Office personnel prepared

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to become part of the Operations Directorate of TG 7.4 when reactivated.

AFSWC reactivated TG 7.4 in mid-1955 with Col. John S. Samuel, the commander of the 4925th Test Group (Atomic), as the task group commander. For the operational period in the PPG, TG 7.4 organized about 2,200 persons and 83 aircraft into three units. The Test Base Unit (an augmented 4930th Support Group) provided the base facilities at Eniwetok and Bikini for air operations, furnished inter-atoll and intra-atoll airlift, and supported weather stations on outlying islands (several Navy amphibious aircraft came under Air Force control for the latter mission). The Test Aircraft Unit performed the operations more intimately connected with the scientific tests -- executed bomb and canister drops, conducted the aerial effects test effort, flew cloud penetration and sampling programs, and made possible documentary photography from the air (the unit also controlled two Navy effects aircraft and a Strategic Air Command experimental detachment). The Test Services Unit conducted weather reconnaissance, provided search and rescue facilities, maintained AACS and navigational aids, and operated the MATS terminal on Eniwetok Island. (See Figure Q).

Many types of planes were needed for the various functions required by REDWING. More craft participated than in CASTLE because of larger effects programs and because of JTF7 hope to execute a dual shot capability -- detonate two weapons at the two different atolls at the same time. Much instrumentation installation was necessary. Some aircraft required extensive modification. The variety of aircraft involved in the operation generated problems of supply and maintenance equipment. Some planes were still undergoing qualifying Air Force tests; since they were not yet in production: spare parts were often hard to get. ARDC, AFSWC,

TASK GROUP 7.3 – AIR & SURFACE FORCES

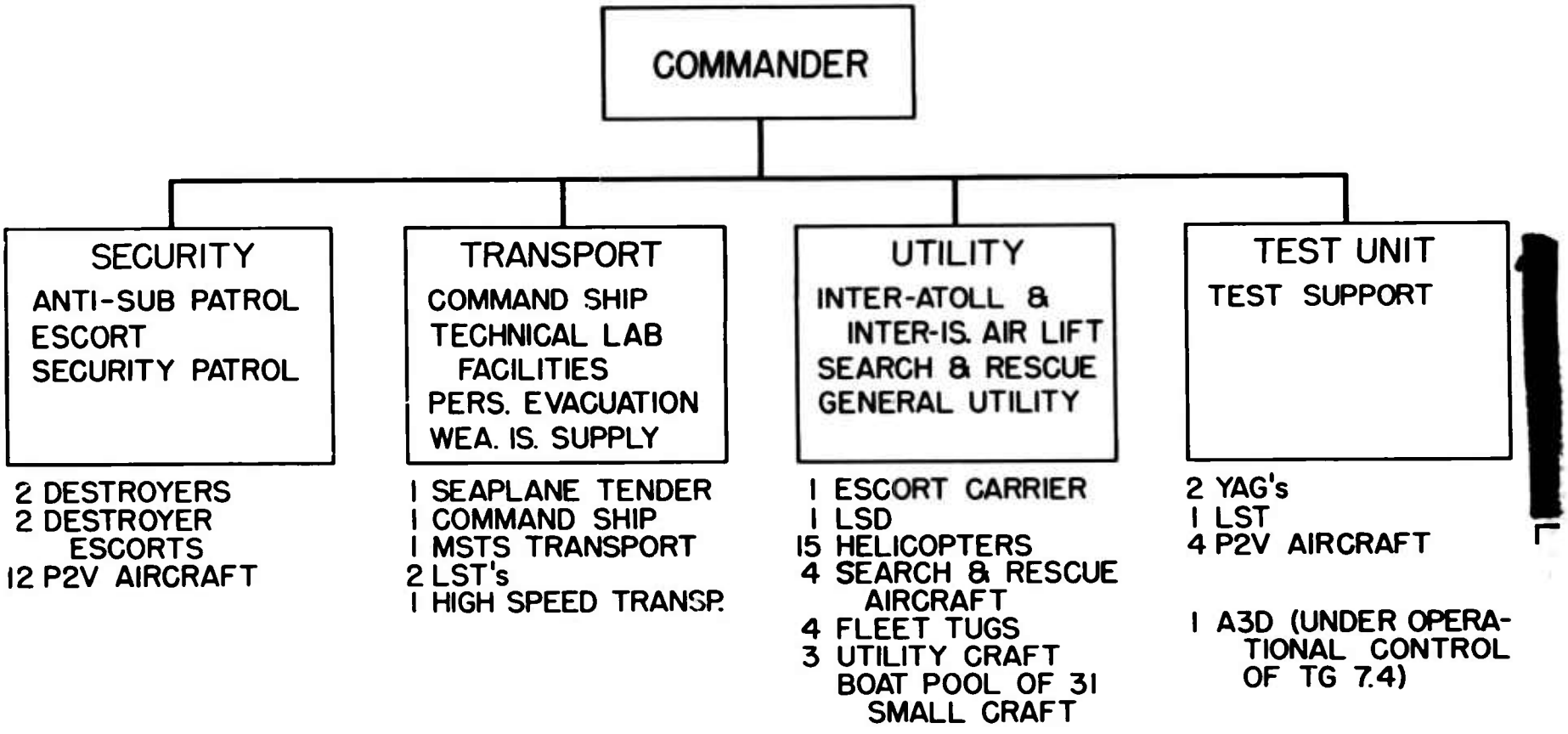

FIGURE P

AIR FORCE TASK GROUP 7.4

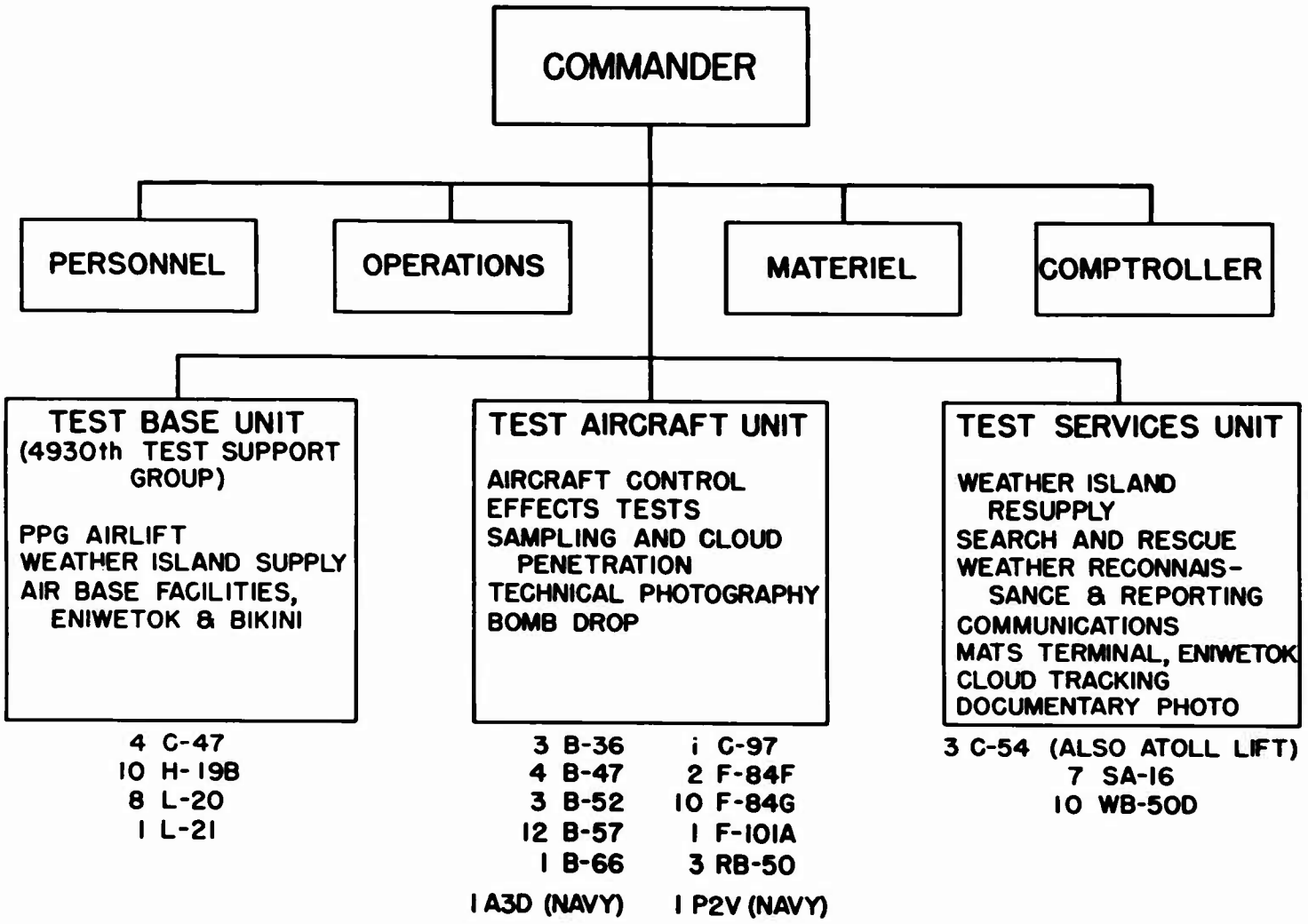

FIGURE 9

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SAC, the Air Materiel Command, the Tactical Air Command, and MATS, provided TG 7.4 the personnel, training, equipment, and services required.

Preparation for REDWING involved the resolution of several unusual problems. Eniwetok Island was small and so crammed and congested with facilities that a serious aircraft parking problem existed, particularly since some of the planes landing at Eniwetok after a detonation would be contaminated. Safety factors in emergency situations were important; for example, the effect of a crash on takeoff of the aircraft carrying an atomic weapon, or the effect of a fire in the airplane before bomb delivery, how to drop a vertical array of canisters containing telemetering instruments over ground zero immediately before a shot, how to enable bomb-drop aircraft to escape blast and thermal effects of the detonation after delivery, and how to protect crews from radiation overexposure and flash blindness were questions that demanded close study. Since the TG 7.4 ACC at Eniwetok was out of range for operations at Bikini, the TG 7.3 CIC aboard the command ship controlled the positioning Air Force planes at Bikini shots; this dictated close co-operation between Air Force and Navy and the integration of certain procedures by both Service elements. Runway barriers at Eniwetok and Bikini airstrips comprised another subject of mutual interest to the Air Force and Navy task groups, and Air Force type barriers and Navy type arresting wires were both eventually installed.

Problems of equipment, personnel, and procedures were well ironed out when TG 7.4 began to arrive in the PPG early in 1956 for the REDWING testing. An unusually effective liaison effort of all air participation was established before the operational period by the Deputy for Air with

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Hq USAF (AFOAT) and the CNO (OPs 36), which were both instrumental in making the operation a success.

18.

Construction

Upon termination of the CASTLE test series, when the CJTF7 relinquished his AEC responsibilities and the commander of TG 7.5 returned to the Albuquerque Operations Office (ALCO) to resume his duties as Director of the Test Division, the Deputy Commander of TG 7.5 became the senior AEC representative at the PPG for the interim period. As Manager, Eniwetok Branch Office (a unit of the ALOO) with headquarters on Parry Island, he was responsible for the structures, utilities, and equipment at the PPG that comprised the AEC-owned real property. He represented the AEC Division of Biology and Medicine in administering the Eniwetok Marine Biological Laboratory, operated at Parry Island through a service-type contract with the University of Hawaii. In co-operation with ATCOM (the commander of TG 7.2), he exercised a host of functions related to REDWING -- among others, furnishing such support facilities as mess, quarters, laundry, medical service, and recreation (including the establishment in the spring of 1956 and the operation of a television station), operating boat pools at the Eniwetok and Bikini Atolls, and providing the site facilities necessary to accomplish the planned scientific test programs.

Since the AEC tries to use a minimum of AEC personnel for adminis-

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trative supervision and thus accomplishes its tasks through contracts with non-governmental concerns, the Manager of the Eniwetok Branch Office performed his functions through Holmes and Narver (H&N). An architect-engineer-construction-management organization operating under a cost-plus-fixed-fee contract, H&N designed, constructed, maintained, and operated camp facilities, airfields, marine facilities, power plants, communications facilities, and fresh water distillation plants. H&N furnished the concomitant services necessary to maintain a working force in the middle of the Pacific Ocean. It also provided the technical installations required by the tests.

The distant location of the construction sites from sources of supply, of both materials and labor, the complicated engineering designs required for structures able to withstand the unusual stresses produced by the detonations, the difficulties of building massive steel and concrete buildings on reefs submerged at high tide or on barren islands, and the necessity for meeting rigid time schedules in completing projects essential for the test series -- these problems demanded competence and flexibility.

Since the REDWING operational concept did not emerge suddenly but rather developed over a relatively long time, H&N concentrated its initial effort on non-scientific construction, the base facilities needed to accommodate JTF7 at various sites during the operational phase. On the basis of tentative REDWING criteria discussed as early as April 1954, it was apparent that expanded and improved facilities were needed at Bikini. Soon after the completion of CASTLE, H&N began to construct a base camp on Enyu Island of that atoll. An LST transported civilian workers, materials, and equipment from Eniwetok to Bikini. The work force

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lived aboard the ship for a few days and commuted to the beach during decontamination procedures. After the men installed a temporary beachhead camp of limited facilities -- tents and portable kitchens, generators, and distillation units -- they moved ashore to free the LST for weekly shuttle service, which brought additional personnel and supplies from Eniwetok. Rapid rehabilitation of an airstrip at Bikini enabled aircraft to supplement the LST shuttle.

At the same time, H&N constructed camp sites at other locations in the PPG, rehabilitated airfields, erected warehouses and barracks, and performed a variety of miscellaneous jobs to improve living and working conditions. To resist the corrosion and rot prevalent at the PPG, H&N designed and built new type buildings of standardized aluminum parts. A major task was construction of a deep water pier at Parry Island to facilitate stevedoring, eliminate ship-to-shore ferry service, and provide more reliable fueling operations from oilers to POL storage tanks ashore.

A unique circumstance that occurred was the necessity to construct projects outside the PPG. H&N built weather and RadSafe stations on neighboring atolls, some of which were as much as 900 miles from Parry Island. H&N also erected camp sites for native populations that had been evacuated from nearby islands during CASTLE because of unexpected fallout.

While H&N expanded and improved the non-scientific base facilities, thought was being given to the scientific requirements -- structures and technical facilities such as instrumentation circuits, control and observation posts. As the REDWING concept became clearer, estimates were made for the number of shot towers and barges, and ground installations that were needed, and eventually plans were made for specific installations at specific sites. As examples of the construction required for

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the tests, the LACROSSE shot demanded 100 scientific stations, the CHEROKEE shot needed 156.

Limited transportation facilities available in the PPG, budgetary complications, and frequent changes in the scope of the operation proved to be the major planning difficulties. Late receipt of design criteria for scientific facilities and major changes occurring throughout the planning period resulted in increased work loads at the PPG and in tightened schedules. The training period needed by H&N for new employees, the time required to process security clearances, the general shortage of qualified engineers, and the relatively short duration of the peak work load created difficulties of scheduling and caused increased overtime work at the PPG.

Procurement of materials was often a difficult process. Floods in 1955 in the United States resulted in shortages of metals and made plywood scarce. Strikes in electrical equipment and copper mining industries held up shipments. A stringent market for basic industrial commodities, particularly copper, steel, and aluminum, created difficulties.

As an indication of the scope of TG 7.5 efforts, H&N operated more than 400 vehicles -- jeeps, pickups, and trucks. Heavy construction items totalled 150 pieces -- dozers, cranes, compressors, transit mixers, paving and ditching machines, pile drivers, rock crushers, and drill rigs. To move passengers and cargo by water and perform a variety of marine tasks, H&N used more than 100 items of marine equipment that included DUKWs (amphibious trucks), LCMs ("M" boats), LCUs ("Tee" boats), tugs, a floating dry dock, water taxis, barges, sea mules, a gilhoist to lift "M" boats, deep water diving gear, and a special cable laying "M" boat.

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In addition to construction, operation, and management responsibilities, TG 7.5 became involved with RadSafe procedures. H&N maintained individual RadSafe records and performed the necessary dosimetry; issued, laundered, and assumed accountability for protective clothing and equipment; repaired and calibrated RadSafe instruments; and provided decontamination facilities.

In September 1954, the number of contractual persons at the PPG totalled more than 700. A year later, 1,300 men were employed there. By March 1956, the peak population reached more than 2,700 persons. (See Figure R).

By the spring of 1956, TG 7.5 was ready to enter the operational phase of REDWING. AEC personnel occupied the staff positions in the organization; H&N personnel filled the line positions. (See Figure S).

PART III. OPERATION

The schedule of REDWING shots listed the proposed detonations by code name in the approximate order of sequence and with readiness dates for the completion of the necessary scientific, logistic, and construction activities. As a result of delays in scientific construction, the readiness date for the first of the REDWING tests, originally established for 15 April 1956, was set back to 1 May.

In February 1956, the Honorable Lewis L. Strauss, Chairman of the Atomic Energy Commission, formally accorded Admiral Hanlon, the CJTF7, full authority to act for the AEC in all matters concerning the successful

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TASK GROUP 7.5 H & N PERSONNEL STRENGTH (APPROXIMATE)

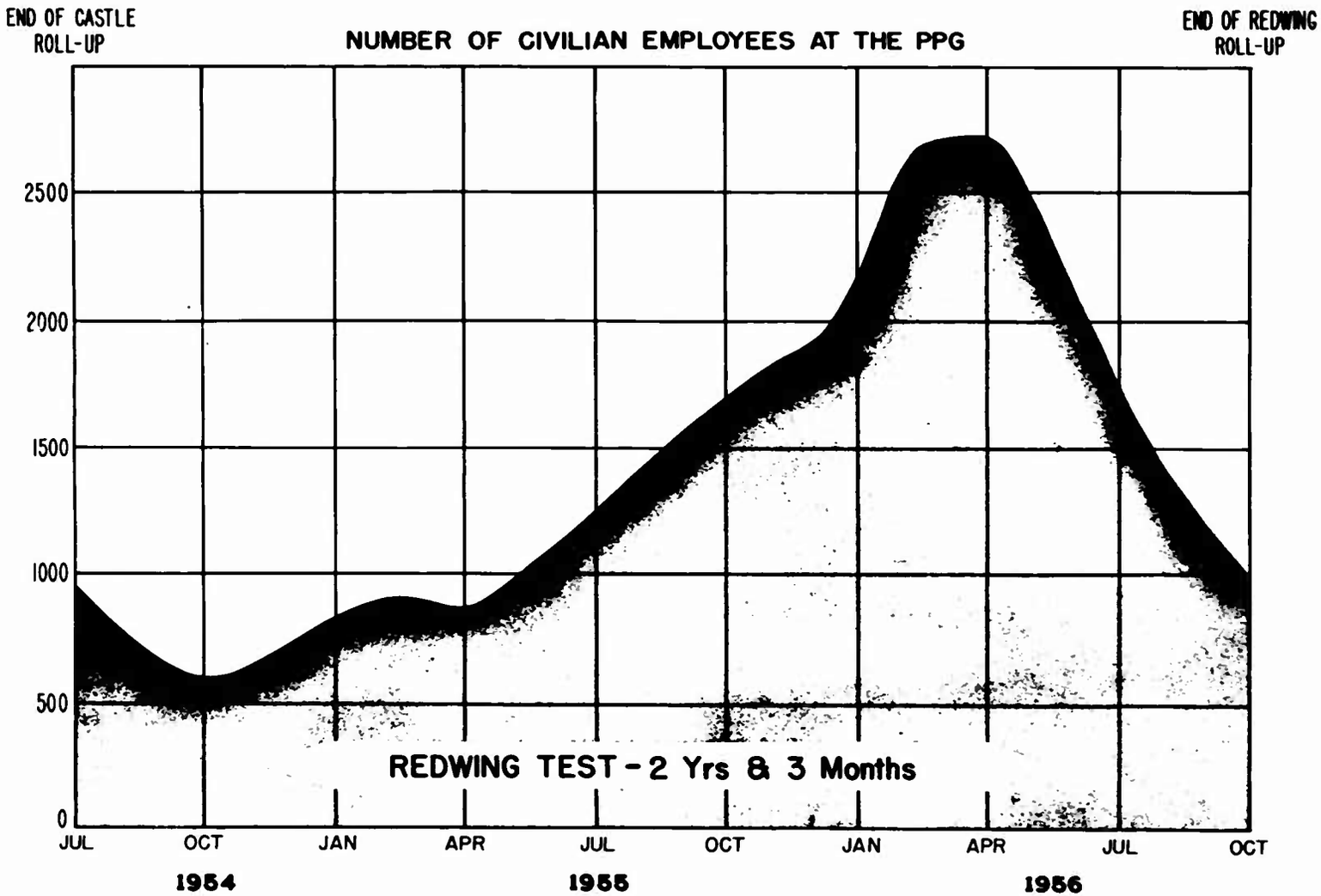

FIGURE R

TASK GROUP 7.5

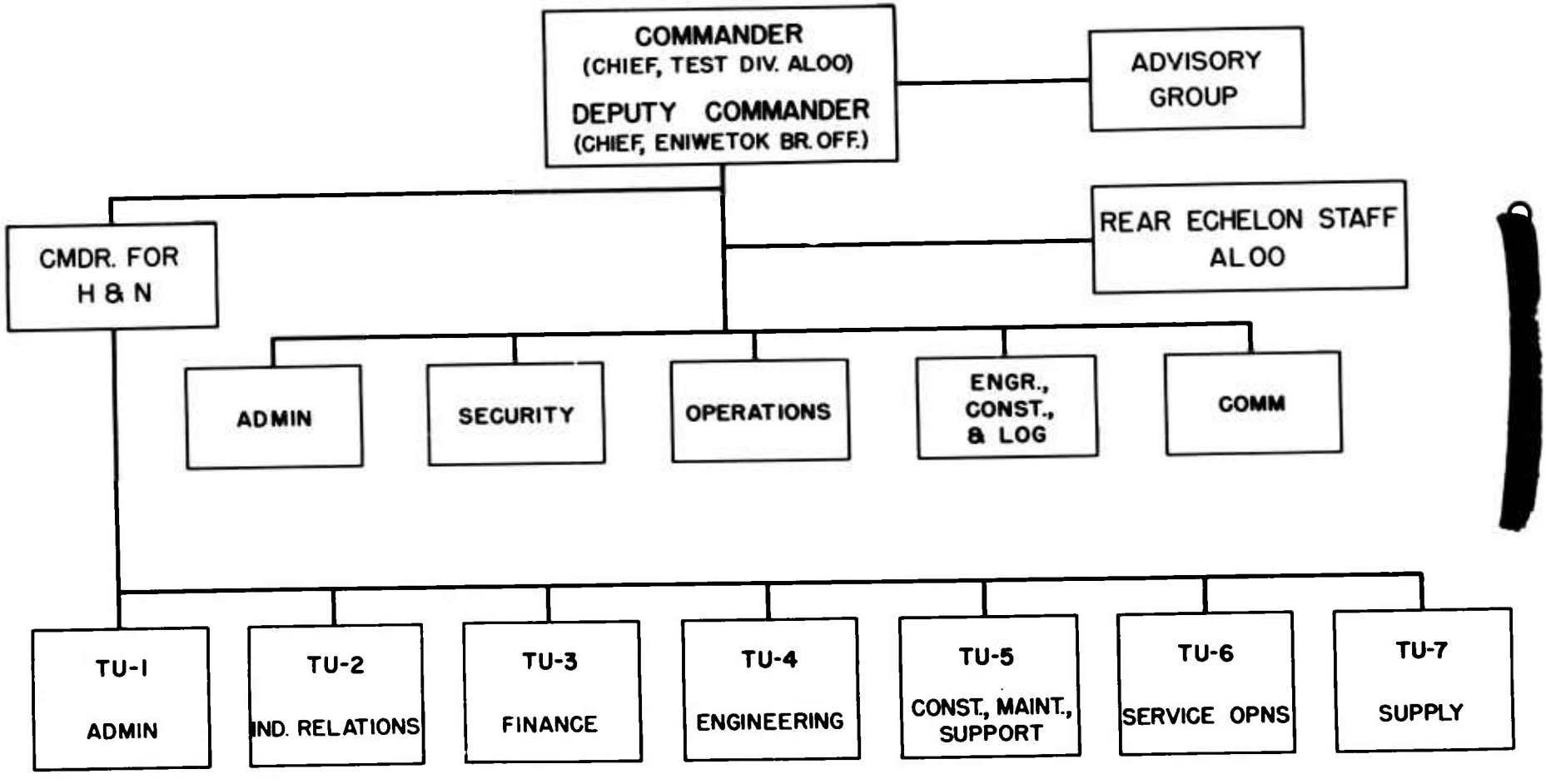

FIGURE S

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execution of Operation REDWING. Admiral Hanlon accepted the responsibility effective 15 March, and on that date the operational period of REDWING began. The task groups that had come to the PPG became operational immediately thereafter. Headquarters, JTF7 opened at the PPG in mid-April upon the arrival of the CJTF7.

19.

Shots

The specified time of each detonation was correlated with the broadcasts of world wide time signals from Radio WWVH, Honolulu (Radio Propagation Laboratory of the National Bureau of Standards). The exact time of the detonation could thus be ascertained to the millisecond, a necessity for certain experiments.

A precise time for each detonation also permitted more effective safety measures. Loudspeakers throughout the PPG carried a voice countdown immediately preceding each shot and enabled personnel to face away from the burst or to don special high density goggles for protection against flash blindness. Communications silence imposed at the PPG immediately before and after a shot precluded interference with vital circuits directly connected with firing the device and recording the experimental data.

Although some shots were fired during the day, detonations usually occurred about forty minutes before sunrise, or at first light, when clouds were normally of lesser consequence and interfered little with

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photographic missions. If cloud cover was heavy at the scheduled time of detonation, or if some delay in the immediate preparations made a slight postponement necessary, the detonation took place at the secondary shot time twenty minutes later.

To prevent inadvertent exposure to hazard, the CJTF7 required that each individual at the PPG be accounted for by a sight muster the day before a scheduled shot. Completed six to twelve hours before the detonation, the muster insured that all persons were in a safe place.

During high yield detonations at Bikini, ships departed the Bikini lagoon and put to sea to be distant from the burst. For events at Eniwetok, ships usually evacuated the Eniwetok lagoon in order to gain the capability of maneuver and dispersal in case of emergency or disaster.

A specific number of messages accompanied each shot. Several days before each detonation, the CJTF7 advised the CNO and AEC of the expected time and date of burst, the weather outlook, and the readiness of the experimental programs; he notified CINCPAC of the possible fallout hazards to populated areas and to air and surface transportation routes. Immediately after the shot, the CJTF7 announced to the CNO and the AEC the exact time of the detonation, stated generally the results obtained, and reported on the safety of personnel at the PPG; several days later he dispatched a general summary of the significant scientific data secured. If the forecasted cloud trajectory changed, the CJTF7 advised CINCPAC.

Before each detonation the J-3 Division published a consolidated operational check list of tasks to be accomplished by various units of the task force. Eventually, as procedures fell into definite patterns, standard check lists became possible, one for events occurring at Eniwetok, another for detonations at Bikini, for the activities about any

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shot at an atoll were much the same for all others there.

The first detonation scheduled was LACROSSE, a relatively low yield burst in the kiloton range on the surface of Runit Island of the Eniwetok Atoll. The ready date of 1 May was advanced to 29 April, then delayed because of unfavorable weather conditions until 4 May.

On the day before the detonation, men who had been working at the LACROSSE shot site and at other test sites in the Eniwetok Atoll were evacuated to Parry Island. After ships of TG 7.3 departed the Eniwetok lagoon during the afternoon before the detonation, everyone at the Eniwetok Atoll was thus either at Eniwetok Island or Parry. Loudspeakers mounted on jeeps toured these islands on the evening before the shot to broadcast warnings and precautions. Sirens awoke personnel in the morning and everyone except those persons intimately connected with the firing, with essential utilities, or with test projects assembled at the lagoon beaches to witness the burst. At the beaches, loudspeaker countdowns synchronized to the firing apparatus (which was located on Parry Island) warned of the time to take precautions to avoid flash blindness.

The second detonation of the REDWING series was CHEROKEE, an air burst of a megaton bomb air dropped over Namu Island of the Bikini Atoll, the first aircraft delivery by the United States of a thermonuclear device. Originally scheduled for readiness on 1 May, then re-scheduled for a week later, CHEROKEE was finally fired on 21 May. Unfavorable weather conditions caused the delay.

Since CHEROKEE was a difficult shot that demanded split-second timing, a rehearsal took place late in April. The practice was valuable not only for co-ordinating the complex participating elements into a

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smooth maneuver but also for working out the details of moving the task force and task group command posts afloat, a procedure that occurred for all Bikini events.

For nearly a week before CHEROKEE, security aircraft patrolled the danger zone to detect unauthorized vessels and planes. A Japanese fishing ship was discovered in the danger area but cleared before shot time.

Four days before detonation, the destroyers of the task force took designated stations from which to secure high altitude wind readings. At the same time, reports from ground weather stations to the JTF7 Weather Central began to increase. As the shot time approached, weather briefings for members of the command took place more frequently.

Meanwhile, men at the Bikini Atoll had begun to evacuate. As they moved aboard ships in the lagoon, mainly to the CURTISS and the AINSWORTH, they brought with them equipment and supplies that would be damaged if left ashore. Heavy equipment such as trailers, trucks, and tractors were moved to Enyu Island and parked in protected locations; tugs towed barges and other small craft to safe anchorages. Air and water lift transported men and materiel not needed for future Bikini shots to Eniwetok. By the day before the shot, only a skeleton force remained ashore at Bikini. These persons performed last-minute technical activity such as checking radio and electrical circuits, readying recording equipment, loading cameras, and setting switches.

While aircraft swept those parts of the danger area where predictions placed the major fallout, the CJTF7 was receiving final weather reports. At 0830 of the day before the shot, staff weather and RadSafe officers presented to the CJTF7 and his advisers conclusions based on data secured as late as two hours earlier.

In mid-morning, selected personnel flew to Bikini to establish command posts aboard the command ships. Members of Headquarters, JTF7 opened the Joint Operations Center aboard the USS ESTES about 1300.

That afternoon, the vessels participating in the scientific projects took their assigned stations. Musters were completed both at Bikini and at Eniwetok. With evacuation from Bikini completed to ships in the lagoon, the vessels departed, assumed night steaming stations, and prepared to take their positions in the shot array during the pre-dawn hours.

By nightfall, half a dozen persons remained ashore at Bikini, the commander of TG 7.1 and several assistants. They occupied a steel reinforced concrete bunker on Enyu Island, twenty miles from the detonation point. Safe from the effects of the detonation, provided with food, water, and living facilities, and in communication with the command ship, the occupants of the bunker operated timing, firing, and recording equipment.

The timing and firing room in the bunker was air conditioned and contained many gray metal and stainless steel cabinets. Hundreds of tiny bulbs represented a complex maze of circuitry; when lighted, they reported circuits functioning properly. In the center of the room was the master control console, the equipment that started the countdown broadcast throughout the PPG; a large red button, if pushed, could stop the process at any time up to the moment the bomb fell from the plane.

A sequence timer, a mechanism little larger than a loaf of bread and protruding from the face of a control cabinet, activated hundreds of pieces of test equipment according to an established pattern by means of a series of cams that closed switches at the proper moments. When the

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bomb left the aircraft, the timer automatically tripped relays to open camera shutters and start mechanical and electronic devices.

To protect high speed cameras that recorded vital aspects of the detonation, a complex system of mirrors and telescopes brought light to the film. In certain instances, heavy doors were triggered to close between the arrival of the light and the arrival of the shock wave.

Aboard the ESTES, weather and RadSafe briefings took place in the evening and again at 0200 of the day of the shot. A destroyer fired window shells and LOKI rockets with WASPs throughout the night to make certain that the wind pattern around the shot site did not change.

At Eniwetok the CHEROKEE bomb had been inspected, then loaded on the drop aircraft. The planes that were to participate in the event were ready to take off during the night in an established order of sequence. The AOC controlled the departure of aircraft from Eniwetok. When the planes were half way to Bikini, they came under the control of the CIC on the ESTES. An intricate radar and communications network positioned the craft at Bikini according to the needs of the experiments -- at various altitudes and at different distances from zero point.

The ships that had steamed out of the Bikini lagoon took up their stations in the test array thirty-five to forty miles from the point of detonation. Destroyers assumed lifeguard stations to pick up survivors of any ditched planes. An amphibious aircraft, a helicopter, and an Air Force crash boat at Eniwetok formed a local rescue unit ready to go to the aid of any air crews forced to make emergency landings. Radiological survey planes departed Kwajalein and assumed orbit stations near Bikini. Should any aircraft in the test array be forced to land at sea immediately before the detonation and thus be exposed to blast, heat, or

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radiation, the commander of TG 7.4 would recommend that the CJTF7 cancel the shot until the crew was rescued. (See Figure T).

After all the participating units had assumed their stations, the commander of TG 7.1 requested permission to fire. All conditions were favorable, and the CJTF7 commanded that the detonation take place.

A single B-52 made this bomb run, the first thermonuclear weapon ever dropped from an aircraft by the U.S., and dropped the bomb over a lighted asphalt target. The burst occurred several thousand feet above the ground. There was little cloud cover to obscure views of the fireball and the mushroom cloud.

The CHEROKEE bomb exploded at about the correct altitude but at some distance from the desired zero point. Human miscalculation (compounded by lights on an island a few miles from ground zero) rather than malfunction of either the weapon or the equipment was responsible for the error in distance that precluded the recording of much experimental data. The shot was nevertheless successful in demonstrating the expected performance of the weapon and the marriage of a thermonuclear weapon to a jet bomber.

Participating aircraft returned to Eniwetok upon the completion of their missions. MATS planes waiting at Kwajalein proceeded to Eniwetok to be ready to carry special sample materials to laboratories in the United States for analysis.

An hour after the detonation, ships began to return to the Bikini lagoon. A helicopter entered the test area and scientific personnel made an initial damage and radiation survey. Planes tracked the fallout cloud and reported its course to the JTF7 RadSafe Plotting Center. When the radioactivity at Bikini had diminished to the point where safe re-entry

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was possible -- about three hours after the blast -- recovery parties entered the atoll by ship, plane, and helicopter to secure recording instruments, scientific samples, and other materials needed for the experiments. By the end of the day of the shot, most of the scientific recovery had been accomplished at Bikini and work was already under way to prepare for the next projected detonation.

To speed up the REDWING series and cut the costs of the operation, JTF7 exploited on two occasions its capability to detonate weapons at both atolls on the same day. The only complicating factor of this course of action was the necessity to split participating units into two parts. No operational difficulties were encountered.

On one occasion a shot at Bikini and another at Eniwetok took place within a few minutes. On the other occasion, both shots took place simultaneously, a situation that had developed somewhat by accident. Numerous postponements due to unfavorable weather had delayed one shot until the day on which another was scheduled. Since the projected detonations were to occur at different atolls, the CJTF7 decided to fire the Bikini device at the primary time (forty minutes before sunrise), the Eniwetok weapon at the secondary time (twenty minutes later). Several hours before the shot, at 0300, staff weather officers recommended cancellation of the Bikini event because of unfavorable winds, and the CJTF7 assented. Shortly thereafter, when the crew of a weather reconnaissance plane reported improving wind fields about the Bikini shot site, the CJTF7 at once rescheduled the shot. To give adequate time for the immediate preshot preparations, specifically to allow aircraft to return to Bikini positions, the CJTF7 designated the secondary shot time as the moment of

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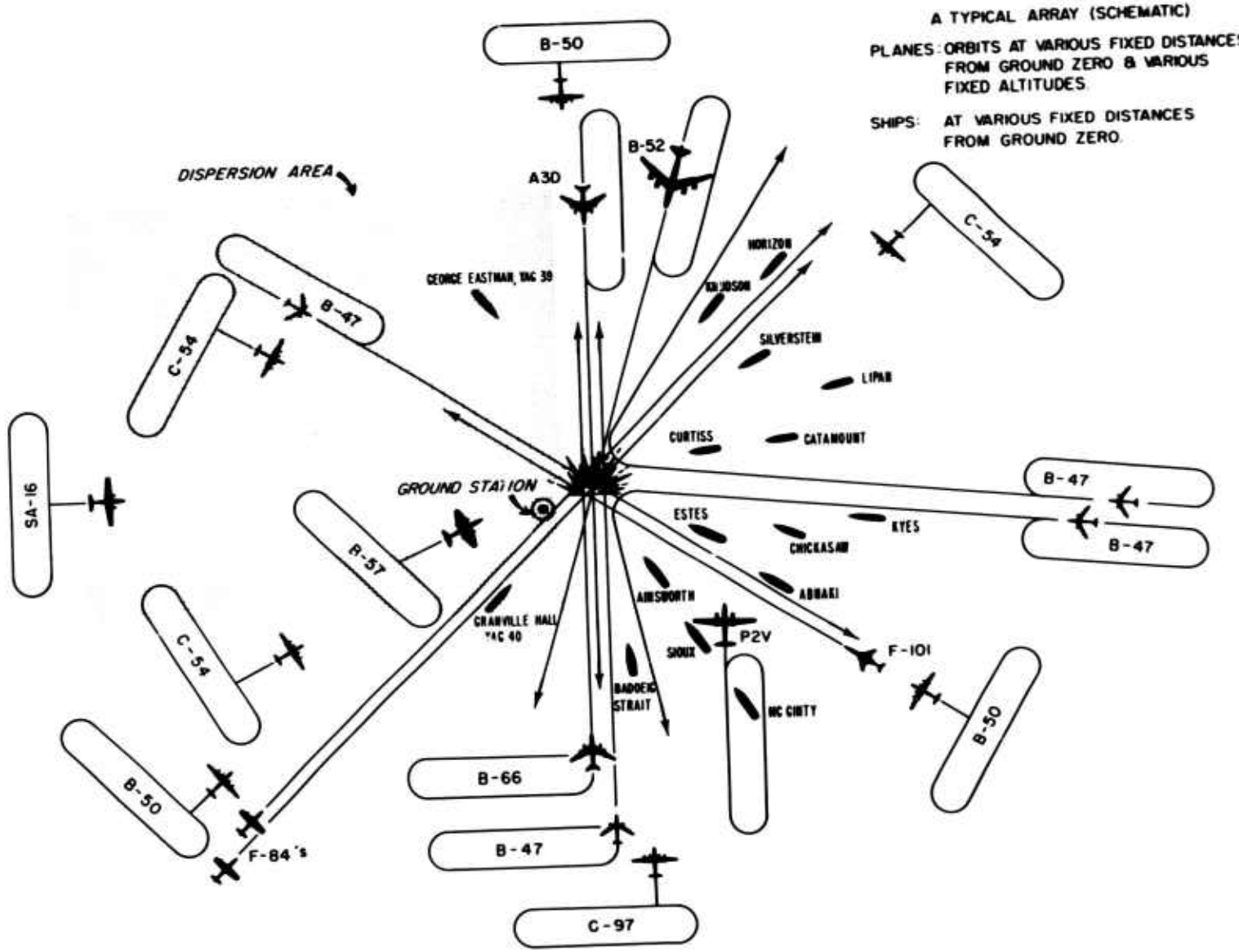
A TYPICAL ARRAY (SCHEMATIC)
PLANES: ORBITS AT VARIOUS FIXED DISTANCES FROM GROUND ZERO & VARIOUS FIXED ALTITUDES.
SHIPS: AT VARIOUS FIXED DISTANCES FROM GROUND ZERO.
B-50
B-52
A30
DISPERSION AREA
C-54
B-47
C-54
GEORGE EASTMAN, YAG 39
HORIZON
SILVERSTEIN
LIPAN
CURTISS
CATAMOUNT
SA-16
GROUND STATION
B-47
B-47
ESTES
KYES
CHICKASAW
B-57
AINSWORTH
ABNAKI
GRANVILLE HALL
YAG 40
P2V
SIOUX
F-101
C-54
BADDECK STRAIT
USC CINTY
B-50
B-50
B-66
F-84's
B-47
C-97

FIGURE 1

detonation. This of course coincided with the detonation time of the device at Eniwetok. The result was an innovation unique to REDWING.

The evaluation of fallout throughout the operation indicated good agreement between forecasted and actual observed patterns. There were no incidents of contamination of populated areas or of traffic along transportation routes. The CJTF7 recommended on two occasions that air routes near the danger zone be closed briefly because of changing radioactive cloud trajectories. Unexpected fallout on future test sites at Eniwetok made it necessary to evacuate a few work camps for a few days until radioactivity decreased; limited work was nonetheless performed by personnel who commuted from Parry Island by boats, planes, and helicopters.

In one instance, four test effects aircraft sustained minor blast and thermal damage without injury to crews. Additional safety measures were taken at Eniwetok for a particular shot -- water towers on Eniwetok and Parry Islands were more securely anchored, a detailed emergency evacuation plan was prepared. To take advantage of favorable weather and thereby shorten the operational period, a shot scheduled for detonation at Bikini was fired at Eniwetok. One detonation produced a yield double the expected amount, but adequate safety precautions precluded damage or contamination of populated areas. Once during the series a slight delay necessitated returning certain participating aircraft to base for re-service and re-instrumentation before re-positioning them in the test array; this was accomplished within a time period of three and a half hours, quite an achievement considering the number of participating planes, the limited service facilities available, and the problem of aircraft congestion at Eniwetok Island.

The final shot of the REDWING series occurred in the latter part of

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the month of July. In retrospect the incidents of the operation were few. There were two minor aircraft accidents -- without serious injuries to crews -- that took place upon landing at Eniwetok. The major accident of the operation concerned an aircraft that fell into the sea and touched off a search and rescue operation that lasted more than ninty-six hours and involved all available ships and aircraft. The pilot was saved; the single other occupant of the plane was unfortunately lost, the only casualty the result of duty activity in an operation that involved more than 14,000 persons at the PPG.

The search and rescue operation illustrated the efficiency of preparations to meet emergencies. Within one minute from the receipt of the pilot's MAYDAY shortly before dawn, an SA-16 scrambled from the Eniwetok strip. Guided by a radar fix on the disabled craft fifty miles from Eniwetok, the SA-16 discovered the pilot's light in the water eighteen minutes later. High seas and darkness prevented immediate recovery, but the Air Force crash boat and the destroyer KYES under forced draft were racing to the scene. Within three hours after the accident, the KYES rescued the pilot. Planes in the air and with adequate fuel had meanwhile been diverted from missions to search for the missing observer, and this began a thorough sea and air sweep that continued for almost a week.

The excellent readings secured from weather balloons caused JTF7 to use many during REDWING, so many that balloon reflectors stocked by the Bureau of Aeronautics became depleted. Unable to obtain additional reflectors through normal supply channels and estimating that the supply on hand would be exhausted early in July, JTF7 queried all agencies in the Pacific area that might have available stocks and requested the assistance of the

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Bureau of Aeronautics for additional procurement. In this manner, JTF7 secured an adequate supply of reflectors for the remainder of the operation.

Certain atomic source and special nuclear materials in the PPG that became excess during the operation were urgently desired by laboratories in the United States. MATS aircraft were available to carry the materials, but JTF7 encountered the problem of securing permission to load such cargo aboard the aircraft. The reason was the absence of appropriate general Air Force regulations governing packaging standards and flight requirements, that are now in the process of being drawn.

The accomplishments of JTF7 in the matter of furnishing support alone was an impressive task. During the buildup and operational phase of REDWING, between September 1955 and August 1956, JTF7 arranged to move between the United States and the PPG approximately 18,000 passengers and 3,000 short tons of cargo and mail by MATS and 600 passengers and 195,000 measurement tons of cargo and POL by MSTS and COMSERVPAC vessels -- totals exclusive of men and materiel lifted by organic planes and ships of the task force. During the same period of time, JTF7 airlifted 13,000 passengers and 675 short tons and shipped by water more than 60,000 measurement tons between Eniwetok and Bikini. Inter-island traffic at the Eniwetok atoll numbered more than 31,000 passengers and 20 short tons of cargo carried by light planes and helicopters; inter-island service at Bikini totalled 30,000 passengers and 50 short tons. In support of the weather and scientific stations on outlying islands, JTF7 transported more than 2,000 passengers and 150 short tons of cargo by air and almost 13,000 measurement tons of cargo by ship.

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JTF7 execution of the vast and complex activities that comprised REDWING, a difficult and potentially hazardous operation, resembled in the final analysis a routine procedure. The operational period formally ended 10 August 1956.

20.

Visitors

Three types of visitors came to the PPG for brief periods of time. Official observers were high government officials and other persons who had a direct interest in REDWING or whose positions made it desirable for them to have special knowledge of the tests. Technical observers were civilians and military officers who worked in fields related to atomic energy. Special observers consisted of civilian representatives of American news media and certain regional and state civil defense leaders selected by the Federal Civil Defense Administration (FCDA).

The visits of the observers to the PPG, the briefings presented them by JTF7 members, and their views of shots were designed to contribute to their knowledge of the meaning of the test series and the potential significance of atomic warfare. Their influential or special positions gave them an opportunity to disseminate information to the interested public.

The AEC and the DOD each selected an equal number of persons they desired to visit the PPG as official observers. JTF7 invited them and arranged for special VIP flights to transport them in groups. Project officers representing the AEC, the DOD, AFSWP, each military Service, and

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JTF7 planned seven flights and scheduled them to reach the PPG at different times during the operation in the hope that each group would be able to view at least one detonation. Only six flights, each accompanied by an escort officer provided by the Services, actually took place before the operation terminated.

During the course of their stay, which usually lasted about five days, the observers made a ground tour of Eniwetok Island and an air sweep over both atolls, visited technical installations and scientific stations, received briefings from Admiral Hanlon and his senior officers on the mission and the organization of JTF7 and the methods applied to accomplish the testing, and finally witnessed detonations that occurred.

A total of 108 official observers visited the PPG during REDWING. The AEC sponsored 53 visitors. The DOD sponsored 55, including 19 from the United Kingdom and Canada led by Dr. John Hannah, Chairman, Permanent Joint Board of Defense and General A.G.L. MacNaughton of Canada.

Numbered among the high U.S. Government officials were the Honorable Charles E. Wilson, Secretary of Defense; the Honorable Lewis L. Strauss, Chairman, AEC; the Honorable Allen W. Dulles, Director of the CIA; the Honorable Frank Newbury, Assistant Secretary of Defense; the Honorable Thomas E. Murray and the Honorable Harold S. Vance, Commissioners, AEC; Senator John Pastore, member of the Joint Committee on Atomic Energy; the Honorable Charles Finucane, Assistant Secretary of the Army; the Honorable Albert Pratt, Assistant Secretary of the Navy; the Honorable Herbert Loper, Assistant to the Secretary of Defense for Atomic Energy Matters; the Honorable Dillon Anderson, Special Executive to the President; and Ambassador Amos Peaslee, Deputy Special Assistant to the President. Among

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senior United States military personnel were General Laurence Kuter, Commander of the Far East Air Force, and Admiral Felix Stump, CINCPAC.

The Technical Observers, selected by the military Services and scientific agencies in co-ordination with the JTF7 deputy commanders, proceeded to the PPG individually. They made their own travel arrangements, assisted by the JTF7 liaison officers. The task groups, and in some instances the Headquarters of JTF7, provided accommodations, services, and orientation briefings to them at the PPG. Some technical observers assisted task force members in their duties and thus came to have a more intimate knowledge of the function of their particular interest. JTF7 issued 174 invitational travel orders to civilians and military officers, most of whom spent one to several weeks at the PPG during REDWING.

The special observers arrived in one group at the beginning of the operational period. Their presence was the result of recognition by the AEC and DOD of increased public interest in atomic developments and in defensive preparations for atomic warfare. Not since Operation CROSSROADS in 1946 had the press been invited to attend an overseas test series.

The principal problem connected with the visit of the special observers was the maintenance of security. Neither the members of the press nor the civil defense leaders had AEC or DOD clearance for access to classified information. To forestall a burdensome problem, the CJTF7 accepted, for the one, FCDA certification of the individuals as good security risks for entry into the PPG and, for the other, press accreditation by the DOD as the basis for certification. For assistance in administering the visit of these uncleared persons and their subsequent release of information to the public, the CJTF7 employed a provisional

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organization called the Joint Office of Test Information (JOTI), an instrument of the AEC and the DOD.

Since JTF7 had no authority to release public information, a prerogative reserved to the AEC and the DOD, both agencies jointly created JOTI as the public information agency for REDWING. The JOTI mission was to prepare for public release as much data as possible to improve public knowledge and support of the nuclear test activities. JOTI was to provide official factual reports to dispel rumors or speculation harmful to the success of the operation or the interests of the United States. Staffed by AEC and DOD experts in classification, security, and public information procedures, JOTI assumed the additional task of accompanying the special observers to the PPG in order to give technical supervision to the program arranged by JTF7.

The CNO provided the USS MOUNT McKINLEY to serve as the "press ship" to house the special observers during their visit to the PPG. Additional communications equipment installed on the ship gave it the capability of handling the transmission of direct voice broadcasts to the United States and vast amounts of teletype traffic.

The AEC and DOD decided to invite 15 news media representatives to witness and report upon the CHEROKEE detonation -- reporters selected by the Standing Committee of Correspondents of the Capital Press Gallery to form a news service pool for morning and evening newspapers, photographers chosen by the White House Photographers Association, radio and television newscasters selected by the Washington Radio and Television Correspondents Association, a reporter covering for all national weekly news periodicals.

The special observers traveled individually to Honolulu where they received a general briefing and indoctrination that emphasized their

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security responsibilities. They learned that JOTI would not censor copy or photographs dispatched from the PPC. The group -- including about 20 civil defense leaders -- moved to Kwajalein via MATS planes and there boarded the MOUNT McKINLEY. The ship arrived off Eniwetok in time for the visitors to witness the LACROSSE shot.

Aboard the ship anchored in the Eniwetok lagoon, the special observers received folders of background information prepared by JOTI. They also participated in a three-hour briefing and question and answer period conducted by the CJTF7 and his key subordinates on the general concept of the operation and the safety precautions applied. They made an aerial tour of the Eniwetok and Bikini atolls and ground tours of scientific installations and technical facilities at both atolls. During the long delay caused by unfavorable weather that prevented immediate detonation of CHEROKEE, the special observers nevertheless filed a tremendous amount of copy and incidentally participated in such recreational activity as deep sea fishing, swimming, and picnics.

When the CHEROKEE detonation finally occurred, a direct voice broadcast from the MOUNT McKINLEY off Bikini passed through commercial facilities at Guam, Midway, and Hawaii and carried the news of the shot to the United States. JTF7 provided immediate air lift facilities to Hawaii (for commercial movement to the United States) for an uncounted number of still photos, 3,500 feet of 16mm film shot by the television pool crew, and 900 feet of 35mm film taken by newsreel cameramen. In addition to an unestimated but large amount of wordage in press copy and on radio tape, six teletype circuits transmitted 172,400 words, and radiofacsimile forwarded 56 still pictures. A special voice circuit carried 180 minutes of broadcast. In support of these activities, JOTI handed out 52 pieces

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of information totalling 254 pages of text and issued 94 informational releases and announcements.

The news media personnel co-operated fully with JTF7. There was neither breach of faith nor disclosure of classified information.

21.

Rollup

Though the final REDWING detonation occurred in the latter part of July, the operational period continued in existence until all unused source and special nuclear materials were returned from the PPG to the United States and transferred from JTF7 to AEC custody. During this period, JTF7 devoted its major effort to the rollup of the operation, making the transition from operational to interim status.

The task force had, on 1 March 1956, requested all DOD agencies to indicate the desired disposition of all property on loan to JTF7 for REDWING. The task force received instructions by mid-May, and this timely action greatly facilitated the rollup.

Rollup had actually commenced early in the operation as men and materiel no longer required at the PPG returned to the United States. Personnel, for example, who conducted an experimental project connected with a specific shot departed the PPG immediately after submitting a preliminary report on results. As an increasing number of shot sites were evacuated and security requirements diminished, military police were released.

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Rollup plans for the activity following the final event were prepared quite early. They involved transporting personnel and equipment to the United States, closing not only temporary and semi-permanent camp sites at the PPG but also weather and scientific stations on the outlying islands, and storing equipment and facilities in the PPG for the next operation.

The most pressing problem of the rollup was how to manage a concentrated mass exodus immediately after the last shot. Since no one could predict exactly when the final detonation would occur, transportation was arranged in advance by selecting the probable date, and on this basis MATS programmed aircraft for JTF7 movement without disrupting schedules. MATS made available more than twenty planes on short notice -- by augmenting regularly scheduled flights, by using back-up aircraft on standby for the sample return flights, and by diverting some regularly scheduled flights from the Philippines and the Far East into Eniwetok. The program took place without incident.

At the same time, MSTS ships docked at the Parry Island deep water pier to load equipment -- sensitive instruments as well as more than a hundred large van-type trailers equipped as rolling laboratories. Navy vessels also loaded equipment for return to the United States, and the CURTISS and BADOENG STRAIT took aboard helicopters, reconnaissance planes, and certain jet aircraft unable to make long-distance flights. LST 306 shuttled among the operational sites at the Bikini atoll to help close down camps and stations there. The USS CATAMOUNT and LST 618 provided the lift required to close the weather, RadSafe, and scientific stations on the outlying islands, stations generally turned over to local authorities for custodianship until the next operation.

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The rollup necessitated disposing of much equipment. Borrowed facilities were prepared, packaged, and returned to the owning agency. Serviceable goods for which no known requirement existed and critical material for which satisfactory long-term tropical storage could not be provided were disposed of in accordance with instructions from appropriate headquarters. Equipment, such as vehicles, that required major overhaul were shipped to the United States. To the extent that was practical, all equipment needed for interim use or for future operational use at the PPG was retained; in some cases, this necessitated special processing for tropical storage -- applying rust preventative and providing dehumidified storage facilities. These functions as well as taking inventory of stocks at the PPG extended the rollup through the autumn until October.

Meanwhile, facilities at Parry Island not required for the interim period were shut down. At Eniwetok, the Army garrison assumed its interoperational duties, and a reduced Air Force complement operated the air facilities. The Manager of the Eniwetok Branch Office was already concerned with employing Holmes and Narver personnel to prepare the base facilities and scientific construction needed for the next operation.

In the United States, Headquarters, JTF7 reduced its strength for the interim period, but retained a sufficient number of personnel to make plans for projected operations in the future. The headquarters recommended that TGs 7.3 and 7.4 do the same. Because the Navy task group had been drastically reduced in strength after CASTLE and after WIGWAM, and because the Air Force task group after CASTLE had disappeared temporarily through absorption into other commands, the JTF7 headquarters had sometimes found it difficult to maintain adequate relations with these groups in the interest of planning for REDWING. The CJTF7

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consequently recommended for the interim period following REDWING that TGs 7.3 and 7.4 maintain their identities in sufficient strength to execute better the planning functions necessary for the next overseas test series. The TG 7.4 unit was immediately set up by Hq ARDC at Kirtland AFB, where it is now an organization in fact. The Hq of TG 7.3 remains at the Naval Gun Factory, Washington, D.C.

Meanwhile, much effort during the rollup was devoted to reports of the activity performed during the operation. The CJTF7 prepared for the JCS a written Commander's Report based on final reports submitted to him by each staff section of the Headquarters and by each task group. With the participation of the chief of staff and the deputy commanders, he also prepared a film report produced by the Lookout Mountain Laboratory at Los Angeles. Each scientific unit that had been responsible for projects at the PPG compiled the data secured and made ready to publish the results of its experiments.

22.

Results

Before the scientific project groups departed the PPG upon the conclusion of their experiments, each submitted a preliminary report on the results attained. Though LASL, UCRL, AFSWP, and other civilian and military organizations studied and evaluated the data secured from the REDWING tests for months following the operation, the preliminary results indicated certain positive findings.

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The President had stated in April 1956 that the objective of the operation was to develop a variety of atomic weapons to meet a wide range of military usage -- to provide defense against air attack and to perfect devices with reduced fallout hazards. Soon after the last REDWING detonation the AEC announced that real progress had been accomplished. Not only had additional devices been proved as weapons suitable for stockpiling; but certain "clean" weapons had achieved predicted effect on the immediate target area with minimum fallout.

Increased yields obtainable from weapons of greatly decreased size and weight were significant in terms of certain projected stockpile weapons. Diversified delivery systems in aircraft missiles and ships were also tested. Structural responses of equipment to blast gust and thermal radiation and tests of washdown decontamination systems, protective coatings, and shielding were important for engineering design. Besides demonstrating the capability of dropping an atomic weapon of megaton yield from existing inventory aircraft, REDWING made it possible for aircraft delivery capabilities and optimum air-speeds and release altitudes for bomb drops to become better known. All the Services benefitted from tests of radiation and fallout, blast, and heat with reference to ground installations, equipment, and troops. In addition, the accumulation of scientific data, both in diagnostics and effects, increased the general fund of atomic knowledge.

JTF7 activity in the field of weather and particularly in the study of upper air readings was of significance and import to all meteorologists. REDWING provided an opportunity for JTF7 weather experts to document the meteorology of the Marshall Islands and to supplement the climatological records of the Central Pacific. Not only were the periodic

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readings and forecasts retained but a continuity of meteorological thought was also preserved. Members of the JTF7 Weather Central recorded on a dictaphone the reasoning behind the forecasts, also compared the predictions with the actual weather conditions. Most stations maintained a running log to give each of the continuous weather watches a full and accurate record of activities during the preceding hours. These records constituted a valuable storehouse for continuing research.

JTF7 weather activity during REDWING provided data to evaluate with some degree of accuracy the speculation that solar outbursts had an effect on the upper level wind structure in the tropics. It appeared that wind systems desirable for an atomic detonation tended to occur within a certain time after a solar explosion. In order to gather data that might prove the existence of a predictable pattern depending upon this observable phenonmenon, JTF7 had arranged to obtain solar data at various parts of the earth on a daily basis in the hope that sufficient advance notice would be available to take advantage of all periods of good shooting weather.

REDWING demonstrated the effectiveness of new and improved weather gathering techniques that furnished fast and accurate wind readings. The WASP rockets, the improved balloons, and the Navy window shells made it possible to collect weather data in remote areas where upper wind information was not readily available, techniques that were essential for the conduct of atomic warfare.

The RadSafe personnel gathered much important information, particularly on the methods of predicting and tracking radioactivity. The significance of this activity pertained especially to civil defense procedures in case of hostile atomic attack. Fallout predictors and

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trackers, for example, were capable of indicating, in the event of atomic disaster, communication routes free of radioactivity and the amount of time available for evacuation of specific locations. In this connection, work was in progress to develop an analog computer that would absorb typewritten data and present its calculations in typewritten form. Also in a stage of development during REDWING was a cloud tracking technique that used radar.

The visit of the news media representatives resulted in a substantial public relations contribution for the military Services and the AEC. By means of the observer programs, JTF7 educated an influential segment of the public to a better understanding of the test program, a privilege that JTF7 considered extending in the future to leaders in industry and education. In somewhat similar fashion, the members of JTF7 secured through their participation a more or less intimate knowledge of the objectives, the methods, and the applications of the atomic testing. In close contact with the activities surrounding the detonations and privileged to witness atomic explosions, JTF7 personnel developed a respect for the capabilities of atomic weapons that perhaps served as an antidote to irrational fear and as a stimulus to learn to cope with the many aspects of atomic warfare.

Though not intended as a training exercise, REDWING provided an operational situation that presented maximum opportunity for individual and unit training. Whatever the specialty or function, the participants in REDWING, by virtue of their participation, became better qualified to perform their duties.

The fact that JTF7 embraced representatives of all military Services as well as civilians, each performing tasks that were mutually interde-

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dependent, provided an experience in the achievement of a harmony of effort that was valuable to all individuals. Personnel of every component received a better understanding, a broader perspective, and a personal knowledge of the co-operation required as well as feasible in the atomic age. This was truly a joint effort of all the military Services working closely in harmony, not only among themselves, but also with the scientific fraternity of the United States and the Free World.

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