

Challenges of Protecting US Nuclear Weapon Materials

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For the past four years, many nations have focused their attention on securing nuclear material around the world. While this is an important goal, it draws attention away from the inherent security challenges associated with maintaining a large nuclear weapons infrastructure. Facilities within the United States' nuclear weapons complex possess enough separated weapons-grade plutonium and high-enriched uranium (HEU) to build tens of thousands of nuclear weapons. Recent events in the United States have highlighted these challenges and demonstrated that, even in nuclear-weapon states with high standards for physical security, seemingly insignificant failures can have potentially significant consequences.

The most recent such event occurred on Saturday, 28 July 2012, at approximately 4:15am, when an 82-year-old nun and two peace activists (aged 63 and 57) infiltrated the Y-12 nuclear weapons production facility in Oak Ridge, Tennessee, eventually gaining access to the facility's protected area. Equipped with no more than hammers and a pair of bolt cutters, they traversed a 600m semi-wooded area, cut through three 8ft fences equipped with alarms and sensors, and avoided detection by armed guards for 30 minutes. Their target was the Highly Enriched Uranium Materials Facility (HEUMF), a 150,000ft² rectangular fortress holding approximately 400t of HEU—the majority of military HEU in the United States. Upon reaching the HEUMF, the activists hung banners and spray painted "Woe to the Empire of Blood" and "the fruit of justice is peace" on the wall.¹

According to the US Government Accountability Office, three scenarios related to weapons-grade nuclear materials are considered when establishing security at sites with separated nuclear-weapons-grade material: the creation of improvised nuclear devices capable of producing a nuclear yield, theft for use in a nuclear weapon, and the potential for sabotage in the form of radioactive dispersal (or a "dirty bomb").² A 2006 report written by the group Project on Government Oversight identified serious security vulnerabilities in the construction of the

1 Matthew Wald and William J. Broad, "Security Questions are Raised by Break-in at a Nuclear Site", *New York Times*, 7 August 2012, <www.nytimes.com/2012/08/08/us/pacifists-who-broke-into-nuclear-weapon-facility-due-in-court.html>.

2 Statement of Gene Aloise, "Poor Planning Has Complicated DOE's Plutonium Consolidation Efforts", testimony before the Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives, United States Government Accountability Office, 7 October 2005.

HEUMF.³ If the group that gained access to the facility in July had malicious intentions, it is easy to imagine a much worse outcome than graffiti art on the side of a building.

The Nuclear Weapons Complex

Y-12 is one site in a network of facilities spread across the United States known as the nuclear weapons complex. The nuclear weapons complex, which is run by the Department of Energy's (DOE) National Nuclear Security Administration (NNSA), is the industrial infrastructure responsible for maintaining the US nuclear weapons arsenal. During the Cold War, the nuclear weapons complex was responsible for designing, building and testing every new nuclear weapon in the US arsenal. For most of the past 20 years, the labs and production facilities within the nuclear weapons complex have focused on the Stockpile Stewardship Program, which modernizes and refurbishes existing nuclear weapons by replacing older non-nuclear components.

There are eight primary sites within the nuclear weapons complex that participate in stockpile stewardship: four production facilities, three laboratories and a test site. Each of these eight sites maintains unique capabilities intended to support the Stockpile Stewardship Program. For the foreseeable future, the three primary sites involved in manufacturing and assembling nuclear components for the Stockpile Stewardship Program will be Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico, the Y-12 National Security Complex in Oak Ridge, Tennessee, and the Pantex Plant in Alamogordo, Texas.

The Pantex Plant, which is spread across 18,000 acres, is responsible for the assembly and disassembly of nuclear weapons. Pantex uses special buildings—"bays" and "cells"—to assemble and disassemble warhead components and the physics package. Bays are made of reinforced concrete, and are covered by earth and separated from other bays so that an explosion in one bay will not cause an explosion in a neighbouring bay. Pantex stores more than 12,000 plutonium pits, as well as HEU and tritium reservoirs in its plutonium pit storage area at Zone 4.

Once HEU is removed from nuclear weapons, it is shipped to Y-12, which is the central location for producing uranium secondaries for nuclear weapons. Y-12 is approximately three miles long and a mile and a half wide, wedged between two ridges. The majority of HEU work at Y-12 takes place in the 9212 complex, which is capable of performing more than 100 operations related to HEU, including down-blending, quality inspections and fuel research. However, the two primary activities that take place at 9212 are enriched uranium (EU) recovery and metallurgical operations. EU recovery involves turning scraps of EU, which come primarily from weapons production and disassembly, into material that can be reused or stored. Scrap from other sites is also processed at 9212. Metallurgical operations at 9212 involve casting EU into metal suitable for nuclear weapons' canned subassemblies, reactor fuel, and storage.

LANL will also play a major role in production of plutonium components for nuclear weapons. There are more than 900 facilities at LANL taking up approximately 8.6 million

3 Project on Government Oversight, "U.S. Nuclear Weapons Complex: Y-12 and Oak Ridge National Laboratory at High Risk", 16 October 2006, <www.pogo.org/pogo-files/reports/nuclear-security-safety/Y-12/nss-y12-20061016.html>.

square feet spread across 37mi². LANL's primary plutonium facility is known as Plutonium Facility 4 (PF-4), located at the Lab's Technical Area 55. This is the only area in the US nuclear weapons complex with a fully functioning capability for plutonium research and development, as well as the ability to manufacture plutonium pits. PF-4 also conducts chemical and metallurgical research processes related to purifying, recovering and converting plutonium into various forms for use in the nuclear stockpile.

Nuclear weapons components and weapons-grade nuclear materials are transported between these facilities by armoured trucks with escorts. The NNSA's Office of Secure Transportation, which manages these shipments, has made 116 shipments—approximately two per week—in 2012.

Nuclear Material in the Complex

Even though the Cold War ended 20 years ago, the United States still retains large quantities of separated weapons-grade plutonium and HEU. Six sites within the nuclear weapons complex have long-term missions involving weapons-grade HEU and plutonium: LANL, Lawrence Livermore National Laboratory (LLNL) in Livermore, California, the Y-12 National Security Complex in Oak Ridge, Tennessee, the Pantex Plant in Alamogordo, Texas, the Savannah River Site and the Nevada National Security Site (formerly known as the Nevada Test Site).⁴

According to recent declarations⁵ made by the United States, as well as independent analysis regarding its historical plutonium and HEU production, acquisition and utilization, the US nuclear weapons complex holds approximately 85t of separated plutonium and more than 400t of HEU.⁶ If only 25kg of HEU or 8kg of plutonium are needed to build a nuclear weapon, this means that there is enough separated plutonium within the nuclear weapons complex for more than 10,000 nuclear weapons and enough HEU for 20,000 nuclear weapons, all of which must be heavily guarded.

Since 2004, NNSA has made a concerted effort to consolidate nuclear weapons materials within the complex—weapons grade material has been removed from Sandia National Laboratory, much of the special nuclear material that was previously located at LLNL has been removed, and HEU previously stored at LANL has been moved to the Nevada National Security Site.

However, recent reports indicate that NNSA may decide to partially reverse its progress in consolidating nuclear materials within the complex. Earlier this year, the NNSA abandoned plans to construct a new plutonium facility at LANL. As a result, other existing sites within the complex will likely take on or retain plutonium missions. Although decisions are still

4 There are two sites not managed by NNSA that possess plutonium: the Hanford Site, which possesses 6.6t, and Idaho National Laboratory, which possess 4.6t. Additionally, Oak Ridge National Laboratory possesses large quantities of HEU.

5 NNSA, *The United States Plutonium Balance, 1944–2009*, update of DOE/DP-0137, June 2012, <<http://nnsa.energy.gov/ourmission/managingthestockpile/plutoniumpits/puinventory>>.

6 Project on Government Oversight, "U.S. Nuclear Weapons Complex: Homeland Security Opportunities", 19 May 2005, <www.pogo.org/pogo-files/reports/nuclear-security-safety/homeland-security-opportunities>.

being made, it is possible that plutonium could be sent back to LLNL and that the Nevada National Security Site could take on a larger plutonium mission.⁷

In addition to the uncertainty surrounding the future of plutonium activities within the nuclear weapons complex, large quantities of separated nuclear material remain spread across the country at a handful of sites. The Pantex Plant stores approximately 68t of plutonium, primarily in the form of pits. The United States opted to dispose of these pits by converting them to mixed-oxide (MOX) fuel at the Savannah River Site. However, cost overruns and poor management have left the MOX programme in limbo. Approximately 400t of HEU are stored at the HEUMF at Y-12, some of which is slowly being down-blended into low-enriched uranium.

“Troubling Displays of Ineptitude”

The large quantities of separated nuclear material located in sites spread across the United States and activities related to stockpile stewardship presents challenges for securing nuclear material. The NNSA spent approximately 6% of its overall budget, or \$700 million, on physical security in 2012. The nuclear weapons complex employs more than 2,000 armed guards across the six sites that store nuclear-weapons-grade material. Each site is supposed to be equipped with sophisticated equipment like integrated alarms and sensors capable of detecting intruders, physical barriers, and heavily armed paramilitary protective forces equipped with automatic weapons and night vision equipment.

However, a recent report by the DOE Inspector General identified staggering deficiencies in Y-12’s security system that allowed the protesters to gain access to the HEUMF.⁸ The reported described “troubling displays of ineptitude” in responding to alarms, failures to maintain critical security equipment and poor communications among guards. In one case, a critical fixed camera that provided coverage of the area that was penetrated had been out of service for approximately six months and was disabled at the time of the break-in. According to the report, cameras were sometimes not repaired because they were not a high priority. Moreover, the trespassers were not “physically observed” until after they had reached the high-security area. Once they were discovered, Y-12 guards initially assumed the protesters were part of a maintenance crew. Apparently, guards were frequently not informed about scheduled maintenance. It was typical for workers to just show up without notice in the high-security area. Finally, plans to install additional delaying barriers that could have impeded the protesters were abandoned during the construction of the HEUMF.

Although the break-in at Y-12 was the most egregious breach of security in recent memory, this was not an isolated incident. Since it was first formed in 2001, NNSA has repeatedly demonstrated at various sites that it could not stop intruders. In 2008, LLNL failed a security force-on-force test involving a commando team posing as terrorists. The team was able to overpower the lab’s defences and reach their objective, a quantity of simulated nuclear-weapons-grade material and make it into a mock nuclear device.

7 “As Plutonium Options Become More Clear, Kehler Softens Concern”, *Nuclear Weapons and Materials Monitor*, vol. 16, no. 34, 10 August 2012, <www.lasg.org/press/2012/NWMM_10Aug2012.html>.

8 US Department of Energy Office of Inspector General, Office of Audits and Inspections, “Inquiry into the Security Breach at the National Nuclear Security Administration’s Y-12 National Security Complex”, document DOE/IG-0868, August 2012, <<http://energy.gov/ig/downloads/inquiry-security-breach-national-nuclear-security-administrations-y-12-national>>.

Over the past decade, similar security test failures have been recorded at the Hanford reservation, Oak Ridge National Laboratory and the Nevada National Security Site. Y-12 failed at least two of these tests in 2003 and 2005. In both cases, the attacking force was able to reach its objective. In 2003, a 1t truck crashed through the perimeter security fence at LLNL and the Sandia facility across the street. If these incidents were not enough to cause concern, agents responsible for protecting convoys of nuclear weapons material were involved in 16 alcohol-related incidents from 2007 through 2009. In at least two of these cases, the agents were arrested for public intoxication.⁹

Security of nuclear weapons and nuclear weapons material is not just a problem within the DOE nuclear weapons complex. The Department of Defense has also had its share of security problems. In 2006, the US military mistakenly shipped four Minuteman missile fuses to Taiwan. In 2007, six cruise missiles were accidentally loaded onto a B-52 bomber at Minot Air Force Base and flown across the country. More recently, on 14 July 2012, Minot Air Force Base was shut down for two hours when guards failed to prevent a truck from driving through the south gate of the base.

While there were certainly significant mistakes made in all of these situations, a recent report by the US National Academy of Sciences points out that there “is no comprehensive analytical basis for defining the attack strategies that a malicious, creative, and deliberate adversary might employ or the probabilities associated with them”.¹⁰ The nuclear weapons complex employs thousands of workers and covers hundreds of square miles of land. But despite extensive security precautions, there remain incalculable scenarios in which unauthorized people could gain access to nuclear materials. This clearly underscores the inherent risk involved with maintaining a nuclear arsenal and large stockpiles of nuclear material.

Consolidate and Dispose of Weapons-Grade Nuclear Material

Although NNSA spends considerable sums of money on physical security and efforts have been made to consolidate weapons-grade material across the complex, more work is needed. It is not essential for the United States to maintain large stocks of nuclear material in so many locations across the country. NNSA should continue to remove nuclear material from LLNL and NNSA’s forthcoming plutonium strategy should continue to reduce the number of facilities that possess weapons-grade materials. Moreover, the United States should immediately reduce its stocks of HEU by increasing the down-blending rate. Finally, NNSA should find a disposition alternative to its MOX plan. The plan to create MOX fuel could potentially increase the quantity of plutonium transported around the world.

9 Emily Yehle, “Probe Finds ‘Alcohol Incidents’ Among DOE Agents on Nuke-Transport Duty”, *New York Times*, 22 November 2010, <www.nytimes.com/gwire/2010/11/22/22greenwire-probe-finds-alcohol-incidents-among-doe-agents-89728.html>.

10 Committee on Risk-Based Approaches for Securing the DOE Nuclear Weapons Complex and Nuclear and Radiation Studies Board, Division on Earth and Life Studies, “Understanding and Managing Risk in Security Systems for the DOE Nuclear Weapons Complex”, 2011, <www.nap.edu/catalog.php?record_id=13108>.

Stronger Federal Oversight

One of the items highlighted in the Inspector General's report of the Y-12 incident was poor oversight of the contractor responsible for security at the site. The debate over the role of the federal government in managing the nuclear weapons complex has been ongoing since the first days of the Manhattan Project. When the NNSA was created, it was argued that it would help to achieve greater accountability in order to maintain a safe and secure nuclear weapons infrastructure. However, there has been little progress to increase accountability since the establishment of NNSA. In fact, there is evidence that there now exists less accountability within the nuclear weapons complex than before NNSA's establishment.¹¹

Incidents like the one at Y-12 emphasize the important role federal governments need to play in maintaining security at nuclear weapons facilities. Unlike the federal government, the profit motive drives the independent contractors that manage the nuclear weapons laboratories and production facilities. The federal government needs to find a way to incentivize security in a manner other than profit. If security had been the priority, it is unlikely that a camera that was vital for the security of Y-12 would have been disabled for so long.

Reduce the Role of Nuclear Deterrence

Although the United States has made considerable advances over the past four years in reducing its reliance on nuclear weapons, its reliance on nuclear deterrence has not wavered. Consequently, as the United States decreases its reliance on its deployed nuclear weapons, the nuclear weapons complex is beginning to take on a greater strategic role in addressing geopolitical and technical uncertainties. This new role involves new facilities capable of producing new nuclear components at a greater capacity. Increasing the role of the nuclear weapons complex will likely make material more vulnerable as more nuclear materials are transported.

Conclusion

If one were to start from scratch building the US nuclear weapons infrastructure, with an emphasis on security, it is unlikely that it would resemble today's complex. Instead of one minimally sized secure site with nuclear-weapons-useable material centrally located, the nuclear weapons complex is spread across the United States, with nuclear material in more than a half dozen states. While spreading these sites out may have made strategic sense during the Cold War, this is no longer appropriate for twentieth-century security concerns that include non-state actors. The United States maintains and transports large quantities of nuclear material across the United States from site to site. Disposition of HEU is taking place very slowly and efforts to dispose of weapons-grade plutonium have completely stalled. Looking at these examples, it would appear that the United States does not think that its stocks of HEU and plutonium are vulnerable. However, the incident at Y-12 suggests otherwise.

11 Matt Bewig, "House of Representatives Considering Bill to Weaken Oversight of Nuclear Weapons Labs", Allgov.com, 29 April 2012, <www.allgov.com/news/top-stories/house-of-representatives-considering-bill-to-weaken-oversight-of-nuclear-weapons-labs?news=844400>.

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