

## Operation HARDTACK I

**Note:** For information related to claims, call the Department of Veterans Affairs (VA) at 800-827-1000 or the Department of Justice (DOJ) at 800-729-7327. For all other information, call the Nuclear Test Personnel Review (NTPR) Program at 800-462-3683.

Operation HARDTACK was the designation given to the atmospheric nuclear test series conducted by the United States in the Pacific Ocean and Nevada in 1958. Operation HARDTACK I was a series of 35 tests, all but two of which were detonated at Enewetak and Bikini Atolls in the Marshall Islands, part of the Atomic Energy Commission's (AEC) Pacific Proving Ground (PPG). The other two were detonations at 43 and 77 km (26.7 and 47.8 mi) above Johnston Island, which lies about 700 nmi (1,296 km) west-southwest of the Hawaiian Islands. The tests were conducted by a joint military and civilian organization, designated Joint Task Force 7 (JTF 7), comprised of approximately 19,100 personnel. JTF 7 was a military organization in form but was made up of military personnel, Federal civilian employees, and contractors of the Department of Defense (DoD) and the AEC. The commander of this force was the appointed representative of the AEC and reported also to the Joint Chiefs of Staff (JCS) and the Commander-in-Chief, Pacific (CINCPAC).

### Historical Background

During HARDTACK I, the United States fired as many nuclear devices (35) as had been fired in all prior Pacific Ocean tests. Not only was the total number of shots in HARDTACK I large, but the variety of types was great; land- and water-surface events, underwater detonations, a balloon detonation, and rocket-borne high-altitude tests were conducted. The names, dates, and locations of the shots are listed in the accompanying table.

In a sense, HARDTACK I was divided into three parts. The first was aimed at the development of nuclear weapons, continuing the type of testing that had taken place at Enewetak and Bikini during the early and mid-1950s. In these tests, the AEC weapon development laboratories (Los Alamos Scientific Laboratory and the University of California Radiation Laboratory) detonated their experimental devices, with the DoD providing support and conducting experiments that did not interfere with the AEC activities.

The second part, sponsored by DoD, consisted of the underwater test shots, WAHOO (open ocean) and UMBRELLA (lagoon). The purpose of these tests was to improve the understanding of the effects of underwater explosions on Navy ships and material. These tests could be considered as a continuation of the BAKER test of the CROSSROADS series at Bikini in 1946 and the WIGWAM test 500 nmi (926 km) off the U.S. west coast in 1955.

### Shot Summary

#### Summary of Operation HARDTACK I Events (1958)<sup>a</sup>

Shot	Local Date	Location	Type	Yield <sup>b</sup> (kt)
YUCCA	April 28	Between Enewetak and Bikini	Balloon <sup>c</sup>	1.7
CACTUS	May 6	Enewetak	Surface	18
FIR	May 12	Bikini	Barge	1360
BUTTERNUT	May 12	Enewetak	Barge	81
KOA	May 13	Enewetak	Surface	1370
WAHOO	May 16	Enewetak, in ocean	Underwater	9
HOLLY	May 21	Enewetak	Barge	5.9
NUTMEG	May 22	Bikini	Barge	25.1
YELLOWWOOD	May 26	Enewetak	Barge	330
MAGNOLIA	May 27	Enewetak	Barge	57
TOBACCO	May 30	Enewetak	Barge	11.6
SYCAMORE	May 31	Bikini	Barge	92
ROSE	June 3	Enewetak	Barge	15
UMBRELLA	June 9	Enewetak, lagoon	Underwater	8
MAPLE	June 11	Bikini	Barge	213
ASPEN	June 15	Bikini	Barge	319
WALNUT	June 15	Enewetak	Barge	1450
LINDEN	June 18	Enewetak	Barge	11
REDWOOD	June 28	Bikini	Barge	412
ELDER	June 28	Enewetak	Barge	880
OAK	June 29	Enewetak	Barge	8900
HICKORY	June 29	Bikini	Barge	14
SEQUOIA	July 2	Enewetak	Barge	5.2
CEDAR	July 3	Bikini	Barge	220
DOGWOOD	July 6	Enewetak	Barge	397
POPLAR	July 12	Bikini	Barge	9300
SCAEVOLA (safety test)	July 14	Enewetak	Barge	0
PISONIA	July 18	Enewetak	Barge	255
JUNIPER	July 22	Bikini	Barge	65
OLIVE	July 23	Enewetak	Barge	202
PINE	July 27	Enewetak	Barge	2000
TEAK	July 31	Johnston Island area	High Altitude (rocket)	3800
QUINCE	Aug 6	Enewetak	Surface	0 <sup>d</sup>
ORANGE	Aug 11	Johnston Island area	High Altitude (rocket)	3800
FIG	Aug 18	Enewetak	Surface	0.02

<sup>a</sup>Source: *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV-209-Rev 15, Dec 2000.

<sup>b</sup>One kiloton equals the approximate energy release of the explosion of one thousand tons of TNT.

<sup>c</sup>Listed as “High-altitude – 86,000 feet” in DOE/NV-209-Rev 15.

<sup>d</sup>Weapon-related; yield not up to expectation.

The third part, also sponsored by DoD, addressed a new military issue: nuclear weapons in air and ballistic missile defense. The HARDTACK I tests directed toward this issue were rocket borne high-altitude shots TEAK and ORANGE (conducted at Johnston Island). A third test (YUCCA) was carried to 86,000 feet by a balloon over the ocean between Enewetak and Bikini. These tests used device placement techniques and data-recording operations that were new to nuclear weapons testing.

Central to the series was the testing program. This program and its requirements dictated the form of the test organization and the detail of personnel participation. The HARDTACK experimental program incorporated two aspects, the first of which was the development of the weapons themselves, and the second involved the measurement of the explosive and radiation effects. Unlike earlier nuclear test series, the HARDTACK test operations supporting each aspect were in large part separate.

These two aspects can serve as a rough measure of differentiation of interest between the major participants: the AEC interest in weapon development, and the DoD interest in the military application of the effects of the explosions. The several parts of the weapon development and effects studies each had particular features that led to the possibility of radiation exposure.

### **Radiation Protection Standards**

For HARDTACK I, CJTF 7 was directed to “assume overall responsibility for the radiological safety of Task Force personnel and of populated islands.” To carry out this responsibility, the JTF 7 Operation Plan further directed that a Fallout Plotting Center be set up and that the capability be established to keep the task force and CINCPAC informed of the fallout situation at all times, including the announcement of safe reentry times. Fallout stations were to be set up and technical assistance given to personnel in the Trust Territory of the Pacific Islands. Monitors and couriers were to be provided for radioactive sample centers.

In addition, the Operation Plan specified that task group commanders establish radiation safety units within the task groups with adequate special clothing and radiological instrumentation. Task groups were also required to provide a roster of their personnel for film badge preparation.

The radiological safety program for HARDTACK I was divided into two parts: onsite and offsite. Onsite radiological safety activities were conducted by the various task groups, with the scientific task group given the responsibility for all radiological safety functions associated with diagnostic experimental programs and for dosimetry and other technical services to the entire task force. The operation of the offsite program and the coordination of the onsite activities were conducted by the Radiological Safety Office of HQ JTF 7.

A maximum permissible exposure (MPE) for personnel was set at 3.75 roentgens (R) (gamma only) per consecutive 13-week period with a maximum of 5 R for the operation. Exceptions were made for emergency and other tactical situations. The operation was defined as the period from 15 days before the first ready date to 15 days after the last shot. A special MPE of 10 R was authorized for crewmembers of air-sampling aircraft. In the event of operational error or emergency, an additional exposure of 10 R would be accepted. Any exposure in excess of 20 R total would be considered as an overexposure for aircrew samplers.

The limit of 3.75 R per 13-week consecutive period was slightly greater than the limit of 3 R per 13-week period in effect at that time (as recommended by the National Council on Radiation Protection and Measurements and the International Commission on Radiation Protection). The limit of 5 R for the operation is equivalent to the annual dose currently permitted by Federal guidelines for radiation workers. Appropriate remarks were to be included in the medical records of personnel who exceeded the 3.75 and 5 R limits. Military personnel were to be advised that they should not be exposed to further radiation until sufficient time elapsed to bring their average radiation exposure down to 0.3 R/week. Civilian personnel in this category were to be informed that limitations of further radiation exposure were to be determined by the laboratory or agency having administrative jurisdiction over such personnel.

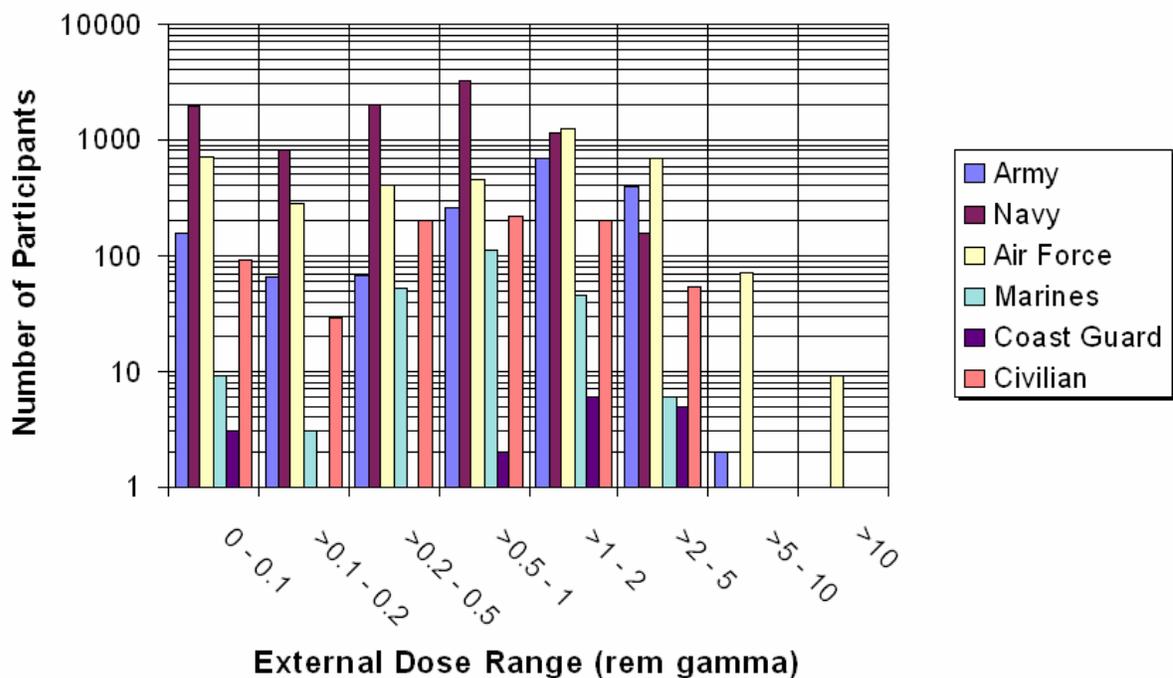
A film badge program provided an exposure-indicating device to all JTF 7 personnel to maintain complete exposure information on everyone entering the PPG during the operation. The commander of the scientific task group assigned overall badging responsibility to a special task unit. Beginning April 1, 1958, film badges were issued to all individuals upon their arrival at the PPG with instructions that the badge be worn at all times and turned in on recall, upon exit from any contaminated area, or upon departure from the PPG.

### **Radiation Doses at Operation HARDTACK I**

The fallout from Shots FIR and KOA contributed most to the reconstructed total dose of 1.3 to 2.7 rem\* for personnel who resided on Enewetak Atoll. The dose range reflects variations due to different residence sites and work activities. Corresponding dose levels are confirmed by the film badge readings that are available for nearly all personnel on the atoll. For personnel who resided on Bikini Atoll (Eneu Island), the reconstructed dose is 1.1 rem, mostly from Shot FIR fallout. Naval personnel aboard ships in the vicinity of Enewetak or Bikini also were exposed to fallout, and some were further exposed to contaminated target ships and seawater after WAHOO and UMBRELLA. The shots over Johnston Island, though visible from Hawaii, did not expose the Hawaiian Islands to fallout.

The mean dose of all DoD personnel at HARDTACK I was 0.8 rem. This was less than for the preceding operations with multiple thermonuclear tests and reflected improvements in weather and fallout predictions. About 140 DoD personnel, or fewer than 1 percent, exceeded the MPE of 3.75 rem. Fewer than 10 personnel exceeded the cloud sampler limit of 10 rem. The highest dose was 12.4 rem. The totals of reconstructed and film badge doses for HARDTACK I participants are depicted in the following chart.

## Doses Accrued by HARDTACK I Personnel



\* A rem is a radiation protection unit of measure that quantifies the risk of biological effects resulting from exposure to ionizing radiation. Ionizing radiation is any radiation (gamma, x-ray, beta, neutron or alpha) capable of displacing electrons from atoms or molecules, thereby producing ions. According to the National Council on Radiation Protection and Measurements (NCRP, Report No. 93, Table 8.1), the general U.S. population receives about 0.36 rem per year from natural background radiation sources (radon, cosmic rays and rocks) and man-made radiation sources (medical diagnostic x-rays and consumer products).

For more information, see the report "Operation HARDTACK I 1958" (DNA 6038F), available online at [http://www.dtra.mil/rd/programs/nuclear\\_personnel/docs/DNA6038F.pdf](http://www.dtra.mil/rd/programs/nuclear_personnel/docs/DNA6038F.pdf).

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