

Operation TEAPOT

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Operation TEAPOT was the fifth series of atmospheric nuclear tests conducted by the Atomic Energy Commission (AEC) within the continental United States. The series, which consisted of 14 nuclear events and one non-nuclear detonation, was conducted at the Nevada Test Site (NTS) from Feb. 18 to May 15, 1955. The operation involved an estimated 11,700 Department of Defense (DoD) personnel who participated in observer programs, tactical maneuvers, and scientific studies. The series was intended to test nuclear devices for possible inclusion in the weapons arsenal, improve military tactics, equipment, and training, and study civil defense requirements.

Historical Background

About 8,000 of the DoD participants at TEAPOT took part in Exercise Desert Rock VI. The remaining DoD personnel assisted in scientific experiments or administration and support activities for the Joint Test Organization (JTO).

Exercise Desert Rock VI, an Army program involving members of the armed services, included observer activities, troop tests, and technical studies. Observer programs, conducted at Shots WASP, MOTH, TESLA, TURK, BEE, ESS, APPLE 1, and APPLE 2, generally involved instruction on the effects of nuclear weapons, observation of a nuclear detonation, and a subsequent tour of a display of military equipment exposed to the detonation. Troop tests were designed to demonstrate military tactics and doctrine and to train command and staff personnel in all phases of planning and conducting combat operations under the anticipated conditions of nuclear warfare. Troop tests included the maneuvers performed at Shots BEE and APPLE 2. Technical studies were conducted at Shots WASP, MOTH, TESLA, TURK, BEE, ESS, APPLE 1, WASP PRIME, MET, and APPLE 2. These projects were used to train armed services personnel and to study the ability of different types of military equipment and structures to withstand nuclear detonations.

Scientific tests studying the effects of each nuclear detonation were conducted by the Armed Forces Special Weapons Project (AFSWP) Military Effects Group, Los Alamos Scientific Laboratory Test Group, University of California Radiation Laboratory Test Group, and Federal Civil Defense Administration Civil Effects Test Group. Scientists and technicians from these groups placed gauges, detectors, and other instruments around the point of detonation in the days and weeks preceding each scheduled nuclear test. After each shot, when the Test Manager had determined that the area was safe for limited access, these participants returned to the test area to recover equipment and gather data.

Support services for both Exercise Desert Rock VI and the JTO included radiological safety, security, transportation, communications, engineering, and logistics. During TEAPOT, approximately 2,000

support troops were assigned to Camp Desert Rock to perform these duties for Exercise Desert Rock VI. The Desert Rock radiological safety section was comprised primarily of members of the 50th Chemical Service Platoon. Some other Desert Rock support elements included the 232nd Signal Company; 23rd Transportation Truck Company; 31st Transportation Truck Company; 2nd Transportation Company; Company A, 505th Military Police Battalion; and 94th Medical Detachment (Veterinary Food Inspection Service). In addition, the 12th Evacuation Hospital¹ provided medical and dental care for the military personnel at Camp Desert Rock and established aid stations for troops in the forward area.

The Air Force Special Weapons Center (AFSWC) provided aircraft and pilots for airdrops, security sweeps, cloud sampling, cloud tracking, and aerial radiological surveys for the JTO. These missions were performed by the 4925th Test Group (Atomic), 4926th Test Squadron (Sampling), 4935th Air Base Squadron, and 4900th Air Base Group. AFSWC aircraft staged from Indian Springs Air Force Base (Nevada) and Kirtland Air Force Base (N.M.).

Radiation Protection Standards

Safety criteria were established to minimize the exposure of participants to the effects of nuclear detonations while allowing them to accomplish their missions. Separate criteria were established for participants in Exercise Desert Rock VI, the JTO, and AFSWC. DoD established an exposure limit for Desert Rock troops of 6.0 roentgens (R) of gamma radiation during TEAPOT, with no more than 3.0 R of prompt radiation. The Desert Rock limit was higher than for JTO participants because the Exercise Desert Rock troops, unlike the JTO participants and some AFSWC personnel, were not likely to be exposed to radiation after the series.

To protect participants from the thermal and blast effects of nuclear detonations, the following additional exposure limits for Desert Rock participants were established:

- Five pounds per square inch of overpressure
- One calorie per square centimeter of thermal radiation

The AEC authorized a maximum exposure for JTO personnel of 3.9 R of gamma radiation during TEAPOT. Since the TEAPOT operational period was approximately 13 weeks, this exposure limit was equivalent to the then-current 0.3 R per week occupational exposure limit recommended by the National Council on Radiation Protection (NCRP). AFSWC personnel were limited to the same exposure of 3.9 R of gamma radiation unless otherwise specified.

In some instances, the Test Manager could authorize selected individual gamma radiation exposure limits higher than the standard 3.9 R for JTO participants or 6.0 R for Desert Rock participants. The Test Manager authorized a special exposure limit of 10.0 R of gamma radiation for the 10 Desert Rock volunteer officer observers at Shot APPLE 2, who observed the shot at 2,380 meters from ground zero (more than 800 meters closer than the other observers). All volunteer officer observers wore film badges and the average reading was 1.3 R. The Test Manager also authorized a limit of 15 R for the pilots of Military Effects Group Project 2.8b, Manned Penetrations of Atomic Clouds. Two film badge readings for participants in this project exceeded the limit of 15 R. One reading of 21.7 R/h was for a member of the 4926th Test Squadron, and the other of 21.8 ¹R was for a member of AFSWC headquarters.

¹ Some subordinate units were not present

Although the Test Manager was responsible for the radiological safety of all participants at TEAPOT, Exercise Desert Rock VI, the JTO, and AFSWC each had responsibility for implementing the radiological safety for its members. The 50th Chemical Service Platoon implemented procedures for Exercise Desert Rock VI. For the safety of all JTO personnel, onsite radiological safety operations were performed for the Test Manager by the Onsite Radiological Safety Organization, headed by the Chief of the Radiological Safety Branch of AFSWP Field Command. The 1st Radiological Safety Support Unit, Fort McClellan (Ala.) provided the main support for the onsite organization and consisted entirely of DoD personnel. Radiological safety procedures for AFSWC personnel at Kirtland Air Force Base were implemented by the 4901st Air Base Wing. For personnel at Indian Springs Air Force Base, AFSWC radiological safety procedures were implemented by the Test Aircraft Branch.

Although the missions of each organization required different types of activities and separate radiation protection plans and staffs, the general procedures were similar:

- Orientation and training – preparing radiological monitors for their work and familiarizing participants with radiological safety procedures
- Personnel dosimetry – issuing, processing, and developing film badges for participants, and analyzing gamma radiation exposures recorded on film badges
- Use of protective equipment – providing anti-contamination equipment, including clothing and respirators
- Monitoring – performing radiological surveys and controlling access to all contaminated areas
- Briefing – informing observers and project personnel of radiological hazards and the current status of contamination in the test area
- Decontamination – detecting, removing, and disposing of contaminated material from personnel and equipment

Summary of TEAPOT Events

The 15 events at TEAPOT are summarized in the accompanying table; ground zeros are shown in the accompanying map. Eight shots – WASP, TESLA, TURK, BEE, ESS, APPLE 1, MET, and APPLE 2 – each included more than 500 DoD participants and are described below.

Shot WASP, an airdropped device, was detonated at an altitude of 762 feet above Area 7 of Yucca Flat. It had a yield of one kiloton (kt) and occurred at noon on Feb. 18, 1955. On-site residual radiation greater than 0.01 R per hour (R/h) was confined to a circular area extending about two kilometers (1.25 mi) from ground zero. As part of Exercise Desert Rock VI, the armed services conducted troop observer and technical service programs involving more than 900 exercise troops, primarily as observers. Troops were scheduled to view the detonation from trenches 4,500 meters (2.8 mi) south of ground zero, but these trenches were in the predicted path of fallout. Observers therefore viewed the detonation from News Nob, approximately 14 kilometers (8.75 mi) south of ground zero. Since the equipment display area was also in the path predicted for the fallout, the post-shot tour of the display area was canceled.

Shot TESLA, a 300-foot tower detonation, was fired at 5:30 a.m. on March 1, 1955, in Area 9 of Yucca Flat. Although the predicted yield was 2 kt, the device detonated with a yield of 7 kt. As at Shot WASP, the armed services conducted troop observer, troop test, and technical service programs as part of Exercise Desert Rock VI. These programs involved almost 600 troops, primarily Camp Desert Rock support personnel, observing the shot. The closest troops witnessed the detonation from trenches 2,220 meters (1.4 mi) southwest of ground zero. Because of high radiation levels, the troops could inspect the

display area only up to 900 meters (0.56 mi) from ground zero. Fallout intensities of up to 10 R/h were detected during the initial survey about 800 meters southwest and south of ground zero.

Shot TURK, a 500-foot tower detonation, was fired with a yield of 43 kt at 5:20 a.m. on March 7, 1955, in Area 2 of Yucca Flat. Fallout of up to 10 R/h was detected about 2,100 meters (1.3 mi) southeast of ground zero during the initial survey, which was conducted from 6:30 a.m. to 9:15 a.m. Exercise Desert Rock included observer, troop test, and technical service programs. Most of the 500 Desert Rock troops were support troops observing the shot. Trenches were constructed for TURK troop observers at a distance of 3,200 meters (2 mi) south of ground zero, but because these trenches were in the expected fallout path, they were not used. Instead, troops occupied the TESLA trenches, located about 5,000 meters (3.1 mi) southeast of ground zero. The post-shot tour of the display area was postponed until the day after the shot due to radiation levels in the display area on shot-day.

Shot BEE, a 500-foot tower detonation, was fired with a yield of 8 kt at 5:05 a.m. on March 22, 1955, in Area 7 of Yucca Flat. Fallout of 10 R/h was detected around ground zero during the initial survey. Fallout between 0.01 R/h and 0.1 R/h extended east of ground zero. Almost 3,000 personnel performed Exercise Desert Rock troop observer, troop test, and technical service programs. About 2,300 officers and enlisted men of the Third Marine Corps Provisional Atomic Exercise Brigade participated in the largest single activity of the TEAPOT series, the Marine Brigade Exercise. The Marine Brigade was comprised of units from the 1st Marine Division and the 3d Marine Air Wing. Air operations units for the exercise included Marine Helicopter Transport Group 36 and Marine Air Support Squadron 363. The Marine Brigade Exercise provided the opportunity for training personnel and for testing the tactics and techniques employed if a nuclear detonation were used in support of an air-ground task force. After the participants observed the shot, some from trenches 3,200 meters (2 mi) southwest of ground zero, they conducted a maneuver which consisted of an airlift and an assault on the objectives. They then toured the equipment display area. A total of 30 H-19 helicopters took part in the airlift, which began about five minutes after the detonation and was completed almost four hours later. After disembarking from the helicopters, the Marines seized objectives about 15 kilometers (9.4 mi) west of ground zero. This part of the maneuver ended at 3 p.m., at which time the Marines toured the display area, located from 460 to 2,560 meters (0.3 to 1.6 mi) southwest of ground zero. Observers had toured this area earlier. At 5:30 p.m., when the maneuver was completed, the Marines checked in at the decontamination station at Yucca Pass.

Shot ESS, the only subsurface detonation of the TEAPOT series, was fired with a yield of 1 kt at 12:30 p.m. on March 23, 1955, in Area 10 of Yucca Flat. This event was an operational test of an atomic demolition munition. Fallout greater than 0.01 R/h occurred mainly southeast of ground zero, but extended up to 2,500 meters (1.5 mi) southwest of ground zero. Because the device was buried 67 feet underground, tons of earth were blown upward by the detonation, creating a crater 88 meters wide and 96 feet deep. Exercise Desert Rock troop observer, troop test, and technical service programs engaged almost 800 troops during Shot ESS; approximately 350 were observers. The closest troops witnessed the detonation in the open, 8,230 meters (5.1 mi) southwest of ground zero. One of the other Exercise Desert Rock projects, Project 40.16, was designed to place and test the ESS demolition munition. Personnel of the 271st Engineer Combat Battalion excavated the shaft and placed the device. Project 40.9, Passive Defense Training, was conducted to train Navy civilian shipyard and laboratory personnel in establishing safe working conditions close to a nuclear detonation. A total of 168 individuals from Navy units all over the country participated in pre- and post-shot training, including monitoring techniques and practice rescue operations. Two other projects, Location of Atomic Bursts and Ordnance

Vehicular Equipment Test, occupied the remainder of the Exercise Desert Rock participants at Shot ESS.

Shot APPLE 1, a 500-foot tower detonation, was fired with a yield of 14 kt at 4:55 a.m. on March 29, 1955, in Area 4 of Yucca Flat. On-site fallout of up to 10 R/h was detected during the initial survey. Exercise Desert Rock VI troop observer, troop test, and technical service projects engaged more than 600 troops, primarily Camp Desert Rock support troops observing the shot. Troops witnessed the detonation from trenches 3,200 meters (2 mi) south-southwest of ground zero. After the detonation, they toured the equipment display area at 900 to 2,250 meters (0.56 to 1.4 mi) southwest of ground zero. In another Exercise Desert Rock project (Sixth Army Passive Defense Training), about 24 persons conducted surveys of the ground zero area on the day after the shot, establishing the 1 and 5 R/h lines to within 100 meters of ground zero.

Shot MET, a 500-foot tower detonation, was fired with a yield of 22 kt at 11:15 a.m. on April 15, 1955, in Frenchman Flat. Fallout of up to 10 R/h was detected around ground zero, extending no farther than 1,500 meters (0.9 mi) southwest of ground zero. Shot MET, an acronym for Military Effects Test, involved the largest number of scientific experiments of any shot in the TEAPOT series. A total of 38 experiments were conducted by DoD personnel of the Military Effects Group. Because of the extensive preparation required for these experiments beforehand, MET was detonated in Frenchman Flat, away from other shots in the TEAPOT Series, to allow project participants to work throughout the series unhampered by radioactivity from other shots. Desert Rock programs involved approximately 260 troops, primarily Camp Desert Rock support troops observing the shot. The troops witnessed the detonation from 10 kilometers (6.25 mi) southwest of ground zero.

Shot APPLE 2, a 500-foot tower detonation, was fired with a yield of 29 kt at 5:10 a.m. on May 5, 1955, in Area 1 of Yucca Flat. On-site fallout occurred northwest of ground zero; readings of 10 R/h were detected northwest of ground zero almost two hours after the detonation. In addition to troop observer, troop test, and technical service programs conducted as part of Exercise Desert Rock VI (which involved about 800 troops), one special troop test involved about 1,000 troops. The test of an Armored Task Force, RAZOR, was designed to demonstrate the capability of a reinforced tank battalion to seize an objective immediately after a nuclear detonation. This project was sponsored by the Army Armored School of Fort Knox, Ky. Task Force RAZOR was composed of the following armored units:

Camp Irwin, California

- 723rd Tank Battalion

Fort Hood, Texas

- Company C, 510th Armored Infantry Battalion, 4th Armored Division
- Company B, 510th Armored Infantry Battalion, 4th Armored Division
- 1st Platoon, Battery A, 22nd Armored Field Artillery Battalion, 4th Armored Division
- 1st Platoon, Company C, 24th Armored Engineer Battalion, 4th Armored Division
- Provisional Aviation Company, 1st Armored Division

The armored test involved the following activities:

- A tactical march across open desert terrain from Camp Irwin to the NTS

- Participation in the APPLE 2 event and the armored task force maneuver
- An overland march back to Camp Irwin
- A chemical warfare exercise at Camp Irwin

Vehicles employed in the maneuver included 55 M48 tanks, 2 M41 tanks, five M74 tank recovery vehicles, one M75 armored personnel carrier, 25 M59 armored personnel carriers, four M7B2 self-propelled 105 mm howitzers, and about 150 wheeled vehicles.

The four-day overland march from Camp Irwin began April 18, 1955. From April 21 to May 4, 1955, the task force rehearsed the maneuver in the forward area of the NTS. Three times during this period, the task force camped in Yucca Flat in preparation for the shot, but in each instance, the shot was postponed due to poor weather. On May 4, 1955, the day before detonation, the task force vehicles were positioned northbound, from three to five kilometers (1.9 to 3.1 mi) south of ground zero. At the time of the shot, all tank turrets were rotated to the rear, all sight apertures were sealed with opaque tape, and all hatches were closed and secured. All personnel took protective measures appropriate to their distance from the shot. The detonation caused no significant damage to the task force, although most of the engine and fan access panels were dislodged from the M59 personnel carriers. They were repositioned for the maneuver, which began upon clearance by the Test Director.

About eight minutes after the shot, all units were mobilized and moving toward ground zero, maintaining radio contact with the Task Force Commander. About 20 monitors from the 50th Chemical Service Platoon were provided to check radiation levels during the assault. When the tanks closest to ground zero obtained an inside reading of 1 R/h, about 890 meters (0.55 mi) from ground zero, the Task Force Commander ordered the formation to execute a partial left turn away from ground zero. Two M59s in the rear of the formation temporarily lost contact and moved to within 820 meters (0.51 mi) of ground zero before they recovered and joined the rest of the task force a few minutes later. After passing through a defile at Syncline Ridge, the task force attained its objective, about 6.4 kilometers (4 mi) from the pre-shot position, about 90 minutes after detonation. To bring realism to the maneuver, tank guns and coaxial machine-guns fired blanks in the final stages of the assault. After the maneuver, task force members were brushed with brooms to remove dust and debris, even though monitoring of both personnel and vehicles showed no significant contamination.

Radiation Doses at Operation TEAPOT

The average radiation dose to TEAPOT participants was less than 1 rem.* However, despite all of the precautions, a limited number of individuals exceeded the authorized dose limits.

Film badge data are available for JTO participants but are generally unavailable for Desert Rock VI participants. However, some aggregate dose data for Desert Rock VI participants are available in the "Final Report of Operations, Desert Rock VI." It states that, for Desert Rock personnel:

- 97 individuals received doses of over 3.0 rem but less than 6.0 rem
- 15 individuals received between 6.0 and 20 rem
- 2 individuals received over 20 rem

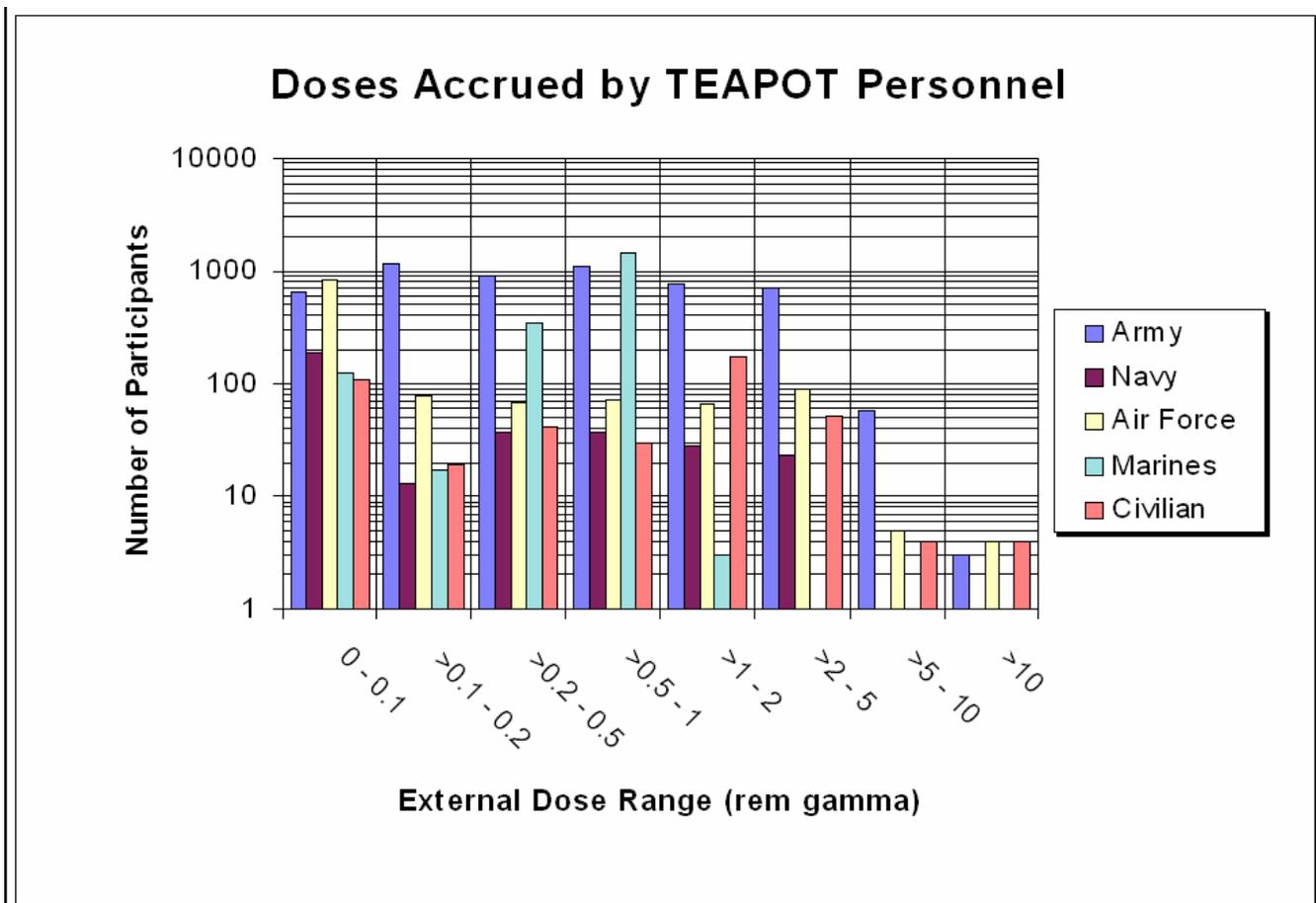
These doses apparently were accrued by certain support personnel because the reconstructed doses for the observers and maneuver units are less than 3 rem. The largest reconstructed dose is 2.8 rem to the observers of Shot TESLA; half of the dose is from neutron radiation in the troop trenches. Most Task

Force RAZOR personnel received less than 1 rem. The dose to members of the Marine Brigade is about 0.5 rem, in agreement with the limited film badge dosimetry data.

Other Desert Rock documentation includes an average dose of 1.3 rem reported for the volunteer observers at Shot APPLE 2 and 1.52 rem for the Sixth Army CBR Defense Teams who were training radiation monitors.

Dosimetry records for JTO and AFSWC indicate that most of the doses exceeding the 3.9 rem limit were for AFSWC pilots and support personnel, and for members of the radiological safety groups (the radsafe monitors). Two of the former received the highest recorded doses for any DoD participants at TEAPOT (21.8 and 21.7 rem).

The totals of reconstructed and film badge doses for DoD participants at TEAPOT are depicted in the following chart.



* 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 on dose reconstruction, see the reports “Analysis of Radiation Exposure for Troop Observers” (DNA 5354F), “Analysis of Radiation Exposure, Task Force RAZOR” (DNA-TR-83-07), and “Analysis of Radiation Exposure, Third Marine Corps Provisional Atomic Exercise Brigade” (DNA-TR-84-13). These reports are available online at http://www.dtra.mil/rd/programs/nuclear_personnel/pubs.cfm. Also see the report “Operation TEAPOT 1955” (DNA 6009F), available online at http://www.dtra.mil/rd/programs/nuclear_personnel/atr.cfm.

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