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Fixing a Broken Arrow

IIE fellow led team that disarmed thermonuclear weapons after B-52 blew apart

By Michael Hughes

Industrial Engineer magazine's annual Engineers Who Make a Difference seeks out those who have made unique contributions to the welfare of the world.

But not too many have deactivated a pair of nuclear bombs with a combined explosive force 500 times more powerful than the atomic weapon that devastated Hiroshima, Japan, in World War II.

Fifty-two years ago, IIE fellow Jack B. ReVelle commanded a U.S. Air Force bomb squad that did just that. Each Mark 39 hydrogen bomb on the B-52 that disintegrated over Goldsboro, N.C., had a yield equivalent to 3.8 megatons of TNT. By comparison, the atomic bomb dropped on Hiroshima had a force of "only" 16 kilotons, according to published reports. Luckily, neither Goldsboro weapon exploded during or after the incident.

"If both had gone off, the eastern seaboard of North Carolina would just be gone," ReVelle recalled. "You'd have the Bay of North Carolina."

Wake-up call

Around midnight on Jan. 23, 1961, a Strategic Air Command B-52 Stratofortress was on patrol, part of a program to keep an airborne nuclear strike force ready to retaliate in case of a nuclear attack by the Soviet Union. During an aerial refueling operation, the crew aboard the KC-135 tanker noticed fuel leaking from the bomber's right wing. The tanker disengaged, and the B-52 headed toward Seymour Johnson Air Force Base near Goldsboro, N.C.

It never made it, ReVelle said. First, the right wing broke off. Then, the stress from the vibrating plane broke off the entire tail section. As the remnants of the bomber spun around, the centrifugal force spewed the two 4,500 kg thermonuclear devices out the back. Five of the eight crewmen parachuted to safety. One, 1st Lt.

Adam Mattocks, fell right past one of the bombs on the way down.

At 5 a.m. Jan. 24, a phone call woke up a sound-asleep 1st Lt. ReVelle of the 2702nd Explosive Ordnance Disposal Squadron, stationed at Wright-Patterson Air Force Base in Ohio. ReVelle's squadron commander didn't use code words.

"He said, 'Jack, I got a real one for you,'" ReVelle remembered.

It was ReVelle's second Broken Arrow, the military's term for an accidental event involving nuclear weapons, warheads or components. The first was a nuclear surface-to-air missile that blew up when its pressurized gas tank exploded at McGuire Air Force Base in New Jersey. All of the Bomarc tactical missile's nuclear warhead and components melted down, and it took several days to clean up the munitions storage area and monitor for any residual radiation.

Each Broken Arrow, and there have been dozens, has the makings of a major disaster. Near Goldsboro, two nukes were on the ground, and nobody knew their status.

Of course, a nuclear explosion was possible. But if only one of a bomb's 92 detonators had gone off, the uranium/plutonium core could have shot out like a cannon ball. Besides the explosive mess to clean up, ReVelle's team would have to deal with a nuclear core sitting in a farmer's field, spewing alpha and beta particles.

Quick success and a long slog

At 7:30 a.m., ReVelle arrived at Seymour Johnson. He knew that the area couldn't be declared safe until he and his team found and disarmed the bombs.

Bomb No. 1 was relatively easy. These MK39s had parachutes to lay the bombs down on the ground, where they would blow up after a few minutes. This device's parachute deployed properly. As the MK39 nestled in a tree, ReVelle said he could see the scrape marks where the nuke slid out of the back of the plane.

"It was sitting there like the Washington monument," ReVelle said.

ReVelle checked for radioactivity and explosive hazards before heading to the site for bomb No. 2, where problems grew exponentially. That bomb's parachute failed, and it slammed into the ground at about 700 mph, breaking up into pieces. A big dig was going to be needed.

Personnel started out with picks and shovels but quickly determined that heavier equipment – dump trucks, bulldozers, excavators – was necessary. The next day, snow, temperatures below freezing and surface water hampered digging. ReVelle remembers being happy when the Salvation Army showed up with coffee and doughnuts. Locals were told that the Air Force was looking for an ejection seat lost in the crash.

By day three, the team struck the area's shallow water table and called in high-capacity pumps. Personnel found the nose impact switch and pieces of high explosive. On the fourth day, they removed the tritium bottle, more high explosives and the first of the 92 detonators, among other bits and pieces.

The fifth day is seared into ReVelle's brain.

"Until my death I will never forgot hearing my sergeant, Sgt. Larry Lack, saying, 'Lieutenant, we found the arm/safe switch,'" ReVelle said. "And I said, 'Great.' He said, 'Not great. It's on arm.'"

A series of sequential steps make nuclear bombs go boom. Personnel on the ground had no way of knowing whether the switch was triggered to arm in sequence, or if it had been bumped into the arm position by impact.

They kept digging, removing the rest of the primary device by the end of day six. A Hiroshima-type atomic bomb aims for just one nuclear explosion. Thermonuclear devices, like the MK39, use a primary nuclear explosion to detonate the larger, secondary bomb. ReVelle calls such weapons "a bomblet and a bomb."

His team was released back to Wright-Patterson on the eighth day, as the Seymour Johnson Air Force Base commander determined that "principal hazards were under control." Seymour Johnson personnel spent the next five months looking for the secondary device, which never has been found.

Officials determined that cave-ins, equipment limitations and the high water table made more digging fruitless. They declared that there was no further danger. The hole was covered up. The government bought a permanent easement on the property and routinely monitors the area and groundwater for radioactivity.

Close really counts with nuclear weapons

The clean-up crews went home. People got old and moved away. The Goldsboro plane crash faded into urban legend about what really happened.

And five decades on, there's still plenty of debate about how close Goldsboro came to placement in the pantheon of nuclear accidents, like Chernobyl and Fukushima.

Officially, the safety devices worked as planned. Exhibit A, of course, is that neither bomb exploded, said Joel Dobson, a Strategic Air Command veteran who wrote The Goldsboro Broken Arrow. His research and Freedom of Information Act requests uncovered previously classified details that allowed ReVelle and others to break 50 years of silence. Before any of the multiple steps toward detonation can happen, a B-52 crew member must arm the arm/safe switch, officials maintain. That never happened, so none of the other steps mattered, according to this view.

Sandia, the company that designed the firing and fusing sets, the arming devices and the safety devices, examined the internal components of the arm/safe switch off bomb No. 2, Dobson said. Although the switch was set to arm, the internal components remained in safe mode. Still, one Sandia scientist called the switch a dud and said he was shocked that the bomb didn't go off, Dobson said.

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"Now later on he tried to walk it back," Dobson said. "You've got a lot of politics going on there."

And in 1983, Defense Secretary Robert McNamara said bomb No. 1, the nuke in the tree, went through all but one of the steps necessary to detonate.

Dobson said such a sound bite simplifies a complex process. McNamara's "one step" was the arm/safe switch. That wasn't the last step, but more like the second or third step in the process. Unless the arm/safe switch was armed in sequence, none of the other steps beyond that mattered, according to the official story.

After years of research, Dobson subscribes more to the unofficial view that eastern North Carolina dodged a nuclear bullet. Each bomb on its own had enough explosive power to exceed the yield of all munitions, outside of nuclear testing, ever detonated in the history of the world – via TNT, conventional bombs, every artillery shell, every bullet, every stick of dynamite, and including the Hiroshima and Nagasaki atomic bombs in World War II. Each bomb's kill zone, where anybody out in the open would have died, was 17 miles wide.

And, Dobson asked, if everything worked so perfectly, then why did Sandia spend millions of dollars and many years improving the safety devices of nuclear weapons? And why did the Air Force change numerous regulations, procedures and equipment? He thinks the authorities went to school on the Goldsboro Broken Arrow and instituted changes to prevent future nuclear bombs from getting so close to detonation.

ReVelle, the EOD technician who had his hands on both thermonuclear devices, agreed.

"How close was it to exploding?" ReVelle asked. "My opinion is damn close."

Michael Hughes is the managing editor for the Institute of Industrial Engineers.