NEVADA TEST SITE

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Abstract

The Nevada Test Site is rooted in the history of nuclear power and weaponry. From the beginning of continental atomic bomb testing, the Nevada Site has played a large role in nuclear testing. Its geological features and placement made it important for research. Testing at the site helped influence future Treaties. It helped in learning about radiation effects on people and land. It also is now a site that is used for national security.

Introduction to the Discovery of Fission and what it is

In Germany in December of 1938 two German physicists Otto Han and Fritz Strassmann discovered that when heavy uranium (unranium 235) is bombarded with neutrons it splits or fissions into separate lighter elements creating high energy of 200 mega electron volts (MeV) and more neutrons. This action under control can create chain reactions of splitting atoms creating powerful bursts of energy. The byproduct of any nuclear fission is highly radioactive.

America and Nuclear Power

America began to work on creating nuclear bombs in hopes of using it to win World War Two. The Manhattan project produced the first atomic bomb and tested it July 16, 1945 in Alamogordo, New Mexico, yielding 19 kilotons of atomic energy. Two atomic bombs were dropped on Japan in August later that year with the result of Japan surrendering to America, ending the war. By 1946 The McMahon Bill was passed through the Senate. It was known as the Atomic Energy Act of 1946 and it began the process of development and control of atomic energy. This is the beginning of the nuclear arms race against the Soviet Union of Russia. From June 30th of 1946 until September 23, 1992 America tested nuclear weapons. The testing of nuclear weapons after World War Two occurred in the pacific, until a continental site was chosen in 1950—the Nevada Test Site. The Nevada Test Site was one of the most used sites. Between the years of 1951 until 1992 there were 928 announced tests of nuclear weapons at the Nevada Test Site. In the Department of Energy (DOE) historical paper *Origins of the Nevada Test Site* it touches on how in 1992, America followed the Comprehensive Test Ban Treaty, which banned all nuclear testing. Although it never passed through the Senate, but the moratorium still remains in effect.

Finding a Test Site

Finding test sites became a high priority as soon as World War Two was over. America started running tests in the Atolls of the Pacific. Testing there, however, was risky. In the event that the territories were to be taken over by other countries America would lose its testing grounds. It also was very expensive as well as time consuming to continue testing only in the Pacific. America needed a continental test site where they could test without these issues. The requirements for a testing site would have to be specific and strictly followed. What a site would need to be was the following: A large space that is a dry arid area and away from large populations within a 125 mile wide radius (*Origins of the Nevada Test Site*, 2000). The government decided on a large area north of Las Vegas in Nevada. Although continental testing would be hazardous to the general public of America, the government was more concerned with weapons data than precise information concerning the effects of radiation on people. The arms race was on and nothing was allowed to inhibit the development of America's Nuclear power (*The American Atom*, pp.177-178, 1984).

For underground testing, which occurred later in the 1950's starting in 1956, there were even more specific requirements: Ideal rock medium needed to be soft and dry so that it could be drilled and mined easily. So that the rocks could absorb shock waves and not distort them. The rocks should be homogeneous so they can be precisely instrumented, as well as chemically inert to avoid any complications of chemical facets in experiments. The rock needs to be structurally sound to insure containment of any material produced during tests. The site itself needs to be far enough from centers of population to avoid ground motion and displacement. A remote site would also help to improve security of site overall. This means it must be away from highways, railroads, pipelines and aqueducts (Houser, *Nevada Test Site,* 1968, p.22).

Geology of Nevada Test Site

The geology of the Nevada Test Site was not well known until after testing began at the site. The area of the Nevada Test Site is 867,000 acres approximately 1354 sq miles. Alluvium filled basins comprise about 30% of the area at the site. 30% of outcrops in the site are uppermost Precambrian and Paleozoic sedimentary rocks, and the rest the of outcrops are volcanic masses from the Tertiary age. There are two major thrust fault systems of Mesozoic age as well as an abundance of normal faults throughout the site. The western and central parts of the site were once volcanic centers creating five calderas. Principle volcanic rocks are rhyolitic and quartz-latitic ash-flow tuffs (Ekren, *Nevada Test Site*, 1968, pp. 11-19). The depth of water table at the Nevada Test Site is over 500 meters below ground. Annul precipitation of the site is 15cm. Of this precipitation less than 5% reaches the water table.

<u>What made it a candidate?</u>

The site, when it was chosen, was not close to any large populations. Testing at the site would have a 125 mile wide radius of possible contamination. Only 4,100 people lived downwind of the test site, the area most in danger of radioactive fallout. Las Vegas, which was about an hour away, was just out of the 125 mile wide radius. In 1950, Las Vegas had at most a population of 24,600 people. The Nevada Test Site bordered by the Nevada Test and Training Range Air force (re-named in 2001 as Nellis Air Force Range) became a likely candidate because of its dry arid climate, its remoteness and the security provided by the Air Force Base (*Origins of the Nevada Test Site*, 2000).

Testing

The first testing of nuclear bombs at the Nevada Test Site occured on January 27, 1951. Known as Operation Ranger, the test involved 5 bombs being shot and tested from the 27th until February 6th. Operation Ranger tested overall 50 kilotons of nuclear energy (*The American Atom,* p.180). The next series of bombs tested at the site were from Operation Buster-Jangler during the fall. The combined tested amount of nuclear energy in Operation Buster-Jangler was 72 kilotons, a larger number than before. Security of the site was a high priority during tests. Soldiers were given hand bills that said, “No Public announcement of the time of any test will be made” (*Origins of the Nevada Test Site,* 2000). This secrecy was for security of the tests and the site. Soldiers, as seen in figure 1, were posted all around the test site for extra security as well for research. The Department of Defense decided to place troops at the Nevada Test Site to test how they would react during a nuclear attack. Psychiatrists would chart the troop reactions to the nuclear blasts and their ability to perform brief maneuvers and simple tasks following an explosion (*The American Atom,* p.178). This exposed soldiers to radioactive fallout.

In 1956 underground testing started at the Nevada Test Site. Underground testing became highly favorable as it reduced the numbers of fall out that were becoming a high concern. Anyone living down wind of the test site was in danger of radioactive fall out. Iodine-131 was a harmful radioactive byproduct from bombs tested at the site. 90 nuclear tests released almost 99% of the I-131 entering the atmosphere from the bombs. These tests released 150 million curies of I-131 mainly in the years of 1952, 1953, 1955 and 1957. Because of high deposits from the bombs the I-131 had high thyroid doses that would effect the population near the test site down wind. This caused large levels of Thyroid cancer, which is an uncommon cancer, to occur in people present during that time down wind of the site. There were two forms of exposure of I-131 to the population: I-131 particles that would land on people after a bomb test and the consumption of foods that were contaminated. Any agriculture of leafy greens or eggs that were contaminated by fall-out passed on I-131 to the consumer. Milk from cows and goats that grazed on contaminated pastures passed it on to its drinkers, who were most often children (Klausner, *legislative.cancer.gov*).

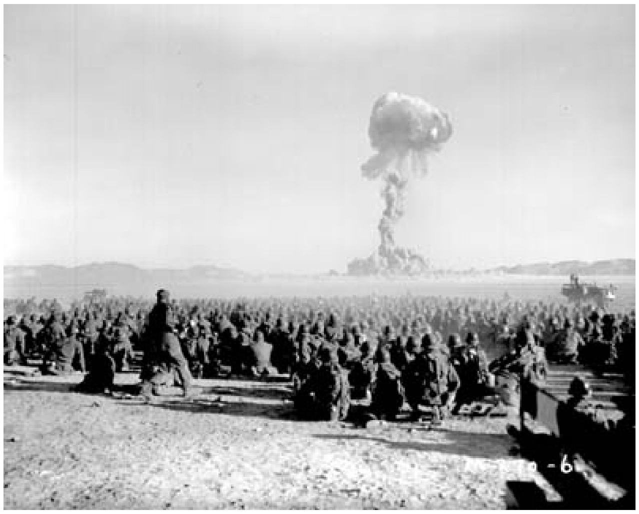

Figure 1. Buster-Jangle: 'Dog', November 1, 1951 Nevada Test Site. *Wikipedia.org*

Under ground testing at the Nevada Test Site became influential in the process of creating a Limited Test Ban Treaty. With how successful the sites underground testing was it became a model for future underground testing that would be enforced by the Treaty.

Testing continued on a larger scale all over the world as newer countries developed nuclear arms. Figure 2 is a visual graph of nuclear testing around the world.

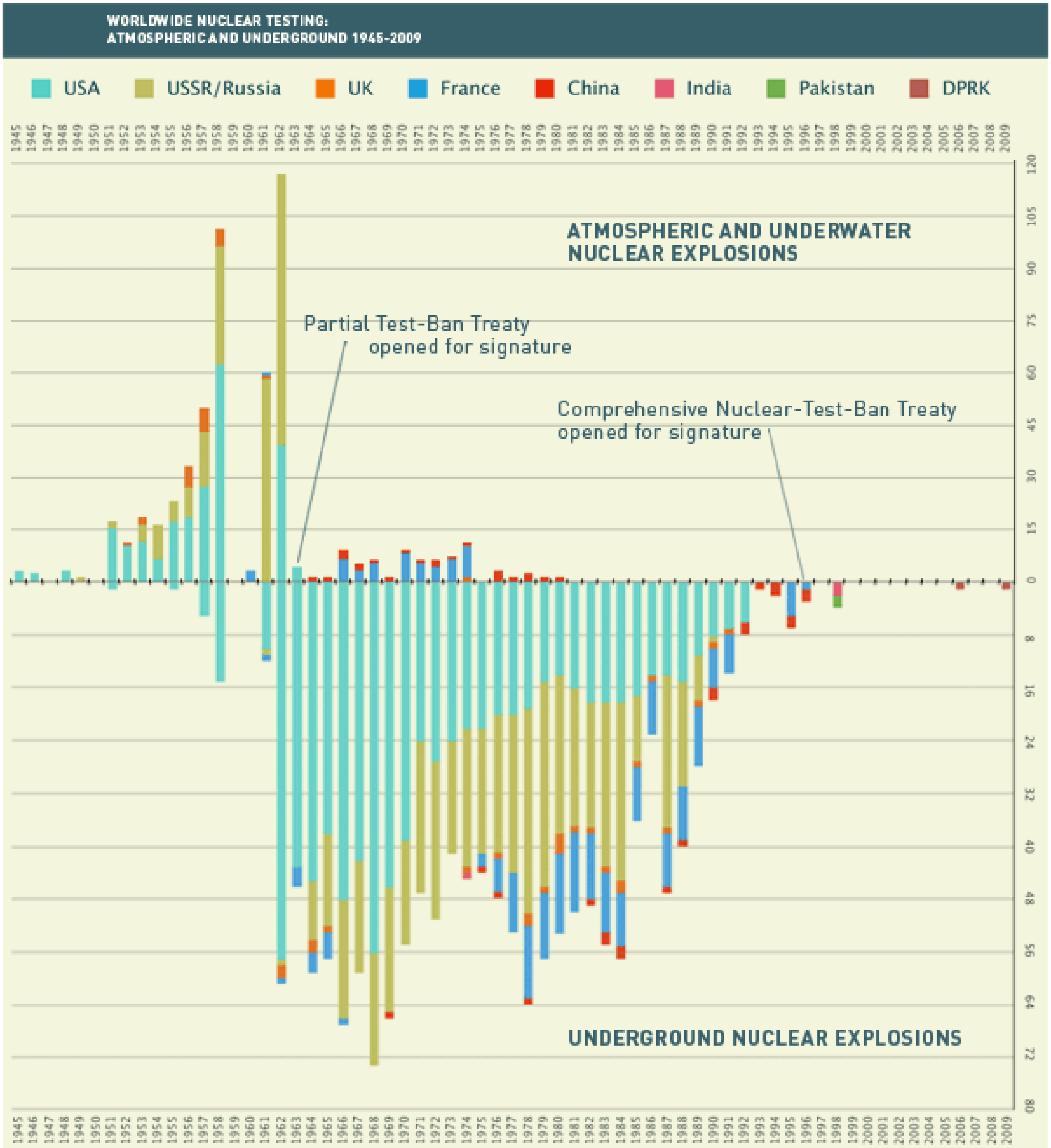

Figure 2. World Wide Nuclear Testing 1945-2009. www.ctbto.org.

As the figure shows not all nuclear testing has stopped. North Korea, India and Pakistan have not signed or ratified the Treaty and have conducted nuclear testing since most has stopped back in 1996.

Limited Test Ban Treaty/ Partial Test Ban Treaty of 1963

The Limited Test Ban Treaty also known as the Partial Test Ban Treaty (PTBT) was brought about by several things. In *The American Atom*, it reports how in the late 1950's, President Eisenhower wished for a test ban and disarmament. In 1958 he announced that America would voluntarily suspend nuclear weapons testing. Until 1961 this was followed. Russia refused the first proposed atmosphere test bans and continued testing. Immediately America continued testing, but underground. This was the beginning of the formation of the PTBT. What further spurred on a movement for an atmospheric test ban was that the American public was beginning to find out how dangerous fall out was. Underground testing drastically lowers fallout numbers and improves instrumentation and scientific experimentation (Houser, *Nevada Test Site 1968*, p21). On August 5, 1963 the Limited Test Ban Treaty was signed. Any who signed the Treaty were not allowed to test nuclear bombs in the atmosphere, outer space, or underwater. It was signed by the United Kingdom, the Soviet Union and the United States of America. Later China and France the last two of the five states that held nuclear power signed the Treaty in 1980 and 1974 (*ctbto.org*).

Threshold Test Ban Treaty of 1976

In 1974 the Threshold Test Ban Treaty was suggested by Russia. It was put together and signed by President Ford (after Nixon signed it and then resigned a month later) and the political leader of the Soviet Union, Leonid Brezhnev in 1974 and would take effect in 1976. It stipulates that it is prohibited to carry out any underground nuclear tests that would yield over 150 kilotons. An important part to the Treaty is that it was agreed by both parties to share technical geographical information about testing sites (*ctbto.org*).

Comprehensive Test Ban Treaty of 1996

President Clinton was dedicated to bringing about a Comprehensive Test Ban Treaty and had hoped to have one instated by 1993 (*ctbto.org*). Negociations and research took several years and in 1996 the Treaty was created. The Comprehensive Test Ban Treaty of 1996 prohibits the testing of any nuclear explosions on earth whither it is peaceful or military related. 180 countries have signed the Treaty, with only 148 Ratified. America has signed but has not Ratified (*ctbto.org*).

<u>Enforcing the Comprehensive Test Ban Treaty</u>

The Comprehensive Test Ban Treaty Organization (CTBTO) uses several methods to enforce the CTBT. Chairman of the Working Group on Verification (WGB) of the CTBTO, Ola Dahlman, talked in detail about the monitoring system they have in an interview about enforcing the CTBT. He says,

> To unequivocally identify the source and nature of an explosion, each of four technologies work primarily in different, but sometimes overlapping, physical environments: seismology monitors underground and, to a considerable extent, underwater; infrasound monitors the atmosphere; hydroacoustics monitor underwater explosions. These are the three so called ‘wave technologies’. In addition; radionuclide particulate technology monitors the atmosphere.

Seismic monitoring is done routinely by 50 CTBTO seismic stations that keep track of and analyze seismic waves all over the world with 120 auxiliary stations, as well. These stations record wave lengths and can alert the CTBTO if any underground quakes caused by nuclear testing have occurred. The seismic technology has been designed to help distinguish between natural and man-made seismic events (*ctbto.org*).

Infrasound is a sound to low in frequency to be heard by the human ear. It is characterized by an ability to cover long distances, getting by obstacles with little dissipation of the sound wave. Infrasound monitor networks can detect these low-frequency sound waves in the atmosphere produced by man-made and natural events (*ctbto.org*).

Hydroacoustic monitoring records the change in signals of water pressure created by sound waves in the water. It can be used to detect underwater explosions, explosion near the oceans surface or by a coast. The hydroacoustics network includes 11 stations to record sound waves. There are 6 large underwater microphones placed around oceans and 5 seismic detectors on small beach islands. When the sound waves hit land they convert into seismic waves (*ctbto.org*).

A radionuclide is an unstable isotope that emits energy as it disintegrates. It can occur naturally but are also artificially produced. The radionuclide monitoring network has 80 stations distributed globally. This technology detects radioactive particles in the atmosphere that are released from explosions or are vented from explosions underground or underwater (*ctbto.org*).

These four technologies keep tabs on any possible nuclear testing around the world and help enforce those that have signed the Comprehensive Test Ban Treaty to adhere to it.

Nevada Test Site Now

Since nuclear testing has stopped at the Nevada Test Site, it has been used for other purposes. The Nevada Site Office (NSO) has declared the missions for the site now. These missions are: To promote national security through supporting the Stockpile Stewardship Program and its experiments, emergency response programs, conventional weapons testing, and other national security experimental programs. Environmental management supports restoration of the environment, groundwater characteristics, and a low level radioactive waste management program. To overall manage the site as a national resource.

There is a push to store nuclear waste in a repository at Yucca Mountain in the test site. Nuclear waste has a long half life of at least a million years before it is considered to no longer be a threat to the general public's health. Concerns that it would be unsafe to have a repository at the Nevada Test Site are not unwarranted. There are several fault systems running through the site that could produce earthquakes that could harm the repository releasing nuclear waste into the ground. The Nevada Test Site also was once a volcanic site indicating that there is a magma chamber underneath. It is possible that in the future there could be an eruption that could break the repository and spew radioactive waste all over the state and neighboring ones.

Conclusion

Until the 1992 the Nevada Test Site was a much used site for nuclear testing in America. It now is used for national security purposes as it is a valuable asset for America. It is still possible for it to be a site for nuclear waste keeping. For this to be possible the geology of the site must be examined and researched very precisely. The fate of nuclear arms lies in the future and its nuclear development.

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