Fact Sheet

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Operation WIGWAM

Operation WIGWAM was a deep underwater nuclear test conducted as part of the 1945-1962 United States series of atmospheric nuclear tests. It took place in May 1955 in the Pacific Ocean approximately 500 miles southwest of San Diego, California, under the joint administration of the Atomic Energy Commission and the Department of Defense (DoD). The purpose of the operation was to determine the radiation and pressure phenomenology associated with nuclear detonations at great depths and to ascertain the effects such explosions would have on submerged and surface vessels. Approximately 6544 personnel and 30 ships took part in this operation under the Commander, Joint Task Force Seven.

Test Array

A single, 30-kiloton nuclear device was suspended by cable from a towed unmanned barge to a depth of 2000 feet in water that was 16,000 feet deep. Located at varying distances along the approximately six-mile (30,000 feet) long towline between this barge and the fleet tug, USS TAWASA (ATF-92), were a variety of pressure-measuring instruments, unmanned and specially prepared submerged submarine-like hulls (called squaws) as well as instrumented and also unmanned surface boats. The ships and personnel conducting the test were positioned five miles upwind from the surface detonation point with the exception of USS GEORGE EASTMAN (YAG-39) and USS GRANVILLE S. HALL (YAG-40). These two extensively reconfigured ships, equipped with special radiological shielding, were stationed five miles downwind of the surface detonation point. With all the ships at their assigned stations and all personnel accounted for, the device was detonated at 1:00 P.M. Pacific Daylight Time on May 14, 1955.

Radiation Contamination

WIGWAM resulted in three sources of radiological contamination: airborne activity, residual fallout and water contamination. During the first three seconds after the detonation, the radioactive debris was primarily contained within an initial bubble formed by the interaction of thermal energy with the water. Then, beginning at approximately H + 10 seconds (ten seconds after the detonation) these gaseous products began to reach the water surface, forming spikes and plumes reaching maximum heights of 900 to 1,450 feet and emerging from an area roughly 3,100 feet in diameter. As the plumes fell back into the water, a large cloud of mist was formed. This was the base surge which at H + 90 seconds, had a radius of 4,600 feet and a maximum height of 1,900 feet. The visible surge persisted to H + 4 minutes. At H + 13 minutes, a foam ring appeared with a 10,400 foot diameter. The area within this ring probably approximated the extent of the contaminated water. While the surface water initially showed significant contamination levels, the water dispersed and radiation decayed rapidly, so that by May 18 the maximum radiation reading found over an 80 square mile area was on the order of one milliroentgen per hour (mR/hr) at 3 feet above the surface. Contaminated water was found at several depths during the weeks following the test and tended to be in layers a few feet thick.

Radiation Safety Procedures

Radiological safety was a paramount consideration of the operation and overall was the responsibility of the US Naval Radiological Defense Laboratory (NRDL). Radiation Safety (Rad-safe) procedures included measures to minimize exposures to personnel, to measure and evaluate radiological hazards and contaminated areas, to control exposures to personnel and the spread of radioactive contamination from samples, equipment and other materials, and the documentation of levels of exposure and contamination. For the duration of the operation, an exposure limitation of 3.9 roentgen (R) was set. In addition, levels were specifically established for radioactive contamination of clothing and personal equipment, food, water, air, ships' surfaces, equipment and materials.

An important part of the Rad-safe procedures was the personnel dosimetry program. Nearly all individuals involved in the operation were issued a film badge to measure any exposure received during the operation. Personnel whose duties were such that exposure to radiation was possible (such as sampling water, recovering equipment or instruments) were issued additional film badges on a daily basis. One of the vessels, the USS WRIGHT, contained a film processing center where badges were read and personnel exposures were recorded. Over the period of the operation, approximately 10,000 film badges were issued. These included operational, daily, calibration, and scientific project badging.

Personnel Exposures

The rad-safe procedures established for the operation were highly effective in keeping personnel exposures to a minimum. The following table summarizes the recorded personnel radiation exposures at WIGWAM based upon a 1979 review of dosimetry:

WIGWAM EXPOSURES

Exposures expressed in roentgen (R)

	Total Issued	Dosimetry Unavailable	Zero Exposure	.100-.165	.200-.280	.315-.385	.425
Badges	6,732	229	6,141	329	19	13	1*
% in each group	100%	3.4%	91.2%	4.9%	0.3%	0.2%	0.01%

*The highest exposure was received by a member (an air sampler pilot) of the aviation support provided through Naval Air Station, San Diego.

The average exposure for the 362 WIGWAM individuals with non-zero exposures was 0.129 R, which is about the average annual exposure to naturally occurring background radiation in the United States.

Data compiled at the time of the test indicated that operational badges showed 350 positive recorded gamma exposures with a maximum reading of 0.425 R. This earlier compilation indicated that the average exposure for these 350 badges was 0.132 R. Although the results of the two data reviews differ slightly, they both confirm that more than 90 percent of all doses at WIGWAM were zero and that recorded exposures at WIGWAM ranged from 0.100 R to 0.425 R.

The two vessels (YAG-39 and YAG-40) stationed downwind of the detonation point were subjected to contamination by water droplets of the base surge. None of the YAG personnel received significant exposures. Both of these vessels had been specially configured and shielded for the purpose of crossing contaminated areas although only YAG-39 had a seawater washdown system. The deck surface radiation

reading on YAG-39 reached levels in excess of 400 R/hr about 17 minutes after the detonation. The washdown system that had been installed to decontaminate the surfaces reduced this level to 0.040 R per hour 30 minutes after the detonation. Recorded shipboard levels were less aboard YAG-40. Both of these vessels had 48 assigned personnel. However, at the time of detonation only about 12 crewmembers and project personnel were aboard each YAG. Six crewmembers aboard YAG-39 and one crewmember aboard YAG-40 received recorded exposures other than zero. In each instance, recorded film badge readings for crewmembers did not exceed 0.130 R. One unidentified, non-crewmember aboard YAG-40 received an exposure of 0.200 R.

From 1945 to 1962 the United States conducted several series of underwater, surface, and above-surface nuclear tests. The Defense Nuclear Agency (DNA) was, in 1978 assigned as Department of Defense's (DoD) Executive Agent to conduct a program to identify DoD participants, determine radiation doses, and write histories of the series. This fact sheet summarizes information on OPERATION WIGWAM, one of those test series. Further information can be obtained from DNA Report #6000F.