

Operation PLUMBBOB

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 PLUMBBOB, the sixth series of atmospheric nuclear tests conducted within the continental United States, consisted of 24 nuclear detonations and six safety tests. The PLUMBBOB series lasted from April 24 to Oct. 7, 1957, and involved about 14,000 Department of Defense (DoD) personnel, mostly military service personnel, participating in observer programs, tactical maneuvers, and scientific and diagnostic studies. The series tested nuclear weapons for possible inclusion in the defense arsenal. The tests were also used to improve military tactics, equipment, and training. The safety tests were conducted to ensure that no nuclear reaction would occur if the high explosive components of the device were accidentally detonated during storage or transport.

Historical Background

During PLUMBBOB, the activity with the largest DoD participation was Exercise Desert Rock VII and VIII, a program involving members of all armed services. Exercise Desert Rock VII and VIII included training programs, tactical maneuvers, and technical service projects. Training programs generally included lectures and briefings on the effects of nuclear weapons, observation of a nuclear detonation, and a subsequent visit to a display of military equipment exposed to the detonation. At Shots HOOD, SMOKY, and GALILEO, maneuvers were conducted to develop tactics applicable to the nuclear battlefield. At Shot HOOD, the Marine Corps conducted a maneuver involving the use of a helicopter airlift and tactical air support. At Shot SMOKY, Army troops conducted an airlift assault, and at Shot GALILEO, Army troops were tested to determine their psychological reactions to witnessing a nuclear detonation. Technical service projects were designed to test equipment and techniques.

In addition to Desert Rock activities, scientific tests to assess the effects of each nuclear detonation were conducted by four test groups of the Nevada Test Organization (NTO). The Weapons Effects Test Group was sponsored by Field Command, Armed Forces Special Weapons Project (AFSWP). The two Atomic Energy Commission (AEC) weapons development laboratories sponsored the Los Alamos Scientific Laboratory (LASL) and the University of California Radiation Laboratory (UCRL) Test Groups. Finally, the Federal Civil Defense Administration sponsored the Civil Effects Test Group (CETG), which evaluated the effectiveness of civil defense measures. Although the Weapons Effects Test Group was the only DoD-sponsored test group, DoD personnel took part in the experiments of the other three groups.

Individuals participating in scientific experiments placed data-collection instruments around the point of detonation in the days and weeks preceding the scheduled nuclear test. They returned to the test area to recover equipment and gather data after the detonation, when the Test Manager had determined that the area was safe for limited access.

Support services for both Exercise Desert Rock VII and VIII and the Nevada Test Organization included radiological safety, security, transportation, communications, engineering, and logistics. The Air Force Special Weapons Center (AFSWC) at Kirtland Air Force Base, New Mexico, provided aircraft and pilots for pre-shot security sweeps, cloud sampling, cloud tracking, and aerial radiological surveys conducted for the NTO. During PLUMBBOB, AFSWC also conducted cloud penetration studies for the Weapons Effects Test Group to determine Air Force needs in monitoring the accumulation of radioactive contaminants on aircraft.

Radiation Protection Standards

Exercise Desert Rock VII and VIII, the test groups, and AFSWC each developed its own organization and procedures for ensuring the radiological safety of its members based on the established criteria of the AEC. The radiological safety plans were developed to minimize operational exposures to ionizing radiation.

The safety of Desert Rock VII and VIII participants was the responsibility of the Desert Rock Exercise Director. A maximum radiation exposure limit of 5.0 roentgens (R) in any six-month period was established for Desert Rock troops. Of this exposure, no more than 2.0 R was to be from prompt radiation.

Exposure limits for blast pressure and thermal radiation were also established. Based on exposure limits and mode of delivery, minimum distance criteria for positioning Desert Rock troops and observers were established. For a tower shot with a predicted maximum yield of about 10 kilotons, troops in the open were positioned at least 4,000 yards from ground zero. Troops in trenches at such a shot were positioned no closer than 2,600 yards from ground zero. Troops in armored vehicles were positioned no closer than 2,800 yards from ground zero.

The Desert Rock Radiological Safety Section implemented procedures for Exercise Desert Rock during PLUMBBOB. The 50th Chemical Platoon supported the Radiological Safety Section by providing materials, equipment, and personnel.

The Test Manager was responsible for the safety of all test group personnel at the Nevada Test Site (NTS) during the operation. The radiological safety criteria for test group personnel (in addition to Desert Rock personnel) were 3.0 R for any 13-week period, and 5.0 R for one calendar year. AFSWC pilots were subject to the same exposure limits as the test groups. Onsite radiological safety operations were performed for the Test Manager by AEC personnel. The AFSWC implemented its own radiological safety procedures.

Although the missions of Exercise Desert Rock, NTO, and AFSWC required different types of activities and separate radiation protection plans and staffs, many of the procedures were similar and were performed by two or more of the three radiological safety groups. These procedures included:

- Orientation and training – preparing radiological monitors for their work and familiarizing participants with radiological safety procedures
- Personnel dosimetry – issuing, processing, developing film badges for participants, and determining 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 and removing contaminated material from personnel and equipment.

Summaries of PLUMBBOB Nuclear Events

The 24 PLUMBBOB test shots and the safety experiments are summarized in the accompanying table, and their locations are shown on the accompanying map. Shots PRISCILLA, HOOD, SMOKY, and GALILEO are described in the following paragraphs. PRISCILLA is significant due to the large number of participants involved and the extensive military effects program. Shots HOOD and SMOKY involved large troop tests. Shot GALILEO is significant because some personnel had been at the test site for an extended period of time awaiting a decision as to whether they would be able to participate at Shot SMOKY. For a number of reasons including delays in the scheduling of SMOKY, the Army troop test was conducted at GALILEO instead of SMOKY.

Shot PRISCILLA, a 37-kiloton shot, was detonated from a balloon 700 feet above Frenchman Flat at 6:30 a.m. on June 24, 1957. While there was no troop maneuver at PRISCILLA, more than 1,700 individuals took part in Exercise Desert Rock activities. Most of these individuals were involved in the troop observer indoctrination program. The closest troops witnessed the detonation from trenches 3,500 meters southwest of ground zero. After the detonation, troops toured the extensive equipment display area, located directly south of ground zero. At the time of the first survey, residual radiation greater than 1 R per hour (R/h) was confined to a circular area within 550 meters of ground zero. Troops were able to view equipment up to the 5 R/h intensity line located 500 meters from ground zero.

The primary objective of the PRISCILLA event was to correlate the yield and characteristics of the device with its effects on military equipment, materiel, structures, and ordnance. To fulfill this objective, about 300 AFSWP personnel conducted 34 scientific projects, making this shot one of the largest military effects tests ever conducted at the NTS. In addition, AFSWC aircrew personnel provided such services to the Test Manager as cloud sampling, cloud tracking, and security sweeps. The principal AFSWC unit involved in PRISCILLA, as at other shots in the PLUMBBOB series, was the 4950th Test Group (Nuclear), with support from the 4900th Air Base Group. During PRISCILLA, AFSWC also conducted the cloud penetration study.

Shot HOOD, a 1,500-foot balloon shot in Yucca Flat, was fired at 4:40 a.m. on July 5, 1957, with a yield of 74 kilotons. HOOD was the largest atmospheric detonation to occur at the NTS. Residual radiation greater than 1 R/h at the time of the first survey was confined to a circular area 1,000 meters from ground zero.

Exercise Desert Rock programs included troop observer and indoctrination projects, a troop test, radiological training projects and technical service projects. Over 3,000 DoD personnel participated in these projects, the largest being the Marine Brigade Exercise, which involved 2,100 to 2,200 Marines from the Fourth Marine Corps Provisional Atomic Exercise Brigade. The principal participating units were from the First Marine Division of Camp Pendleton, California, and the Third Air Wing from the Marine Corps Air Station at El Toro, California.

Originally scheduled to take place during Shot DIABLO, the exercise was rescheduled for Shot HOOD when DIABLO misfired. The Marine exercise had several objectives, including the training of personnel in the effects and employment of nuclear weapons, the formulation of tactics and techniques relative to nuclear war, and the training of personnel in passive defense measures against the effects of nuclear weapons. The post-shot troop maneuver involved a coordinated air-ground assault by a reinforced Marine battalion against a military objective. After observing the shot, the Marines were transported by helicopters to landing zones near the attack objective. A ground assault on the objective, supported by tactical aircraft, was to follow the airlift. When the objective was obtained at 11 a.m., more than six hours after the shot, some of the troops viewed an equipment display area, located from 240 to 2,170 meters from ground zero.

Another 100 project participants took part in 24 scientific tests and six operational training projects at Shot HOOD. AFSWC activities included the cloud penetration study, as well as such standard support missions as cloud sampling, courier missions, cloud tracking, and security sweeps. About 80 AFSWC aircrew took part in these activities at HOOD.

Shot SMOKY was fired from a 700-foot tower in Yucca Flat at 5:30 a.m. on Aug. 31, 1957. The shot had a yield of 44 kilotons. At the time of the first survey, the 1 R/h line extended more than 6 kilometers to the southeast of ground zero. Exercise Desert Rock troops observed the detonation from a location 13 kilometers southwest of ground zero. The closest approach was 4,100 meters west of ground zero. Exercise Desert Rock activities at SMOKY included a troop test, the troop observer program, technical service projects, and radiological monitoring training. The most significant of these activities, an attack and resupply maneuver, involved an estimated 1,150 troops. The initial phase of the project was conducted two weeks before the shot. Troops prepared defensive positions north and west of SMOKY ground zero for inspection after the shot. The troops, a reinforced Infantry Company named Task Force WARRIOR, were part of the 1st Battle Group, 12th Infantry Regiment, 4th Infantry Division, Fort Lewis, Washington. They observed the shot from assembly areas some 13 kilometers from ground zero. Fifteen minutes after the shot, a Pathfinder unit, accompanied by radiological monitors, flew into the objective area northwest of ground zero and determined it radiologically safe to occupy. At 5:50 a.m., assault elements of the task force had been brought into the objective area. The exercise ended at 9:45 a.m. on August 31, 1957.

About 200 additional participants took part in the scientific tests at SMOKY. Another 22 Navy and Air Force crewmen participated in operational training projects designed to indoctrinate personnel, practice photographic reconnaissance, and test indirect bomb damage assessment equipment and techniques. In addition to performing cloud sampling, sample courier returns, security sweeps, and cloud tracking missions, AFSWC pilots provided support to Desert Rock, AFSWP, UCRL, and CETG projects. More than 200 AFSWC aircrew personnel were involved in these activities.

Shot GALILEO, with a yield of 11 kilotons of explosive energy, was detonated from a 500-foot tower at 5:40 a.m. on September 2, 1957. At the time of the first survey, fallout of 1 R/h was detected as far as 2,750 meters northwest of ground zero. Exercise Desert Rock activities at GALILEO, which involved 300 individuals, included a troop test and two technical service projects. The troop test, conducted by the Human Resources Research Office (HumRRO), was to monitor the performance of persons who had witnessed a nuclear detonation for the first time.

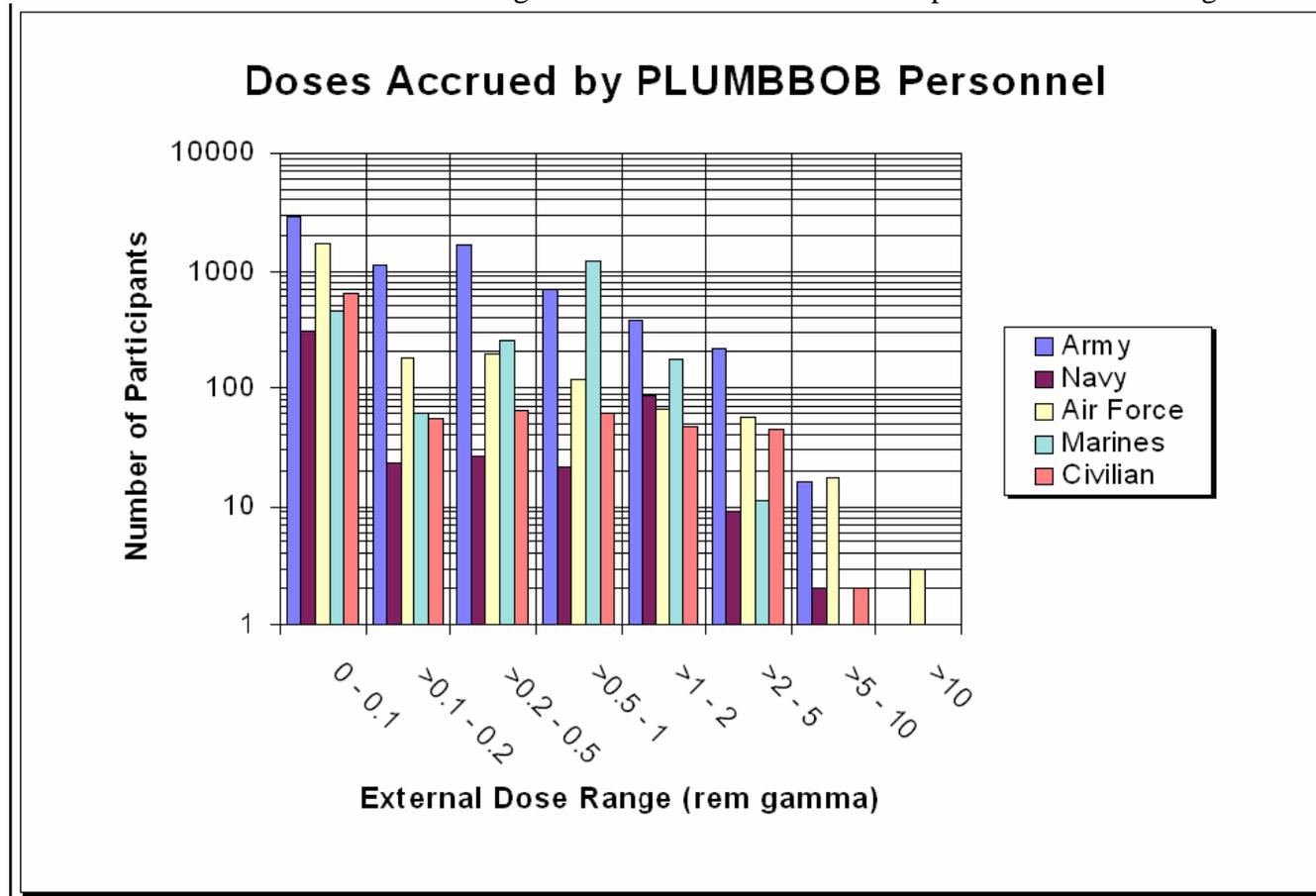
Immediately after witnessing GALILEO, troops performed a rifle disassembly/assembly to test their reactions. They then proceeded to the SMOKY trench area, where they performed the infiltration course test. Film badge records suggest that only 110 of the 167 servicemen scheduled to participate actually took part in the troop test. Eighty-six of these were test troops, and seven were troop monitors who were to supplement the HumRRO monitors who had left early. The remaining 17 probably also assisted in the HumRRO team as monitors.

Radiation Doses at Operation PLUMBBOB

Although personnel were continuously film badged during PLUMBBOB, no film badge records have been located for the majority of the Marine maneuver troops. Radiation doses have been reconstructed for all of the major troop test units at the operation. These doses are in agreement with the available film badge dosimetry.

About 40 DoD personnel received total doses exceeding 5 rem* during PLUMBBOB; half of these were accrued by cloud samplers or penetrators. The three largest doses were between 13 and 22 rem to Air Force fliers who penetrated the Shot JOHN cloud at about 10 minutes after burst. The other doses over 5 rem were scattered, mostly among Desert Rock VII and VIII support and technical service project personnel. Very few of the personnel in the major troop test described above received as much as 2 rem. The average total dose to DoD participants at PLUMBBOB was 0.4 rem.

The totals of reconstructed and film badge doses for PLUMBBOB 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).

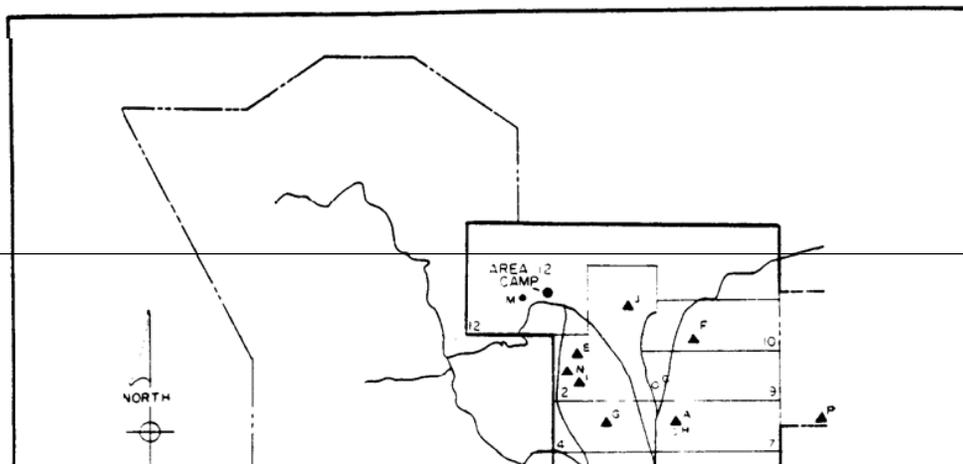
For more information on dose reconstruction, see the reports “Analysis of Radiation Exposure, 4th Marine Corps Provisional Atomic Exercise Brigade, Exercise Desert Rock VII, Operation PLUMBBOB” (DNA 5774F); “Analysis of Radiation Exposure for Task Force WARRIOR, Shot SMOKY, Exercise Desert Rock VII-VIII, Operation PLUMBBOB” (DNA 4747F); and “Analysis of Radiation Exposure for Task Force BIG BANG, Shot GALILEO, Exercise Desert Rock VII-VIII, Operation PLUMBBOB” (DNA 4772F). These reports are available at http://www.dtra.mil/rd/programs/nuclear_personnel/pubs.cfm.

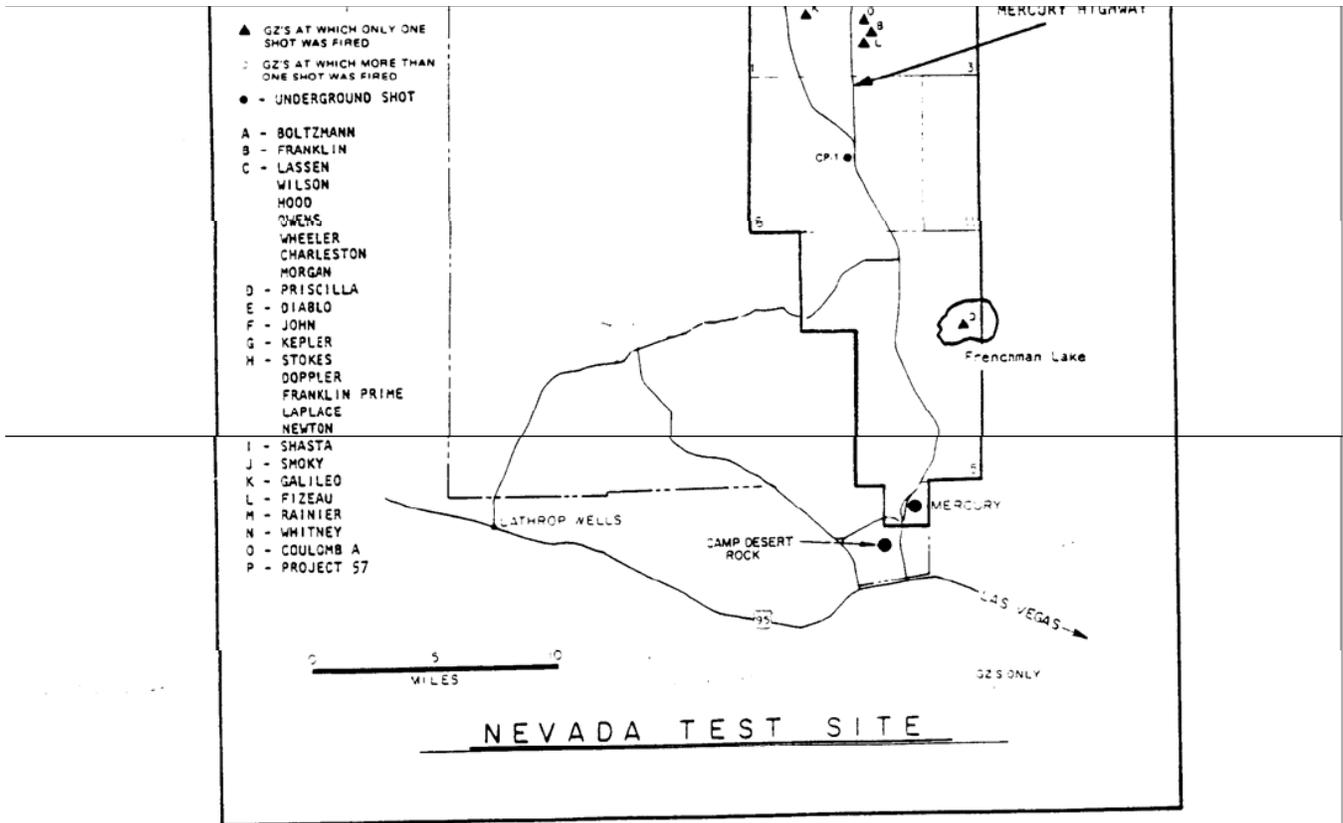
Also see the report “PLUMBBOB Series 1957” (DNA 6005F), available online at http://www.dtra.mil/rd/programs/nuclear_personnel/atr.cfm.

Summary of Operation PLUMBBOB Events (1957)^a

Shot ^b	Sponsor	Date	Local Time ^c	Type	Height of Burst (ft)	Yield ^d
PROJECT57	AEC	April 24	6:27 a.m. PST	Surface	0	0
BOLTZMANN	LASL	May 28	4:55 a.m. PDT	Tower	500	12 kt
FRANKLIN	LASL	June 2	4:55 a.m. PDT	Tower	300	140 tons
LASSEN	UCRL	June 5	4:45 a.m. PDT	Balloon	500	0.5 tons
WILSON	UCRL	June 18	4:55 a.m. PDT	Balloon	500	10 kt
PRISCILLA	LASL/DoD	June 24	6:30 a.m. PDT	Balloon	700	37 kt
COULOMB A Safety Test	LASL	July 1	10:30 a.m. PDT	Surface	0	0
HOOD	UCRL	July 5	4:40 a.m. PDT	Balloon	1500	74 kt
DIABLO	UCRL	July 15	4:30 a.m. PDT	Tower	500	17 kt
JOHN	DoD	July 19	7 a.m. PDT	Air to Air Missile	18,500	about 2 kt
KEPLER	LASL	July 24	4:50 a.m. PDT	Tower	500	10 kt
OWENS	UCRL	July 25	6:30 a.m. PDT	Balloon	500	9.7 kt
PASCAL A Safety Test	LASL	July 26	1 a.m. PDT	Shaft	-500	Slight
STOKES	LASL	Aug 7	5:25 a.m.	Balloon	1500	19 kt

			PDT			
SATURN Safety Test	UCRL	Aug 9	6 p.m. PDT	Tunnel	-100	zero
SHASTA	UCRL	Aug 18	5 a.m. PDT	Tower	500	17 kt
DOPPLER	LASL	Aug 23	5:30 a.m. PDT	Balloon	1500	11 kt
PASCAL B Safety Test	LASL	Aug 27	3:35 p.m. PDT	Shaft	-500	slight
FRANKLIN PRIME	LASL	Aug 30	5:40 a.m. PDT	Balloon	750	4.7 kt
SMOKY	UCRL	Aug 31	5:30 a.m. PDT	Tower	700	44 kt
GALILEO	LASL	Sept 2	5:40 a.m. PDT	Tower	500	11 kt
WHEELER	UCRL	Sept 6	5:45 a.m. PDT	Balloon	500	197 tons
COULOMB B Safety Test	LASL	Sept 6	1:05 p.m. PDT	Surface	0	300 tons
LAPLACE	LASL	Sept 8	6 a.m. PDT	Balloon	750	1 kt
FIZEAU	LASL	Sept 14	9:45 a.m. PDT	Tower	500	11 kt
NEWTON	LASL	Sept 16	5:50 a.m. PDT	Balloon	1500	12 kt
RAINIER	UCRL	Sept 19	10 a.m. PDT	Tunnel	-880	1.7 kt
WHITNEY	UCRL	Sept 23	5:30 a.m. PDT	Tower	500	19 kt
CHARLESTON	UCRL	Sept 28	6 a.m. PDT	Balloon	1500	12 kt
MORGAN	UCRL	Oct 7	5 a.m. PST	Balloon	500	8 kt





NOTE: THE BOUNDARY BETWEEN AREAS 1 & 3 AND AREAS 4 & 7 IS MERCURY HIGHWAY, THE NORTH-SOUTH ROAD SHOWN TRAVERSING THOSE AREAS. THE BOUNDARY BETWEEN AREA 2 AND AREA 9 LIES ALONG THE CENTER OF THE THREE ROADS SHOWN.