PeaceMeal - Food for Thought

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Why we can't trust the government's figures about nuclear close calls

Dan Drollette Jr,.
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In the world of accidents, close calls, and near-misses, perhaps nothing is more chilling than incidents involving nuclear weapons. For years, the U.S. military has said that the number of unintentional launches, detonations, thefts or losses of nuclear weaponry — often referred to as "Broken Arrows" — has been no more than 32. But investigative journalist Eric Schlosser, author of the 2013 book C*ommand and Control: Nuclear Weapons, the Damascus Accident, and the Illusion of Safety*, asserts that the Pentagon's list includes inaccuracies and is missing key events. Due to the looseness with which a nuclear weapons accident is defined, there may be hundreds more accidents. In this interview, Schlosser tells the Bulletin's Dan Drollette Jr. what led him to that realization.

More important, the large number of close calls and near-misses shows that no system for safeguarding nuclear weapons can ever be 100-percent effective — meaning that the United States (and other nuclear weapons nations, which have Broken Arrows of their own) can never completely eliminate the potential for catastrophic nuclear error. Schlosser says: "These are the most dangerous machines ever invented, and we need to reduce the number of them and eventually get rid of them. But until the day that nuclear weapons are abolished, we need to spare no expense in terms of their safety and their management and take them deadly seriously.

"About the year 2000, I spent time at the Air Force Space Command, I spent time at Kirtland Air Force Base. And a lot of the people I met who were with the U.S. Space Command were former (nuclear) missileers. They started telling me stories about nuclear weapons during the Cold War. I became really intrigued, especially after one of them told me the story of the Damascus accident — the explosion of a Titan missile in its silo in Damascus, Georgia, in 1980.

"I thought that the story of these nuclear close calls was a really compelling one, and an important one to tell. I felt like the whole issue of nuclear weapons had been so forgotten, and I wanted to remind people that these things are still out there, ready to go. They're not some archaic thing only of historical interest — although I think that these days, there's much less of that amnesia, what with the war in Ukraine, and Putin's nuclear saber-rattling.

Drollette: I think you're right; the *Bulletin* now gets more readers in a month than it used to get in a whole year. Speaking of topic, can you define your terms? My understanding is that the phrase "Broken Arrow" is generally used to refer to unintentional launches or unintentional detonations. But things gets fuzzy when talking about fires or accidents, or thefts or losses — such as what if the U.S. military can't account for a nuclear weapon's whereabouts, or misplaces it. And while I understand that we in the States use the phrase to refer to just U.S. nuclear weapons, I'm not sure what that means for U.S. weapons based outside the geographic boundaries of the country.

Schlosser: Well, this is where things get interesting. ... To answer your question, the US Defense Department uses "Broken Arrow" to mean a nuclear accident with a US weapon that caused the unauthorized launch or jettisoning of a nuclear weapon, a fire, an explosion, a radioactive release, or a full-scale detonation. A "Bent Spear" is one step below a Broken Arrow and refers to damage to a weapon, without any (risk of) harm to the public or detonation. And an "Empty Quiver" is loss, theft or seizure of a nuclear weapon.

While if you go to a source like the Atomic Archives, they define a Broken Arrow as "an unexpected event involving nuclear weapons that result in an accidental launching, firing, detonating, theft or loss of the weapon" — in other words, they lump some of the things in these different categories together. And places like the National Security Archive note that there are dangerous incidents that don't fit easily into any one category, such as when lax security at a NATO nuclear weapons depot in the Netherlands in 2014 allowed activists to breach the perimeter. Now what would you call that?

Or, to give another example from the National Security Archive, the U.S. Air Force mistakenly shipped six nuclear-armed cruise missiles in 2007 from an air base in North Dakota to an air base in Louisiana — and no one realized that they were there, so these missiles just sat unguarded for several hours. Technically, that wasn't an accident, but it definitely was a mistake, and one that could have had very dangerous ramifications. They weren't lost, they weren't stolen, but they were in the wrong place, unaccounted for and unprotected.

Drollette: That's really interesting to me, because we recently published a piece written by someone affiliated with the Nuclear Emergency Support Team — sort of like a SWAT team for anything nuclear-related, a federal government agency that's one of the first to respond whenever there's a nuclear incident or nuclear blackmail. And the author was adamant that there have been only 32 Broken Arrows, and he was equally firm that the last Broken Arrow was in 1980.

Schlosser: That's only if you follow the Defense Department's list. Look, to give them their due, there are 16 accidents on that Defense list that really could not have led to a nuclear detonation, which is the bottom line. In some cases, the bombs were not fully assembled; in other cases, there was no nuclear material involved—which was what happened, for example, when there was an explosion at an explosives-storage igloo in Medina, Texas. The same with a similar situation at Manzano Base, New

Mexico—again, no nuclear core had been previously inserted. But those incidents are still included on the Pentagon's list as Broken Arrows.

Now, I guess you could argue that including those incidents is to the Pentagon's credit. They really didn't have to include them on their list of Broken Arrows, but they did. But it goes to show how nebulous these things are, and how arbitrary the definitions are. Under the Pentagon's definition of a Broken Arrow, if a Jupiter missile was hit by lightning, that technically would not be considered a Broken Arrow. (The Jupiter was a U.S. medium-range, ground-launched, liquid-fueled ballistic missile used in the 1950s and 1960s.) But that would certainly be more likely to cause a full-scale detonation than just jettisoning a weapon into the ocean that doesn't even have a nuclear core in it. But more than the questionable semantics, the really troubling thing is all the accidents that could have led to a detonation but didn't make it to the list.

Drollette: Such as?

Schlosser: While I was researching *Command and Control*, I obtained some newly declassified documents through the Freedom of Information Act. One of them, titled "Accidents and Incidents Involving Nuclear Weapons," lists about 1,000 accidents and incidents, just from July 1957 to March 1967 — the period covered by the document. To give you an idea of the significance of what was on that list, Bob Peurifoy and Bill Stevens, the two leading safety engineers at Sandia (National Laboratories) during the Cold War, had never seen this document until I shared it with them … and they had never heard about many of these accidents and incidents, and reading the report greatly upset them. The document gives a sense of the daily, routine screw-ups and mistakes that could lead to a BWF, an acronym colloquially used at the labs to denote an accidental detonation — a Blinding White Flash. Again, some of them are very, very mundane and trivial. But some of them are really serious.

Drollette: Let's talk about the more serious cases.

Schlosser: There was one that I revealed for the first time, which I got from a Freedom of Information Act request. It happened with a U.S. military plane in the U.K. and it was much more dangerous than some of the things on that official Pentagon Broken Arrows list.

The underwing fuel tanks of an Air Force F-100D fighter plane were mistakenly jettisoned when the pilot started the engines. The plane was on alert at Lakenheath Air Force Base in Suffolk, England. The fuel tanks from the fighter jet hit the runway, ruptured, and fuel ignited. A Mark 28 hydrogen bomb mounted beneath the plane became engulfed in flames. Fortunately, firefighters were able to get to the plane and put out the fire before the high explosives in the hydrogen bomb could detonate.

Now that should be a Broken Arrow. But because this occurred at an overseas Air Force Base, the United States and Great Britain both denied that it had ever happened. And that was so much more of a Broken Arrow than the 16 accidents on that list that didn't even involve a fully assembled bomb — yet they're on the list. When things happen overseas, they're easier to sweep under the rug.

Drollette: What do you think the real number is?

Schlosser: There's no way to say, other than "a lot." One of the documents I got through the Freedom of Information Act said that a rocket-propelled version of the Mark 7 nuclear bomb was unloaded, fully armed, with its X-Unit charged, from a U.S. Navy plane in the spring of 1960. Now when an atomic bomb has a fully charged X-Unit, that means that it's ready to detonate. It's fully loaded up with electricity that just needs to be dumped into the detonators.

So, you're at a very delicate moment when those X-Units are fully charged. You don't want lightning anywhere nearby, no short circuits, no glitches with the arm/safe and ready/safe switches; you don't want any wiring faults; you don't want to drop nuclear weapons from any height, especially the older models. With some of the older weapons, when the X-Unit's charged, even dropping one from a height of six or seven feet could lead to a detonation. And you never want the X-Unit fully charged, unless you're ready to detonate the bomb. Preventing electricity from getting to the detonators is the bedrock of nuclear weapon safety.

And, you know, during the Cold War, some ground crews at NATO bases were very casual about removing atomic bombs from planes, pulling out wires, and inadvertently charging up the X-Unit. There were quite a few cases of weapons that could have been detonated in that way. The physicist (and former director of Los Alamos National Laboratory) Harold Agnew told me that while visiting a NATO base in 1960, he was amazed to see a group of weapon handlers pull the arming wires out of a Mark 7 atomic bomb while unloading it from a plane. When those wires were pulled, the arming sequence began.

In those days, the nuclear weapons in the NATO stockpile were often old and poorly maintained; the Mark 7 atomic bombs that NATO fighters carried dated back to the Korean War almost a decade earlier, and a Mark 7 could be detonated by so many things: its radar, its barometric switches, its timer, or just by falling a few feet from the airplane onto the runway.

Those routine accidents and mistakes were rarely jotted down and recorded. There's no way to actually say how many close calls we've had. The bottom line is that when it comes to 32 official cases of Broken Arrows, that 32 number is completely arbitrary. There have been hundreds of serious incidents, if not thousands.

Drollette: It makes you wonder how we've managed to not blow ourselves up.

Schlosser: Well, the design skills of the engineers and physicists at all those national labs helps to explain why we've never had an accidental detonation. Plus, there's the overall military discipline of the Air Force, the Army and the Navy. But there's also a fair amount of sheer luck that so far has prevented an accidental detonation of any size. And the way it works is, the more accidents you have, the more likely you are eventually going to get an accidental detonation.

Now, I think the weapons today are far safer than they've ever been; the safety mechanisms are far more advanced. And yet, the probability of an accidental detonation is still greater than zero. And whenever the odds are greater than zero, that means it's still going to happen. It may be a million years from now or it may be tomorrow, but it will happen. They may be low-probability events, but low-probability things happen all the time.

The only weapons that are entirely safe are the weapons that have the nuclear core stored at a separate location, so that they need to be assembled before they're ready to go. As soon as they're assembled — once there's a nuclear core surrounded by high explosives — they're never perfectly safe.

The Goldsboro accident in North Carolina was perhaps the closest that we've come to a full-scale detonation on American soil. At Goldsboro, a hydrogen bomb was dropped from a plane

that was breaking apart in mid-air. One of the hydrogen bombs it was carrying went through all of its arming steps, except for the last one — the ready/safe switch. The rudimentary ready/safe switch that prevented a full-scale detonation is not anything that you would want to have protecting you from a nuclear catastrophe. It worked in that case, but there were other ready/safe switches identical to that one which were later found to be defective. That accident is on the Pentagon list of Broken Arrows, and it definitely belongs there.

Drollette: And we're just talking about American weapons.

Schlosser: Right, we're not talking about close calls or near-misses with Russian weapons, British weapons, French weapons, or what might have happened with weapons in India, Pakistan, North Korea, China. Worldwide, we have no idea how many nuclear-weapon accidents have occurred. Who knows what might have happened in Russia, especially during the Soviet era? We can be sure it cannot have been good, given the massive explosion at their nuclear processing facility in Kyshtym in 1957 — not to mention those old Soviet nuclear subs that were abandoned above the Arctic Circle, where they've been sadly leaking ever since. I would bet that there must have been a number of Broken Arrows in the Soviet Union. Just look at their high rate of industrial accidents.

Drollette: What do you think is the takeaway from this discussion about the nature of nuclear weapons, Broken Arrows, Bent Spears, Empty Quivers, industrial accident rates, and close calls that never got recorded?

Schlosser: Nuclear weapons are the most dangerous machines ever invented. We need to reduce the number of them and eventually get rid of them. But until the day that nuclear weapons are abolished, we need to spare no expense in terms of their safety and their management and take them deadly seriously.

Drollette: Any last comments?

Schlosser: We need to always maintain a sense of humility about our creations, and about our ability to manage them. The safer we assume something to be, the more dangerous it's becoming. So we have to maintain a healthy level of anxiety about what's happening with this technology. And safety improvements usually happen after accidents, especially after there was public knowledge about the accidents. When bureaucracies are able to keep things secret, there's often less accountability and less pressure to change. This is especially true with nuclear weapons, which by their very nature face the always/never dilemma.

Drollette: The always/never dilemma?

Schlosser: It means that from the military point of view, you always want the weapon available available for immediate use. But you never want the weapon to detonate accidentally, or to detonate through unauthorized use, or to be stolen. And so, the design criteria for the "always" part of the equation sometimes conflict with the design criteria for "never." And that creates an inherent tension. For example, if you had nuclear weapons designed in such a way that the nuclear capsule was stored outside of the warhead, there would be no risk of an accidental detonation, but then it would take you a quite a while to use them, because you'd have to install the nuclear capsule and close up the warheads first. So, the "always" comes at the expense of the "never," and vice versa.

My aim in writing *Command and Control* was to provoke debate and discussion of the most dangerous machines ever built. And like all machines, they can go wrong.

– The interview has been edited

A fatal mistake: The truth behind a Marine Corps lie and broken promises

National Public Radio, April 7, 2023

All these years later, the Marines who survived are still haunted by the blinding flash and the piercing screams. "I knew who some of the guys were that got hit," Chris Covington remembers, "because I recognized their screams."

On the night of April 12, 2004, a deadly explosion rocked a schoolhouse in Fallujah, Iraq, where U.S. troops had set up a temporary base. A Marine 81 mm mortar sailed into the school's courtyard, killing Lance Cpls. Brad Shuder and Robert Zurheide, as well as an Iraqi interpreter. A dozen others were wounded, three so seriously that they had to be medically retired. It was the worst Marine-on-Marine "friendly fire" in decades, but the families weren't told the truth about how the men died. They were told by Marine officers who knocked on their doors that the deaths were the result of hostile fire. As seared as the fatal explosion is in the men's memory, to the Pentagon it's as if it never happened.

An NPR investigation found that the explosion at the schoolhouse in Fallujah was a tragic accident — the worst Marine-on-Marine "friendly fire" of recent decades. Officers determined almost immediately that the explosion was caused by an errant 81 mm mortar fired by the victims' own comrades, yet the families of the dead men weren't told for years, despite Marine Corps regulations. Some of the wounded have never been told.

Three officers involved in the deadly mortar fire were recommended for punishment, but that was rejected by the Marines' ground commander in Iraq — Maj. Gen. James Mattis. Consequently, no one was ever disciplined.

And NPR found another secret: An officer who was part of the confusion, but was not cited for discipline, was the son of an important and powerful member of Congress. Then-1st Lt. Duncan D. Hunter was working in the command center that mistakenly approved the mortar launch. His father — U.S. Rep. Duncan L. Hunter — was then-chairman of the House Armed Services Committee, responsible for oversight of the war.

In interviews, Pentagon officials and officers involved didn't explain why families were initially told the Marines died from hostile fire, or why the mishap isn't used as a case study in Marine Corps training. Or why for years, the Pentagon claimed it had no record of the mishap or any investigations, until a federal judge forced the Marines to conduct additional searches and turn over documents in response to an NPR lawsuit.

"I thought some enemy blew himself up in our compound. My first thought. And that means we have people probably coming in the wire," said retired Sgt. Maj. William Skiles. "So, it was smoke, I couldn't see — flashlights everywhere, and screaming everywhere."

Skiles remembers how confused he and others were by the blast. What had just happened? Did someone fumble a grenade? Was this a rocket that targeted them?

However, Marine commanders knew instantly that it was a terrible mistake. "My heart sank," said then-Lt. Col. Gregg Olson, who was the battalion commander and approved the mortar

mission.

Not only that, the Marines failed to follow their own procedures and tell the families an investigation had begun. The Marines also failed to tell the families when the investigation concluded four months after the explosion that the cause was friendly fire.

It would take three more years before families were told the truth, when the Marine leadership was ordered to appear before Congress. Some of those wounded only learned recently what happened — because they were told by NPR reporters.

As part of a years-long investigation, NPR talked to the families, the Marines and members of Congress. We asked the Marines for a copy of any investigation about the incident — filed a request under the Freedom of Information Act. The Marines said they couldn't find one.

NPR obtained a copy of the report from Elena Zurheide, the widow of Robert, one of the Marines killed. Nearly two decades ago, she had been pregnant with their first child, due on April 12, 2004, the same day Robert died.

She remembered the Marines initially telling her it was hostile fire. A few days after the mortar explosion, Robert's friends began to tell her it was friendly fire. One of those friends, Covington, was a lance corporal at the time. He said he got into trouble with his Marine command and was ordered to keep quiet.

Elena Zurheide recalled what the Marines finally told her in 2007: It was friendly fire, and no one was punished. The Marine Corps investigation — known as a JAG Manual investigation, or JAGMAN investigation — concluded that the bungled mortar mission was caused by two mistakes. The first was the failure of an officer to specify "danger close" when requesting the mission, meant to take out a barricade of tires set up by Iraqi insurgents. Those two words would have alerted those in the command center to pay extra-close attention because friendly troops were close to the target and in danger of being killed or wounded.

The second mistake came in the command center. The battalion commander, Olson, walked in and was informed that a mortar mission had been requested. He was told the target was 400 meters from friendly troops — a relatively safe distance — and Olson approved the mortar mission. The actual target, the tire barricade, was just over 100 meters from U.S. forces. And the mortar is not a precise weapon, often off by many meters.

Olson recently told NPR that Duncan D. Hunter had pointed to the wrong target on a map, though that detail is not in his statement in the 2004 investigative report. As Olson described it, Hunter's misidentification was the first step in the command center confusion that resulted in the tragedy. Hunter, who later held his father's seat in Congress, declined multiple requests for an interview with NPR.

The mortar round devastated the second platoon of Echo Company 2/1, leading not only to death and serious wounds, but to confusion, anger and guilt — and heartache among the survivors that persists to this day.

Jason Duty is a Navy corpsman, or combat medic, who tended to the wounded that night. We shared the investigative report with him, and he told us he read it one night at a bar. "I think that was the first time ... in my entire life I've ever had what they call a real flashback. I was really there for a few seconds. I could smell the blood and the meat 'cause it smells like a butcher shop in there. I could smell the smoke. I could smell the dust. I could remember sneezing because I got so much f****** dust in my nose. I can remember Shuder screaming and screaming and screaming," he said.

After Mattis decided no one would be punished, he sent his recommendations to his boss, then-Lt. Gen. James Conway, the top Marine officer in Iraq. Conway agreed with Mattis and signed off on the report two days after a visit to his headquarters in Iraq from Rep. Hunter. Mattis declined NPR's interview request.

For months, NPR reporters reached out to Conway through phone messages and emails. No response. Finally, NPR talked with Conway outside his home in Annapolis and handed him a letter with questions about the friendly fire incident in Fallujah. He said he couldn't recall it and would have to refresh his memory.

Five months later, he sent this reply in an email: "The regrettable incident, in the heat of combat, was made worse by the failure of higher command to properly notify family members that their Marines had died from friendly fire — a failure that was corrected by the Assistant Commandant of the Marine Corps as soon as it was discovered."

What the general failed to explain was that the Marine Corps only "discovered" the problem after a Capitol Hill hearing where they failed to fully account for friendly fire incidents. They were ordered back to testify a second time, where they finally acknowledged the deadly mistake at the schoolhouse. Only later did NPR discover that Conway obtained a copy of the investigative report after requesting it from one of the Marines we interviewed.

"I believe that, in the sight of God, the mere possession of nuclear weapons must be an abomination comparable to the mere possession of slaves some 150 years ago."

~ Rev. William Sloane Coffin, 1924-2006
American clergyman and anti-war and civil rights activist

"The just war theory should be filed in the same drawer that contains the flat earth theory."

~ Bishop Carroll Dozier, 1911-1985, Bishop of Memphis, Tennessee

To avoid an AI "arms race," the world needs to expand scientific collaboration

Charles Oppenheimer
Bulletin of the Atomic Scientists, April 12, 2023

Humans create technology using science and engineering. That process is as natural as the flowers in the field, a consequence of billions of years of the universe expanding and becoming what it is today. "As the ocean 'waves,' the universe 'peoples,'" as British philosopher Alan Watts said. And as they multiply, people create — our cities, roads, boats and bridges crusting the world, in much the same way that ants build a colony — with the planet now reaching an indisputable anthropocene epoch, as one can clearly see from a night-time airplane flight.

The arc of our collective evolution came to an inflection point on July 16th, 1945, in the form of a mushroom cloud created by the first atomic bomb explosion over the Jornado del Muerto in New Mexico, a test called Trinity. The atomic bomb wasn't a singular isolated development that suddenly changed humanity but an indelible step in an ongoing evolution. Now, at this stage in that evolution, humans can control the natural world with their minds and tools — and control it so completely that they can destroy the very fabric of human society if they choose that path.

In 1945, there were those who recognized the change humanity was going through — Los Alamos lab director J. Robert Oppenheimer, Nobel laureate Niels Bohr, Secretary of War Henry Stimson, and Albert Einstein, among many others — and who advocated for a world of cooperation based on science. Some — those officials and bureaucrats who believed in power politics and in protecting budgets more than humanity — did not see the fundamental shift in human affairs that atomic weapons had wrought. Their simplistic understanding drove us-versus-them policies that echoed their neolithic ancestors' tribal fears. So in the aftermath of World War II, the world got a nuclear arms race instead of a new level of human collaboration.

The scientists who discovered the physical reality that allowed for the creation of atomic bombs were forced to consider what they should do about their extremely dangerous scientific and technological advance. On November 2nd, 1945, pouring his heart out to the scientists he led to build the bomb in Los Alamos, Oppenheimer said: "If you are a scientist, you believe that it is good to find out how the world works — that it is good to find out what the realities are, that it is good to turn over to mankind at large the greatest possible power to control the world and to deal with it according to its lights and its values." The same considerations are being pondered today about other technological threats, including those posed by climate change and artificial intelligence (AI).

History shows that humans will push science in new directions, regardless of whether some of those directions are dangerous. Even if an area of scientific inquiry and advance were simply too dangerous to pursue, past example makes clear that the advance couldn't be stopped by a moral, political or regulatory decision put forward by one group. If the world couldn't put the brakes on something as purely evil as a thermonuclear weapon 1,000 times more powerful than the atomic bomb used on Hiroshima, it's laughable to assume there will be any stopping the development of the way a computer outputs sequences of characters. If the research that advances AI isn't done in the United States, somebody else will do it.

So if humanity will create technology, despite its level of danger, how will we manage it? That is always the question, and it is a question of human relations more than technical science. Our science may have advanced to new heights, but inside, human beings remain — to a significant degree — the tribal apes who grew together for millions of years in natural competition and conflict. There are, of course, some modern and evolving forms of cooperation and of new consciousness. The question is whether humans can fundamentally change their ways of relating and create forms of international cooperation that are more akin to science-based policy than ancient tribal warfare.

With the benefit of hindsight, it's clear the policy suggestions scientists made in mid-1945 through 1947 in regard to dealing with nuclear weapons — placing them under international control, among other things — could have worked and prevented an arms race. It's not surprising U.S. and other world leaders didn't choose to work together collaboratively back then. It's only surprising that choosing to go into a wasteful and dangerous nuclear arms race hasn't killed us all. Yet.

So what should we do now about artificial intelligence and other advances in technology that could pose catastrophic risks? The same thing we should have done in 1945, and what the smartest and wisest people in modern history advised doing: Expand scientific collaboration, instead of trying to use national borders and secrecy to grab power from our "enemies." American, Chinese and Russian scientists can get along, even if politicians in those countries foment fear and conflict.

With climate change, the way forward is clear: The solutions must be global and focused on producing carbon-free energy and driving energy innovation with Manhattan Project scale and urgency to meet our common climate challenge. Similarly, we could and should form new international bodies to deal with AI on a scientific rather than merely commercial basis. By forging and then expanding such productive alliances, humans could eventually unwind the cataclysmic threats they face — long before some humanity-threatening form of advanced AI is released.

Our technology has already proven it can kill us. It will always increase in power and scope. The collaboration and cooperation in managing the effects of technological and scientific advance is the area humans need to improve on, to focus on, to invest in.

The best time to share and collaborate on dangerous technology is before trust erodes, and before an arms race begins. But since it's no longer 1945, as the Chinese proverb goes, the second-best time to cooperate on managing our technological threats — by sharing scientific knowledge instead of hoarding it in secrecy for a projected advantage — would be now.

Charles Oppenheimer, a grandson of J. Robert Oppenheimer, is a software entrepreneur in San Francisco.

"We women of one country will be too tender of those of another country to allow our children to be trained to injure theirs. From the bosom of the devastated earth a voice goes up with our own. It says, 'Disarm! Disarm!' "

~ Julia Ward Howe, 1819-1910, writer, abolitionist and suffragist

Dealing with a debacle: A better plan for U.S. plutonium pit production

Curtis T. Asplund and Frank von Hippel

For two decades, the Pentagon and Congress have been increasingly concerned that the United States does not have a reliable capability to produce plutonium "pits," the cores of U.S. thermonuclear warheads. In 2018, the agency responsible for the production and maintenance of U.S. nuclear warheads, the National Nuclear Security Administration (NNSA), responded with a plan to build, on a crash basis, pit production lines in New Mexico and South Carolina at the same time, with a combined production capacity of 80 pits per year.

One of the production lines is in an advanced state of installation at the Los Alamos National Laboratory in New Mexico, the home of U.S. pit-production expertise. The other is to be installed at the Department of Energy's Savannah River Site (SRS) in South Carolina, where there is no pit-production expertise, in a massive building that the Department of Energy built for another purpose and was then forced to abandon because of huge cost overruns. South Carolina's congressional delegation successfully prevailed on the Trump administration to repurpose this $6 billion building — once known as the Mixed Oxide Fuel Fabrication Facility intended to downblend surplus military plutonium for use as commercial reactor fuel — to plutonium pit production. History is repeating itself, however. The NNSA's cost estimate for using the Savannah River facility to manufacture warhead pits has already risen from $3.6 billion in 2017 for an 80 pit-per-year production capacity to $11.1 billion for a 50 pit-per-year capacity in 2023.

The NNSA's rationale for its ambitious pit production program is questionable. The agency proposes to first build 800 pits for new U.S. intercontinental ballistic missile (ICBM) warheads, which would be needed only if the U.S. decides to increase the number of warheads on each missile from one to three. Previous U.S. administrations have considered such a move destabilizing; silo-based ICBMs are targetable and increasing the number of warheads they each carry would make them more attractive targets. Loading the ICBMs with more warheads would also make compliance with the New START arms control agreement with Russia extremely difficult, should that agreement be extended.

After producing the ICBM warheads, the NNSA plans to replace all 1,900 U.S. submarine-launched ballistic missile warheads with new warheads equipped with insensitive high explosive, which is shock resistant and therefore less susceptible to accidental explosions that could disperse a warhead's plutonium. No such accident has ever happened with ballistic missile warheads, and it is unclear how much this program would actually improve safety.

There is also another concern about the NNSA's plans: The designs of new warheads in which new plutonium pits would be used may depart from designs that have been previously tested. This could result in demands to resume explosive testing, which would undermine the moratorium on nuclear testing that has been observed by all nuclear-weapon states (other than North Korea) since 1998.

Given these questionable production plans and the already out-of-control cost and schedule of the Savannah River pit production facility, and because the remaining life expectancy of the pits in current U.S. warheads is at least 60 years and perhaps much longer, we propose that the Savannah River facility be put on hold and that the Los Alamos program be focused on demonstrating reliable production of 10 to 20 pits per year. Such a demonstration production line would establish that the United States has the capacity to produce pits and would reduce the time required to build additional production lines, if they are needed.

The NNSA should also renew research programs at the Livermore and Los Alamos Laboratories to study the aging of the already existing plutonium pits in the U.S. arsenal as well as older pits from retired warheads. Before the NNSA cut back this pit-aging research program, the weapons laboratories estimated that the existing pits had expected functional lives of at least 100 to 150 years — that is until at least 2080.

Pits are the hollow plutonium cores of the fission "primaries" (triggers) of two-stage modern warheads. A warhead explosion begins with the implosion of the pit to supercriticality, which enables an exponentially growing fission chain reaction in the plutonium. That fission explosion — "boosted" by neutrons from a fusion reaction in tritium-deuterium gas injected into the middle of the hollow pit just before implosion — ignites a much more powerful "secondary" nuclear fission-fusion explosion.

The pits in U.S. nuclear warheads have reached about 40 years of age. Experts from Los Alamos and Lawrence Livermore National Laboratories annually examine sample pits from each type of warhead, both nondestructively and destructively; they continue to find their internal surfaces pristine and that the aging plutonium metal is not becoming significantly weaker or more brittle. In addition, they have been examining pits from older retired Cold War warheads and, since 2002, have been doing accelerated-aging tests.

In 2006, Congress instructed the Department of Energy (DOE) to focus on producing pits in Los Alamos National Laboratory's large Plutonium Facility 4. PF-4 has other plutonium-related missions, however, including extracting plutonium from old pits and fabricating Pu-238 heat sources for space missions. After allowing room for those other missions and production support functions, NNSA found in 2017 that only 19,500 square feet remained available for pit production. Congress also lost confidence in PF-4 being the sole pit production site after Los Alamos struggled for years to produce even a small number of pits there and then shut down major plutonium operations for more than three years after safety infractions in 2013.

The Savannah River Site became the leading candidate for a second pit production facility after a plutonium-disposal project failed there. In 2001, NNSA had given the Savannah River Site the mission of fabricating excess Cold War plutonium into "mixed-oxide" (or MOX) plutonium-uranium fuel for U.S. power reactors. The completion schedule for the MOX Fuel Fabrication Facility slipped steadily and its cost escalated drastically. Congress finally terminated the the MOX facility after NNSA had spent nearly $6 billion on its construction. Under political pressure from South Carolina, however, the Trump administration endorsed a plan to convert the MOX facility into a pit production factory.

Now, the Savannah pit production project has developed a dysfunctional dynamic quite similar to that which afflicted the MOX facility. Billions are being spent on construction and equipment for pit production even though the design of the facility has not been finalized. The complex MOX building contains six hundred rooms, many of whose reinforced concrete walls will have to be broken through to accommodate the glovebox

production line. The production of a single pit will require tens of person-years of labor. The NNSA is therefore already hiring thousands of pit-production workers for both Los Alamos and the Savannah River Site and training them in plutonium work at Los Alamos at the same time that pit production lines are being installed and unrelated plutonium work is continuing in other parts of the Los Alamos facility. NNSA complains that it is unable to find sufficient qualified workers in the trades required for both the construction of the facilities and their operation.

Ever since U.S. nuclear testing ended in 1992, NNSA's nuclear-weapon laboratories have been putting forward proposals to replace some of the existing U.S. warhead types with new designs. The labs have developed great expertise in computer modeling of nuclear weapon processes and now feel confident in their abilities to design improved warheads and certify them without explosive nuclear testing. The NNSA emphasizes that deviations from previously tested designs will be small. But warhead designs without a test pedigree could undermine confidence in the reliability of the U.S. stockpile and inspire calls for renewed U.S. testing — a prospect that would endanger the global moratorium that has been observed since 1998.

The first new warhead design the NNSA proposes for production would be deployed on the intercontinental ballistic missiles (ICBMs) deployed in 400 underground "silos" scattered across the northern U.S. Great Plains. The current Minuteman III ICBM — which is itself being replaced by a new ICBM — currently carries two warhead types, the W78 and W87. The labs would like to replace the older W78 with an updated version of the W87, which has modern safety features not included in the earlier warheads. Specifically, the W78s are more vulnerable than the W87s to plutonium dispersal accidents because the conventional explosive used to implode their pits is sensitive to shock.

To replace the W78, NNSA has chosen a design close to that of the W87. Indeed, the new warhead would be given the label W87-1. The W87 has insensitive high explosive to reduce the probability of a plutonium-dispersing conventional explosion if, for example, a bullet were fired into the warhead. The W87 pit also has fire-resistant cladding with a melting point that is designed to contain the plutonium in case of a jet fuel fire (about 1000° C) — but not in the much hotter temperatures that would be produced by burning missile propellant.

According to NNSA's current plan, the first 800 or so pits it would produce would be for W87-1 warheads — about 10 years' output from both of the NNSA's proposed pit production facilities operating at design capacity. The United States reportedly already has 540 W87 warheads, however, enough to equip its 400 ICBMs with a single warhead each.

The rationale for producing the additional W87-1 warheads appears to be to preserve an "upload hedge," i.e. the ability to increase the U.S. ICBM warhead loading to three warheads per missile in case the New Strategic Arms Reduction Treaty (New START) expires without a successor agreement, or if — as is already being urged — the U.S. decides to deploy more strategic ballistic missile warheads in response to China's nuclear buildup.

Multiple-warhead ICBMs are, by their nature, destabilizing. If each ICBM were to carry three warheads, one attacking warhead could destroy three U.S. warheads, increasing the incentive to strike first in a crisis.

In 2006, the JASON group of independent science advisors who provide consulting service to the U.S. government concluded, on the basis of research done at the Lawrence Livermore and Los Alamos National Laboratories, that the plutonium in existing pits has a functional life expectancy of at least a century. It added that "continued work is required [that] includes … extending accelerated aging experiments on [plutonium], and determining how aging affects primary performance by way of material strength." In 2012, the Livermore lab announced that it had found "no unexpected aging issues … in plutonium that has been accelerated to an equivalent of ~150 years of age."

The United States has about 15,000 excess and reserve pits from dismantled Cold War warheads stored in NNSA's Pantex warhead assembly/disassembly plant in Amarillo, Texas.

As of September 30, 2020, the U.S. nuclear stockpile contained 3,750 operational warheads. Of these, approximately 1,800 were deployed and the remainder constituted a reserve that could be used to either replace warheads withdrawn for servicing or to increase deployments.

Congress' current concern is driven in part by the fact that NNSA has not demonstrated that it can reliably produce pits on any scale. Trying to build a second pit production facility at the Savannah River Site in a building designed for another purpose while simultaneously re-equipping Los Alamos's plutonium facility and crowding it with hundreds of trainees for both facilities is a prescription for a fiasco. The NNSA will have a better chance for success if it focuses on getting one well-designed pit production line up and working well.

The obvious place for such a pit production line is at the Los Alamos Plutonium Facility, the center for U.S. pit-production expertise. In fact, the current focus at Los Alamos is to do exactly that. According to a recent Government Accountability Office review, "The scope of work at Los Alamos … involves a range of activities necessary to achieve the capability to reliably produce 10 pits per year… [including] gloveboxes and equipment for melting, casting, and machining processes."

Beyond that, there are separate projects devoted to acquiring equipment to expand the PF-4 production capacity to 30 pits per year and to hiring and training 1,600 new full-time-equivalent employees for the plutonium facility. Some have argued that these expansions would exceed the area's capacity for worker housing and transport. Limiting pit production to 10-20 pits per year might be beneficial from that perspective.

A crash effort to manufacture new plutonium pits for the U.S. nuclear arsenal might be justified if a crisis existed. Given that the remaining longevity of the existing pits is at least several decades, if not a century or more, a step-by-step approach makes more sense than the wasteful approach currently being pursued. Such a measured approach should also reduce the likelihood of potential threats to worker and public health from plutonium accidents, which are more likely to occur with a deadline-driven, unnecessarily large pit production plan. Congress should pause the construction of the Savannah River pit production facility and ask for an independent review by the Government Accountability Office of alternative approaches, such as that suggested in this paper, before sinking more funds into the apparently bottomless pit of the current pit-production program. No one should want a repeat of the MOX program debacle to play out in the same building.

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National Park Service commemoration of the atomic bombing of Nagasaki

Wednesday, August 9, 8:00 p.m.
Fingernail stage in Richland's Howard Amon Park

The NPS one hour "Lights for Peace" ceremony will feature a guest speaker and music by the Mid-Columbia Mastersingers. Attendees will have an opportunity to ring a peace bell and walk a path lit with luminarias for a quiet, contemplative experience based on their own personal reasons for participating.

World Citizens for Peace is promoting this event.

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