Starfish Prime: The Largest Nuclear Test in Space

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Starfish Prime was a high-altitude nuclear test conducted on July 9, 1962 as part of a group of tests collectively known as Operation Fishbowl. While Starfish Prime was not the first high-altitude test, it was the largest nuclear test ever conducted by the United States in space. The test led to the discovery and understanding of the nuclear electromagnetic pulse (EMP) effect and a mapping of seasonal mixing rates of tropical and polar air masses.

Key Takeaways: Starfish Prime

Starfish Prime was a high-altitude nuclear test conducted by the United States on July 9, 1962. It was part of Operation Fishbowl.

It was the largest nuclear test conducted in outer space, with a yield of 1.4 megatons.

Starfish Prime generated an electromagnetic pulse (EMP) that damaged electrical systems in Hawaii, just under 900 miles away.

History of the Starfish Prime Test

Operation Fishbowl was a series of tests conducted by the United States Atomic Energy Commission (AEC) and Defense Atomic Support Agency in response to the August 30, 1961 announcement that Soviet Russia intended to end its three-year moratorium on testing. The United States had conducted six high-altitude nuclear tests in 1958, but the results of the test raised more questions than they answered.

Starfish was one of five planned Fishbowl tests. An aborted Starfish launch occurred on June 20. The Thor launch vehicle began to break apart about a minute after launch. When the range safety officer ordered its destruction, the missile was between 30,000 and 35,000 feet (9.1 to 10.7 kilometers) of altitude. Debris from the missile and radioactive contamination from the warhead fell into the Pacific Ocean and Johnston Atoll, a wildlife refuge and airbase used for multiple nuclear tests. In essence, the failed test became a dirty bomb. Similar failures with Bluegill, Bluegill Prime, and Bluegill Double Prime of Operation Fishbowl contaminated the island and its surroundings with plutonium and americium that remain to the present day.

The Starfish Prime test consisted of a Thor rocket bearing a W49 thermonuclear warhead and Mk. 2 reentry vehicle. The missile launched from Johnston Island, which is located about 900 miles (1450 kilometers) from Hawaii. The nuclear explosion occurred at a height of 250 miles (400 kilometers) above a point about 20 miles southwest of Hawaii. The warhead yield was 1.4 megatons, which coincided with the designed yield of 1.4 to 1.45 megatons.

The location of the explosion placed it about 10° above the horizon viewed from Hawaii at 11 pm Hawaii time. From Honolulu, the explosion appeared much like a bright orange-red sunset. Following the detonation, bright red and yellow-white auroras were observed in the area for several minutes surrounding the explosion site and also on the opposite side of the equator from it.

Observers at Johnston saw a white flash upon detonation, but did not report hearing any sound associated with the explosion. The nuclear electromagnetic pulse from the explosion caused electrical damage in Hawaii, taking out the telephone company microwave link and knocking out street lights. Electronics in New Zealand were also damaged, 1300 kilometers from the event.

Atmospheric Tests Versus Space Tests

The altitude achieved by Starfish Prime made it a space test. Nuclear explosions in space form a spherical cloud, cross hemispheres to produce auroral displays, generate persistent artificial radiation belts, and produce an EMP capable of disrupting sensitive equipment along line-of-sight of the event. Atmospheric nuclear explosions may also be called high-altitude tests, yet they have a different appearance (mushroom clouds) and cause different effects.

After Effects and Scientific Discoveries

The beta particles produced by Starfish Prime lit up the sky, while energetic electrons formed artificial radiation belts around the Earth. In the months following the test, radiation damage from the belts disabled a third of the satellites in low Earth orbit. A 1968 study found remains of the Starfish electrons five years after the test.

A cadmium-109 tracer was included with the Starfish payload. Tracking the tracer helped scientists understand the rate at which polar and tropical air masses mix during different seasons.

Analysis of the EMP produced by Starfish Prime has led to a better understanding of the effect and the risks it poses to modern systems. Had Starfish Prime been detonated over the continental United States instead of the Pacific Ocean, the effects of the EMP would have been more pronounced because of the stronger magnetic field at the higher latitude. Were a nuclear device to be exploded in space over the middle of a continent, the damage from the EMP could affect the entire continent. While disruption in Hawaii in 1962 was minor, modern electronic devices are much more sensitive to electromagnetic pulses. A modern EMP from a space nuclear explosion poses a significant risk to modern infrastructure and to satellites and space craft in low Earth orbit.

Sources

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