Learning from (Near) Disaster

In 1966, a B-52 collided with a tanker over Palomares, Spain, while refueling. Three of its four hydrogen bombs fell on land, and the fourth fell into the sea, where it was recovered after a lengthy search (see photo on page 17). Two bombs were destroyed when their conventional high explosives detonated; the surviving two bomb casings are on display at the National Atomic Museum in Albuquerque, New Mexico. The incident helped prompt the initiative at Los Alamos to develop insensitive high explosives to prevent future accidental explosions of nuclear weapons. (Photo: Sandia National Laboratories)

Just short of high noon on May 22, 1957, an Air Force B-36 bomber was powering down on its final approach to Kirtland Air Force Base in Albuquerque, New Mexico, completing what should have been a routine flight ferrying a nuclear weapon from a base in Texas. In an instant, all hell broke loose.

A few miles south of the control tower and 1,700 feet off the deck, the bomb bay doors of the huge plane sprang open. In a blink the nuclear bomb plunged earthward, smashing into the ground seconds later with an impact that detonated the high-explosive charges designed to trigger the weapon's nuclear material. The ensuing explosion destroyed the weapon and blasted a crater 12 feet deep and 25 feet wide, hurling debris and bomb fragments a mile away.

As awful as that accident sounds, a nuclear detonation was impossible. For safety, bomb designs in those days centered on a removable capsule of nuclear material carried separately on the plane. The crew would only insert the capsule to arm the weapon in an actual combat operation. This bomb was not armed.

The Kirtland calamity was just one of 32 cited in a 1981 Department of Defense (DoD) report covering the history of the nuclear program. In a dozen cases, the conventional high explosives unintentionally detonated, and although none tripped a nuclear explosion, they sometimes wreaked destruction and injured or killed crew members and rescuers alike. A 1950 B-29 crash in California claimed 19 lives.

Two tragic, high-profile incidents spewed radioactive material around the landscape and elevated awareness of the risks involved. In January 1966, a B-52 carrying four nuclear weapons collided with its refueling tanker plane at high altitude above Palomares, Spain, knocking both from the air and killing several crew members. The high explosives of two nuclear weapons exploded when they slammed into the ground, scattering plutonium and other nuclear materials up to 500 yards away and contaminating about 650 acres. One bomb whose descent was slowed by a parachute did not detonate, and another disappeared into the Mediterranean Sea; it was recovered more than two months later after the most expensive salvage operation in U.S. Naval history.

Workers hauled off 1,400 tons of soil and vegetation, which were shipped to the United States for disposal, and burned or buried nearby tomato crops that were a key agricultural

In the Palomares incident, a hydrogen bomb vanished into the sea. Sailors recovered the weapon two months later in the most expensive U.S. Navy salvage operation in history. The casing is currently displayed at the National Atomic Museum. (Photo: Open Source)

product in Palomares. But traces of nuclear material remained, as tests starting in the 1990s revealed. After years of wrangling between the two allies over new cleanup details, in October 2015, U.S. Secretary of State John Kerry signed an agreement with Spain to remove, almost 50 years after the accident, additional contaminated soil to an as-yet-unspecified location in the United States.

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Two years after the accident over Palomares, a bomber carrying four nuclear weapons crash-landed seven miles short of the runway at Thule Air Base, Greenland, several hundred miles north of the Arctic Circle. The ensuing fire destroyed all the weapons and scattered plutonium and uranium. Although intense cold and the total darkness of Arctic winter hampered the cleanup, crews ultimately removed 237,000 cubic feet of contaminated ice and debris.

If the high explosives inside these weapons could be rendered incapable of accidently detonating, many lives could be saved, property protected, and expensive environmental cleanups prevented. As weapons designers looked for ways to increase the safety of nuclear weapons, they turned to developing safer high explosives for triggering the implosion of a nuclear blast. Fire and impact cannot start a nuclear explosion—only the high explosives precisely detonating in their carefully designed configuration within the warhead can do that. But as the DoD's report reveals, accidentally detonating high explosives caused tremendous problems all on their own.

The solution was achieved at Los Alamos through development of less sensitive high explosives. Los Alamos developed manufacturing and formulation methods for the explosive TATB (triaminotrinitrobenzene) for triggering nuclear weapons (and for use in conventional ordnance). TATB burns but does not explode when it's heated, and does not react even when struck by bullets or shrapnel. Deliberately detonating this unique material requires a well-engineered initiation system.

Los Alamos began researching insensitive high explosives in the 1950s. Based on that expertise, the Laboratory played a key role in refining TATB, patenting the TATB manufacturing process, and becoming the first national lab to use a TATB composition in nuclear weapons.

From the beginning, the skills of Los Alamos weapons designers at making sure their nuclear weapons were safe meant that none of these weapons unintentionally detonated, even after the most horrific accidents. Even so, servicemen lost their lives in these accidents. The advances in explosives science at the Lab means that today, the risk of accidental detonation and death is more remote than ever.

~Charles C. Poling