# Fact Sheet

*Defense Threat Reduction Agency*
*U.S. Strategic Command Center for Combating Weapons of Mass Destruction*
*Standing Joint Force Headquarters for Elimination*

## Projects GNOME and SEDAN
## The PLOWSHARE Program

**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 Helpline at 800-462-3683.*

The U.S. Atomic Energy Commission (AEC) established the PLOWSHARE program in June 1957, under the technical direction of the Lawrence Radiation Laboratory (LRL). The program consisted of 27 nuclear detonations conducted at the Nevada Test Site (NTS) and other sites in Colorado and New Mexico from 1961 to 1973. The nuclear tests, identified in the first of the accompanying tables, were all underground, either shaft or cratering shot, and they had yields of no more than 200 kilotons. The PLOWSHARE detonations were designed to evaluate nonmilitary applications of nuclear explosives. The primary potential use envisioned was in large-scale geographic engineering, in such projects as canal, harbor, and dam construction; the stimulation of oil and gas wells; and mining. Considering the peaceful objectives of PLOWSHARE, the AEC took the name of the program from the Bible: "And they shall beat their swords into plowshares" (Isaiah 2:4).

### Historical Background

Projects GNOME and SEDAN, the first two detonations of the PLOWSHARE program, were selected for discussion because they were conducted during the period of U.S. atmospheric nuclear testing, had documented (although limited) Department of Defense (DOD) participation, and had sufficient documentation for a discussion of the detonations and associated activities. DOD did not conduct military exercises during PLOWSHARE and had limited involvement in the shots. The primary role of the military was to provide logistical support; technical participation was allowed, provided it did not interfere with AEC activities.

Project GNOME, a shaft detonation, was fired at noon Mountain Standard Time on December 10, 1961, at a site 40 kilometers southeast of Carlsbad, New Mexico. The first of the accompanying figures shows the site location. The device was buried 1,184 feet underground in bedded rock salt at the end of a 1,116-foot hooked and self-sealing tunnel. A shaft 1,216 feet in depth and 10 feet in diameter ended in a station room connected to the tunnel. The detonation, which had a yield of 3 kilotons, resulted in an underground dome-shaped chamber 60 to 80 feet high and 160 to 170 feet in diameter.

Although it had been planned as a contained explosion, GNOME vented to the atmosphere. A cloud of steam started to appear at the top of the shaft 2 to 3 minutes after the detonation. Gray smoke and steam, with associated radioactivity, emanated from the shaft opening for about 7 minutes after the detonation. Radioactive materials vented to the atmosphere about 340 meters southwest of ground zero. The highest measured onsite gamma intensity was 1 Roentgen per hour (R/h). This intensity was recorded 1,300 meters northwest of the shaft opening at 1938 hours on shot day. The highest offsite reading was 1.4 R/h,

encountered 5.5 kilometers west of the Control Point on Highway 128 one hour after the detonation. Underground recovery operations were delayed, in part because of high radiation levels at the shaft opening (for example, 5 R/h at 9:08 a.m. on the day after the detonation). Six days after the shot, an initial radiological and toxicological survey was conducted to the bottom of the shaft. After the survey was completed, underground recovery operations were permitted.

An extensive program of scientific and technical projects was conducted to obtain information on the characteristics of a nuclear detonation in an underground rock salt formation and to explore the feasibility of energy recovery, radioisotope recovery, and generated-neutron utilization. To emphasize the peaceful aims of Project GNOME, the AEC conducted an observer program involving, among others, Government officials, representatives of scientific and industrial groups, and news media personnel.

DOD personnel took part at GNOME in the VELA UNIFORM program, conducted by DOD to develop U.S. capabilities in detecting and identifying underground nuclear detonations. DOD's Advanced Research Projects Agency administered the program, which consisted of 19 projects. The Air Force Technical Applications Center formulated technical requirements for the projects, and the Defense Atomic Support Agency developed and directed the activities. DOD personnel also conducted at least one other project (Design, Testing, and Field Pumping of Grout Mixtures). In addition, the Air Force Special Weapons Center (AFSWC) conducted photography, cloud-sampling, and cloud-tracking missions at the shot.

Project SEDAN, a nuclear cratering experiment, was detonated with a yield of 104 kilotons at 9 a.m. Pacific Standard Time on July 6, 1962. The shot was fired in Area 10 of the NTS, shown in the second of the accompanying figures. The device was buried 635 feet underground in desert alluvium, and the detonation resulted in a crater with a radius of 607 feet, a depth of 323 feet, and a volume of about 6.5 million cubic yards. The lip of the crater ranged in height from 18 to 95 feet above the pre-shot surface. Two and one-half hours after the detonation, the 10 R/h line extended 3.3 kilometers to the west and 3.1 kilometers to the south, and the 1 R/h line extended 3.5 kilometers to the west and 3.3 kilometers to the south. The radiation isointensity contours were not completely plotted to the north and east, the direction of the fallout. Two days later, intensities of 1 R/h were confined to within 3.2 kilometers of ground zero.

The purposes of Project SEDAN were to extend knowledge of cratering effects from detonations with yields of 100 to 200 kilotons and to provide safety data related to nuclear cratering detonations. To collect information, the LRL conducted an extensive program of scientific and technical projects.

DOD personnel took part in four projects studying peaceful uses of nuclear detonations. In addition, they participated in five VELA UNIFORM projects. Participating DOD agencies were:

- Defense Atomic Support Agency
- Army Engineer Nuclear Cratering Group
- Army Engineer Waterways Experiment Station
- Naval Radiological Defense Laboratory
- Air Force Technical Applications Center

AFSWC and other Air Force personnel conducted cloud-sampling, cloud-tracking, and support missions at the shot.

**Radiation Protection Standards**

To minimize the exposures of PLOWSHARE personnel to ionizing radiation, the AEC established an individual exposure limit of 3 rem* of gamma and neutron radiation per calendar quarter and not more than 5 rem annually. The radiological safety programs for Projects GNOME and SEDAN operated within these exposure guidelines. The AEC provided onsite radiological support, which included:

- Issuing anti-contamination clothing and equipment to personnel entering radiation areas
- Monitoring radiation areas and controlling access into these areas
- Plotting isointensity contour maps of radiation areas and providing radiation information to personnel entering radiation areas
- Decontaminating personnel, vehicles, and equipment
- Maintaining film badge and exposure records to determine the exposure of each participant to gamma radiation.

Neutron exposures were to be assessed on a case-by-case basis. Such exposures would occur, however, only if personnel were positioned close-in at shot time. Personnel were not permitted into areas of 10 R/h or greater unless they had special permission from the AEC.

U.S. Public Health Service (USPHS) personnel conducted offsite monitoring. Their activities involved:

- Monitoring for offsite radiation
- Conducting environmental monitoring of air, water, and milk
- Collecting data on fallout patterns.

USPHS personnel prepared reports, maps, and records describing results of the monitoring and data collection.

**Radiation Doses at Projects GNOME and SEDAN**

Dosimetry records indicate that radiation doses for two DOD participants in GNOME and SEDAN exceeded the 3-rem limit. Both were Air Force officers who received about 4 rem after SEDAN. Of the 150 military participants, all 35 who received more than 0.1 rem were from the Air Force. Fourteen of these received more than 0.5 rem, including eight over 1 rem and four over 2 rem.

For more information, see the report “Projects GNOME and SEDAN, The PLOWSHARE Program” (DNA 6029F), available online at http://www.dtra.mil/Home/NuclearTestPersonnelReview.aspx.

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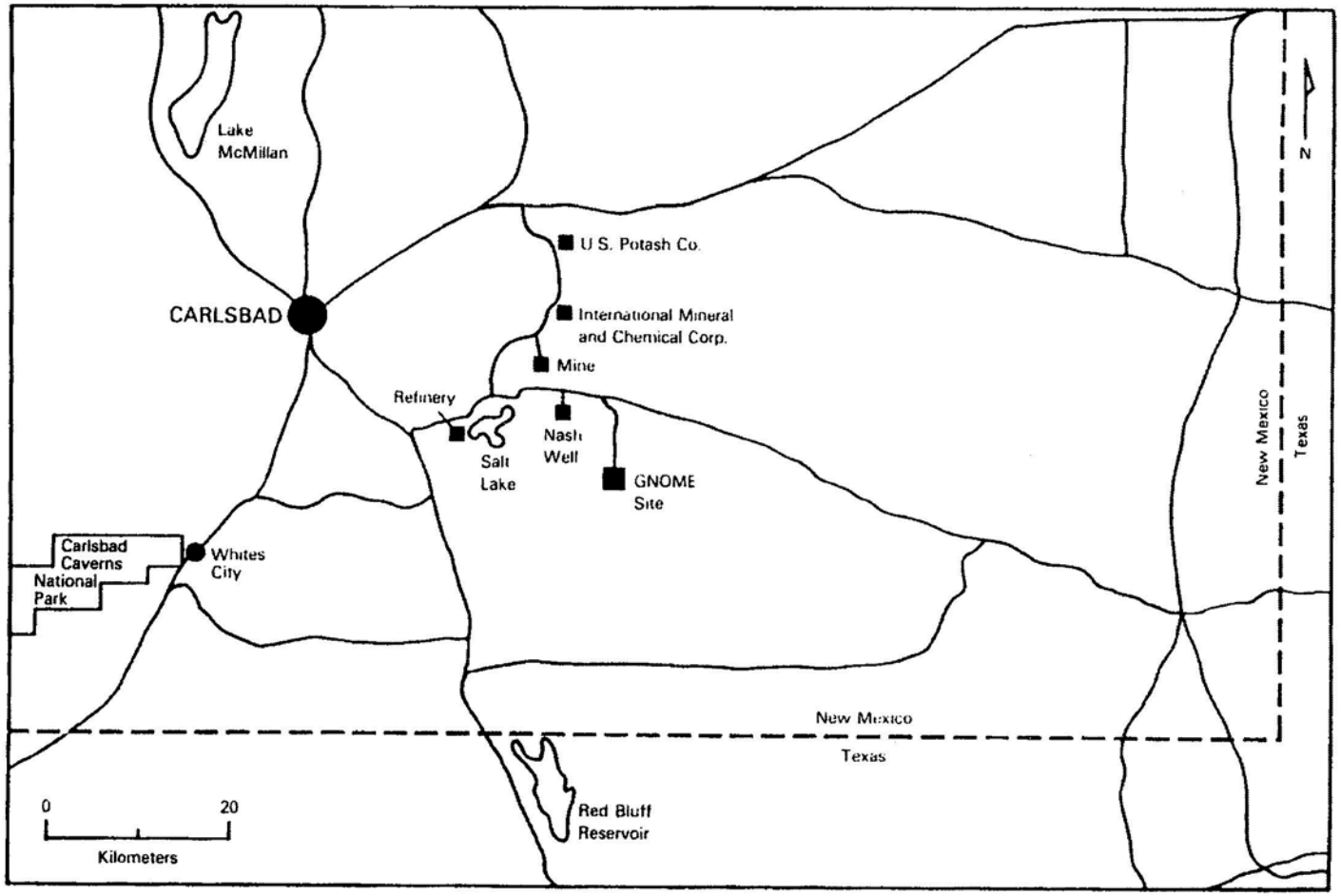
* *A rem is a radiation protection unit of measure that quantifies the risk of biological effects resulting from exposure to ionizing radiation. Ionizing radiation is any radiation (gamma, x-ray, beta, neutron, or alpha) capable of displacing electrons from atoms or molecules, thereby producing ions. According to the National Council on Radiation Protection and Measurements (NCRP, Report No. 160, Table 1.1), the general U.S. population receives about 0.62 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). As a basis of comparison, a standard diagnostic chest x-ray delivers a radiation dose of about 0.02 rem*.

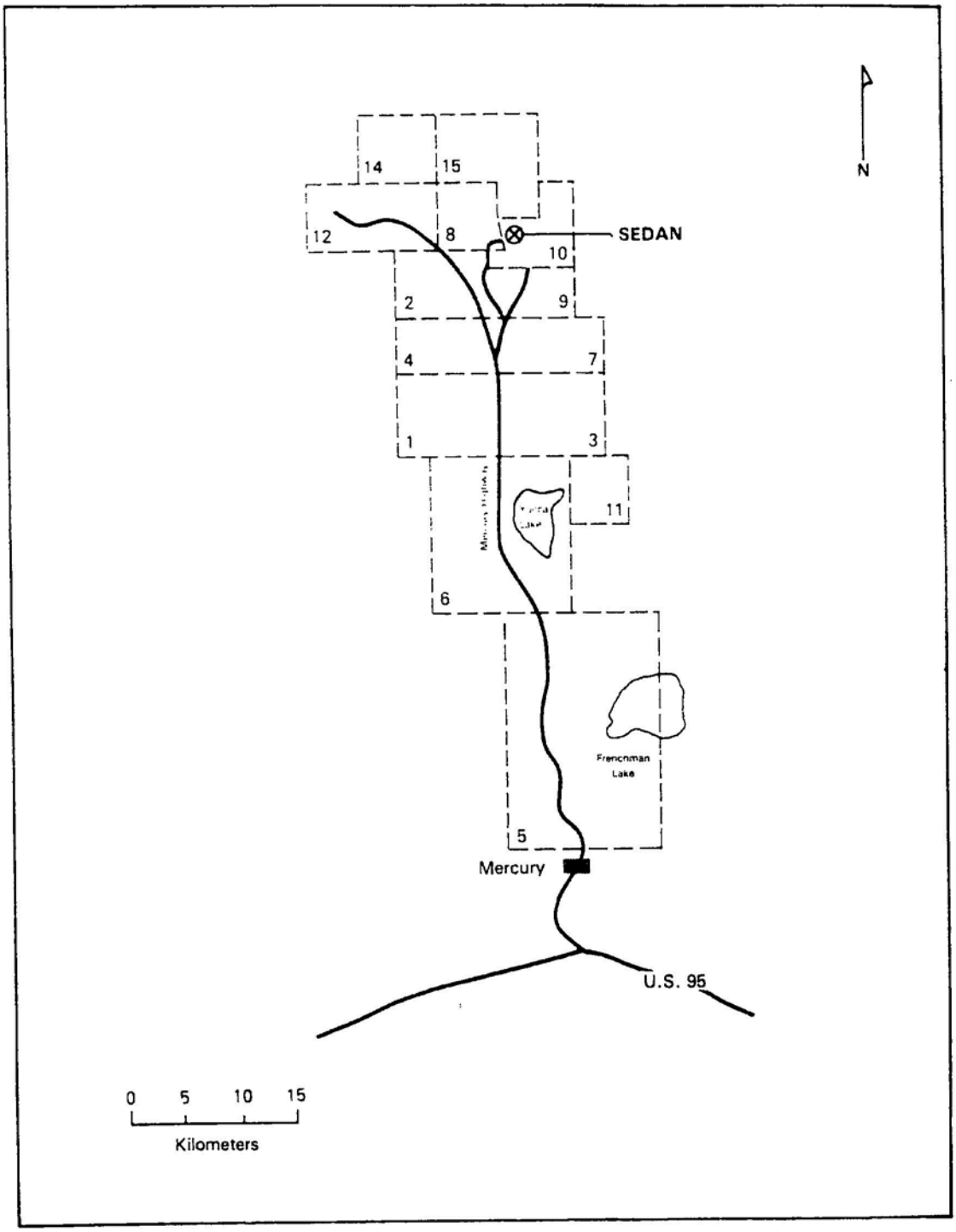
**Summary of PLOWSHARE Nuclear Weapons Tests[a]**

| Shot | Date | Location | Type | Yield (kilotons)[b] |
|---|---|---|---|---|
| GNOME | Dec 10, 1961 | Carlsbad, NM | Shaft | 3 |
| SEDAN | Jul 6, 1962 | NTS | Crater | 104 |
| ANACOSTIA | Nov 27, 1962 | NTS | Shaft | 5.2 |
| KAWEAH | Feb 21, 1963 | NTS | Shaft | 3 |
| TORNILLO | Oct 11, 1963 | NTS | Shaft | 0.38 |
| KLICKITAT | Feb 20, 1964 | NTS | Shaft | 70 |
| ACE | Jun 11, 1964 | NTS | Shaft | 3 |
| DUB | Jun 30, 1964 | NTS | Shaft | 11.7 |
| PAR | Oct 9, 1964 | NTS | Shaft | 38 |
| HANDCAR | Nov 5, 1964 | NTS | Shaft | 12 |
| SULKY | Dec 18, 1964 | NTS | Shaft | 0.092 |
| PALANQUIN | Apr 14, 1965 | NTS | Crater | 4.3 |
| TEMPLAR | Mar 24, 1966 | NTS | Shaft | 0.37 |
| VULCAN | Jun 25, 1966 | NTS | Shaft | 25 |
| SAXON | Jul 28, 1966 | NTS | Shaft | 1.2 |
| SIMMS | Nov 5, 1966 | NTS | Shaft | 2.3 |
| SWITCH | Jun 22, 1967 | NTS | Shaft | 3.1 |
| MARVEL | Sep 21, 1967 | NTS | Shaft | 2.2 |
| GASBUGGY | Dec 10, 1967 | Farmington, NM | Shaft | 29 |
| CABRIOLET | Jan 26, 1968 | NTS | Crater | 2.3 |
| BUGGY | Mar 12, 1968 | NTS | Crater | 1.08 (for each of five devices) |
| STODDARD | Sep 17, 1968 | NTS | Shaft | 31 |
| SCHOONER | Dec 8, 1968 | NTS | Crater | 30 |
| RULISON | Sep 10, 1969 | Grand Valley, CO | Shaft | 40 |
| FLASK | May 26, 1970 | NTS | Shaft | 105, 0.09, 0.035 (for each of three devices) |
| MINIATA | Jul 8, 1971 | NTS | Shaft | 83 |
| RIO BLANCO | May 17, 1973 | Rifle, CO | Shaft | 33 (for each of three devices) |

[a] Source: *United States Nuclear Tests, July 1945 through September 1992*, DOE/NV-209 (Rev. 15), Dec 2000.
[b] One kiloton equals the approximate energy release of one thousand tons of TNT.




**PROJECT GNOME SITE**




**SEDAN GROUND ZERO WITHIN THE NEVADA TEST SITE**