Nevada National Security Site

Underground Nuclear Testing at the Nevada Test Site

Introduction

Between 1951 and 1992, 828 underground nuclear tests were conducted in specially drilled vertical holes, vertical shafts, and horizontal tunnels at the Nevada Test Site, now known as the Nevada National Security Site (NNSS). Most vertical shaft tests assisted in the development of new weapon systems. Horizontal tunnel tests occurred to evaluate the effects (radiation, ground shock) of various weapons on military hardware and systems.

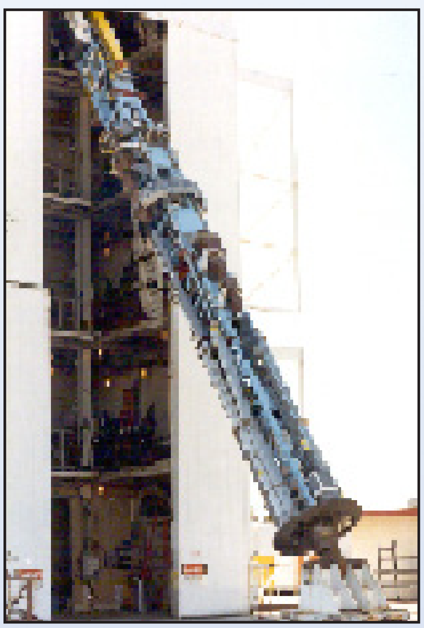
An aerial view of the emplacement tower, diagnostic cables and diagnostic trailers used during an underground nuclear test.

Background

Between 1951 and 1963, a total of 100 atmospheric nuclear tests were conducted at the NTS. Atmospheric testing ceased for good in 1963, after which nuclear testing moved completely underground as a result of the Limited Test Ban Treaty (LTBT), signed by President John F. Kennedy in Moscow on August 5, 1963. The LTBT prohibited testing nuclear weapons in the atmosphere, underwater, and in outer space. As a result, scientists from the U.S. Atomic Energy Commission (now the U.S. Department of Energy) weapons laboratories had to relocate all test packages underground.

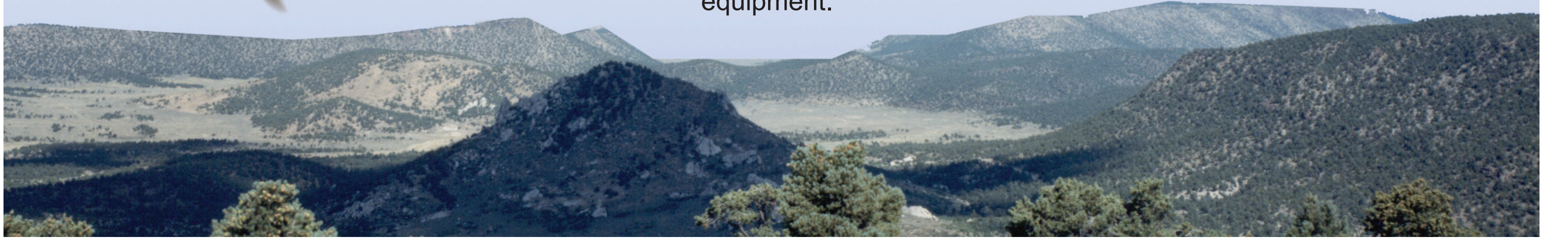
Challenges to underground testing

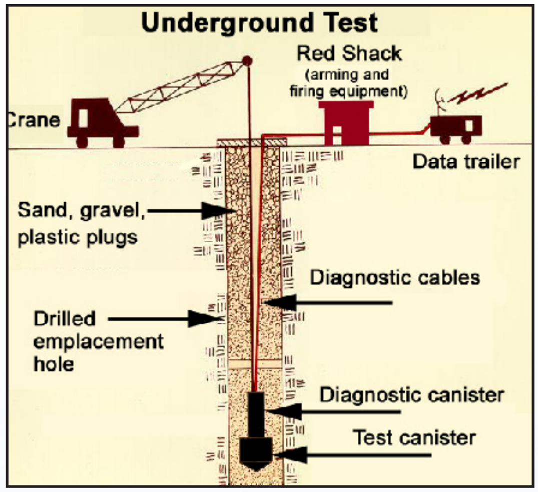
There were significant challenges to moving nuclear testing underground. When “big hole” drilling began at the NTS, the biggest problem was the length of time it took to drill into the desert floor. A 36-inch diameter hole at a depth of 1,000 feet could take up to 60 days to complete due to a slow penetration rate, porous terrain, and the need for straight line-of-sight holes. The holes needed to accommodate underground test packages that ranged from six feet to 12 feet in diameter, larger than any of the holes previously drilled at the site. NTS contractors worked with the drilling industry to design new equipment and employ different techniques for drilling large diameter holes faster and more efficiently.



The diagnostic canister moves into the emplacement tower for underground placement.

National weapons laboratory scientists had to establish a viable means of capturing the data provided by an underground test. During an underground test, the test device was placed at the lower end of a long (up to 200 feet) cylindrical canister, housed aboveground by a tall emplacement tower which also contained diagnostic instruments. Miles of electrical cables connected the canister to firing and recording stations on the surface. After the canister was lowered down the shaft, the hole was closed by filling it with sand and gravel and sealing it with up to three coal tar epoxy plugs. When the device was detonated at the bottom of the vertical drill hole, data from the tests were transmitted through electrical and fiber-optic cables to the data trailers containing recording equipment.

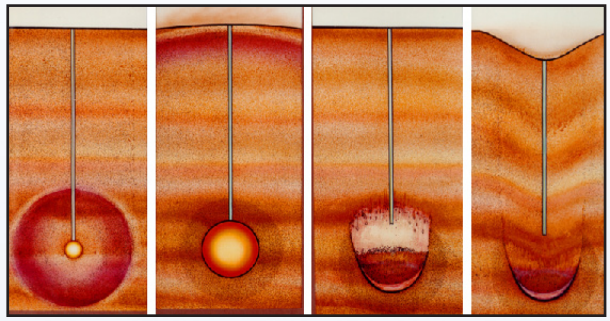




Testing moves underground

The first underground tests of nuclear explosives designed to be contained were the Pascal-A and Pascal-B tests, part of the Operation Plumbbob series conducted at the NTS in 1957. Operation Nougat (September 1961 - April 1962) was the first test series to be conducted entirely underground at the NTS.

In an underground test in a vertical drill hole at depths of more than 1,000 feet, the explosion caused the surrounding rock to liquefy almost instantly, causing a cavity within the earth. As the molten rock cooled, it formed a solid mass at the base of the cavity. This mass contained most of the radioactive material released during the detonation.



This diagram shows the stages of an underground nuclear test: first the explosion, then the surrounding rock is liquefied; next, as the rock cools and settles to the bottom of the cavity, the roof collapses into the cavity forming a depression on the surface, or a subsidence crater.

Subsidence craters

Underground testing often leaves visible evidence on the surface in the form of subsidence craters in varying dimensions. Subsidence craters are depressions on the surface that occur when the roof of the blast cavity collapses into the void left by the explosion. This creates a new roof, which may also collapse into the new, larger, but partially rubble-filled cavity. A chain reaction of successive roof collapses forms a "chimney" that works its way to the surface. The size of the subsidence crater depends on the yield of the device, the depth of emplacement, and the geological characteristics of the surrounding soil.

Conclusion

On average, 12 underground tests per year were conducted at the NTS. Shaft tests were the most common (representing over 90 percent of all tests conducted) and primarily occurred on Yucca Flat or Pahute Mesa. The nation's underground testing program concluded on September 23, 1992 with the last test, Divider.

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