An Atomic Veterans Experience on Nuclear weapons Test in 1958

John C. Taschner, Lt. Col., USAF (BSC) (Ret.)

2332 Arroyo Falls St. NW

Albuquerque, NM 87120

505.899.1410 (Home)

505.270.3421 (Cell)

John.taschner@comcast.net

Figure 1. Title

I. Introduction.

1958 was a banner year for nuclear weapons testing by the United states, with a total of 77 tests, more than the three previous years combined (Operation Plumbob, Project 57 and 58 had a total of 34 shots). This burst of activity was partly due to building pressure for a moratorium on above ground nuclear weapon testing at the end of October 1958. This prompted the Los Alamos Scientific Laboratory (now Las Alamos National Laboratory) and the University of California Radiation Laboratory (now Lawrence Livermore National Laboratory) to rush as many device types to the Pacific and later the Nevada Test Site as possible.

Figure 2. Operation Hardtack

Operation Hardtack was conducted in two phases.

A. **Hardtack I** focused on the testing of high yield thermonuclear devices in the Pacific Ocean from April through /august 1958. A total of 35.6 MT was fired.

Figure 3. Map of Nevada Test Site

B. **Hardtack II** was a series of low yield nuclear weapon tests conducted at the Nevada Test Site (Figure 3) from September 12 through October 1958. The operation consisted of 19 nuclear weapon tests and 18 nuclear safety experiments (one-point safety tests). Most of these tests were to prove the safety and effectiveness of new “sealed pit” fission primaries and tactical nuclear weapons such as the XW-51 Davy Crocket warhead.

   There were 10 balloons, 4 underground and 5 tower detonations in this series. For the “balloon shots”, the nuclear device was attached to a large balloon tethered some 500-1500 feet over an earth bunker. Air bursts were used to better evaluate the weapons yield and reduce radioactive fallout and study blast effects.

The nuclear safety experiments were designed to determine the stability of nuclear weapons during transportation and storage. These were so called "One point detonation safety experiments" in which all but a few detonators on a weapon were removed to simulate what might happen in an accident when the shock of impact of a weapon might set off the conventional high explosive. The question was, "would that situation cause enough implosion for the weapon to go nuclear?"

Hardtack II was the last series before the United States adopted an above ground nuclear test moratorium, which had been intended to last one year but continued until 1961.

Figure 4. My Road to Los Alamos and Hardtack II

II. My Road to Los Alamos and Hardtack II.

In the fall of 1957 I was assigned to the Armed Forces Institute of Pathology for a year's training in Nuclear Medicine. Part of that training included an extensive course in nuclear medicine at the National Naval Medical Center in Bethesda, Maryland in the spring of 1958. Upon completion of the one year assignment I was to have gone to one of the Air Force's Regional hospital to set up a nuclear medicine program. About half way through the Navy course I was called to the Air Force Surgeon General's Office. I was told that the Air Force was establishing a Radiological Health Laboratory at Wright-Patterson AFB in Dayton, Ohio and needed three officers to man it. The Air Force had become concerned about the possibility of nuclear powered aircraft, about accidents involving nuclear weapons, radiation dosimetry for occupational workers, as well as the use of radioactive material throughout the Air Force.

I was given an option but the new career in Radiological Health seemed far more challenging, especially when I was told that I would be assigned to the Los Alamos Scientific Laboratory (now the Las Alamos National Laboratory) for a year of training in all aspects of health physics, plutonium and tritium contamination issues, and nuclear weapon design.

Upon arrival in the first week of October 1958 I was told to settle into an efficiency apartment with my new bride and in three days I would be going to the Nevada Test Site for about three weeks of nuclear weapons tests as part of the LASL weapons testing support group. I was given a top secret clearance and was on my way. Remember, at that time I was a wet behind the ears first lieutenant with a BS degree in Medical Technology, not in nuclear physics.

Figure 5. Hardtack II Operations – Nuclear Weapon Tests

III. Hardtack II Operations

A. Nuclear Weapon Tests

As I said earlier, the nuclear weapon tests at Hardtack II consisted of nineteen shots: ten balloon, four underground and five tower shots.

For the "balloon shots", the nuclear device was attached to a large balloon tethered some 500-1500 feet over a bunker. Air bursts were used to better evaluate the weapons yield and reduce radioactive fallout.

At the entry of the bunker was a large steel door held closed by 8 large hex nuts. Inside the bunker was an array of instruments and gauges plus high speed movie cameras pointed through slits toward the nuclear device. Much of this instrumentation was radiation sensitive, especially the high speed movie film so it was necessary to make an entry to the bunker (ground zero) as soon after shot as possible to recover these experiments.

Figure 6. Hardtack II Operations – Nuclear Weapon Tests

After a shot, two LASL (now LANL) health physics personnel in double sets of personal protective equipment (PPE) consisting of overalls, hoods, gloves, booties and air purifying respirators would drive across the desert (about 5 miles) in the direction of the bunker, making radiation measurements "on the fly" as they approached the bunker. Our turn-around point was 5 R/hour. If we were seeing levels above 5 R/hour we were to exit the area and wait until radiation levels decreased. However, if we were within site of the bunker we generally would radio back to the Command Post requesting permission to continue since to exit and reenter later often resulted in higher exposures.

Once at the bunker the person in the passenger seat, who had been the taking radiation measurements, picked up a big speed wrench, approached the bunker door and removed the eight hex nuts. He would then enter the bunker where radiation levels were in the mR/hour range. The driver would radio for the technicians to enter the area to collect their equipment and film. He would then join his partner inside the bunker. When the technicians retrieved their equipment we would then leave the area. Health physics personnel were always **"first in, last out."**

At the contamination control entry/exit point we were surveyed for contamination. The outer set of PPE and respirators were removed and we were surveyed again to make certain the inner PPE were not. We would then get into a clean (radiologically) car and drive to the command post to be surveyed again for contamination, shower, rest and wait for the next entry. We all worn self-reading pocket dosimeters and film badges. These were processed the same day and a record was kept of each of our exposures. We were permitted to have 3 rem whole body exposure for the series. My total exposure was about 650 mrem.

Figure 7. Summary of the 10 Balloon shots

Figure 7 is a summary of the 10 balloon shots.

Some examples of these tests are as follows:

Figure 8. Socorro

1. Socorro

   Socorro was fired at 13:20 on October 22, 1958 from a balloon at a height of 1150 feet. It was a successful test of an XW-54 primary. The yield was 6 KT. The dimensions of the XW-54 were 11.7"D and 15"L and weighed 63 pounds.

Figure 9. De Baca

2. De Baca

   De Baca was fired at 16:00 on October 26, 1958 from a balloon at a height of 1500 feet. It also was the test of an XW-54 primary but was only partly successful with a yield of only 2.2 KT.

Figure 10. Lea

3. Lea

   Lea was a fissile attempt to fire the LASL designed XW-54 primary at full yield. The shot was fired at 13:20 on October 22, 1958 from a balloon at a height of 1500 feet. The yield was only 1.4 KT.

   In the picture, spikes can be seen propagating down the mooring cables. They are caused by thermal energy from the fireball surface vaporizing the cables. They were termed "rope tricks" by Dr. John Maliki, Los Alamos nuclear scientist.

Figure 11. Blanco

4. Blanco

   Blanco was the last weapons effects shot in Operation Hardtack II. It was fired just ahead of midnight (15:00 GMT) on October 30, 1958. It was a tunnel shot at a depth of 987 feet. It was a full yield test of a W-47 primary and had a yield of 22 KT. As you can see there was slight venting.

Figure 12. Nuclear Safety Experiments

B. **Nuclear Safety Experiments**

1. The **Nuclear safety experiments** in Hardtack II were designed to determine the stability of the new "sealed pit" implosion type nuclear weapons during transportation and storage and especially under accident conditions. The concern always was that if a nuclear weapon was involved in an accident, could the detonation of the high explosives in the weapon result in a nuclear yield? There were 18 safety experiments during Hardtack II designed to determine **one-point safety** of several new weapon designs.

2. Before a nuclear weapon entered the US stockpile a prototype has to be tested to insure the weapon was **"one-point safe."** This was done by disconnecting the firing set from all but a few of the detonators then firing the device. The standard that was adopted was that the fission device must be **"one-point safe"**. In other words, the initiation of the high explosive at one point (in contrast to the simultaneous multi-point detonation of a proper implosion) could not cause a detectable release of nuclear energy. The result must be **"zero yield".**

3. Also of interest was the extent of the plutonium contamination in the event of an accidental detonation of the high explosive in the weapon.

Figure 13. Early "Open-pit" design
Figure 14. Mark 5 weapon

1. **Open-pit nuclear weapons design.**

   Prior to about 1958, in the days of large fission bombs, nuclear weapons came in two parts. The bomb casing housed a large spherical shaped shell made of natural or depleted uranium which was surrounded by up to 5,000 pounds of conventional high explosive and detonators. This is the tamper-high explosive assembly.

   In the front of the bomb casing was a "trap door" that provided access to the weapon. There was an opening in the tamper-high explosive system where the plutonium core was inserted. The core consisted of a plutonium capsule, attached to an aluminum cone, which would be inserted in the system prior to use as a nuclear weapon.

Figure 15. Bird cage.

The plutonium capsule was always carried in the aircraft in a device called the "birdcage". Thus, the possibility of a nuclear detonation being initiated by accident could be eliminated by not inserting the capsule into the tamper-high explosive assembly until just before actual use. Full assembly was accomplished in flight either manually or by equipping the bomb with an automatic in-flight insertion mechanism (AFI).

Figure 16. Internal view of a Mark 5 bomb

Open pit systems were inherently safe because the plutonium core was never inserted in the weapon unless it was intended to be used.

Figure 17. Early "Open-pit design

Figure 18. "Sealed-pit implosion design

2. **"sealed-pit" implosion design.**

A “sealed-pit” weapon contains a subcritical central core of fissile material, called the “pit”, because it resembles a peach, or apricot, surrounded by a layer of high explosive (HE) lenses. The pit is a hollow, spherical, subcritical mass of fissile material (plutonium).

When the high explosive is fired, a pressure wave is formed that crushes the subcritical plutonium core into a supercritical mass, resulting in a nuclear detonation.

Figure 19. Animated firing of “sealed-pit weapon

Figure 20. “One-point safety

Nuclear weapons are designed to be **One-point detonation Safe.** Weapons are designed so that any conventional high explosive detonation caused by other than the intended firing sequence will not produce a nuclear yield. When the high explosives surrounding the “pit” are initiated at one-point, the result is a non-simultaneous and highly irregular detonation of all or most of the HE. Its effect lacks the squeeze or implosion necessary to produce uniform compression of the plutonium in the pit that is required for a full nuclear yield.

During the nuclear safety tests in Hardtack II, elements of the conventional high explosives in these systems were fired to simulate accidental damage from shock or fire as might occur if the weapon was involved in a transportation accident and to determine the potential for such partial firings to result in a nuclear yield.

The firing of the HE at one point may occur when the weapon is subjected to the shock from the impact of the weapon with a hard surface as could happen in a nuclear weapon accident.

Figure 21. One-point safety – Pu scattering

If this occurs the result is a scattering of plutonium. This is what happened at the two nuclear weapon accidents at Palomares, Spain in January 1966 and at Thule, Greenland two years later. At Palomares four bombs fell from the B-52 bomber after it collided with its refueling tanker. The bombs contained parachutes used to slow their decent to allow the B-52 to escape the blast. The parachutes deployed on two weapons. One soft landed on the beach near Palomares the other drifted out to sea. The parachutes did not deploy on the other two. Upon impact the high explosives in the weapons detonated resulting in a contaminated area of about 650 acres.

At Thule, the conventional HE detonated in all four weapons when the B-52 bomber crashed. Again a large area was contaminated with plutonium but there was no nuclear yield.

Figure 22. Davy Crocket

3. Davy Crockett

The Davy Crockett MK54 warhead was the smallest nuclear weapon deployed by the US. It weighed only 51 pounds and had a nuclear yield of up to 0.5 KT. It was the most tested of all during Hardtack II both from a nuclear safety stand point but also nuclear yield.

The Davy Crockett recoilless rifle was deployed in the 1960's in West Germany under the control of US Atomic Battle Groups (ABGs) to guard against Soviet attack. The ABGs were stationed every few kilometers along the West Germany border. The warhead could be fired from either of two recoilless rifles. The 4 inch diameter recoilless rifle could fire the warhead 1.25 miles and the 6 inch diameter rifle could fire the warhead 2.5 miles.

Figure 23: summary of weapon safety experiments

IV. Kiwi

In the summer of 1959 I was back at NTS to provide health physics support to the Kiwi Project. Kiwi was a nuclear reactor rocket assembly being designed for deep space flight. The reactor was mounted on a railroad car. Surrounding the reactor at various distances were capsules containing a variety of neutron threshold detectors (sulpher, nickel, uranium, etc.). These materials would be activated by neutrons of various energies.

After a power run we would collect the capsules and take them back to Camp Mercury for analysis. In those days there were no neutron spectrometers so the only way to determine the neutron spectra coming from the reactor during power runs was to use a variety of threshold detector.